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LESSON 1

FUNDAMENTALS OF FINANCIAL ACCOUNTING

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STRUCTURE

1.1 LEARNING OBJECTIVES

After reading this chapter, students will be able to understand:

- Basic concept of Financial Accounting, Accountancy and Book-keeping
- Relationship between Accountancy, Accounting and Book-keeping
- Difference between Book-keeping and Accounting
- Users of Accounting information both Internal and External.
- Merits and Demerits of Accounting.
- Basic Accounting terms and concepts
- Double Entry System of Book-keeping
- Fundamental accounting assumptions and Accounting principles.
- Accounting standards and International Financial Reporting Standards and their difference with each other.
- Basis of Accounting (Cash vs Accrual).

1.2 INTRODUCTION

As per the definition of Accounting given by the AICPA:

Accounting is an art of recording, classifying and summarising the transactions and events which are monetary and business related in a significant manner as per accounting rules and principles, transactions and events and interpretating the financial results.

Accounting aims to provide quantitative financial information economic and business entities about their financial position and performance so that users can use the information in making prudent economic decisions."

It is logical and sequential the process of identifying, collecting, recording, classifying, summarising and communicating financial information (monetary transaction and events related to business) to the users for their own customised judgment, analysis and decision-making.

1.3 OBJECTIVES OF ACCOUNTING

Accounting is done to achieve the following objectives:

1. **Keeping systematic, accurate, structured and complete records** of financial transactions and events in the primary and secondary books of accounts such as journal,

ledger as per specified accounting principles, rules and standards to avoid omission, error and fraud.

2. **Calculation of the profit earned or loss incurred** by a business during a particular accounting period to assess the financial results of business activities.

3. **Determination of the financial strength or position** of the business through a position statement known as balance sheet which shows the application of funds in the form of current and non current assets and and sources of funds in the form of Equity (Capital and Reserves and surplus & and External Liabilities).

4. **Providing useful accounting information to users** of financial information such as owners, prospective investors, suppliers, banks, employees and government authorities, regulators, customers etc who analyse and interpret them as per their own customised requirements such as investors use information for investment decisions, bankers use for taking lending decisions.

5. **Providing financial information to the management** to facilate them to take decisions regarding expansion, diversification, shutdown, etc. , prepare budgets and forecast the results and financial position so as to prepare projected financial statements.

6. **Safeguarding assets and detecting and preventing frauds** by maintaining regular and systematic accounting records of the business transaction and events relating to the acquisition and disposal of assets, earning revenue and incurring expenses.

1.4 MERITS/ADVANTAGES OF ACCOUNTING

The significance and importance of accounting can be considered through following points:

1. Provides information management facilitating them to make prudent economic decisions.

2. It help owners to compare results of current years with past results and with the results of others in same industry to identify trends and the factors which leads to changes and evaluate the competitive performance.

3. It provide information regarding financial position of the business enterprise through balance sheet which shows the application of funds in the form of assets and and sources of funds in the form of capital & and external liabilities.

4. It help in keeping accounting records in a structured, systematic, accurate and complete manner of financial business related transactions and events in the books of accounts as per specified generally accepted accounting principles, which is accepted by the regulators, authorities and courts as valid evidence to settle various litigations.

5. It help in correct determination of tax liabilities under various taxes such as Income tax, GST and Custom duties, etc.

6. It facilitates costing of products, job, activity and project so that proper pricing decision can be taken.

1.5 LIMITATIONS OF ACCOUNTING

Inspite of many advantages, accounting suffers from many limitations discussed below:

1. **Historical in nature:** Accounting is concerned with transactions and events are already occurred in the past. It does not provide a tool for future decision making. Further it does not shows the business assets and investments at their current market value as per the demand and supply of securities in the market or as per the current value prevailing for the assets in the relevant market because it does not take into account the effects of changes in price level.

2. **It ignores qualitative aspects:** It accounts and recognises only transactions and evenets which can be expressed in terms of money because of Money measurement concept. It does not consider qualitative aspects such as efficiency with which the management works, quality of operations, loyalty and sincerity of employees, customers satisfaction level, etc.

3. **It allows scope for window dressing:** i.e. It might involve manipulation in accounts to present a more favourable or unfavourable results and financial position than its actual position to serve the vested interests of the insiders.

4. **It is subjected to personal bias and judgment:** Since different people hold different opinions with respect to accounting estimates such as useful life of asset to determine amount of depreciation, provision for doubtful debts on the basis of likelihood of the default by the debtors, etc.

5. **It is based on concepts and conventions:** Since accounting is based on concepts and conventions which sometimes distort the disclosure of true and realistic financial position and results of a business enterprise. For example as per Historical Cost Concept, Fixed assets in balance sheet are shown at their purchase cost less depreciation and not at their current market value prevailing in the market if they are sold in the relevant market.

1.6 BOOK KEEPING

Book keeping is identification and recording of business transactions and events only. It is the recognition component of accounting syttem which involves the recording of monetary

business transactions and events in a defined manner as per the standards and principles given in the relevant Financial Reporting framework.

It is concerned with only the recording part whereas accounting covers both the recording, summarizing, communicating and interpretation part of an accounting system.

The differences between Book keeping and Accounting can be described as under:

Basis	Book keeping	Accounting
Component	It is the recording phase involving recording of business transactions and events in journal and other accounting books.	It is much wider than book keeping as it covers recording, summarizing, communication, and interpretation part of an accounting system.
Stage of accounting	It is the first and primary stage and forms basis for accounting.	It is the secondary and subsequent stage, cover the part where the book keeping ends.
Nature/Skill or Knowledge requirement	It involves activities which are routine and clerical in nature and does not require any specialised skills or knowledge in their application.	It involves activities which are analytical in nature and requires specialised skills or knowledge of accounting ratios and other analytical tools.
Level of staff required	It is carried out by junior level employees called book-keepers	It is carried out senior level employees called accountants.
Depiction of Financial position	Financial position and performance cannot be determined on the basis of journal entries.	It provides the complete and summarised blue print of the financial position and performance of an entity.

1.7 COMPONENTS OF ACCOUNTING INFORMATION/ STATEMENTS

Accounting information can be break down into following components:

1. **Statement financial performance:** The statement of profit or loss (in case of companies)/ profit or loss account/ income statement (in case of non corporates) shows the net profit earned or loss incurred from business operations during a particular accounting period which is usually a financial year.

2. **Information relating to financial position:** Balance Sheet is a statement which shows the application of funds in the form of assets and and sources of funds in the form of capital & and external liabilities.

3. **Schedules and Notes to Accounts:** which forms the part of balance sheet and statement of profit and loss to give detailed information of various line items shown in balance sheet and income statement and significant accounting policies relating to recognition, valuation, classification and disclosures, which are used in the preparation and presentation of financial statements.

4. **Cash Flow Statement:** It shows the inflows and outflows of cash and cash equivalents from three activities operating, investing and financing.

1.8 BRANCHES OF ACCOUNTING

Accountimng can be classified into following sub fields:

1. **Financial Accounting:-** It is that subfield/branch of accounting which is aimed at generating General Purpose Financial Statements covering identification and recording of business transactions and events of financial nature (which can be expressed in monetary terms) in a systematic and significant manner as per generally accepted accounting principles, to ascertain the financial performance/results (profit earned or loss incurred) during the accounting period and to depict the financial position or health of the entitiy in the form of assets and liabilities.

2. **Cost Accounting:-** It is concerned with ascertaiment or calculation of total cost or per unit cost of object which can be goods produced or services rendered, job work performed or project undertaken.

3. **Management Accounting:-** It involves obtaining financial information to help the management in planning, orgainsing and controlling the operations by setting benchmarks and also facilitates in taking sound business decisions.

IN-TEXT QUESTIONS

1. Select the correct answer for the following multiple choice questions:
   (a) Accounting includes :
   (i) Identifying the transactions and events;
   (ii) Recording the transactions and events;
   (iii) Classying and summarizing the transactions and events;
   (iv) All of the above
   (v) None of the above

2. Please indicate if the following statement is true or false.
   (a) Accounting and Book Keeping are same and there is no difference between the two.
   (b) There is no scope for window dressing in Accounting.
   (c) Accounting is subject to personal bias and judgements.

3. Financial Accounting recognises only transactions and evenets which can be expressed in terms of……...

4. As per ……..concept fixed assets in balance sheet are shown at their purchase cost less depreciation and not at their current market value prevailing in the relevant market if they are sold as such.

5. …….shows the inflows and outflows of cash and cash equivalents from three activities operating, investing and financing

1.9 INTERESTED USERS OF ACCOUNTING INFORMATION AND THEIR NEEDS

There are various categories of stakeholder or users of financial information which are interested in determining the financial position and financial performance of the business.

Users	Category of User	Information need of the user
Internal	Owners/Proprietor/ Shareholders	Return on investment, Net profit, financial position of the company/business, growth rate.
	Management	Rate of return from different segments, products and investments.
	Employees	Profitability of the employer to bargain wages rates and bonus, dues (PF, ESI, etc.) are being deposited regularly.
External	Potential investors	Business and financial risk, EPS, future prospects of the business.
	Creditors/Suppliers	Short term liquidity: creditors are interested in knowing financial capability and ability of the business to pay its debts on time.
	Lenders	Repaying capacity, credit worthiness, short term liquidity and long term solvency.
	Tax Authorities	Assessment of income and expenses, tax dues, true and fair disclosure of accounting information.
	Others	Customers, researchers seek different in-formation for different own customised interests and reasons.

1.10 QUALITATIVE ASPECTS OF ACCOUNTING INFORMATION

Usefulness of accounting information for different interested users is determined on the basis of the following attributes of accounting:

1. **Reliability:** Financial information must represent the actual facts and can be verified through source documents (vouchers).

2. **Relevance:** Financial information must be readily available on the time when it is required for decision making and must play an important role in the economic decisions of users of information by helping them to form nearly correct prediction about the future Income and financial position.

3. **Understandability:** Information should be presented in such a manner such that the users can understand and interpret it with much ease and in a concise manner.

4. **Comparability:** Information should be presented and disclosed so that it can compared with entity's past year's figures (intra firm comparison) and other business's in the same industry (Inter firm comparison).

1.11 SOME IMPORTANT ACCOUNTING TERMS

Business Transaction: It refers to a business activity which involves exchange of money or money's worth between parties (buyer and seller). It can be measured in terms of money and changes the financial position of an entity e.g. purchase of goods would involve inflow of material and goods (asset) and outflow of cash (asset) or creating an obligation to pay (liability) towards the supplier at a future date. transaction can be:

1. **Cash transaction:** When the parties (buyer and seller) settle the transaction immediately by making payment in cash or by bank.
2. **Credit transaction:** when the payment is to be settled at a future date as per agreement or mutual consent between the parties.

Account: refers to a summarized record of all relevant transactions relating to a particular item at one place. It has two sides debit side and credit side. The left side of the account is known as debit side and the right side is known as credit side.

Capital: It is amount of resources invested by the owners into the business organisation either in the form of cash or cash equivalents or in kind or assets. The amount can be invested in the form of cash, goods, or any other asset. For Business Entity, capital is a liability towards the owners which is to be settled only in the event of closure or transfer of the business. In case of corporates it is called as share capital.

Drawings: It represents an amount of cash, goods or any other assets which the owner withdraws from business for personal use. e.g. if the life insurance premium of proprietor is paid from the business bank account, goods withdrawn for personal use. It will result in reduction in the owners' capital.

Asset: Asset is a resource controlled by the business entity from which probable future economic assets will flow to the entity by using it for generating future profits. Assets can be Tangible and Intangible.

Tangible Assets: are the assets which have some physical existence. They can be seen, touched and felt such as:

- Plant and Machinery
- Furniture and Fittings
- Land and Building
- Books and periodicals
- Computers and laptops
- Vehicles

Intangible assets: Assets which have no physical existence (cannot be seen or felt although they help to generate revenue in future) and whose value is determined and restricted by the rights and expected future benefits that their possession confers upon the owner such as

- Goodwill
- Patents
- Trade-marks
- Copyrights
- Brand equity
- Industrial designs
- Other intellectual property rights, etc.

Assets can also be classified into Current Assets and Non-Current Assets.

Current Assets – Asset which satisfies any of the following :

a. It is expected to be realised in, or is intended for sale or consumption in the company's normal operating cycle,

b. It is held primarily for the purpose of being traded ,

c. It is due to be realised within 12 months after the reporting date, or

d. It is cash or cash Equivalent unless it is restricted from being exchanged or used to settle a liability for at least 12 months after the reporting date.

Current Asset includes:

- Inventory
- Trade recievables (sundry debtors and bill recievables)
- Prepaid expenses
- Current investments
- Cash and cash equivalents
- Short term loans and advances

Non-Current Assets – All other assets which are not classified as current assets are non-current assets such as:

- Plant and Machinery
- Furniture and Fittings
- Land and Building
- Patent
- Trade-mark
- Copyright

Liability: It is the present obligation to be settled through outflow of economic resources. In other words it is the amount of money that the business owes to the other parties. E.g. when goods are purchased on credit, the entity will have an obligation to pay to the supplier the price of goods on an agreed future date or when a loan is taken from bank, there is an an obligation to pay interest and principal amount at a future specified date.

On the basis of the period of holding, liabilities or obligations can be further classified into long term (non-current liabilities) and short term (current liabilities).

Current liabilities – A liability which satisfies any of the following :

a. It is expected to be settled in the normal operating cycle,

b. It is held primarily for the purpose of being traded,

c. It is due to be settled within 12 months after the reporting date, or

d. The entity does not have an unconditional right to defer settlement of the liability for at least 12 months after the reporting date

Note: Terms of a liability that could, at the option of the counterparty, result in its settlement by the issue of equity instruments do not affect its classification.

Non-Current Liabilities – All other liabilities not classified as current liabilities shall be classified as Non-current liabilities such as:

- Debentures
- Public deposits
- Long term bank loan
- Inter corporate loans
- Long term loan from director

Internal Liability: It refers to owner's equity, i.e. all the amounts which proprietors are entitled such as:

- Capital
- General reserve
- Deneture redemption reserve
- Undistributed profits, etc.

Working capital: The assets which are held to maintain the flows of revenue from operation in the form of current assets such as:

- Cash required to pay for expenses or to the creditors
- Inventories required to smoothen production and sale
- Accounts receivables (debtors and bills receivable) to increase the sales .
- Cash at bank
- Prepaid expenses

The total of current assets constitute the working capital of a firm which is termed as Gross working capital.

Gross working capital = Total current assets = long term internal liabilities + long term debts + the current liabilities – Non current assets.

Net working capital is the excess of current assets over current liabilities. It is the amount of current assets that remain in a firm if all its current liabilities are paid. This aspect of working capital is a more realistic concept.

Working capital (net) = Current assets – Currents liabilities.

Receipts: It is the gross inflow of cash and cash equivalents to the entity. It can be further classified into:

1. **Revenue receipts**: these are the receipts which are occurred or received in the normal course of operations of business like amount received through sale of goods and services in the ordinary course of business.
2. **Capital receipts**: these are the receipts which are recieved from other than principle business operations like proceeds from long term investments or sale of fixed assets,.

Expenses: refers to costs incurred (the part of the expenditure whose benefit is already expired during the accounting period) by a business for earning revenue such as:

- Rent
- Wages
- Salaries
- Interest
- Depreciation
- Carriage

Expenditure: It is the amount of outflow of monetary resources or money or incurring a liability for acquiring any asset, goods or services. The expenditure can be further classified into 3 categories:

1. **Revenue Expenditure**: If the benefit of expenditure incurred is utilised within the accounting period in which they are incurred. For example: electricity, insurance, rent, carriage, interest, salary, etc.
2. **Capital Expenditure**: If benefit of expenditure is received or lasts for more than one accounting period, for example: construction of building, purchase of machinery, furniture, etc.
3. **Deferred Revenue Expenditure**: There are the expenditures which are revenue in nature but their benefit is utilised over a number of years. For example: huge Advertisement Expenditure, preliminary expenses, etc.

Profit: It the amount by which revenues exceeds their related expenses during an accounting period is called profit. Profit = Revenue - Expenses

Gain: It is a profit of non-recurring nature arising from events or transactions which are incidental to business but are not part of principle revenue generating activities of a business enterprise such as sale of fixed assets at a value more than written down value, appreciation in the value of an investment or asset, etc.

Loss: The excess of expenses incurred during an accounting period over its related revenues. Loss = Expenses – Revenue.

Goods: The tangible items in which the business mainly deal in the ordiary course of business. These are the items which are purchased for resale or for use as raw material in further production and are not held or intended for use in the business for administration purposes.

Purchases: procurement of goods by a business for the purpose of resale or for using them as raw material in further production. For a trader of goods, it refers to purchase of stock is trade

and in case of manufacturing businesses it is purchase of raw materials and consumable supplies. Purchases may further be classified into cash purchases and credit purchases.

Purchase Return: When goods which are purchased are returned back to the suppliers because they are not as per specifications mentioned in the purchase order, are defective or due to any other reason.

Sales: It is the amount of total revenues earned from customers through sale of goods or rendering of services in the normal course of business. Sales may further be cash sales or credit sales.

Sales Return: When customer return the goods to the business entity due to any reason which can be defect in the goods, inappropriate quality, lack of attributes as specified by the customer.

Debtors: refers to the entities to whom the entity has sold goods or render services on credit and the amount is not completely paid and still to be received by the business entity. These are considered assets of the business, usually current assets.

Creditors/ Sundry Creditors: If the business buys goods/services from the suppliers on credit ie. the amount is not paid to the suppliers at the time of purchase and payment is deffered to a mutually agreed specified date in future. These are treated as financial obligations/liabilities for the entity (trade payables under current liabilities) which is to be paid usually within the normal operating cycle period.

Bill Receivable: It is a bill of exchange where by debtors (to whom goods are sold on credit) of the business undertakes to pay a certain amount mentioned therein a specified date. These are considered assets of the business, usually current assets.

Bill Payable: It is a bill of exchange where by the business undertakes to pay a certain amount mentioned therein a specified date to suppliers from whom goods are purchased on credit. These are considered liabilities for the business usually current liabilities.

Discount: It is the amount of rebate given by the seller of goods or servives to the purchaser. It can be further classified into:

1. **Trade Discount**: This discount is given to persuade or encourage the buyer to buy more quantity of goods. It is given in the form of agreed percentage of list price at the time of sale of goods. This discount is not recognised in the books of accounts as it is deducted in the invoice/cash memo and taxes like GST are imposed on after trade discount amount.
2. **Cash Discount**: This discount is given to encourage the debtors to pay their dues before the expiry of agreed credit period. This discount is recognised in the books of account as finance cost and charged to statement of profit and loss. It is given as percentage of the dues.

Account : It refers to a summarised record of all the transaction relating to particular head or accounting item at one place.

Income: Income is a very wider term profit as it includes not only profit but also the gains which are non recurring in nature. Income refers to the increase in the net wealth of a business enterprise over an accounting period.

Stock : It is the amount of total goods (raw material, work in progress, and finished goods) available for sale on a particular date.

Cost : It refers to amount of expenditures incurred (the expired portion of benefits) in manufacturing and processing goods to produce finished goods for sale in the ordinary course of bsuiness.

Voucher: It is documentary evidence of a transaction. For example, if goods are purchased for cash, the supplier provide a cash memo, if ggods are purchased on credit, the supplier issues an invoice, when the payment is made to creditors, receipt of payment is issued by the creditors.

Goods and Service Tax (GST) : GST is an indirect consumption tax which is levied on the supply of goods and service other than alcoholic liquor for human consumption. It is recovered from the buyer and paid to the appropriate government. It does not forms part of revenue or sales.

1.12 ACCOUNTING PRINCIPLES, CONCEPTS AND CONVENTIONS

The first and foremost objective of accounting is to provide general purpose financial information which is easily understandable, appropriate, relevant and reliable information about the financial results and position of the business to various users or stakeholders so that they can make sound and judicious financial and economic decisions. For this accounting records are to be maintained on the basis of uniform standards, rules and principles.

Generally Accepted Accounting Principles (GAAP): It is the collection of all the accounting principles, policies, concepts and conventions. GAAP provides the very base of Accounting.

GAAP refers to the rules, principles or guidelines with respect to recognition, valuation, classification, disclosures which are used for recording, classifying, summarising and reporting of business and financial transactions and events so as to bring standardisation, consistency and comaprability in the preparation and the presentation of financial statements.

These principles are evolved and developed over a long period of time based on the accounting experiences of the accountants, business-customs and practices, legal decisions, economic environment, etc. These are generally accepted and followed by the accounting practitioners and professionals working over a large geographical area in preparation and presentation of financial statements.

1.13 FUNDAMENTAL ACCOUNTING ASSUMPTIONS

Following are the assumptions used by default in preparation and presentation of financial statements, if these are followed and valid then entiry is not required to give any disclosure, disclosure is to be given only if any of the below assumption is invalid:

1. Going Concern Assumption: It is assumed that a business enterprise has an indefinite life or existence. Thus business will continue for long foreseeable period of timeand there is neither any intention to liquidate nor to scale down its operations or any of the undertakings significantly.

Implication and Relevance:

1. Distinction between capital expenditure and revenue expenditure can be made.
2. Classification of both assets and liabilities into current and non-current based on this assumption and definition of operating cycle.
3. Depreciation is charged on Property Plant and Equipment/fixed assets as on their acquisition they are capitalised in the balance sheet at book value (after deducting depreciation), irrespective of their current market value prevailing in the market.

2. Consistency Assumption: As per this assumption, accounting practices once selected and applied should be followed and applied consistently year after year. If the accounting policies are followed consistently then it will ensure meaningful analysis and comparison of the financial position as well as performance of the same business for a number of years known as intrafirm and interperiod comparison. It does not mean that practices and policies, once adopted, cannot be changed in the future. When a change is required and desirable as per the requirements of the changing circumstances, it can be changed but proper disclosures as per the applicable accounting standards are given in the financial statements along with its effect in statement of income (profit or loss) and Balance Sheet (change in the value of asset or liability). Any accounting policy may be changed if required by the change in governing law, reporting framework requirements or accounting standard applicable so as to make the financial information more relevant and transparent or to give better true and fair view of financial postion and performance.

Implication and Relevance: Helps the management and other stakeholders of financial information in decision-making by comparing the current year' financial information with the information of previous years.

3. Accrual Assumption: All revenues and related expenses are recorded/recognized as and when they are earned or incurred irrespective of whether the cash and cash equivalents are received or payment is made at the time of transaction or on a future date for example, if good are sold on credit (with credit given for two months) for Rs. 2,00,000 on 15th march. 2023 and all the risks and rewards incidental to ownership are transferred to the buyer, then the Sale is

to be recorded on 15th march. 2023 and not on the date when cash is received after two months from the debtors.

In case of revenue expenses such as salary or rent, if at the end of the accounting period (31st march), salary for four months is due to the employees but not paid, such unpaid salary will be recorded in the current year as outstanding salary and the salary expense account will be debited and transferred to profit and loss statement for the year in which the salary is due, it is not charged to profit and loss statement in the next year when it will be paid to the employees.

Implication and Relevance: Earning of revenue and consumption of a resource (expenses) can be accurately matched with each other realting to a particular accounting period providing the accurate measurement of financial performance.

1.14 ACCOUNTING PRINCIPLES AND CONCEPTS

1. **Business Entity/Separate Legal Entity:** A business entity has a separate existence from its owners and management. According to this principle, business is treated as a separate legal entity, distinct from its owners and managers. Thus, transactions are recorded and analyzed, and the accounting records and financial statements are prepared and presented from the view point of business and not the owner or proprietor. The Proprietor/businessman is treated as a inside creditor (Internal liability) for his investment made in the business equal to the amount of capital in the form of cash or other assets invested by him in the business. Interest on capital is treated as an expense. If the private expenses of the owners are paid out of business's money, then it is treated as drawings leading to reductions in capital of the owners.

2. **Money Measurement:** As per this concept, only those transactions and events that can be measured or expressed in monetary terms are recorded and accounted for in the books of accounts of the business enterprise. Non-monetary events like hiring of a loyal and intelligent employee, death of an efficient employee, strikes by workers, disputes with customers etc., are not recognised and recorded because they can not be quantified in terms of money, even though they affect the operations of the business significantly.

   Limitations of Money Measurement Concept:
   1. It does not considers the qualitative aspect such as efficient and loyal human employees (assets), loyal and satisfied customers (assets) and dishonest and inefficient employees and workers (liabilities), strong and healthy relstionships with the suppliers.
   2. Since the value of money (currency) is fluactuating on account of inflation. To keep accounting records simple and understandable, transactions and events are recorded using a fixed measurement unit therefore carrying value does not matches with the changes in value of money over a period of time.

3. **Accounting Period Concept:** Even though we assume the business as Going Concern, but the users of financial information are interested in knowing the financial results at regular intervals, therefore as per this concept, the life of any business organisation is split into smaller periods (accounting period) so that its peformance can be evaluated and financial position can be determined at regular intervals of time.

   Accounting period refers to the interval of time, at the end of which financial statements comprising profit and loss account/or statement of profit and loss and the balance sheet with notes to accounts are prepared, so that the financial performance can be measured and financial position can be determined at regular intervals and decisions such as shutdown, continue, expansion can be taken to control the affairs on timely basis.

   Accounting period is generally a period of one year starting from 1st april and end on 31st march of next year.

   Relevance of the concept:
   1. Facilitates the classification of expenses into capital expenses and revenue expenses.
   2. Part of capital expenditure which is consumed during the current accounting period is charged to the Statement of profit and loss and the remaining unconsumed portion is recognised as an asset in the Balance Sheet.
   3. Compliance with taxation laws: According to the income tax provisions, income tax is computed on annual basis.
   4. Prompt corrective action can be taken by the management to improve th results and financials.

4. **Full Disclosure:** As per this concept, besides applicable legal provisions, all material facts and information related to the economic activities of the entity should be properly disclosed in the financial statements and the accompanying notes to accounts as per applicable financial reporting framework.

   The financial statements should act as a means of communicating and not escaping the material and relevant information. The objective of disclosure is to create better understanding and the users may be able to take sound financial decisions. For example following disclosures can be provided in the footnotes such as:
   1. Disclosure of Contingent liabilities such as pending claims and litigations of a very big amount against the business, Arrears of dividend on cummulative preference shares, etc.
   2. Change in the method of providing depreciation on fixed assets (Property Plant and Equipment).
   3. Market value of investment in securities and changes thereof.

5. **Materiality Principle:** Materiality is not defined in exact monetary limits but any item which influences the economic decisions of the users is considered as material. Disclosure of all material transactions and information is necessary but it does not mean that even figures of big amount which are irrelevant are to be mandatorily disclosed in

the financial statements. Therefore, items having insignificant effect or which are irrelevant to users is not required to be disclosed separately, it may be merged with other items. Materiality is a subjective item as an item may be material for one enterprise may not be material for another enterprise, e.g., an item of expense of Rs. 50,000 may be immaterial for an organisation having a turnover of Rs. 10,000 crores but it may be material for an enterprise having a turnover of just Rs. 10,00,000.

6. **Prudence/ Conservatism Principle:** As per this principle, prospective or anticipated future profit should not be recognised or recorded but all prospective future losses should immediately be recorded by making a provision for them. The aim of this principle is to protect overstatement of the profit and depiction of a realistic financial picture of the organisation. Where different alternative methods or policies of accounting on a particular subject matter or transaction are available, then the alternative having the least favorable effect on profit should be adopted in formulating and selection of accounting policies, for example:

    1. Stock should be valued at lower of cost or net realizable value (as per AS-2) .
    2. Provision should be made for future liabilities or expenses such as provision for doubtful debts and provision for taxation.

7. **Cost Principle:** The major concern is that at what value fixed assets should be recorded. As per this principle, fixed assets are recorded in the books of accounts at its original cost consisting of the cost of acquisition (purchase cost) and all the expenditure incurred for making the assets ready to use and bringing the asset to present location and condition (friegth, carriage, installation, commison on the purchase of fixed assets).

    For Example: Machinery is purchased for Rs. 4,50,000 and Rs. 60,000 was spent on the installation of machine and Rs 50,000 is paid as purchase commission, then machine is recorded at rs. 5,60,000 in the books of accounts and depreciation will be charged on this amount. If the market value of the machine in the relevant market increases to Rs. 6,00,000 due to price fluctuation, then the increased value due to market fluctuation will not be accounted for in the books of account. This cost of Rs. 5,60,000 is systematically reduced year after year by charging depreciation in the income statement and the assets are shown in the balance sheet at carrying value/book value (cost – accumulated depreciation).

8. **Matching Principle:** Accounting information is relevant if it provides true and accurate picture of financial performance, therefore as per this Matching concept, all expenses incurred by an enterprise during an accounting period are matched with the related incomes or revenues recognized during the same accounting period. It facilitates the accurate calculation of profit earned or loss incurred in a particular accounting period.

    The following accouting treatment are done due to matching principle:

    1. Calculation of Prepaid Expenses and recording them as assets.
    2. determination of Income received in advance from the customers as liabilities.

3. Determination of closing stock at the end of accounting period to reduce it from the cost of goods sold.
4. Depreciation charged on fixed assets (Property, Plant and Equipment) in a systematic manner as per their use in the business in earning revenue.

9. **Dual Aspect Principle:** Every business transaction has two aspects - a debit and a credit of equal amount. In other words, for every debit in an account there is a credit of equal amount in one or more accounts and vice-versa. This system of accounting is also known as "Double Entry System". This concept ensures that the two sides of the Balance Sheet i.e Assets (application of funds) side and Equity and Liability 9sources of funds) side always match and thereby following accounting equation will always holds true at any point of time.

   Accounting Equation is expressed as follows:

   Assets = Liabilities + Capital

   For Example : Sohan started business with cash Rs. 5,00,000. This transaction increases cash in assets side and capital in liabilities- side by Rs. 5,00,000.
   Assets (Cash) Rs. 5,00,000 = Liabilities Rs. 0 + Capital Rs. 5,00,000

1.15 BASIS OF ACCOUNTING

There are two basis of recording transactions and ascertaining profit or loss during the accounting period:

1. Cash Basis and
2. Accrual Basis

Cash Basis of Accounting: as per this basis transactions are recorded in the books of accounts by passing journal entires only on the receipt/ payment of cash and cash equivalents.

The Profit is calculated as the excess of actual cash receipts from sale of goods, services, other non operating incomes over actual cash payments or outflow of cash and cash equivalents for purchase of goods, wages, expenses such rent, electricity, salaries, interest etc. transactions like credit sale and credit purchases are not accounted for in the books of accounts.

No transaction is recorded when a payment or receipt is merely due i.e., outstanding expenses, accrued incomes are not recognised.

This method is in contravention to the matching principle.

Accrual Basis of Accounting: As per this accrual basis Revenue and expenses are recorded as and when they are incurred or earned. Income is recorded as Income when it is accrued

(when transaction takes place, risk and reward incidental to ownership are transferred and obligation are performed) irrespective of whether corresponding cash and cash equivalents are received or not. Similarly, expenses are recorded when they are incurred or become due (when the benefit of the resource or facility is expired) and not when the cash is paid for them.

Items such as outstanding expenses, prepaid expenses, accrued income and income received in advance are identified and taken into account as assets and liabilities.

As per Companies Act 2013, all companies are required to maintain their accounts on accrual basis of accounting.

Basis	Accrual Basis of Accounting	Cash Basis of Accounting
Nature of Transactions	Both cash and credit transactions are recorded.	Only cash transactions are recorded.
Assessment of Profit or Loss	Profit or Loss is ascertained correctly due to complete record of transactions.	Correct profit/loss is not ascertained because it records only cash transactions.
Capital vs Revenue items	makes a distinction between capital and revenue items.	does not make a distinction between capital and revenue items.
Legal recognition	This basis is recognized under the companies Act.	This basis is not recognized under the companies Act.

1.16 ACCOUNTING STANDARDS

The accounting principles or GAAP (Generally Accepted Accounting Principles) have been developed in the form of concepts and conventions to bring comparability and uniformity preparation and presentation of financial statements. However they allow alternative accounting treatments for the same items.

Different organizations may adopt different accounting policies depending upon their requirements, industry, scale of operations for the same transaction or an entity may follow different accounting policies for different accounting periods. As a result, the financial statements become inconsistence and incomparable. So it was felt to prescribe minimum standards universally applicable, so that the accounting statements possess qualitative characteristics of reliability, relevance, understandability and comparability.

International Accounting Standard Committee (IASC) was set up in 1973 as a non profit international organisation to improve the financial reporting thrioughout the world. (now International financial Reporting Committee (IFRC)). The Institute of Chartered Accountants

of India (ICAI) and the Institute of Cost and Management Accountants of India are also members of this committee.

ICAI set up the Accounting Standard Board (ASB) in 1977 to identify the areas in which accounting standards are to be developed. ASB prepares and submits a draft accounting standard to the Council of ICAI.

The Council of ICAI issues the draft AS for the comments by the Govt., industry, academicians and professionals etc. After due consideration on the comments received, the Council of ICAI notifies it for its use in the financial statements.

Accounting standards are written statements, issued by autonomous professional accounting bodies such as FASB, IASB, ICAI, etc specifying standardised rules and practices for preparing and presenting the financial statements.

1.17 OBJECTIVES OF ACCOUNTING STANDARDS

Accounting Standards are formulated and issued with the following objectives:

1. **To ensure Uniformity/Consistency** in slection and application of accounting practices and policies in preparation and presentation of financial statements by proposing standard accounting treatment.
2. **To improve reliability of financial Information:** Since the standards are of high quality and received large scale acceptance which create a sense of confidence and reliance among the users.
3. **To sagfeguard assets, prevent frauds and manipulation** by codifying the accounting policies, methods and practices which limits the scope of fraud and manipulation.
4. **To facilitate Auditors**: It helps auditors by providing standardised accouting procedure to audit the books of accounts.

1.18 INTERNATIONAL FINANCIAL REPORTING STANDARDS

IFRS refers to the accounting and financial reporting standards issued by International Accounting Standards Board (IASB), london. These standards are made to improve the financial reporting at the international level to help users throughout the world to gain better understanding of financial statements.

Financial Statements under IFRS framework: Following financial statements are prepared and presented under IFRS framework:

1. **Statement of financial position:** Balance sheet which includes the following components:
    a. Assets
    b. Liability
    c. Equity (Shareholder's fund)
2. **Comprehensive Income statement including other comprehensive income**: which includes the following components:
    a. Revenue
    b. Expense
3. **Statement of changes in Equity** showing transactions with the shareholders and change in their claim over the entity.
4. **Statement of Cash flow** showing inflow and outflow of cash and casdh equivalents from operating, investing and financing activities
5. **Notes to accounts and significant accounting policies** showing details od the line items in the Balance sheet and statement of compreshensive income.

Significant differences between IFRS (International Financial Reporting Standards iisued by IASB) and AS (Accounting Standards issued by ICAI)

1. IFRS are principle based, they consider the substance over legal form in the transaction while AS are rule based, they require inflexible accounting procedures to be followed based on legal form.
2. IFRS are based on Fair Value in that they require valuations should be based on fair value measures which ensure true realistic valuations while AS are based on Historical Cost in that they require Assets shoul;d be recognised initially at their historical cost.

1.19 SUMMARY

Accounting is a logical and systematic process of identifying, collecting, recording, classifying, summarising, interpretating and communicating financial information to the interested users.

Objectives of Accounting:

a) Keeping structured, systematic, accurate and complete records of business transactions and events.
b) ascertain the profit earned or loss incurred
c) ascertain the financial position
d) provide useful accounting information to users
e) provide financial information to the management
f) safeguard assets and detect and prevent frauds

Limitations of Accounting:

a) Historical in nature
b) Ignores Qualitative Aspects
c) Scope for Window Dressing
d) Subject to personal bias and judgment
e) Based on concepts and conventions

Subfields/Branches of Accounting

1. Financial Accounting
2. Cost Accounting
3. Management Accounting

Interested users of Accountings information:

Internal	Owners
	Management
	Employees
External	Potential investors
	Creditors/Suppliers
	Lenders
	Tax Authorities
	Others

Qualitative Characteristics of Accounting Information:

a) Reliability
b) Relevance
c) Understandability
d) Comparability

1.20 GLOSSARY

Accounting: Process of identification, recording, classifying, summarising, interpretating and communicating financial information.

Account: refers to a summarized record of all relevant transactions relating to a particular item at one place.

Accounting Standard: written policy documents issued by professional accounting body for preparation and presentation of financial statements.

Asset: Asset is a resource controlled by the business entity from which probable future economic assets will flow to the entity by using it for generating future profits.

Business Transaction: It refers to a business activity which involves exchange of money or money's worth between parties.

Expenses: amount of expenditure incurred (the benefit of which has already been expired) by a business for earning revenue.

Profit: The excess of operating sales/revenues over its related revenue expenses during an accounting year.

Liability: It is the present obligation to be settled through outflow of economic resources.

Working capital is the excess of current assets over current liabilities

IN-TEXT QUESTIONS

1. Select the correct answer for the following multiple choice questions:
   Accounting includes :
   (i) Identifying the transactions and events;
   (ii) (ii) recording the transactions and events;
   (iii) classying and summarizing the transactions and events;
   (iv) All of the above
   (v) None of the above

2. Please indicate whether each of the following statements is true or false.
a) Book Keeping and Accounting are one and the same thing.
b) There is no scope for Window Dressing in Accounting.
c) Accounting is subject to Personal bias and Judgements.

3. Financial Accounting recognises only transactions and evenets which can be expressed in terms of……...

4. As per ……..Concept Fixed assets in balance sheet are shown at their purchase cost less depreciation instead at current market value in the relevant which could be realised on their immediate sale.

5. …….shows the inflows and outflows of cash and cash equivalents from three activities operating, investing and financing

1.21 ANSWERS TO IN-TEXT QUESTIONS

1. All of the above
2. a) False
   b) False
   c) True
3. Money
4. Historical Cost Concept
5. Cash Flow Statement

1.22 SELF-ASSESSMENT QUESTIONS

1. Define the Concept of Accounting
2. What is the difference between Accounting and Book Keeping?
3. What are the Objectives of Accounting and explain its significance.?
4. Discuss the interested users of Accounting Information with their customised areas of interest?
5. What are the drawbacks of Accounting?
6. Discuss the different Branches of Accounting.
7. What essential characteristics Accounting Information must possess?
8. Write a short note on :
    a) Money Measurement Principle
    b) Accounting Period Principle
    c) Dual Aspect Principle
    d) Going Concern
    e) Historical Cost

1.23 SUGGESTED READINGS

Latest editions of the following text books to be used:

1. Narayanaswamy R. Financial Accounting: A Managerial Perspective. PHI Learning Pvt. Ltd., Delhi
2. Robert N. Anthony, David F. Hawkins, Kenneth A. Merchant. Accountancy- text and cases. McGraw Hill Education (India) Private Limited, New Delhi.
3. Garg CA Kamal, and Sehrawat Neeraj Kumar. Beginner`s Guide to Ind AS & IFRS. Bharat Law House Pvt. Ltd., New Delhi
4. Maheshwari S. N., Maheshwari Sunil K., and Maheshwari Sharad K, An Introduction to Accountancy, Vikas Publishing House Pvt. Ltd.

LESSON 2

ACCOUNTING EQUATION AND CONCEPTS OF ACCOUNTING

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STRUCTURE

2.1 LEARNING OBJECTIVES

After reading this chapter, readers will be able to understand

- Concept of Accounting Equation
- Effect of a transaction on Financial Position
- How to use debit and credit

2.2 INTRODUCTION

In every business enterprise, users of general purpose financial statements (owners, management, employees, customers, competitors, suppliers, lenders, investors, government and regulatory bodies, etc) are interested to know the application of funds and sources of funds. Since what ever money is either borrowed or invested by owners is applied in the acquisition of current and non current assets. Therefore, in this lesson we will study how sources of funds (Equity and liabilities or Capital) matches or equates with the application or usage of funds (Assets).

2.3 MEANING OF ACCOUNTING EQUATION

Before moving to the Accounting Equation let us understand some of the important concepts used in the understanding the Accounting Equation:

Asset: Asset is a resource controlled (either through right to title/ownership or right to use) by the business entity from which it is likely that future economic benefits will flow to the entity by using it in the business for generating future profits. Assets can be Tangible and Intangible.

Capital: It is amount of resources invested by the owners into the business organisation either in the form of cash or cash equivalents or in kind or assets. The amount can be invested in the form of cash, goods, or any other asset. For a Business Entity, capital is a liability towards the owners which is to be settled only in the event of closure or transfer of the business. In case of corporates it is called as share capital.

Liability: It is the present obligation to be settled through outflow of economic resources. In other words it is the amount of money that the business owes to the other parties. E.g. when goods are purchased on credit, the entity will have an obligation to pay to the supplier the price of goods on an agreed future date or when a loan is taken from bank, there is an an obligation to pay interest and principal amount at a future specified date.

Accounting equation refers to an equation equating Sources of Funds with Application of Funds showing that the amount of assets or resources of an entity are always equal to the total amount of its liabilities and capital (funds brought by the owners).

The Accounting Equation is expressed as follows:

$$A = L + C$$

Where,
A = Assets

L = External Liabilities
C = Capital (Inside Liabilities)

Since, the Accounting Equation shows the relationship among various elements of the

balance sheet (Assets, liabilities and Capital), therefore it is also known as the Balance Sheet Equation.

At any point of time during the accounting period, Assets (resources controlled by the entity from which probable future economic benefits will flow to the entity) of the business must be equal to liabilities and capital (sources of financing the business or the claims of those who finance the resources both internal and external to the entity). The owners and outsiders provide the funds to finance the resources or assets of the business to carry out its business operations.

The claim of the owners on the business is called Capital in case of Sole Proprietor, Partner's Capital in case of Partnership, Shareholders' Fund in case of Company and that of the outsiders' claim is known as liabilities.

Asset side of the balance sheet shows the resources, which the business entity owns (such as Machinery purchased) and controls (such as right to use intellectual property rights such as patent, copyright, trademark). The liabilities side of the balance sheet shows owner's claims and outsider's claims i.e what the organisation owes to owners and outsiders.

Let us understand how Accounting equation works with the help of an example:

Consider the transactions in case of a Sole proprietor Ajay who started business with a capital of Rs.10,00,000.

Assets in the form of cash Rs.10,00,000 comes into the business. Source of finance is the contribution by Ajay (Owner) of Rs. 10,00,000 as capital.

Now the balance sheet after above transaction will appear as follows:

In the Books of Ajay
Balance Sheet as at.....

Liabilities	**Amount(in Rs.)**	**Assets**	**Amount(in Rs.)**
Capital	10,00,000	Cash in hand	10,00,000
	10,00,000		10,00,000

In the above balance sheet, the total assets are equal to the liabilities of the business.

Now if we add the following transactions in the above example:

1. Opened a bank account in HDFC with Rs. 4,50,000.

   Effect of transaction: This transaction increases the cash at bank (assets) and decreases cash (asset) by Rs. 4,50,000.
2. Purchased furniture for Mehta Furnitures for Rs. 80,000, payment made through issue of cheque.

Effect of transaction: This transaction increases furniture (assets) and decreases bank balance (assets) by Rs. 80,000.

3. Purchased Plant and Machinery for the for Rs. 1,50,000 and an Rs. 20,000 in cash is paid to M/s Ajay Verma.

   Analysi of Effect of transaction: This transaction increases plant and machinery (assets) by Rs. 1,50,000, decreases cash by Rs. 20,000 and increases liabilities (M/s Ajay Verma as creditor) by Rs. 1,30,000.

4. Goods purchased from M/s Amit Traders for Rs. 75,000.

   Analysis of Effect of transaction: This transaction increases goods (assets) and increases liabilities (M/s Amit Traders as sundry creditors) by Rs. 75,000.

5. Goods costing Rs. 50,000 sold to Rashmi Enterprises for Rs. 60,000 on credit.

   Analysis of Effect of transaction: This transaction decreases stock of goods (assets) by Rs. 50,000 and increases assets (Rashmi Enterprises as debtors Rs. 60,000) and capital (with the profit of Rs. 10,000)

A summarised statement of above transactions can be presented in the form of a balance sheet as under:

Balance Sheet as at. 20XX

Liabilities	Amount (in Rs.) `	Assets	Amount (in Rs.) `
Sundry Creditors	2,05,000	Cash	5,30,000
Capital	10,10,000	Cash at Bank	3,70,000
		Sundry Debtors	60,000
		Inventory	25,000
		Furniture and Fixtures	80,000
		Plant & Machinery	1,50,000
	12,15,000		**12,15,000**

In terms of accounting equation:

A = L + C

Rs. 12,15,000 = Rs. 2,05,000 + Rs. 10,10,000

2.4 USING DEBIT AND CREDIT

Since every transaction involves both dual give and take aspects. In double entry accounting system, every transaction affects and is recorded in at least two accounts one with with debit and other with credit of equal amount. While recording a transaction, the total amount of debit must equal to the total amount of credit.

In accounting context — debit and credit indicate whether the transactions are recorded on the left hand side or right hand side of the account or ledger. An account typically looks like the letter T. Because of its shape, it is called a **T-account.**

The T format has a left side for recording increases and a right side for recording decreases in the item to determine the final position of each item at the end of the accounting period. For example, in the account of a debtor, all goods sold on credit will appear on the left (debit) side of customer's account depicting increase in the amount of debtors and all payments received from the debtor will be shown on the right side showing decrease in the amount of debtors. The difference between the totals of the debit and credit sides is balance due from or to the customer as the case may be.

In a T account, the left side is known as debit side (abbreviated as Dr.) and the right side is called as credit side (abbreviated as Cr.). To enter amount on the left side of an account means debit the account. To enter amount on the right side means credit the account.

Account Name

(Left Side)	(Right Side)

The summary of effects of above transactions on accounting equation is shown in the following table:

S. No.	Cash	Bank	Assets Debtors	Goods (Stock)	Furniture	Plant and Machinery	Total Assets	Liabilities (Creditors)	Capital	Total of Capital &Liabilities
1.	+10,00,000								+10,00,000	
bal	10,00,000						10,00,000		10,00,000	10,00,000
2.	(4,50,000)	+4,50,000								
bal	5,50,000	4,50,000					10,00,000		10,00,000	10,00,000
3.		(80,000)			+80,000					
bal	5,50,000	3,70,000			80,000		10,00,000		10,00,000	10,00,000
4.	(20,000)					+1,50,000		+1,30,000		
bal	5,30,000	3,70,000			80,000	1,50,000	11,30,000	1,30,000	10,00,000	11,30,000
5.				+75,000			+75,000			
bal	5,30,000	3,70,000		75,000	80,000	1,50,000	12,05,000	1,30,000	10,00,000	12,05,000
6.			+60,000	(50,000)					+10,000	
bal	5,30,000	3,70,000	60,000	25,000	80,000	1,50,000	12,15,000	1,30,000	10,10,000	12,15,000

2.5 RULES OF DEBIT AND CREDIT

All accounts/ ledgers are divided into five categories or masters for the purposes of recording the transactions:

(a) Asset
(b) Liability
(c) Capital
(d) Expenses/Losses, and
(e) Revenues/Gains.

Fundamental rules to be applied to record the effect of transactions and events in these accounts are as follows:

(1) For increase or decrease in Assets and Expenses (Losses):
  (i) "Increase in asset is debited, and decrease in asset is credited."
  (ii) "Increase in expenses/losses is debited, and decrease in expenses/ losses is credited."

(2) For increase or decrease in Liabilities, Capital and Revenues (Gains):
  (i) "Increase in liabilities is credited and decrease in liabilities is debited."
  (ii) "Increase in capital is credited and decrease in capital is debited."
  (iii) "Increase in revenue/gain is credited and decrease in revenue/gain is debited."

The rules for different kinds of accounts have been summarised as follows:

Asset

(Increase)	**(Decrease)**
+	–
Debit	Credit

Expenses

(Increase)	**(Decrease)**
+	–
Debit	Credit

Liabilities

(Decrease)	**(Increase)**

-	+
Debit	Credit

Capital

(Decrease)	(Increase)
-	+
Debit	Credit

Revenue/Gains

(Decrease)	(Increase)
-	+
Debit	Credit

2.6 ASSET AND ITS CLASSIFICATION

Asset: Asset is a resource controlled by the business entity from which probable future economic benefits will flow to the entity by using it for generating future profits. Assets can be classified as Tangible and Intangible, Current and Non Current.

Tangible Assets: are the assets which have some physical existence. They can be seen, touched and felt such as:

- Plant and Machinery
- Furniture and Fittings
- Land and Buildings
- Books and periodicals
- Computers and laptops
- Vehicles

Intangible assets: Assets which have no physical existence (cannot be seen or felt although they help to generate revenue in future) and whose value is determined and restricted by the rights and expected future benefits that their possession confers upon the owner such as:

- Goodwill
- Patents
- Trade-marks
- Copyrights
- Brand Equity
- Industrial Designs
- Geographical Indications
- Other Intellectual Property Rights, etc.

Current Assets – Asset which satisfies any of the following:

i. It is expected to be realised in, or is intended for sale or consumption in the Company's normal Operating Cycle,
ii. It is held primarily for the purpose of being traded ,
iii. It is due to be realised within 12 months after the Reporting Date, or
iv. It is Cash or Cash Equivalent unless it is restricted from being exchanged or used to settle a Liability for at least 12 months after the Reporting Date.

Current Asset includes:

- Inventory (raw material, work in progress, finished goods, stock in trade, consumable supplies)
- Trade recievables (Debtors+Bills Recievables)
- Prepaid expenses
- Short term loans and adavnces
- Current investments
- Cash and cash equivalent

Non-Current Assets – All other Assets which are not classified as Current Assets are Non-Current Assets such as:

- Plant and Machinery
- Furniture and Fittings
- Land and Building
- Patent
- Trade-mark
- Copyright

Non-Current Assets are long term assets held for production of goods, rendering of services, administrative purpose and for earning rent and royalty.

2.7 LIABILITY AND ITS CLASSIFICATION

Liability: It is the present obligation to be settled through outflow of economic resources. In other words it is the amount of money that the business owes to the other parties for example

if goods are purchased on credit, the entity will have an obligation to pay to the supplier the price of goods on an agreed future date or when a loan is taken from bank, there is an obligation to pay interest and principal amount at a future specified date.

On the basis of the period of holding, liabilities or obligations can be further classified into Long Term (Non-current liabilities) and Short Term (Current liabilities).

Current Liabilities – A liability which satisfies any of the following:

i. It is expected to be settled in the normal operating cycle,
ii. It is held primarily for the purpose of being traded,
iii. It is due to be settled within 12 months after the reporting date, or
iv. The Company does not have an unconditional right to defer settlement of the liability for at least 12 months after the reporting date.

Note: Terms of a Liability that could, at the option of the counterparty, result in its settlement by the issue of Equity Instruments do not affect its classification.

Non-Current Liabilities – All other liabilities not classified as current liabilities shall be classified as Non-Current Liabilities such as:

- Debentures
- Bonds
- Public deposits
- Long term bank loans
- Inter corporate loans
- Long term loans from other parties

Internal Liability/Equity: It refers to owner's equity, i.e. all the amounts which proprietors, owners, shareholders are entitled such as:

- Capital
- Reserves (general reserve, capital reserve, dividend equalisation reserve, revaluation reserve, etc.)
- Undistributed Profits

2.8 RECIEPTS AND ITS CLASSIFICATION

Receipts: Gross inflow of cash and cash equivalents to the entity from sale of goods, services or business assets. Reciepts can be further classified into:

1. **Revenue Receipts**: Revenue Receipts are those receipts which are received on account of transactions in the normal operation of business such as sale of goods, rendering of services to the customers. These are regular and reccuring in nature.
2. **Capital Receipts**: Capital Receipts are those receipts which are received on account of transactions and events which are not in the ordinary course of business sale of fixed

assets, business undertaking, long term investments. These are non recurring in nature as they do not occur regularly.

2.9 EXPENSES, EXPENDITURE AND ITS CLASSIFICATION

Expenses: It is the part of expenditure whose benefit has been expired during the current accounting period for earning revenue. For example: rent, wages, salaries, interest, repairs, etc. It is shown in the debit side of the profit and loss account or statement of profit and loss.

Expenditure: It is the amount of money spent or liability incurred for acquiring any resources, assets, goods or services for the purpose of using them in business is called expenditure. The expenditure is classified as:

1. **Revenue Expenditure**: If the benefit of expenditure is received/expired within a year, it is called revenue expenditure. For example: rent, interest, salary, etc. It is shown in the debit side of the profit and loss account or statement of profit and loss.
2. **Capital Expenditure**: If benefit out of resources, assets, goods or services acquired from the expenditure is received for more than one accounting period. The part of the capital expenditure whose benefit is not expired till the reporting date is shown as the asset in th balance sheet. For example: purchase of plant and machinery is shown as asset at cost minus depreciation.
3. **Deferred Revenue Expenditure**: There expenditure are revenue in nature but benefit of which is derived over number of years. To comply with the matching concept we have to record these expenditure on initial recognition as Assets and written off in the period of their occurrence and in the subsequent periods. For Example: Huge Advertisement Expenditure.

Intext Questions

1. Which is of the following is considered as Capital?

a. Capital is the equity stake or ownership of the shareholders/Propreitors.
b. Capital is the raw material used in the production production of goods or rendering of services.
c. Capital is the total amount of funds used in the business.
d. Capital is excess of revenue over expenses.

2. How the Accounting equation is expressed?

a. A = L + C , where A = Assets, L = Liability and C = Capital
b. A = I – E, where A = Assets, I = Income and E = Expenses
c. A = L + E, where A = Assets, L = Liability and E = Expenses
d. L = A + C, where L = Liability, A = Assets and C = Capital

3. Why both sides of the balance sheet must be equal?

a. because of money measurement concept
b. because incomes are to be matched with expenses
c. because total of Application of funds is equal to total of Sources of funds
d. because of Going Concern Concept

4. The Mathematical equation explaining relationship between Assets, Liabilities and Capital of a business entity is known as-
(a) Accounting
(b) Accounting Equation
(c) Book – keeping
(d) None of these.

5. If a business enterprise has Liabilities of Rs. 1,52,000 and Assets of Rs. 17,200 respectively. The difference Amount represents -
(a) Debtors
(b) Income
(c) Profit
(d) Capital.

6. The basis for recording business transactions is known as -
(a) Vouchers
(b) Sale invoice
(c) ledger
(d) Trial Balance.

7. Accounts are classified into how many masters of accounting-
(a) Six
(b) Five
(c) Two
(d) Three.

8. Which of the following transactions are recorded cash book of a business enterprise:

a. Only cash transactions
b. Only credit transactions
c. Only cash sales transactions
d. Both cash and credit transactions

9. Which of the following transactions would have no influence over the Capital.

a. Purchase of Machinery on Credit
b. Payment of personal expenses through cash of business.
c. Loss incurred during the year
d. Additional money invested into the business by the owners.

10. Revenue includes:

a. Cash Sales only
b. Credit Sales Only
c. Both Cash and Credit Sales
d. Both Cash and Credit Purchases.

11. The credit balance of Profit in the profit and loss account should be:

a. Subtracted from Liabilities
b. Added in current Assets
c. Subtracted from the Capital
d. Added in the Capital

12. If the capital of a business is Rs. 14,00,000 and liabilities are Rs. 6,00,000, then the assets of the business are

Rs. 8,00,000

Rs. 20,00,000

Rs. 16, 00,000

Rs, 6,00,000

13.Calculate the value of Trade recievables, if Cash at bank is Rs. 96,000, Trade payables Rs. 66,000, Property Plant and Equipment is Rs. 42,000 owner equity Rs. 1,54,000.

Rs. 42,000
Rs. 82, 000
Rs. 30, 000
Rs. 2,20,000

14. If a business borrows a sum of money from bank in the form of loan, then it will:
(a) Decrease the capital
(b) Increase the capital
(c) No effect on capital
(d) None of the above

15. Which of the following account has a debit balance
(a) Creditor's A/c
(b) Capital A/c
(c) Land and Building A/c
(d) Loan A/c

2.10 SUMMARY

Accounting Equation is the mathematical equation that equates Total Assets with sum of Capital. In other words, It shows that the assets and liabilities of a firm are equal.

An accounting equation is based on dual aspect concept which states that every transaction has two aspects.

Accounting equation is expressed as:

Assets= Capital+ Liabilities

or

Capital =Assets – Liabilities

or

Liabilities = Assets – Capital

Ledger are divided into five categories:
(a) Asset
(b) Liability
(c) Capital
(d) Expenses/Losses
(e) Revenues/Gains

Fundamental rules of Accounting:

For Assets/Expenses (Losses):
"Increase in asset is debited, and decrease in asset is credited."
"Increase in expenses/losses is debited, and decrease in expenses/ losses is credited."

For Liabilities and Capital/Revenues (Gains):
"Increase in liabilities is credited and decrease in liabilities is debited."

"Increase in capital is credited and decrease in capital is debited."
"Increase in revenue/gain is credited and decrease in revenue/gain is debited."

Asset: is a resource controlled by the business entity from which probable future economic assets will flow to the entity by using it for generating future profits. Assets can be Tangible and Intangible.

Tangible Assets: are the assets which have some physical existence. They can be seen, touched and felt

Intangible assets: Assets which have no physical existence (cannot be seen or felt although they help to generate revenue in future) and whose value is determined and restricted by the rights and expected future benefits.

Current Assets – Asset which is:

v. expected to be realised in, or is intended for sale or consumption in the Company's normal Operating Cycle,
vi. held primarily for the purpose of being traded ,
vii. to be realised within 12 months after the Reporting Date, or
viii. Cash or Cash Equivalent.

Non-Current Assets – All other Assets which are not classified as Current Assets

Liability: It is the present obligation to be settled through outflow of economic resources.

Current Liabilities – A liability which satisfies any of the following:

v. expected to be settled in the normal operating cycle,
vi. held primarily for the purpose of being traded,
vii. to be settled within 12 months after the reporting date, or
viii. entity does not have an unconditional right to defer settlement of the liability for at least 12 months.

Non-Current Liabilities – All other liabilities not classified as current liabilities

Internal Liability/Equity: It refers to owner's equity, i.e. all the amounts which proprietors, owners, shareholders are entitled

Receipts: Gross inflow of cash and cash equivalents to the entity from sale of goods, services or business assets. Reciepts can be further classified into:

Revenue Receipts: Revenue Receipts are those receipts which are received on account of transactions in the normal operation of business such sale of goods or services to customers.

Capital Receipts: Capital Receipts are those receipts which are received on account of transactions and events which are not in the ordinary course of business sale of fixed assets,

business undertaking, long term investments. These are non recurring in nature as they do not occur regularly.

Expenses: It is the part of expenditure whose benefit has been expired during the current accounting period for earning revenue. For example: rent, wages, salaries, interest, repairs, etc.

Revenue Expenditure: Expenditure whose benefit is received/expired within the same accounting period in which they are incurred. For example: rent, interest, salary, etc.

Capital Expenditure: If benefit out of resources, assets, goods or services acquired from the expenditure is received for more than one accounting period. For example: Purchase of plant and machinery is shown as asset at cost minus depreciation.

Deferred Revenue Expenditure: There are the expenditures which are revenue in nature but benefit of which is derived over number of years. To comply with the matching concept we have to record these expenditure on initial recognition as Assets and written off in the period of their occurrence and in the subsequent periods. For Example: Huge Advertisement Expenditure.

2.11 SELF-ASSESSMENT QUESTIONS

1. Explain the Concept of Accounting Equation.
2. Explain the following terms:
   i. Asset
   ii. Liability
   iii. Capital
3. What is the Difference between Capital and Revenue Expenditure.
4. Differentiate between Expense and Expenditure
5. Explain the rules of debit and credit.
6. Explain the following Concepts:
   a) Current liability
   b) Current Asset
   c) Non Current liability
   d) Non Current Asset

2.12 SUGGESTED READINGS

Latest editions of the following text books to be used:

5. Narayanaswamy R. Financial Accounting: A Managerial Perspective. PHI Learning Pvt. Ltd., Delhi

6. Robert N. Anthony, David F. Hawkins, Kenneth A. Merchant. Accountancy- text and cases. McGraw Hill Education (India) Private Limited, New Delhi.
7. Garg CA Kamal, and Sehrawat Neeraj Kumar. Beginner`s Guide to Ind AS & IFRS. Bharat Law House Pvt. Ltd., New Delhi
8. Maheshwari S. N., Maheshwari Sunil K., and Maheshwari Sharad K, An Introduction to Accountancy, Vikas Publishing House Pvt. Ltd.

LESSON 3

RECORDING, CLASSIFYING AND SUMMARISING

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STRUCTURE

3.1 LEARNING OBJECTIVES

This lesson would enable students to:

- Understand the nature of Accounts
- Understand the rules of Debit and Credit
- Analyse the transactions and journalise them
- Record transactions in Triple column Cash Book
- Prepare Ledger Accounts
- Prepare Trial Balance

3.2 INTRODUCTION

An account is a systematic record of business transactions related to a particular head at one place. It records the date wise details about the amount of transaction and their effect/direction. According to the concept of double entry or dual aspect concept, every transaction has two effects- a debit and a credit. Accordingly, an account has 2 sides – left is referred to as debit side and right side is referred as credit side. Debit is abbreviated as Dr. and is written on the top left side of the account and credit is abbreviated as Cr. and is written on the top right side of the account. If a transaction is recorded on the debit side, it means account is debited and and if a transaction is recorded on the credit side, it means account is credited. Debit either means an increase or a decrease in the account balance depending on the nature of the account. An account may be related to an asset, a liability, capital, revenue or expense. An account is made in a T form as follows:

Dr. NAME OF ACCOUNT Cr.

Date	Particulars	J.F.	Amount(₹)	Date	Particulars	J.F.	Amount(₹)

3.3 NATURE OF ACCOUNTS

Accounts can be classified as follows:

1. Traditional Classification

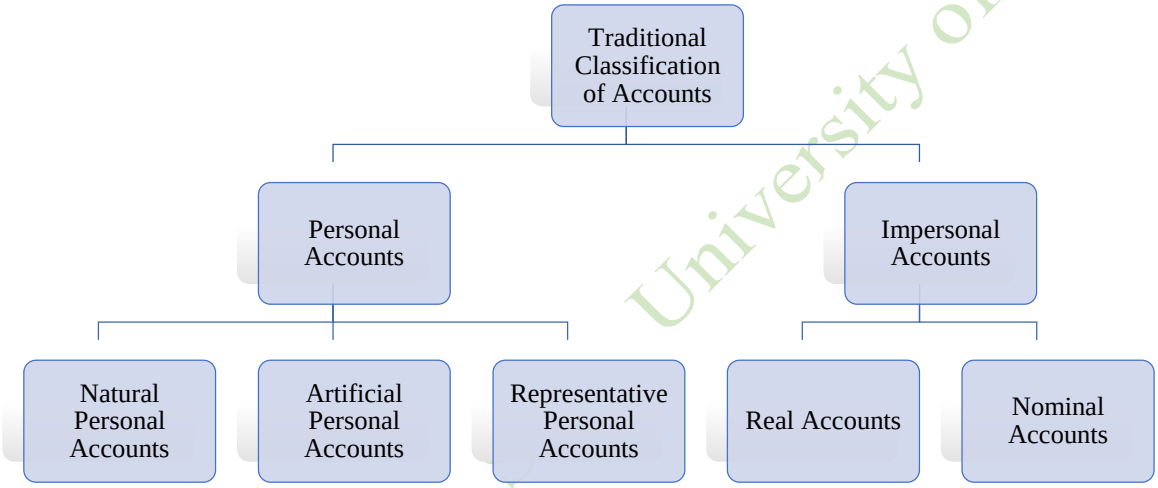
2. Modern classification

3.3.1 Traditional Classification

A complete record of transactions must be kept in the double entry system of bookkeeping. These transactions could be connected to:

• Assets or properties
• Persons

Accounts can be classified into different categories as follows:
Personal accounts are the first category.
Real Accounts make up the second group.
The third group is Nominal Accounts.



Personal accounts

These pertain to people like clients (debtors) and suppliers of goods (creditors), who may be private individuals, businesses, or corporations. These could symbolise the proprietor's capital, drawings, or other people, or they may be related to it. These can also be categorised as follows:

a) A Natural Personal Account is one that is connected to a living, natural person. In other words, those who are God's creatures. Examples include Ramesh A/c being the natural personal account if Ramesh is the company's creditor and Suresh A/c being the firm's debtor.

b) Artificial Personal Accounts are any accounts held by businesses, partnerships, banks, financial institutions, or other non-living artificial persons, i.e., entities recognised as persons by law. Examples include the accounts of Videocon Industries, ABC Co., Reliance Industries, banks, etc.

c) Representative Personal Accounts are accounts that stand in for an individual or a group of individuals. Although the costs or revenue accounts are nominal accounts, they are categorised as representative personal accounts when they are payable to or recoverable from a specific individual on a specific date. For instance, Outstanding Rent A/c will be a

representative personal account since it is representing the landlord to whom the rent is owed . The person's identity as an individual is known, yet they are collectively represented through a representative personal account. Even though the identity of the individual employee and the amount that has to be paid to each of them is known, let's say that the wages that need to be paid to the employees are due. We would write it as Outstanding Wages A/c. Other examples include rent that must be paid but not yet paid (outstanding rent), prepaid insurance, advance revenue, and accrued interest. Accounts for capital and withdrawals are also representative personal accounts because they reflect the owner who put money in the company and withdraws it.

Real accounts

These are the firm's possessions or assets. Each asset is maintained in a separate account. They can be categorised according to their physical existence as follows:

a) Assets with a physical existence—those that can be seen, touched, or felt—are referred to be Tangible Real Accounts. Examples include tools, money, real estate, buildings, furniture, etc.

b) Assets that cannot be seen, touched, or felt yet have monetary worth associated to them include goodwill, trademarks, patents, copyrights, etc. they are referred to as Intangible Real Account.

Nominal accounts

Nominal accounts are those that reflect gains, revenues, expenditures, and losses. For each category of expense (or gain), separate accounts are kept. These come in two varieties:

a) Accounts for expenses, such as salaries, wages, rent, commissions, losses due to fire, interest payments, bad debts, and discounts permitted

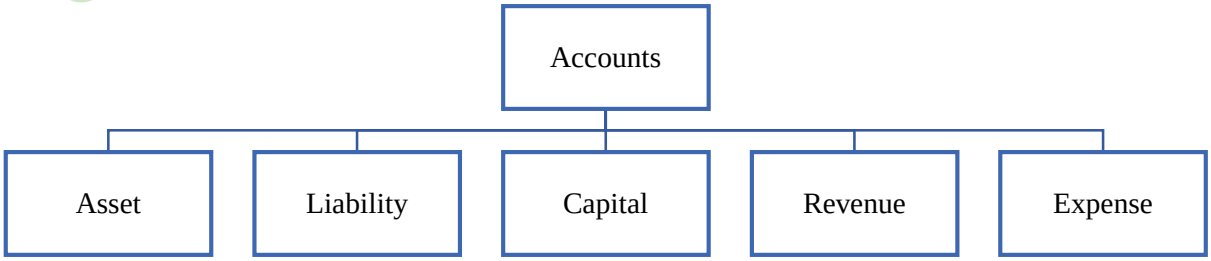
b) Revenue accounts, including money received and income received in the form of rent, dividends, and commissions.

The nominal accounts are closed at the conclusion of the financial year by transferring their balance to the Trading & P&L A/c. Their balance is not carried over to the following financial year, in contrast to real and personal accounts.

NOTE- If a prefix or suffix (like outstanding or prepaid or accrued or received in advance) is added to the nominal account, it becomes a personal account.

3.3.2 Modern Classification

Under modern classification, accounts are classified as follows:



1. Asset Account - Accounts linked to an enterprise's financial resources, i.e., its assets and real estate. They can be tangible (plants, machinery, furniture, buildings) or intangible (goodwill, patents, trademarks).
2. Liability accounts: These accounts show the sums that an enterprise owes to other parties. Basically comprises creditor accounts, unpaid bills, lenders, etc.
3. Capital Account - This account shows the money an entrepreneur has put into his business. Both capital and drawings account are included in this.
4. Revenue Account - Income and gains are shown in these accounts. Examples include sales account, rent account, discount account, commission account, interest, bad debts recovered, etc.
5. Expense Account - Losses or expenses incurred while operating the business are reflected in the expenses account. Wages, salaries, rent, commission, etc. are some examples.

IN-TEXT QUESTIONS

1. Classify the debtors account as per
   i. Traditional approach
   ii. Modern approach
2. Bank Account is a real account or a personal account?
3. Is capital account a representative personal account?

3.4 RULES OF DOUBLE ENTRY

As we follow the double entry system, every transaction has two aspects – a debit and a credit. In order to understand as to which accounts are to be debited and which are to be credited, we follow the rules of debit and credit.

The "Rules of Double Entry" or "Rules of Debit and Credit" are the guidelines that determine which account should be debited and which should be credited.

The rules of debit and credit are as follows:

3.4.1 For accounts as per traditional classification

These are known as the "Golden Rules of Accounting".

1. For personal accounts, debit the receiver and credit the giver

When a supplier of products provides a benefit to a business (by providing items on credit), the creditors account is credited because the rule states that credit should be given to the giver. Conversely, when a person receives a benefit, such as a debtor of the business, the debtors account is debited.

2. For Real Accounts, debit what comes in and credit what goes out

The assets that the company has are represented by real accounts. According to the norm, the Furniture Account is debited if an asset enters the business, such as newly purchased furniture. If an asset leaves the business, like in the case of the furniture purchase, cash is paid out and the cash account is credited.

3.For nominal accounts, debit all expenses and losses and credit all incomes and gains.

The rule states that when an expenditure is incurred, such as paying rent or a salary, these expense accounts are debited, and when an income or gain is realised, such as from sales, a discount, a gain from the sale of an asset, etc., these revenue accounts are credited.

3.4.2 For accounts as per traditional classification

Type of account	When to debit	When to credit
Asset	Increase	Decrease
Liability	Decrease	Increase
Capital	Decrease	Increase
Revenue	Decrease	Increase
Expense	Increase	Decrease

These rules are elaborated as follows:

1) Asset accounts are credited whenever a transaction results in a decrease in the assets balance and debited whenever the assets balance rises. For instance, when a company buys machinery, the asset account is debited since the asset balance increases. When equipment is sold, the equipment account is credited.

2) Liability accounts - A liability account is credited when a business transaction creates a liability, and it is debited when the liability is paid off or the balance of the liability lowers for some other reason. For instance, when things are purchased on credit, a liability is created, and the creditor account is credited. The creditor account will be debited after the debt is paid off to the creditor.

3) Capital accounts — When the business's owner invests money, the capital account is credited. When a transaction occurs that results in a reduction in capital account, it is credited.

4) Revenue accounts: A rise in revenue accounts, such as sales, is credited. Any decline in revenue results in a debit.

5) Expense accounts - Any increase in expenses is debited and any decrease is credited.

Notes:

- Depending on the type of account, a debit could result in either an increase or a reduction. Debit, for instance, denotes a drop for liabilities but an increase for assets. The nature of the accounts will determine whether a credit represents an increase or decrease. For instance, credit indicates a gain in capital but a decline in assets.
- Credit is not always advantageous, and debit is not always disadvantageous. For instance, debiting an asset is advantageous, but debiting a revenue account is bad because it results in lower revenue. Similar to this, it is advantageous to credit the revenue account but not the asset account. Debit and credit cannot be equated with positive and negative outcomes respectively.

Let us understand with the help of an example.
Classify the following accounts as per

a) Traditional approach
b) Modern approach

i. Bank A/c
ii. Bank Overdraft A/c
iii. Interest Paid A/c
iv. Capital A/c
v. Plant and Machinery A/c
vi. Goodwill A/c
vii. Sales A/c
viii. Outstanding Salaries A/c
ix. Discount Received A/c
x. Prepaid Rent A/c

Solution:

Name of account	**Nature of account (as per traditional approach)**	**Nature of account (as per modern approach)**
Bank A/c	Personal	Asset
Bank overdraft A/c	Personal	Liability
Interest paid A/c	Nominal	Expense
Capital A/c	Personal	Capital
Plant and Machinery A/c	Real	Asset

Goodwill A/c	Real	Asset
Sales A/c	Nominal	Revenue
Outstanding salaries A/c	Personal	Liability
Discount received A/c	Nominal	Revenue
Prepaid Rent A/c	Personal	Asset

IN-TEXT QUESTIONS

4. Rules of debit and credit are same for capital and liability. Why?
6. Anil received an advance for sale of tables by him. How should this be treated?
7. What does a credit in expense account signify?

3.5 RECORDING TRANSACTIONS IN JOURNAL/GENERAL JOURNAL

3.5.1 Journal

Journal is a book which records daily business transactions in a chronological order i.e. the sequence in which they occur.

As per the accounting process, any transaction is recorded first in the journal from the vouchers. That is why the Journal is known as the 'Book of Original Entry' or 'Book of Prime Entry'. The transactions are recorded in the chronological order.

A Journal is made as follows:

JOURNAL

Date	Particulars	L.F	Debit (₹)	Credit(₹)

3.5.2 Journalising

Journalizing is the process of entering financial transactions using the debit and credit rules in a journal.

The accounts that the transaction affects are identified after it is entered. The type of account is then determined. The transaction may effect accounts of the same kind or accounts of other sorts. The rules of debit and credit are then applied based on the kind of accounts to determine which account should be debited and which account should be credited.
For example, payment of insurance premium ₹20,000
Step 1: Identify the accounts involved.
Here, the accounts involved are Insurance A/c and Cash A/c.
Step 2: Identify the nature of accounts involved.
Insurance is nominal account and cash is real account.
Step 3: Apply the rule of debit and credit.
Insurance is a nominal account. Rule for nominal account is "Debit all expenses and credit all incomes". Since insurance is an expense, it will be debited.
Cash is real account and rule for real account is "Debit what come in, Credit what goes out". Cash is going out, so Cash A/c will be credited.
The journal entry will be:

Insurance A/c	Dr.	₹20,000	
To Cash A/c			₹20,000

3.5.3 Analysis and journalizing of certain transactions

Let us understand this with an example.
Analyze the following transactions as per Traditional Approach. And state which account will be debited and credited in each transaction.

i. Vaibhavi started a business by investing ₹5,00,000
ii. Purchase of office furniture worth ₹25,000
iii. Purchased goods for cash ₹ 50,000
iv. Sold goods to Rajeev for ₹40,000
v. Paid wages ₹25,000
vi. Received interest on investment ₹10,000

Solution:

ANALYSIS OF TRANSACTIONS

Transactions	Accounts involved	Nature of account	Rule to be applied	Debit(₹)	Credit(₹)
Vaibhavi started a business by investing ₹5,00,000 in cash	Cash Capital	Real Personal	Debit what comes in Credit the giver (giver is the proprietor in this case and capital account is representing the owner)	5,00,000	 5,00,000

Purchase of office furniture worth ₹25,000	Furniture Cash	Real Real	Debit what comes in Credit what goes out	25,000	25,000
Purchased goods for cash ₹ 50,000	Purchases Cash	Nominal Real	Debit all expenses Credit what goes out	50,000	50,000
Sold goods to Rajeev for ₹40,000	Rajeev Sales	Personal Nominal	Debit the receiver Credit incomes	40,000	40,000
Paid wages ₹25,000	Wages Cash	Nominal Real	Debit expenses/loss Credit what goes out	25,000	25,000
Received interest on investment ₹10,000	Cash Interest	Real Nominal	Debit what comes in Credit incomes	10,000	10,000

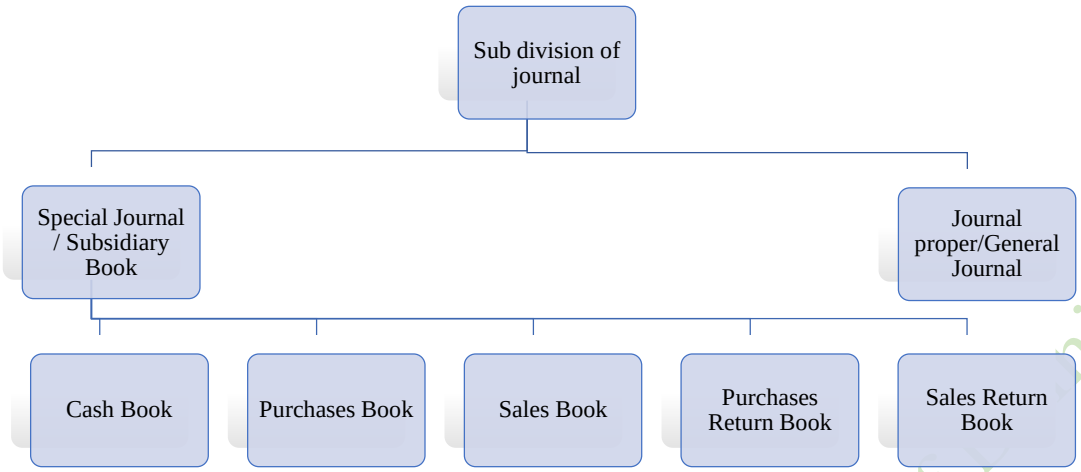
Readers are advised to analyse the above transactions using modern approach. The results will be the same.

3.5.4 General Journal

If the organization is small, all entries—including those for cash sales, cash purchases, credit sales, credit purchases, and other types of transactions—will be made directly in the journal.

But there are a lot more transactions when it comes to big commercial concerns. It will be lengthy and heavy if all of the cash and non-monetary transactions are recorded in one journal. As a result, the Journal is divided into special journals called "Subsidiary Books," "Day Books," or "Special Journals" rather than recording all transactions in a single book. For instance, the sale of goods on credit (items that a firm deals in) is noted in the sales book, and the purchase of goods on credit is noted in the purchases book. Similar to this, various customised journals are kept to track particular types of transactions in one location. By doing this, the issue of a single journal being too large is avoided.

Additionally, because all transactions of the same kind are recorded in one location, it offers the advantages of specialisation. JOURNAL PROPER contains the remaining transactions that were unable to be documented in any of the subsidiary books.



- Cash Book

A record of all monetary/cash transactions (receipt or payment).

- Purchases Book

lists of products purchased on credit. Does not keep track of purchases of fixed assets or goods in cash.

- Sales Record

Records goods' sales. Does not track sales of products besides those the business deals in and cash sales of goods.

- Purchases Return Book

Records goods that have been returned after being bought on credit. Does not keep track of returns of goods purchased with cash or returns of anything besides goods like assets.

- Sales Return Book

Returns of goods sold on credit are recorded. D oes not keep track of returned non-goods or goods purchased with cash.

- General Journal

Records transactions which could not be recorded in any of the subsidiary books mentioned above.

Some concerns also maintain

- Bills Receivable Book
- Bills Payable Book

The transactions that are not recorded in any of the aforementioned subsidiary books are then documented in the General Journal. The transactions are listed in the order they occurred. Furthermore, because such transactions take place so infrequently, it is unnecessary to keep a separate journal just for them. The term "general journal" also refers to "journal proper."

The transactions recorded in General Journal/ Journal Proper may be of the following types:

- Opening entry
- Closing entry
- Adjustment entry
- Rectification entries
- Miscellaneous entries

Opening entry

"The journal entry passed to record the opening balances is known as Opening Entry."

When a new accounting year begins for an ongoing business (an already-existing business), an opening entry is first made in the journal/journal proper. The closing balances of the accounts from the prior year are brought forward in the current year by making this entry (in the form of opening balances). The opening entry for the current period is based on the Balance Sheet created at the conclusion of the prior year.

Keep in mind that only the balances of assets, liabilities, and capital accounts (or the traditional classification of real and personal accounts) are moved forward to the current year by opening entry. Since expense and revenue accounts (also known as nominal accounts) are closed annually by moving their balance to the statement of profit and loss, they are not permitted to be carried forward. As a result, there is no balance in these nominal(revenue and expense) accounts to carry over to the following year.
All of the assets are individually debited in the opening entry, while all of the liabilities are separately credited together with the capital account.

The opening entry is as follows:
Sundry Assets A/c Dr.
To Sundry Liabilities A/c
To Capital A/c

In case the amount of capital is not known, it can be found out by using the Accounting Equation as follows:
Assets = Liabilities + Capital or
Capital = Assets – Liabilities
Once the opening journal entry is passed, the journal entries for other transactions entered into by the business during the current accounting year are passed.

The opening entry is shown in ledger accounts by writing "To balance b/d" on the debit side of assets account and writing "By balance b/d" on the credit side of liabilities and capital account.

Elaborating with the help of an example,
Mohan has been running a cloth business. The ledger balances in his books on 31 March, 2022 are as follows:

Debtors 50,000
Creditors 70,000
Computer 10,00,000
Inventory 1,00,000
Cash 80,000
Bank overdraft 35,000
What will be the opening journal entry passed in Mohan's accounts book on 1st April, 2022?

Since the amount of capital is not known, we will calculate it using accounting equation.
Capital = Assets – Liabilities
Total Assets = Debtors + Computer + Inventory + Cash = 50,000 + 10,00,000 + 1,00,000 + 80,000 = 12,30,000
Total Liabilities = Creditors + Bank Overdraft = 70,000 + 35,000 = 1,05,000
Capital = Assets –Liabilities = 12,30,000 – 1,05,000 = 11,25,000

Opening entry will be as follows:

JOURNAL PROPER

Date	Particulars		L.F.	Dr. (₹)	Cr.(₹)
2022					
April 1	Cash A/c	Dr.		50,000	
	Computer A/c	Dr.		10,00,000	
	Inventory A/c	Dr.		1,00,000	
	Debtors A/c	Dr.		50,000	
	To Creditors A/c				70,000
	To Bank Overdraft A/c				35,000
	To Capital A/c				11,25,000

Note – Posting of the above entry to the ledger will involve writing "To balance b/d" on the debit side of the asset accounts and writing "By balance b/d" on the credit side of liabilities accounts and capital account.
Apart from being a special journal (or a subsidiary book), Cash Book also serves as the Cash Account, so opening balance of cash will be shown on debit side of Cash Book in cash column as "To balance b/d" and bank overdraft will be shown as "By balance c/d" on the credit side of Bank column in case of double or triple column cash book.

In the case of commencement of a new business, the opening entry is passed with the amount of capital introduced in the form of cash or other assets. If only cash is brought in by the owner, a direct posting will be made in the Cash Book. But if capital is brought in the form of cash and other assets, then opening entry will be made in the Journal Proper by debiting concerned assets accounts and crediting the capital account.

Closing entries
"Entries passed for closing the nominal accounts by transferring their balance to Profit and loss account are known as closing entries."

The accounting year ends with the passing of closing entries. These are required for the creation of final accounts, particularly the trading and profit and loss account,. The revenue and expense accounts—or nominal accounts under the classical classification—are closed in the closing entries by transferring their balance to the Trading and Profit and Loss Account. Examples include closing a rent account by transferring the balance to the P&L account and closing a sales account by transferring the balance to the Trading Account.

The expense accounts have debit balances, as is common knowledge. Thus, crediting the expenses account is necessary before closing them. Additionally, the P&L account is being debited because we are terminating these accounts by moving their balances to the Trading and P&L Account (showing the expenses incurred). There is a credit balance in the revenue accounts. To close them, you must debit these revenue accounts and crdit the Trading and P and L Account.

The following closing entries are passed:

Trading and P&L A/c Dr.
To Expenses A/c

Revenue A/c Dr.
To Trading and P&L A/c

Once these closing entries are passed, no balance remains in the nominal accounts.
Let us elucidate with an example for better understanding.

Following information is given in respect of the business M/s Suman Ltd.
Opening Stock ₹40,000; Wages ₹27,000; Purchases ₹40,000; Sales ₹1,00,000; Rent Received ₹7,000 ; Insurance ₹3,000; Discount Allowed ₹2,500 ; Closing Stock ₹70,000; Interest Received 3,000; Electricity 1,500
Pass the closing journal entries.

JOURNAL PROPER

Date	Particulars	L.F.	Dr. (₹)	Cr.(₹)
2022 March 31	Trading A/c Dr.		1,07,000	
	To Purchases A/c			40,000
	To Wages A/c			27,000
	To Opening Stock A/c			40,000
	Sales A/c		1,00,000	
	Closing Stock A/c		70,000	
	To Trading A/c			1,70,000

	Trading A/c (1,70,000 – 1,07,000) To P&L A/c		63,000	63,000
	P&L A/c To Insurance A/c To Discount Allowed A/c To Electricity A/c		7,000	3,000 2,500 1,500
	Rent received A/c Interest received A/c To P&L A/c		7,000 3,000	10,000
	P&L A/c To Capital A/c (Net profit transferred to P&L A/c)		66,000	66,000

Rectification entries

While entering transactions into the journal or posting them to the ledger, mistakes may be made. These mistakes/errors can be categorised as follows:

- Errors of commission,
- Omission,
- Principle, and
- Compensating errors.

To rectify is to make corrections. Rectification entries are passed to correct such errors made when recording transactions in the books of accounts.

Adjustment entries

To guarantee that financial statements reflect honest and fair business performance and position, adjustment entries are passed at the conclusion of the accounting year to make adjustments in the amounts of various accounts. The following entries are passed:

- Outstanding Expenses

Expenses A/c Dr.
To Outstanding Expense A/c

Unpaid expenses are those that belong to the present time and should have been paid now but weren't, such as wages, rent, etc. They are outstanding as a result. Due to the fact that Outstanding Expense is a liability and relates to the current period, it is credited and regardless of whether it is paid or not, it counts as an expense for currentperiod. (This is due to the accrual method of accounting that we utilise.) The expense account is therefore debited. (This suggests that it is an expense for the present period.)

- Prepaid Expenses

Prepaid Expenses A/C
To Expenses A/c

Prepaid expenses are an asset since they are paid for in advance (in the current year), but the benefits will be realised later (in next year or coming years). It gets debited since it is an asset. The expense account had to be debited at the time the payment for the expense was made. The expense account will be credited to the extent of the prepaid expense showing that such amount of prepaid expense is deducted from expense account so that it can be shown in next year's P&L Account. All of this is done because, since the amount of prepaid expense is not related to the current year and P&L Account shows items relating to the current year.

- Accrued Income

Accrued Income A/c Dr.
To Income A/c

Similar logic as for outstanding expense will apply.

- Income Received In Advance

Income A/c Dr.
To Income Received In Advance A/c

Logic similar to prepaid expense will apply.

- Depreciation

Depreciation A/c Dr.
To Fixed Asset A/c

Since depreciation is an expense, it is debited. Fixed assets have a debit balance and since depreciation reduces their value, Fixed Assets Account is credited.

- Interest on Capital

Interest on Capital A/c Dr.
To Capital A/c

Funds invested by the proprietor in his business is known as capital. Interest is allowed on such capital. Such interest is an income for the proprietor but an expense for the business. So, Interest on Capital A/c is debited. The amount of interest on capital is credited to the capital account as it increases the capital balance belonging to the proprietor.

Miscellaneous entries

Certain types of transactions are there which are left out and not recorded in specialized journals as they do not have separate subsidiary book for them. So such transactions are also recorded in Journal proper. Such transactions and their entries are discussed below.

- Credit purchase of fixed assets

If fixed assets like machinery, furniture, etc. are bought on cash basis, the entry will be made directly in cash book. But if they are purchased on credit, then such entry cannot be made in Cash Book and also cannot be made in purchase book as purchase book records credit purchases of goods in which the business deals. Hence, this transaction will be recorded in Journal Proper. The entry will be as follows:

Fixed Asset A/c Dr.
To Vendor A/c
(Fixed Asset purchased on credit)

- Insolvency of a customer

If goods were sold to a customer on credit basis and the customer become insolvent before receipt of payment from him, the entry will be made in Journal proper as follows:

Bad Debts A/c Dr.
To Debtor A/c
(Bad debts written off)

Since the amount of debt owed by the customer to the firm has become irrecoverable (i.e. bad), it is a loss for the firm and losses are debited. And since debtor can't pay now, his account is closed by making a credit.

- Occurrence of accidents like loss of goods or fixed assets by fire or theft

The following entries are passed:

(a) On occurrence of loss
Loss by theft or fire A/c Dr. (With full amount of loss incurred)
To Purchases A/c or Fixed Assets A/c *

*Either of the two will appear. If goods are destroyed then purchases account will be credited indicating reduction of stock of goods. If the fixed asset is destroyed, then fixed asset account will be credited indicating reduction in balance of fixed asset (since fixed assets have a debit balance, a decrease in them will be denoted by a credit).

(b) If goods or assets were insured and insurance company accepts the claim
Insurance Company A/c Dr. (With the amount of loss accepted as claim)
Profit and Loss A/c Dr. (With the amount of loss not accepted as claim)
To Loss by theft or fire A/c

(c) On receipt of claim money from the insurance company
Bank A/c Dr. (Amount of claim received)

To Insurance Company A/c

- Capital brought in kind by the business owner

If capital is brought in by the proprietor in the form of cash, this will be recorded directly in the cash book. But in case capital is brought in kind, then it is recorded in Journal Proper. Entry is made as follows:

Assets A/c Dr.
To Capital A/c

- Discount allowed or received (if triple column cash book is not maintained)

If, in order to get payment from a debtor, some cash discount is allowed to him/her, then the following entry will be made:

Discount Allowed A/c Dr. (With the amount of discount allowed/ given to debtor)
To Debtor /c

In a similar manner, when payment is made to a creditor and some discount is received from him/her, the following entry will be passed:

Creditor A/c Dr. (With the amount of discount received)
To Discount Received A/c

- Goods distributed as free samples

The entry will be as follows:

Advertisement Expense A/c or Samples A/c Dr.
To Purchases A/c

IN-TEXT QUESTIONS

8. What will be the journal entry for bad debts recovered?
9. Nominal accounts are never balanced but totalled and transferred to P and L account. True or False?

3.6 RECORDING TRANSACTIONS IN TRIPLE COLUMN CASH BOOK

3.6.1 What is a cash book?

In any business, a myriad of cash transactions are entered into. Such transactions may either relate to receipt of cash or payment of cash. Cash sales, receipt from debtors , sale of assets for cash, receipt of investment income are some examples of transactions involving receipt of cash. Cash purchases, payment to creditors, payment of expenses like rent, wages, insurance, etc. are some examples of transactions involving payment of cash. All these transactions involving cash are recorded in the cash book. Left side records the receipts of cash and credit side records the payment of cash.

Cash book is a book of original entry (Journal) as well a book of final entry (ledger). Since the transactions in the cash book are recorded directly from the source documents, it is a book of original entry. It performs the function of a ledger as well because it is prepared just like a cash account in T-format with debit side showing receipts of cash and credit side depicting payments of cash. This eliminates the need to prepare separate cash account in the ledger of the business. But the ledger account for the other aspects of the transaction involving cash needs to be prepared. That means if cash is received then debtors account still need to be prepared in ledger and if cash is paid to creditor, then creditor account still needs to be made in the ledger. In conclusion, the cash book is a dual purpose book. It serves as a journal as well as a ledger.

3.6.2 Kinds of cash book

- Single column cash book – There is only a single column for amount on each side (debit and credit) to record cash transactions. Payment or receipt in form of cheque (bank) is NOT recorded here.
- Double column cash book – On the debit and credit sides, there are two amount columns: one for recording bank transactions and the other for recording cash transactions. This book DOES NOT include any information about discounts given to customers or received by suppliers.
- Triple column cash book – There are three columns for amount on each side of the cash book- one for recording cash transactions, the second column for bank transactions and the third one for discount.

In the present text, we are going to discuss triple column cash book which is also known as three column cash book.

3.6.3 Triple Column Cash Book

As the name suggests, a triple column cash book consists of triple columns i.e. three columns on both the sides (debit and credit).
Column I is for Cash
Column II is for Bank
Column III is for Discount

A Triple Column Cash Book is made as follows:

Dr. Triple Column Cash Book

Date	Particulars	L.F.	Cash	Bank	Discount	Date	Particulars	L.F.	Cash	Bank	Discount

The debit side of the triple column cash book is the receipts side or discount allowed side

Cash and bank columns in the cash book represent the cash and bank accounts respectively. Since cash and bank are assets (as per modern classification) and an increase in assets in debited ,whenever any transaction involving receipt of money from a debtor will occur, it will be recorded on the debit side of triple column cash book. If any discount is allowed to a debtor, that is also recorded on the debit side (since discount allowed is an expense and expenses are debited). Cash is entered on the debit side (column pertaining to cash) if payment is received in cash. If payment is received by cheque, the amount on the debit side only but in the column pertaining to bank. Any allowed discount is also shown in the discount column on the debit side.

The credit side of the cash book is the payments side or discount received side

As stated above, cash and bank columns in cash book represent the cash and bank account respectively. Both cash and bank are assets (as per modern classification) and a decrease in asset is credited. So, whenever any transaction involving payment of money to the creditors of the firm will occur, it will be recorded on the right (credit) side. In case of any discount received from a creditor, it is also recorded on the credit side in the discount column (since discount received is an income and incomes are credited). If the payment is made in cash, the amount paid is recorded on the credit side in the column pertaining to cash . If a cheque is used to make the payment, the amount is noted on the credit side in the column pertaining to bank. Any discount that the creditor grants to the business is likewise noted on the credit side in the column named as 'Discount'..

Totaling and balancing triple column cash book

Once all the transactions are recorded in the cash book following the procedure discussed above, all the three columns of the cash book are totaled. The debit and credit side of cash and bank columns are totaled and balance is found out.

For the cash column, the debit side will always be either greater than the credit side or equal to the credit side. This means that there will be a debit balance of cash. This debit balance is shown on the credit side (the side having the lesser total) by writing "By balance c/d".

For the bank column, there can be a debit balance or a credit balance. Whenever the debit side exceeds the credit side, there will be a debit balance of bank which will be recorded on the credit side (the side having the lesser total) by writing "To balance c/d". If he credit side is

greater than the debt side, there will be a credit balance, which will be recorded on the debit side (the side with a lesser total) by writing "To balance c/d". The credit balance in the bank column means there is existence of bank overdraft.

The discount column on the debit and credit side are always totaled but never balanced. The total discount column on the debit side represents the overall discount given to debtors by the business. The total of the discount column on the cash book's credit side represents the entire discount that the company has received from its creditors.

Posting from the credit side of the cash book is made in the respective ledger accounts' debit side. The name of the account appearing in the 'Particulars' column on the credit side of the cash book is debited by the amount of cash/cheque paid and the amount of discount received, if any. The total of discount received is shown on the credit side of the Discount Received A/c by writing "By Total Discount received".

Posting from the debit side of the cash book is made on the credit side of the respective ledger accounts. The account appearing in the 'Particulars' column on the debit side of the cash book is credited by the amount of cash/cheque received and amount of discount allowed appearing against its name in the cash book. On the debit side of the Discount Allowed A/c, write "To Total Discount Allowed" to display the total amount of discount allowed (on the debit side of the cash book).

Contra entries: Triple column cash book can involve contra entries or cross entries. These are those entries which involve transfer of money from cash to bank (depositing cash in bank account) or bank to cash (withdrawing cash from bank from office use).Such transactions are recorded on both the sides of the cash book. If on one side of the cash book, it is recorded in cash column, then on the other side it will be recorded in the bank column and vice versa. This is because such entries affect both – the cash account and the bank account simultaneously. Such entries are denoted by writing the letter 'C' in the Ledger Folio (L.F.) column of the cash book. Writing 'C' indicates that the double entry aspect of such a transaction is complete. As a result, such entries are not posted to the ledger accounts as it involves cash and bank accounts which are represented by the cash book itself. Cash book being both - a book of original entry and a ledger account; such entries are not posted in ledger.

Let us understand this with the help of an **example.**
Cash deposited into bank ₹10,000.
As a result of the above transaction, the bank balance will increase by ₹10,000 and cash balance will decrease by ₹10,000 simultaneously. On the debit side of the cash book, the increase in bank will be noted by putting "To Cash A/c" in the Particulars column and "10,000" in the bank column. By entering "By Bank A/c" in the Particulars field and "10,000" in the cash column, the decrease in cash will be noted on the credit side of the cash book.The symbol 'C' will be written in the ledger folio column on both the sides.
It will be shown as follows:

Triple Column Cash Book

Date	Particulars	L.F.	Cash	Bank	Discount	Date	Particulars	L.F.	Cash	Bank	Discount
	To Cash A/c	C		10,000			By Bank A/c	C	10,000		

IN-TEXT QUESTIONS

9. Preparation of cash book eliminates the need for preparation of a cash A/c. True or false?
10. Can the bank column in cash book have a credit balance?
11. Cash deposited into bank ₹10,000. Such an entry in cash book is called?

3.7 PREPARATION OF LEDGER ACCOUNTS

3.7.1 What is ledger?

"Ledger is a book which contains, in a summarized and classified form, a permanent record of all transactions."

Ledger is a book containing a record of all transactions relating to a particular account at one place. A ledger consists of different accounts like assets accounts, liabilities accounts, revenue accounts, expense accounts and capital account. It is called as Book of Final Entry or Book of Secondary Entry as after recording transactions in the journal; they must ultimately have to be posted in the ledger. Ledger is also called the Principal Book of Accounts. This is because it helps in preparation of trial balance, which in turn helps in preparation of final accounts.

Specimen of a ledger account:

Dr. NAME OF ACCOUNT Cr.

Date	Particulars	J.F.	Amount(₹)	Date	Particulars	J.F.	Amount(₹)

3.7.2 Utility of ledger

All the transactions recorded in the journal are ultimately posted in the ledger. Journal provides a chronological record of transactions but do not show the net effect of transactions on a particular account. This effect on a particular account can be shown by ledger. Ledger can show us the balance of a particular account, how much amount is due from debtors, how much is due to creditors, etc. Let us understand this with the help of an example.

Say, Mahesh is a customer of M/S Savita Devi and Sons. Goods are sold by the firm to him on credit and fresh purchases can be made by Mahesh from the firm even without completely clearing his old balance. Now if we want to know the amount owed by Mahesh to the firm at a particular date, we won't be able to determine it without preparing Mahesh A/c in the ledger.

This is because even though journal will show the entries for sales made to Mahesh and amount received from him, but they will be scattered throughout the journal and hence journal will not be able to provide ready information as to whether any amount is owed by Mahesh to the firm or not and if yes then how much. Such information can be made readily and easily available if Mahesh A/c is opened in the ledger. Ledger helps to know the position of a business account wise in a particular period.

3.7.3 Posting

It is the process of transferring journal entries to the corresponding ledger accounts. There must be a corresponding account in the ledger book for each account in the general journal.

Procedure for posting

In a journal entry, posting is carried out on the debit side of the account for the account that is debited and on the credit side for the account that is credited.

Take up one journal entry. Identify the accounts which are debited and credited. After this follow the below mentioned procedure:

Posting of account debited in journal

1) Once the account which is debited is identified, find the T shape account with same name in the ledger.
2) On the debit side of the account, enter the date in the "Date" column.
3) Name of the account that has been credited in the specific journal entry is written on the debit side of the account in the "Particulars" column by using the phrase "To (account which is credited)".
4) On the debit side of the account in the J.F. column, note the page number of the journal where the entry was made. To complete cross-referencing, record the page number of the ledger on which the account is made in the journal's L.F. column at the same time.Enter the amount in the 'Amount' column on the debit side.

Posting of account credited in journal

1) Once the account which is credited is identified, find the T shape account with same name in the ledger.
2) Enter the transaction date in the "Date" column, on the account's credit side,.
3) Name of the account that has been debited in the specific journal entry is written on the credit side in the "Particulars" column of the account by writing "By (account which is debited)".
4) On the credit side of the account in the J.F. column, note the page number of the journal on which the entry was made.
5) On the credit side, enter the sum in the "Amount" field..

Let us illustrate this with an example.

A firm purchased furniture for ₹10,000 from Manish Furniture House on 1st April, 2022.

The journal entry for this is:

Furniture A/c	Dr.	10,000	
To Manish Furniture House A/c			

The accounts affected by this transaction are: Furniture A/c and Manish Furniture House A/c.

Firstly, let us post the debit side of the journal entry.
Furniture account is debited in the journal entry. So furniture A/c is opened in ledger book.
On the debit side of Furniture A/c, the date is written in 'Date' column as "April 1, 2022".
In 'Particulars' column, on the debit side, is written the name of the account which is credited in the journal entry, i.e., "To Manish Furniture House A/c".
In J.F. column, the Journal page number would have been written had it been given in the question.
Then the amount of ₹10,000 is written in the 'Amount' column on the debit side of Furniture A/c.
Similarly is done for posting the credit side of the journal entry by opening Manish Furniture House A/c.
The two ledger accounts will appear as follows:

Dr. Furniture A/c Cr.

Date	Particulars	J.F.	Amount(₹)	Date	Particulars	J.F.	Amount(₹)
2022 Apr 1	To Manish Furniture House A/c		10,000				

Dr. Manish Furniture House A/c Cr.

Date	Particulars	J.F.	Amount(₹)	Date	Particulars	J.F.	Amount(₹)
				2022 Apr 1	By Furniture A/c		10,000

3.7.4 Balancing of ledger accounts

After all the entries are posted in an account, mostly it will have entries on both the sides. Both the sides of the account are totaled. After the debit and credit totals are obtained, the difference between the two sides is found out and written on the side with smaller total. Such a difference is known as balance. It is a debit balance and is written as "By balance c/d" or "By balance carried down" on the credit side in the "Particulars" column if the debit side total exceeds the credit side total. The total of the two sides then becomes equal. Since the closing balance of one year is treated as the opening balance of the following accounting year. On the first day of the next accounting year, this debit balance is shown as "To balance b/d" or "To balance brought down" on the debit side.
It is a credit balance and is noted as "To balance c/d" in the "Particulars" column on the debit side if the credit total exceeds the debit total. The two sides' sum then becomes equal. This credit amount will be noted as "By balance b/d" on 1st day of the following year on the credit side.
For some accounts, debit total may be equal to credit total. Such accounts will have nil balance.
Following types of accounts will typically have following balances:

Type of account	**Type of balance**

Asset	Debit balance
Liability	Credit balance
Capital	Credit balance
Revenue	Credit balance
Expense	Debit balance

It is important to note here that only the balance of asset, liability and capital accounts (real and personal accounts as per traditional classification) are carried forward to the next year as balance b/d. The revenue and expense accounts (nominal accounts) are not balanced rather totaled up. Hence, their amount is not carried forward to the next accounting year. These accounts are closed by transferring their total in a given year to Trading and P&L A/c. However, before passing the closing entry for transferring them to Trading and P and L A/c, Trial Balance is prepared to check arithmetical accuracy of accounting records.

IN-TEXT QUESTIONS

12. Name the type of accounts that are balanced.?
13. Which accounts are related to opening entries? (As per traditional classification)
14. Which kinds of accounts are related to closing entries? (As per traditional classification)
15. Which of the accounts are not related to closing entries?(As per modern classification)

3.8 PREPARATION OF TRIAL BALANCE

3.8.1 What is trial balance?

Trial balance is a statement showing debit and credit balances of all the ledger accounts (asset, liability, revenue, expense and capital) on a specified date.

Once the journal entries are posted in the ledger accounts, the trial balance is prepared. A trial balance *generally* contains two columns, one column showing the debit balances of different ledger accounts and the other column showing the credit balances of different ledger accounts. Once this is done, the amounts in these columns (debit and credit columns) are totaled. The total of the amount in the two columns must agree i.e. the totals should be equal. This ensures arithmetical accuracy of posting from journal to ledger. Although trial balance ensures arithmetical accuracy and shows the errors committed while making entries or posting them but it does not ensure absolute accuracy of accounts. In other words, if the trial balance agrees, it does not mean that accounting is error free. There are certain errors which are not disclosed

in trial balance like compensating errors and others. Matching of two columns just means that the amount of debits and credits is equal.

The concept of trial balance is based on the "Dual Aspect Concept". This means for every transaction, entered into by the business, there are two aspects i.e., a debit and a credit. Every debit has an equal and corresponding credit. As a result, when the ledger accounts' debit balances are added together, they must match the sum of the accounts' credit balances.In other words, the debit column of trial balance must be equal to the credit balance in terms of their total.

Format of a trial balance is as follows:

Trial Balance as on……

Heads of Accounts	L.F.	Dr. (₹)	Cr. (₹)

1.8.2 Features of trial balance

- It is a statement and not an account
- It is not a part of the double entry system of accounting. It is rather a result of the double entry system.
- It is a summarized statement containing the debit and credit balance of the ledger accounts.
- Although it is generally prepared at the end of accounting period but it is not necessary. It can also be prepared at any time of the year provided balances of ledger accounts are available.
- It ensures arithmetical correctness of ledger posting.
- It is not absolute verification of the accuracy of the books of accounts. This is because some inaccuracies, such as compensatory errors and complete transaction omissions, are not exposed by the trial balance.
-

1.8.3 Methods of preparing trial balance

Total method
Performa of trial balance under Total method is as follows:

Trial Balance as on……

Heads of Accounts	L.F.	Debit total (₹)	Credit total (₹)

Trial balance is prepared using the totals of the ledger accounts. In this method, the trial balance consists of three columns. First column shows name of ledger account, second column shows the debit totals and third column shows the credit totals Both the debit and credit sides are individually added up for each ledger account. The sum of an account's credit and debit sides is referred to as the credit total and the debit total, respectively. An account's debit total is recorded in the trial balance's debit column, while the account's credit total is recorded in the trial balance's credit column. Similar procedure is adopted for all the ledger accounts. Once this is done, the 'debit total' column and 'credit total' column of the trial balance are totaled. The total of debit column and that of credit column of the trial balance should match. The trial balance prepared using this method is called Gross Trial balance. This method is not widely used.

Balance Method

Performa of trial balance under balance method is as follows:

Trial Balance as on……

Heads of Accounts	L.F.	Debit Balances (₹)	Credit Balances (₹)

Trial balance is prepared using the balances of the ledger accounts instead of the totals of ledger accounts. In this method, trial balance consists of three columns, first column shows the names of ledger accounts, second column shows the debit balances of ledger accounts (instead of debit totals) and third column shows the credit balances of ledger accounts.(instead of credit totals).

A ledger account is totaled. Both the credit and debit sides are totaled and the balance of the ledger account is obtained. A ledger account can have either a debit balance or a credit balance. The balance of all ledger accounts is obtained. Then the balance amounts of ledger accounts with credit balances are posted in credit column and the balance amounts of ledgers with debit balances are posted on the debit side of trial balance. The trial balance's debit and credit column totals are calculated. They should match indicating arithmetical correctness of the ledger posting. The trial balance prepared using this method is called Net Trial Balance. This method is most widely used.

Compound Method

Performa of trial balance under compound method is as follows:

Trial Balance as on.....

Heads of Accounts	L.F.	Debit total (₹)	Credit total (₹)	Debit Balances (₹)	Credit Balances (₹)

This method is a combination of the two methods discussed above i.e. Totals method and Balance method. Hence, this method is also called totals-cum-balance method. Trial balance is prepared using both - the totals and the balances amounts of ledger accounts. The debit totals, credit totals and credit/debit balance of a particular account are used.

For a particular ledger account, its debit total, credit total and balance (which can either be debit or credit) are determined. All these three amounts are posted in the respective columns of the trial balance. Same procedure is followed for all ledger accounts. Once this is done, all the four columns of the trial balance are totaled. The total of column showing 'debit total' and the total of the column showing 'credit total' of should match. Similarly, the total of columns showing debit balances and credit balances should match. Since this method involved a lot of effort, it is rarely used.

Let us understand the preparation of ledger and trial balance from an example below.
Information regarding business of XYZ Ltd. for year ending 31 March 2022 is as follows:
April 1 Capital introduced ₹20,000
May 1 Assets bought by cheque₹ 20,000
May 1 Goods purchased from Divya ₹65,000
Jun 15 Sales of goods to Jigar ₹80,000
July 31 More capital introduced ₹1,50,000
Nov 25 Goods purchased from Gaurav ₹22,000
Nov 24 Goods sold to Arushi ₹35,000
Mar 31 Cash deposited into bank ₹50,000
Mar 31 Salary paid ₹ 60,000

Dr. Capital A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2022 Mar 31	To Balance c/d		1,70,000	2021 Apr 1 July 31	By Cash A/c By Cash A/c		20,000 1,50,000
			1,70,000				1,70,000

Dr. Cash A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2021 Apr 1 July 31	To Capital A/c To Capital A/c		20,000 1,50,000	2022 Mar 31 Mar 31 Mar 31	By Bank A/c By Salary A/c By Balance c/d		50,000 60,000 60,000
			1,70,000				1,70,000

Dr. Salary A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2022 Mar 31	To Cash A/c		60,000	2022 Mar 31	By Balance c/d		60,000
			60,000				60,000

Dr. Bank A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2022 Mar 31	To Cash A/c		50,000	2021 May 1 2022 Mar 31	By Asset A/c By Balance c/d		20,000 30,000
			50,000				50,000

Dr. Asset A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2021 May 1	To Bank A/c		20,000	2022 Mar 31	By Balance c/d		20,000
			20,000				20,000

Dr. Purchases A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2021 May 1 Nov 25	To Divya A/c To Gaurav A/c		65,000 22,000	2022 Mar 31	By Balance c/d		87,000
			87,000				87,000

Dr. Divya A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2022 Mar 31	To Balance c/d		65,000	2021 May 1	By Purchases A/c		65,000
			65,000				65,000

Dr. Gaurav A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2022 Mar 31	To Balance c/d		22,000	2021 Nov 25	By Purchases A/c		22,000
			22,000				22,000

Dr. Sales A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2022				2021			

Mar 31	To Balance c/d		1,15,000	Jun 15 Nov 24	By Jigar's A/c By Arushi's A/c		80,000 35,000
			1,15,000				1,15,000

Dr. Jigar's A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2021 June 15	To Sales A/c		80,000	2022 Mar 31	By Balance c/d		80,000
			80,000				80,000

Dr. Arushi's A/c Cr.

Date	Particulars	J.F.	₹	Date	Particulars	J.F.	₹
2021 Nov 24	To Sales A/c		35,000	2022 Mar 31	By Balance c/d		35,000
			35,000				35,000

We are preparing Trial Balance using Balance method as it is most commonly used.

TRIAL BALANCE
As on 31st March, 2022

Name of Account	**Debit Balance (₹)**	**Credit Balance (₹)**
Capital A/c		1,70,000
Cash A/c	60,000	
Salary A/c	60,000	
Bank A/c	30,000	
Asset A/c	20,000	
Purchases A/c	87,000	
Divya A/c		65,000
Gaurav A/c		22,000
Sales A/c		1,15,000
Jigar A/c	80,000	
Arushi A/c	35,000	
Total (₹)	3,72,000	3,72,000

IN-TEXT QUESTIONS

16. Trial Balance lists the balances of all accounts. True or False?
17. Is Trial Balance a conclusive proof of absolute accuracy of accounts?
Is Trial Balance prepared for a particular period or on a particular date?

3.9 SUMMARY

- As per traditional classification, accounts are classified as personal, nominal and real accounts.
- Three golden rules of accounting are to be kept in mind while making journal entries.
- Any transaction is recorded first in the journal from the vouchers. That is why the Journal is known as the 'Book of Original Entry' or 'Book of Prime Entry'.
- Ledger is called as Book of Final Entry or Book of Secondary Entry.
- Cash book can be of three types – single column, double column and three column. Triple column cash book contains three columns – cash, bank and discount.
- There are three methods of preparing trial balance – Total method, Balance method and Compound method.

3.10 GLOSSARY

Account: A systematic record of business transactions related to a particular head at one place.
Rules of Debit and Credit: The guidelines that assist in determining which account should be credited and which should be debited.
Ledger: A book which containing a permanent record of all transactions in a summarized and classified form.
Cash Book: A book of original entry (Journal) as well a book of final entry (ledger).
Trial Balance: A statement showing debit and credit balances of all the ledger accounts (asset, liability, revenue, expense and capital) on a specified date.

3.11 ANSWERS TO IN-TEXT QUESTIONS

1. (i) Asset A/c (ii) Personal A/c	10. Yes (Credit balance in bank column represents bank overdraft)
2. Personal account	11. Contra entry
3. Yes. Capital A/c represents proprietor	12. Real and personal accounts
4. As per Business Entity concept, business and its owner are two separate entities.	13. Real and personal accounts
5. Liability	14. Nominal Accounts
6. Decrease in expense	15. Asset, liability and capital accounts
7. Cash A/c Dr. To Bad Debts Recovered A/c	16. True
8. True	17. No
9. True	18. On a particular date

3.12 SELF-ASSESSMENT QUESTIONS

1. Describe an account. State the golden rules of accounting.
2. How is a Trial Balance different from a Balance Sheet?
3. Mention the nature of accounts as per modern classification.
   i. Rent received
   ii. Interest payable
   iii. Ram (Proprietor)
   iv. Bank a/c
   v. Accrued commission
   vi. Bad debts written off
   vii. Bank overdraft
   viii. Carriage inwards
   ix. Excise duty
   x. Goodwill
   xi. Prepaid insurance
   xii. Outstanding salary

4. Pass the following entries in the General Journal of Rohit Ltd.

2022 April 1	Ledger balances on 31 March, 2021 were: Building - ₹2, 00,000, Machinery - ₹1,00,000, Debtor - ₹20,000, Cash - ₹45,000, Creditors - ₹65,000 Capital - ?
April 5	Insurance prepaid ₹8,000
April 6	Old machine sold to Mahesh for ₹6,000
April 10	Goods lost by fire worth ₹10,000.

April 14	Rohan, a debtor of firm, was declared insolvent and sum of ₹12,000 could not be received
April 16	Purchased stationery from P.R. Mart ₹1,500
April 20	Goods withdrawn for personal use of proprietor ₹8,000
April 28	Half claim for goods lost by for accepted and paid by insurance company
April 30	Depreciate plant and machinery by ₹3,000

5. Prepare the triple column cash book of Faiza Ltd.

2021	
March 1	Cash at bank ₹ 65,000 ; Cash in hand ₹50,000
March 3	Cash purchases ₹ 15,000
March 7	Purchased furniture for cash ₹ 20,000
March 10	Received cheque of ₹2,500 from Dipak and deposited into bank the same day
March 12	Cash withdrawn from bank for office use ₹12,000
March 14	Cash sales ₹ 25,000
March 17	Cheque received from Himanshu ₹3,400
March 19	Paid to creditor ₹15,000 by cash and received discount of ₹500
March 20	Withdrew cash from bank for personal use ₹ 1,000
March 22	Sold goods worth ₹3,500 to Ashok
March 23	Received cheque from Hashmi ₹20,000. Discount allowed ₹450
March 26	Commission paid ₹8,500
March 27	Salary of office staff paid from Bank ₹5,000
March 29	Cheque received from Himanshu deposited into bank
March 31	Received cash from Meeta ₹4,000 and allowed her discount ₹100

6. Journalise the following transactions and prepare ledger accounts.

2021	
April 1	Purchased goods for cash ₹ 1,37,500
April 3	Sold goods to Aggarwal and Co for cash ₹ 1,75,000
April 5	Purchased goods from Suresh ₹ 1,00,000
April 10	Returned goods to Suresh (for not being up to the specification) ₹ 5,000
April 14	Cash deposited into bank ₹ 2,00,000
April 15	Sold goods to Gupta ₹ 75,000
April 17	Discount allowed to Gupta ₹ 1,500
April 21	Purchased machinery by cheque ₹ 25,000
April 25	Paid to Suresh by cheque ₹50,000
April 26	Paid salary to staff ₹ 25,000
April 27	Withdrawn money from bank for personal use ₹ 25,000
April 28	Received cheque from Gupta and deposited into bank ₹ 50,000
April 29	Received bank interest ₹ 1,000
April 29	Cheque from Gupta dishonored ₹ 50,000
April 30	Purchased stationery for cash ₹ 2,500

7. Enter the transaction in the books of Ramesh and Co. and prepare ledger accounts. Also, make Trial Balance using Balance method.

Date	Particulars
2021	
Oct 1	Mahira commenced business with cash ₹2,00,000
Oct 3	Bought furniture worth from Raja House ₹10,000
Oct 5	Purchased goods from Meera Co. worth 13,500
Oct 9	Deposited cash into bank ₹20,000
Oct 10	Purchased goods for cash ₹15,000
Oct 11	Payment to Meera by cheque ₹5,000
Oct 14	Sold goods ₹20,000
Oct 18	Goods purchased from Khosla for cash ₹10,000
Oct 20	Purchased stationery from K.K. Mart ₹ 650
Oct 21	Electricity bill paid ₹ 1,000
Oct 25	Sold goods to Zahir Khan ₹15,000
Oct 27	Goods returned to Khosla ₹2,000
Oct 28	Withdrew from bank (personal use) ₹ 5,000
Oct 30	Goods returned by Zahir ₹ 5,000
Oct 31	Cash sales ₹15,000

3.13 REFERENCES/SUGGESTED READINGS

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LESSON 4

PREPARATION OF FINANCIAL STATEMENTS OF SOLE PROPRIETOR

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STRUCTURE

4.1 LEARNING OBJECTIVES

After reading this lesson, students will be able to understand:

- Meaning and compnents of the financial statements
- Difference between the capital and revenue expenditure
- Difference between the capital and revenue reciepts
- How to prepare Trading and profit and loss account of a sole proprietor firm.
- Concept and calculation of Gross profit, Net profit and Operating profit.
- Preparation of Balance Sheet of a sole proprietor firm and its components.
- Meaning and classification of Assets and Liabilities.

4.2 INTRODUCTION TO FINANCIAL STATEMENTS

Financial Statement are the statements showing the financial performance and financial position of a business enterprise. These are the end product of Accounting process.

Financial Performance:It refers to the amount of profit earned or loss incurred during a particular accounting period.

Financial Position: It refers to the solvency of the business in the form Assets, Liabilities and Capital of a business enterprise on a particular date which is usually the end date of the accounting period which is technically known as Reporting date.

4.3 COMPONENTS OF FINANCIAL STATEMENTS

Financial statements consist of the following statements as its components:

i. **Statement of Financial Performance or Income statement:** For non corporates such as sole proprietor, partnership, HUF, income statements prepared in the form of Trading and profit and loss account, while Statement of profit and loss or Statement of Comprehensive Income is prepared in case of companies. It shows the revenue and expenses. It is prepared to ascertain the amount of profit earned /loss incurred during an accounting period.

ii. **Statement of Financial Position** –It is prepared in the form of Balance Sheet which shows the assets, liabilities, capital and reserves. It shows the application of funds in the form Assets and Sources of funds in the form of Capital and Liabilitiesi. It is shows the financial position of a business enterprise at the end date of accounting period (which is usually 31st March of financial year).

iii. **Schedules or Notes to Accounts:** These statements also forms the part of financial Statements - to give detailed information and segregation of various items in the Balance Sheet and Trading and Profit and Loss account and significant accounting policies.

4.4 OBJECTIVE BEHIND PREPARATION OF FINANCIAL STATEMENTS.

1. To present a True and Fair view of the financial performance/results (Profit earned/Loss incurred) of the business enterprise during the accounting period.
2. To safeguard and supervise the assets by showing proper value of the Assets considering the depreciation and amortisation.
3. To show the Liquidity, Profitability and Solvency of the business enterprise.
4. To present a true and fair view of the financial position (Assets/Liabilities/Capital) of the business enterprise at the end of accounting period.

4.5 CAPITAL EXPENDITURE

It is the expenditure which does not occur on recurring basis and its benefit lasts for more than one accounting period. It refers to the amount spent or liabilities incurred to construct, purchase, acquire or improve/enhance any fixed asset or acquiring any legal rights such as amount spent on the acquiring right to use copyright, trademark, patent, Industrial Designs or other intellectual property rights, or initial expenses to make fixed assets ready to use as installation charges, testing of plant and machinery, etc.

These expenditures are capitalised i.e. recorded on the assets side of the Balance Sheet at time of purchase or acquisition (initial recognition) and charged as Expense through the mode of depreciation on tangible assets or amortisation on intangible assets (subsequent recognition).

4.6 REVENUE EXPENDITURE

These expenditures are recurring and are routine nature expenditures incurred for running or operating the business smoothly and to maintain business's operating facilites continously such as:

- Salary of staff
- Rent, rates and taxes
- Lighting Expenses

- Insurance Premium
- Commission paid
- Purchase of raw material,
- Power
- Repairs, etc.

The benefit of these expenses are expected to be expired with the operating cycle or one year. These expenses are recognised by showing them on Debit side of the Trading and Profit and loss account.

4.7 Deferred Revenue Expenditure

These expenditure are also revenue in nature, but heavy amount is incurred on them and benefit likely to be derived over a number of years such as huge expenditure on advertising at time marketing the launch of a new product and therefore part of it is capitalized like capital expenditure and part of the expenditure is charges to Trading, Profit and Loss account.

Matching concept requires that expenses incurred in an accounting period are traced to their revenues recognized in that accounting period. Thus if the benefit of some expenditure is aviled over a long period of time, then it should be spread over the number of years over which the benefit of it is likely to be derived by the business in earning the revenues.

Part of the expenditure whose benefit is utilised in the current accounting period should be debited to the profit and loss account, remaining part of expenditure should be capitalised in the balance sheet on the assets side to amortise it in future accounting periods.

4.8 CAPITAL RECEIPT VS REVENUE RECEIPT

Capital Receipts: These are the irregular receipts that does not occur regularly in the normal course of business and does not affect profit or loss of the business; they either increases the liabilities (raising of omey through loans) or reduces the fixed assets (sale of fixed assets).

Capital receipts can not be distributed as profit to the owner because they increase the obligations or reduces assets.

Revenue Receipt: These are the reciepts are recurring in nature that occurs frequently.They increases the profit earned, They can be due to Direct or Indirect incomes.

Reciepts in the normal and regular course of business and related to main business operations of the entitiy such as proceeds from sale of goods and rendering services are the part of Revenue receipts from Direct Income and credited to the Trading Account.

Reciepts from non-operating business activities such as income from investment i.e. interest on debentures or bonds purchased and dividend on shares and rent received from land and buiding lent on rent basis, commison received, etc. are credited to Profit and Loss account as these are considered as receipts on account of Indirect incomes.

4.9 TYPES OF EXPENSES

Direct Expenses: These expenses are directly traceable to per unit of production and are incurred on acquisition or purchase of goods for sale in the normal course of business

These expenses are usually incurred in manufacturing operations of converting the raw materials into the finished goods such as purchase of raw material, payment of wages to labour in the factory, purchase of other direct material used in the manufacture of good, and otheroperating expenses of factory. Examples of Direct expenses are as follows:

1. Wages to labour in factory
2. Purchases of raw material and consumable supplies
3. Freight , Cartage or Carriage paid for purchase of goods
4. Custom duties and indirect taxes such GST paid on purchases whose credit is not available, Power, water and fuel used in the production of goods
5. Factory lighting, rent and rates
6. Royalty based on per unit of Production
7. All direct expenses are debited to Trading account.

Indirect Expenses: These expenses are not directly traceable to per unit of production and are not directly concerned to production or purchase of the goods. These are related to office and administration, selling and distribution of goods to customers and financial expenses such as interest expense, lumsump royalty for obtaining right to use intangibles, etc.

These expenses are debited to the Profit and Loss A/c to calculate the net profit earned during the accounting period.

4.10 CALCULATION OF GROSS PROFIT, OPERATING PROFIT, OPERATING COST, NET PROFIT AND OPERATING EXPENSES

Gross Profit, Operating Profit, Operating Cost, Net Profit and Operating Expenses can be determined using the following equations:

Gross Profit = Net Sales - Cost of Goods Sold

Sales are also known as Revenue from Operations

Where Net Sale = Total Sale (Cash sale + Credit Sale) - Sale Return

Cost of Revenue from Operations are also known as Cost of goods sold

Cost of goods sold = Opening Stock + Net Purchases + Direct Expenses (Wages+Expenses on Purchases+ Frieght or Carriage Inward, etc.) - Closing Stock.

Purchase return is also known as Return Inward

Net Purchases = Total Purchases (Cash Purchases + Credit Purchases) - Purchase Return

Example: Consider the following information for the year ended 31st March 2023:

Particulars	**Amount**	**Particulars**	**Amount**
Opening Stock	1,00,000	Purchases during the year	5,60,000
Freight Inward	20,000	Closing Stock	1,20,000
Packing Charges on Purchases	20,000	Packing Expenses on Sales	24,000
Sales	7,60,000		

Compute the Gross Profit for the year ended 31st March, 2023

Solution:

Gross Profit = Sales + Closing Stock – (Opening Stock + Freight Inward + Packing Charges + Purchases)

= 7,60,000 + 1,20,000 – (1,00,000 + 20,000+ 20,000 + 5,60,000)

= 8,80,000 – 7,00,000 = 1,80,000

Or it can be calculated by preparing a Trading Account as follows:

Trading Account
for the year ended March 31, 2023

Dr. Cr.

Particulars	**Amount**	**Particulars**	**Amount**
To Opening Stock	1,00,000	By Sales	7,60,000
To Purchases	5,60,000	By Closing Stock	1,20,000
To Freight Inward	20,000		
To Packing charges on purchases	20,000		
To Gross Profit	1,80,000		

Total	8,80,000	Total	8,80,000

Example: Consider the following information for the year ended 31st March 2023:

Particulars	**Amount**	**Particulars**	**Amount**
Opening Stock	80,000	Purchases made during the year	2,80,000
Cash Sales	2,40,000	Credit Sales	1,60,000

Rate of Gross Profit: 33.33% on Cost

Calculate the amount of Closing Stock on 31st March 2023 from the above information.

Solution:
Given Gross Profit = 331/3% on Cost

Gross Profit = 1/3rd of Cost

Gross Profit on Sales =1/4th of Sales

Sales = Cash Sales + Credit Sales

= 2,40,000+1,60,000 = Rs 4,00,000

Gross Profit = 4,00,000×1/4

= Rs 1,00,000

Cost of Goods Sold=Sales−Gross Profit

= 2,00,000−1,00,000 = Rs 1,50,000

Cost of Goods Sold = Opening Stock + Purchases made during the year
+Direct Expenses−Closing Stock

1,50,000 = 40,000+1,40,000+0−Closing Stock

Closing Stock =Rs 30,000

Example: Calculate Gross Profit from the following for the accounting year ended 31st March 2023:

Particulars	Amount	Particulars	Amount
Opening Stock	8,00,000	Carriage paid on Sales	1,20,000
Closing Stock	7,20,000	Office Rent	2,32,000
Purchases made during the yaer	38,00,000	Sales during the year	56,28,000
Freight paid on Purchases	92,000		

Solution: Gross profit can be calculated by preparing the Trading Account as follows:

Trading Account

for the year ended March 31, 2023

Dr. Cr.

Particulars	Amount	Particulars	Amount
Opening Stock	8,00,000	Sales	56,28,000
Purchases	38,00,000	Closing Stock	7,20,000
Freight paid on Purchases	92,000		
Gross Profit	20,56,000		
Total	63,48,000	Total	63,48,000

Operating profit = Net sales - Operating cost

Operating profit = Gross Profit - Operating

Operating Cost = Cost of Goods Sold + Operating Expenses

Net Profit = Operating Profit + Non-operating Income - Non-operating expenses.

Operating expenses: expenses to the main or normal business activities such as:

1. Office and Administrative expenses
2. Selling and distribution expenses.

Operating Expenses = Office and Administrative Expenses + Selling and distribution expenses

Operating profit is also known as Earnings before interest and taxes (EBIT).

4.11 INCOME STATEMENT

Income statement for a saloe proprietor is divided into two components:

1. Trading Account which shows revenues from operations, direct expenses, the gross profit or loss.
2. Profit and Loss Account which shows indirect incomes, indirect expenses, the net profit loss.

Format of Trading Account and Profit and Loss Account

Name of Business of Sole Proprietor
Trading Account

Dr. **Cr.**

Particulars	**Amount**	**Particulars**	**Amount**
To Opening Stock		By Sales Less:Sales Returns	
To Purchases Less: Purchases Returns		By Sale of Scrap	
To Direct Expenses such as Gas, Fuel and power		By Closing Stock	
To Carriage Inwards		By Gross Loss transferred to Profit & Loss A/c)	
To Wages			
To Manufacturing Expenses			
To import duty			
To Dock and clearing charge, Freight, and cartage			
To Factory rent and lighting			
To Royalty paid per unit			
To Gross Profit transferred to Profit & Loss A/c)			

Format of Profit & Loss Account

Profit & Loss A/c
for the Year Ended.....

Dr. **Cr.**

Particulars	Amount	Particulars	Amount
To Gross Loss (Transferred from Trading A/c)		By Gross Profit (Transferred from Trading A/c)	
To Salaries		By Rent Received	
To Legal Expenses		By Commission Received	
To Rent Rates Taxes		By Discount Received	
To Office Lighting		By Dividend Received	
To Establishment Expenses		By Interest Received	
To Printing and Stationery		By Bad Debts Recovered	
To Trade Expenses		By Miscellaneous Receipts	
To Postages and Telephones		By Gain on Sale of Fixed Asset	
To Audit Fees		By Net Loss Transferred to capital Account	
To Insurance Premium			
To Travelling Expenses			
To General Expenses			
To Bad Debts			
To Export Duty			
To Packing Expenses			
To Interest paid on loans			
To Carriage Outwards			
To Salaries of Salesman			
To Commission			
To Rebate Allowed			

To Brokerage			
To Bank Charges			
To Advertisement			
To Depreciation on Fixed Assets			
To Publicity			
To Repairs			
To Loss by Fire			
To Conveyance Expenses			
To Donations & Charity			
To Loss on Sale of Fixed Assets			
To Loss by theft			
To Net Profit Transferred to Capital Account			

Example: Consider the following information of Mr X for the year ended 31st March 2023::

Particular	**Amount**	**Amount**	**Amount**
Opening Stock	92,000	Purchases Return	9,600
Purchases	1,16,000	Closing Stock	1,90,800
Sales Return	2,000	Carriage Inwards	400
Sales	1,01,600	Depreciation	8,000

Prepare Trading Account from the information given above

Solution:

In the Books of Mr. X
Trading Account
for the year ended March 31, 2023

Dr. Cr.

Particulars	**Amount**	**Particulars**	**Amount**
Opening Stock	92,000	Sales 1,01,600	
Purchases 1,16,000		*Less*: Sales Return (2,000)	99,600
Less: Purchases Return: (9,600)	1,06,400	Closing Stock	190,800
Carriage Inwards	400		
Gross Profit	91,600		

Total	2,86,400	Total	2,86,400

4.12 BALANCE SHEET

Balance Sheeet: It is that part of financial statements which is concerned with depicting the financial position of the business enterprise. In other words it is a summarised statement showing application of funds in the form of assets and and souces of funds in the form of capital and liabilities at the end of accounting period.

Presentation of Assets, liabilities and Capital in the Balance Sheet: In case of Horizontal format of Balance Sheet, liabilities and capital are together presented on the left hand side of balance sheet while assets are presented on right hand side of the balance sheet.

Arrangement of Assets and Liabilities:

1. The assets are arranged and presented on the basis of their liquidity in descending order. The most liquid asset such as cash-in-hand, credit balance in current account with the bank are shown in the starting. The least liquid asset such as right to use intellectual property rights, goodwill purchased are shown at the end.
2. The liabilities are arranged and presented in the decreasing order of their timing of maturity or expected due date of settlement. The liabilities which are to be settled immediately such as outstanding salary, outstanding rent, creditors are shown shown in the staring while liabilities which are to be settled after a long period of time such as long-term loans are shown at end.

Liabilities on the basis of their timing of maturity or expected due date of settlement and Assets on the basis of their liquidity can be presented in the Balance Sheet as follows:

Balance Sheet of .....

as at 31St March .....

Total Liabilities (Capital and external liabilities)	Amount	Assets	Amount
Current Liabilities:		**Current Assets:**	
Overdraft		Cash-in hand	
Bills Payable		Cash at Bank (credit balance in the current account with bank)	
Sundry Creditors		Bills Receivable	
Outstanding Expenses such as Outstanding Salary, Outstanding Wages, Outstanding Rent, etc		Sundry Debtors	

Advance received from Customer		Short Term Investment in time deposit of banks, shares and securities of other entities	
Long-term Liabilities:		Prepaid Expenses such prepaid insurance, prepaid rent, prepaid salary	
Long term loan		Accrued Income such as accrued interest	
Reserve and Surplus		Closing Stock	
Capital:		**Long term Investments**	
Add : Net Profit		**Fixed Assets (Property Plant and Equipment):**	
Less : Drawings		Furniture and Fixtures	
Less : Income Tax paid		Plant & Machinery	
Less : Life Insurance Premium for Sole Proprietor		Building	
Less : Net Loss during the year		Land	
		Patent	
		Goodwill	

Order of Permanence: This order of arrangement of assets and liabilitiesis is reverse of the liquidity order. Therefore, the least liquid asset such as patents, goodwill will be presented in the begining and the most liquid asset such as Cash-in-hand and credit balance in current account with the banks are presented at the end.

Generally companies are required to follow the order of Permanence as per their applicable Financial Reporting Framework.

Format of Balance Sheet based on the order of performance

Balance Sheet of ……

as at.....

Liabilities	Amount	Assets	Amount
Capital		**Fixed Assets/ Property Plant and Eaquipment and Intangibles:**	
Opening Balance of Capital	-	Goodwill	-
Add: Net Profit	-	Patents, Copy right, Trademark	-
(Less: Net Loss)	-	Vehicles	-
Less: Drawings	-	Land	-
		Building	-
Long-term Liabilities:		Furniture & Fixtures	-
Long term Bank loan	-	Investment: (long term)	-

Current liabilities:		**Current Assets:**	
Income received-in-advance	-	Closing Inventory	-
Outstanding Expenses	-	Accrued Incomes: Accrued interest	-
Sundry Creditors	-	Prepaid Expenses	-
Bills Payable	-	Sundry Debtors	-
Bank Overdraft	-	Bills Receivable	-
		Cash at Bank (credit balance in current Account)	-
		Cash in Hand	-
Total of Laibilities and Capital	XXX	**Total Assets**	XXX

4.1 ADJUSTMENT TO BE MADE WHILE PREPARING FINANCIAL STATEMENTS OF SOLE PROPRIETOR

Now let us understand the meaning of certain terms to be used in adjusting the items in the preparation and presentation of financial statements

Adjustment entries: These are the entries which need to be passed to calculate correct profit or loss during the accounting period and show true and fair financial position of the business at the end of the accounting period.

Since there are number of transactions or items which are not presented in Trial Balance such as Closing Stock (which is valued by physical stock taking at the end of the accounting period), Manager's Commission which is calculated as a specified percentage of Net profits. Adjustment entries are required to be passed to account for their impact on the profitability and financial position of the business organisation.

Closing Stock: It is the cost of inventory left unsold at the end of the accounting period.

Outstanding Expenses: These are the expenses which remain unpaid at the end of an accounting period, they relate to resources whose benefit is used during the current accounting period in the earning of revenue, so as to satisfy the Matching concept.

Prepaid Expenses: It refers to the amount of expenditure realting to resources whose benefits is not fully expired during the accounting period and would be received in the subsequent accounting period.

Accrued Income: It may sometime happen that certain items of income such as a interest on loan, commission, rent, etc. are earned during the current accounting year but have not been actually received by the end of the same year. Such incomes are known as accrued income. .

Income Received in Advance: Sometimes, a certain income is received but the whole amount of it does not belong to the current period. The portion of the income which belongs to the next accounting period is termed as income received in advance or an Unearned Income.

Depreciation: It is the decline in the value of assets on account of wear and tear and passage of time. It is treated as a business expense and is debited to profit and loss account. This, in effect, amounts to writing-off a portion of the cost of an asset which has been used in the business for the purpose of earning profits.

Closing Stock	**Closing Stock A/c**	**Dr.**	**(i) Credit side of Trading A/c.**
	To Trading A/c		**(ii) Show on the assets side of BALANCE SHEET.**
Outstanding/Unpaid Expenses	Expenses A/c	Dr.	(i) Add to the concerned item on the Debit side of Trading/Profit & Loss A/c.
	Outstanding Expenses A/c		(ii) Shown on the liabilities side of BALANCE SHEET.
Prepaid expenses/Unexpired expenses	Prepaid Expenses A/c	Dr.	(i) Deduct from the concerned expenses on the debit side of Profit & Loss A/c
	To Expenses A/c		(ii) Show on the assets side of BALANCE SHEET.
Accrued income/ Income due but not received	Accrued Income A/c	Dr.	(i) Add to the concerned income on Credit side of Profit and Loss A/c
	To Income A/c		(ii) Show on the assets side of BALANCE SHEET.
Unearned income/Income received in Advance	Income A/c	Dr.	(i) Deduct from the concerned income on the credit side of Profit & Loss A/c
	To Unearned Income A/c		(ii) Show on the liabilities side of Balance Sheet.
Depreciation	Depreciation A/c	Dr.	(i) Show on the debit side of Profit Loss A/c
	To Asset A/c		(ii) Deduct from the concerned asset in the Balance Sheet.

Bad Debts : The debtors from whom amounts cannot be recovered are treated in the books of accounts as bad and are termed as bad debts.

Further Bad Debts : These Bad debts is a loss that occurred after reparation of Trial Balance. Further bad debts be added in the bad debts already appearing in the Profit and Loss Ae and Debtors would be reduced with the same amount.

Provision for Bad Debts : In the balance sheet, debtors appears on the assets side of the Balance Sheet, which is their estimated realisable value during next year. It is quite possible that the whole of the amount may not be realized in future. However it is not possible to accurately know the amount of such bad debts. Hence, a reasonable estimate of such loss is provided in the book. Such provision is called provision for bad debts. Provision for doubtful debts is shown as a deduction from the debtors on the asset side of the balance sheet. **Note :** The provision for doubtful debts brought forward from the previous year is called the opening provision or old provision. When such a provision already exists, the loss due to bad debts during the current year are adjusted against the same and while making provision for doubtful debts required at the end of the current year is called new provision. The balance of old provision as given in trial balance should also be taken into account.

Provision for discount on Debtors : Discount is allowed to customers to encourage them to make prompt payment. The discount likely to be allowed to customers in an accounting year can be estimated and provided for by creating a provision for Discount on debtors. Provision for discount on debtors is made on good debtors which are arrived at by deducting further bad debts and provision for bad debts out of Debtors shown in the Balance sheet.

To write off bad debts	Bad Debts A/c	Dr.	(i) Debit side of P&L A/c.
	To Debtors		(ii) Deduct from debtors on the as- sets side of Balance Sheet.
Provision for bad and doubtful debts	Provision for Doubtful Debts A/c	Dr.	(i) Debit side of P & L A/c.
	To Debtors A/c		(ii) Deduct from debtors on the assets side of Balance Sheet.
Provision for discount on debtors	P & L A/c	Dr.	(i) Debit side of P & L A/c.
	To Provision for Discount on Debtors Debtors A/c		(ii) Deduct from debtors on the assets side of Balance Sheet.

Manager's Commission The manager of the business is sometimes given the commission on the net profit of the company. The percentage of the commission is applied on the profit either before charging such commission or after charging such commission. In the absence of any such information, it is assumed that commission is allowed as a percentage of the net profit before charging such commission.

1. Commission on net profits before charging such commission Commission =Net profit before commission×Rate of Commission100

2. Commission on net profits after charging such commission Commission =Net profit before commission×Rate of Commission 100+Rate of Commission

Interest on Capital	Interest on Capital A/c	Dr.	(i) Debit side of P & L A/c.
	To Capital A/c		(ii) Add to capital on the liabilities side of Balance Sheet.
Interest on drawings	Capital/Drawings A/c	Dr.	(i) Credit side of P & L A/c.
	To Interest on Drawings A/c		(ii) Deduct from capital on the liabilities side of Balance Sheet.
Interest payable on loan (borrowed)	Interest on Loan A/c	Dr.	(i) Debit side of P & L A/c.
	To Loan A/c		(ii) Add to loan on the liabilities side of Balance Sheet.
Commission payable to manager	P& L A/c	Dr.	(i) Debit side of P & L A/c.
	To Comm. Payable to manager A/c		(ii) Show on the liabilities side of Balance Sheet.

Adjustment in Respect of Goods Abnormal Loss : Sometimes losses occur due to some abnormal circumstances such as accident, fire, flood, earhquakes etc. Such losses are called Abnormal losses. These may be divided into two categories :- (A) Loss of Goods (B) Loss of fixed assets **Good taken for personal use {Drawings in goods) :** When the goods are withdrawn by proprietor for personal use the cost of such goods deduct from purchases and the amount should be deduct from capital in Balance Sheet. **Goods distributed as free samples :** Sometime goods are distributed as free sample by the businessman for the purpose of advertisement. The cost of free sample deduct from purchase and shown in Debit side of profit and loss account.

Abnormal loss of goods by fire, theft, accident, etc.

Adjustment	**Treatment in Trading & P & L A/c**		**Treatment in Balance Sheet**
1) Loss of Goods (By accident, Fire, Theft)	1) Loss of ... A/c	Dr.	(i) Gross Loss: Deduct from Purchases or show on the credit side of Trading A/c.
	To Trading A/c (or)		
	To Purchases A/c		
If goods were note insured	2) P & L A/c	Dr.	(ii) Net Loss: Debit side of P & L A/c.
	To Loss by ..... A/c		
If goods were insured and full claim accepted by insurance company	2) Insurance company A/c	Dr.	(iii) Insurance claim: Assets side of Balance Sheet.
	To Loss by ... A/c		
If full claim not accepted by Insurance Company	2) Insurance Company A/c	Dr.	
	Profit & Loss A/c	Dr.	

	To Loss By .... A/c		
2) Goods taken by the proprietor for his personal use	Drawings A/c	Dr.	(i) Deduct the amount of goods from the purchases in Trading A/c.
	To Purchases A/c		(ii) Deduct the amount from the capital on the liabilities side of Balance Sheet.
3) Goods distributed as free samples	Advertising A/c	Dr.	(i) Deduct the amount of goods from the purchases in Trading A/c.
	To Purchases A/c		(ii) Show on the debit side of P & L A/c.
4) Goods given as charity	Charity A/c		(i) Deduct the amount from the purchases on the debit side of Trading A/c.
	To Purchases a/c		(ii) Show on the debit side of P & L A/c.

Key Points to be kept in mind:

1. **If closing stock** is given in Trial Balance – show it in balance sheet only as purchases amount already gets adjusted.
2. **Salary and wages** will be debited in profit and loss A/c on the debit side (indirect expenses) while wages and salary will be debit in trading A/c (direct expense).
3. **Freight, carriage, cartage** will be debited in trading A/c if it is freight inward, if it is freight outward then it will be debited to profit and loss account.
4. Factory related expenses such as factory lighting, factory rent are debited to trading account, otherwise general lighting and rent will be debited to profit and loss account.
5. **Trade expenses** are always debited to profit and loss A/c.
6. **Packaging material**: If the packaging material is used in packing the finished goods, it will debited to trading A/c.
7. **Packing**: refers to the big containers used for transporting the goods are debited to profit and loss account as it is an indirect expense.

LESSON 5

PREPARATION OF FINANCIAL STATEMENTS, CORPORATE BALANCE SHEET

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STRUCTURE

5.14 Suggested Readings

5.1 LEARNING OBJECTIVES

The objective of thIS lesson is to explain students with the mechanics and ways of preparing financial statatements of a company. This lesson will familiarize students with the basic terminonlogies, methods, Accounting Standards, Indian Accounting Standards. After preparation of financial statement this lesson will help the students to analyse it under different conditions.

5.2 INTRODUCTION

A financial statement is collection of all the financial information of a Business. It provides information about financial position and performance of an organization. While analyzing and interpreting the financial statement of a company one can make important decisions and draw conclusion about financial health of an organization. Assets, liabilities and equity are the key components associated with the measurement of financial position. However, to assess the financial performance of the business Revenue and Expenses are taken as essential element.

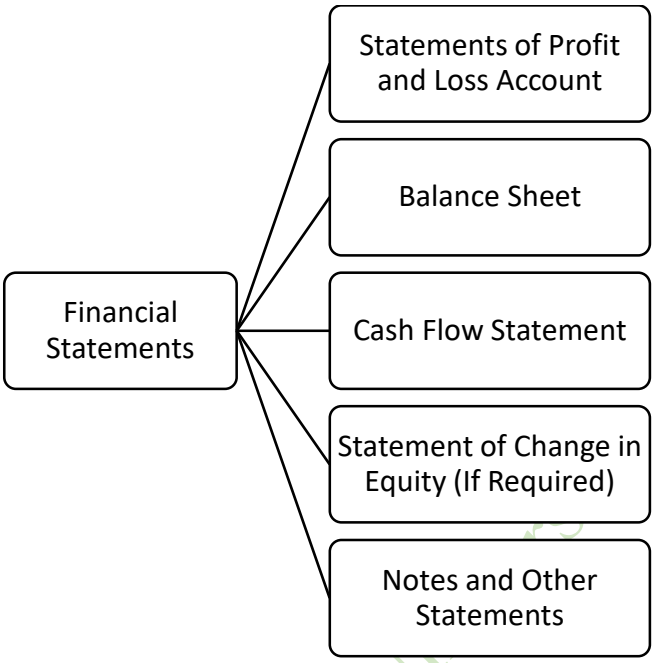
Maintenance of Book of Account: Under section 128 of Companies Act 2013, every single company should prepare and place all financial statements and other relevant books/ papers of the company for financial year at its registered office and its branches (if any) on accrual basis and double entry system of accounting. These financial statements should present a true and fair picture of the financial position and financial performance of the company during the accounting period.

5.3 MEANING AND COMPONENTS OF FINANCIAL STATEMENTS

As per Section 129 of Companies Act 2013, the Directors of the Company should lay financial statements at the annual general meeting of the company. The financial statement under **Section 2(40)** of Indian Companies Act 2013 includes the followings:

i) Balance Sheet reports the financial position of a business at a certain point in time.
ii) Profit &Loss Account/ Income Expenditure Account shows the financial performance throughout the time frame.
iii) Cash Flow Statement encapsulates the total cash inflow and outflow for the period from operating, investing and financing activities.
iv) Statement of Changes in Equity summarizes how equity in the organization (if applicable).

Along with the statements mentioned above it is necessary to give explanatory notes annexured of better understanding. There is an exception for mandatory requirement for making Cash flow Statement of One Person, Dormant and Small Companies.



Provisions Applicable: While preparing final account of the company the following point should be kept in mind:

a) As per Schedule III of Companies Act 2013 all necessary requirements,
b) Other statutory requirements
c) Accounting Standards by MCA from AS -1 to AS -29.
d) Statement and Guidance Notes issued by ICAI for understanding the rules related to accounting treatments, valuation, disclosure for the following companies:

1. If any specific act is applicable e.g. for an insurance company, banking company, company working in generation of electricity or any other company prescribed under Act for which a Form of Balance Sheet and Profit and Loss Account has been prescribed.
2. All other companies.

As per Section 2(41) of Companies Act 2012 the financial year for making financial statement should end on 31st March.

ACTIVITY 1

Go to the official website of the following companies and download the statement of profit& loss and balance sheet of the companies and check the format of each document downloaded.

i. Bharat Heavy Electricals Limited,
ii. Reliance ltd.,
iii. Infosis ltd. and
iv. HDFC Bank ltd.

5.4 USERS OF FINANCIAL STATEMENTS

The financial Statements provides financial position, performance and cash flows of the organization which is helpful for various stake holders such as: investors, employees, lenders, suppliers, creditors, customers, government and general public. The stake holders mentioned above uses these summarized as per their requirement.

There are various categories of stakeholder or users of financial information which are interested in determining the financial position and financial performance of the business.

Users	Category of User	Information need of the user
Internal	Owners/Proprietor/ Shareholders	Return on investment, Net profit, financial position of the company/business, growth rate.
	Management	Rate of return from different segments, products and investments.
	Employees	Profitability of the employer to bargain wages rates and bonus, dues (PF, ESI, etc.) are being deposited regularly.
External	Potential investors	Business and financial risk, EPS, future prospects of the business.
	Creditors/Suppliers	Short term liquidity: creditors are interested in knowing financial capability and ability of the business to pay its debts on time.
	Lenders	Repaying capacity, credit worthiness, short term liquidity and long term solvency.
	Tax Authorities	Assessment of income and expenses, tax dues, true and fair disclosure of accounting information.

	Others	Customers, researchers seek different in-formation for different own customised interests and reasons.

5.5 PRESENTATION OF FINANCIAL STATEMENTS

MCA has layed down the roadmap for all companies (except banking companies, non-banking finance companies, insurance companie) for option of Ind -AS on February 2015. Under presentation of financial statement Companies Act (Revised) 2016, IFRS conversed with Indian Accounting Ind-AS from financial year 2016-17 is mandatory where the Finance Ministry has taken various steps to simplify the implementation of Ind -AS. Ind -AS-1 provides appropriate guidelines related to presentation of Financial Statements. The basic purpose is to ensure the compatibility of the business entity with its previous year's performance and with other business entities.

Structure of the Ind AS Schedule III

- **A.** General Instructions for preparation of Companie's Financial Statements
- **B.** Part I- Preparation of Balance Sheet and Statement Change in Equity (if any)
- **C.** Part I Notes-Notes and general instruction related to point no B
- **D.** Part II-Form of Statement of Profit and Loss account
- **E.** Part II Notes- General Instructions for Point no D.
- **F.** Part III-General Instruction for Preparation of Consolidated Financial Statements

IN-TEXT QUESTIONS

4. Under section 128 of Companies Act 2013 the financial statements of the company should kept in_____.
5. Which of the following is not a part of financial statements under section 2(40) of companies act 2013:
   a) Statement of Profit and Loss A/c b) Balance Sheet
   c) Cash Book d) Cash Flow Statements
6. Government and regulators uses the financial statements of various companies to check its governance and tex related matters. (True/False)

5.6 STATEMENTS OF PROFIT AND LOSS ACCOUNT

The Statement of Profit and Loss account reports the financial performance of the business during a specific period taking revenue and expenses as a key variable usually a fiscal quarter or a year.

There are three major types of profits in an organization based on specific information: Gross Profit, Operating profit and Net Profit. Gross Profit determines the business efficiency and talks about the profit margin of the business, operating profit is net income of an organization derived from its core operating activities. Net profit is representation of the amount company takes for itself.

The main objective of profit and loss account are as follows:

i. Profit and Loss account is helpful in knowing the trading results i.e. gross profit/gross loss and net profit/ net loss.
ii. It is helpful in analyzing the relationship between profit and turnover of a business. Further, it is helpful in calculating and comparing profitability ratio of a company.
iii. It helps in identification and analysis of direct and indirect expense, and also helpful in reducing the indirect expenses of the business for better performance of the business.

As per Part II of Schedule III [u/s. 129(1)] of Companies Act 2013 Profit and loss account should follow the vertical format given as follows:

(Statement of Profit and Loss without stating EBITDA)

Name of the Company
Statement of Profit and Loss
for the year ended 31 March, 20XX

	Particulars	Note No.	For the year ended 31 March, 20X2	For the year ended 31 March, 20X1
			Rs.	Rs.
A	**CONTINUING OPERATIONS**			
1	Revenue from operations (gross)		XXX	XXX
	Less: Excise duty		XXX	XXX
	Revenue from operations (net)		XXX	XXX
2	Other income		XXX	XXX

3	**Total revenue (1+2)**	XXX	XXX
4	**Expenses**		
	(a) Cost of materials consumed	XXX	XXX
	(b) Purchases of stock-in-trade	XXX	XXX
	(c) Changes in inventories of finished goods, work-in-progress and stock-in-trade	XXX	XXX
	(d) Employee benefits expense	XXX	XXX
	(e) Finance costs	XXX	XXX
	(f) Depreciation and amortisation expense	XXX	XXX
	(g) Other expenses	XXX	XXX
	Total expenses	XXX	XXX
5	**Profit / (Loss) before exceptional and extraordinary items and tax (3 - 4)**	XXX	XXX
6	Exceptional items	XXX	XXX
7	**Profit / (Loss) before extraordinary items and tax (5 ± 6)**	XXX	XXX
8	Extraordinary items	XXX	XXX
9	**Profit / (Loss) before tax (7 ± 8)**	XXX	XXX
10	**Tax expense:**		
	(a) Current tax expense for current year	XXX	XXX
	(b) (Less): MAT credit (where applicable)	XXX	XXX
	(c) Current tax expense relating to prior years	XXX	XXX
	(d) Net current tax expense	XXX	XXX
	(e) Deferred tax	XXX	XXX
11	**Profit / (Loss) from continuing operations (9 ±10)**	XXX	XXX
B	**DISCONTINUING OPERATIONS**		
12.i	Profit / (Loss) from discontinuing operations (before tax)	XXX	XXX
12.ii	Gain / (Loss) on disposal of assets / settlement of liabilities attributable to the discontinuing operations	XXX	XXX
12.iii	Add / (Less): Tax expense of discontinuing operations		
	(a) on ordinary activities attributable to the discontinuing operations	XXX	XXX
	(b) on gain / (loss) on disposal of assets / settlement of liabilities	XXX	XXX

13	**Profit / (Loss) from discontinuing operations (12.i ± 12.ii ± 12.iii)**		XXX	XXX
C	**TOTAL OPERATIONS**		XXX	XXX
14	**Profit / (Loss) for the year (11 ± 13)**		XXX	XXX
			`	`
15.i	**Earnings per share (of ` ___/- each):**			
	(a) Basic			
	(i) Continuing operations		XXX	XXX
	(ii) Total operations		XXX	XXX
	(b) Diluted			
	(i) Continuing operations		XXX	XXX
	(ii) Total operations		XXX	XXX
15.ii	**Earnings per share (excluding extraordinary items) (of ` ___/- each):**			
	(a) Basic			
	(i) Continuing operations		XXX	XXX
	(ii) Total operations		XXX	XXX
	(b) Diluted			
	(i) Continuing operations		XXX	XXX
	(ii) Total operations		XXX	XXX
	See accompanying notes forming part of the financial statements			

Source: Guidance Note on Schedule VI to the Companies Act 2013

IN-TEXT QUESTIONS

4. Under which main Head of Sub-Head of the balance sheet (Equity and Liabilities) following items are shown?
   a)Bills Payable b) Premium on Redemption of Debentures
   c)Sunder Creditors d) Public Deposits
5. Give major Heads and Subheads shown in balance sheet as per Schedule III of Comoanies Act 2013of the following:
   a)Bills Receivable
   b)Mortgage Loan
   c) Goodwill
   d)Patent Rights
   e)Surplus i.e. Balance of Statement of Profit and Loss Account

5.7 BALANCE SHEET

The balance sheet of the company is a summarized statement of its financial position. It represents assets, liabilities and other essential things of the company. The old format of balance sheet was a represented in horizontal form also known as T-Shaped balance sheet. However, the method of preparation of Balance Sheet and its format has been revised in Companies Act 2013 and the new format is in statement form also known as vertical format of balance sheet.

The balance sheet of the company has two sections i.e., the asset and liabilities where the former shows what a company owns and the later reports what the company owes. Financial statements report the information about entity's:

i) Assets
ii) Liabilities
iii) Equity
iv) Income and Expenses, including loss and gain:
v) Contribution made by the Owner (Contribution/Distributions made by owner and his/her capacity in the business as owner)
vi) Cash flow in the organization

There is no separate format of Balance Sheet as per Ind-AS.

A. Items necessarily required to be included the following items in Balance Sheet: As per Ind-AS asset is defined as follows:
"An asset is a resource controlled by the entity as a result of past events and from which future economic benefits are expected to flow to the entity."

	Assets

a)	Property, plant and equipment
b)	Capital Work in progress
c)	Investment Property
d)	Goodwill
e)	Other Intangible Assets
f)	Intangible assets under development
g)	biological assets other than Bearer Plants within the scope of Ind AS 41, Agriculture;
h)	Financial assets i. Investments ii. Trade Receivables iii. Loans iv. Others (to be specified)
i)	Deferred Tax Liabilities
g)	Other Non-Current Assets
	Current Assets
a)	Inventories
b)	Financial Assets (i) Investments (ii) Trade receivables (iii) Cash and cash equivalents (iv) Bank balances other than (iii) above (v) Loans (vi) Others (to be specified)
c)	Current Tax Assets (net)
d)	Other current assets

As per Ind-As Equity and Liabilities are defined as follows:

"Equity is the residual interest in the assets of the entity after deducting all its liabilities."

"A liability is a present obligation of the entity arising from past events, the settlement of which is expected to result in an outflow from the entity of resources embodying economic benefits."

B). Current and Non-Current Assets and Liabilities distinction in Balance Sheet

Under Ind- AS 1 an entity should make clear distinction between current and non-current assets and liabilities side of Balance Sheet.

For classification of current items the Ind-AS focuses on the following factors:

a) The asset is expected to realize/ consume/ sell in its normal operating cycle.
b) It should be for the purpose of trading.

c) Expected to realized within 12 month of reporting period
d) the asset is cash or a cash equivalent (as defined in Ind AS 7) unless the asset is restricted from being exchanged or used to settle a liability for at least twelve months after the reporting period.

For classification of current items the Ind-AS focuses on the following factors:

a) A liability which is expected to settle within its operating cycle
b) It is primarily held for the purpose of trading.
c) Liability which is due to be settled within 12 months after reporting period.
d) it does not have an unconditional right to defer settlement of the liability for at least twelve months after the reporting period. Terms of a liability that could, at the option of the counterparty, result in its settlement by the issue of equity instruments do not affect its classification.

C). Detailed disclosure of Share Capital : The entity should disclose the following details about share capital either in Balance Sheet or in the statement of change in equity or in the notes to accounts:

a) The number of authorized shares
b) Number of fully paid and not fully paid issued shares
c) Par value per shares
d) Reconciliation of number of outstanding shares at the beginning and end.
e) Preference Shares, right shares and any restriction on distribution of dividend of such shares
f) shares in the entity held by the entity or by its subsidiaries or associates; and
g) shares reserved for issue under options and contracts for the sale of shares, including terms and amounts; and

The format of balance sheet as per Guidance Note on Schedule III to the Companies Act 2013 is as follows:

PART I – Form of BALANCE SHEET
Name of the Company…….
Balance Sheet as at ……
(Rupees in……)

	Particulars	Note No.	As at 31 March, 20XX (Current Year Fig) `	As at 31 March, 20XX (Prev. Year Fig) `
A	**EQUITY AND LIABILITIES**			
1	**Shareholders' funds**			
	(a) Share capital		XXX	XXX
	(b) Reserves and surplus		XXX	XXX
	(c) Money received against share warrants		XXX	XXX

2	**Share application money pending allotment**		XXX	XXX
3	**Non-current liabilities**			
	(a) Long-term borrowings		XXX	XXX
	(b) Deferred tax liabilities (net)		XXX	XXX
	(c) Other long-term liabilities		XXX	XXX
	(d) Long-term provisions		XXX	XXX
4	**Current liabilities**			
	(a) Short-term borrowings		XXX	XXX
	(b) Trade payables		XXX	XXX
	(c) Other current liabilities		XXX	XXX
	(d) Short-term provisions		XXX	XXX
	TOTAL		XXX	XXX
B	**ASSETS**			
1	**Non-current assets**			
	(a) Fixed assets			
	(i) Tangible assets			
	(ii) Intangible assets	XXX		
	(iii) Capital work-in-progress	XXX		
	(iv) Intangible assets under development	XXX		
	(v) Fixed assets held for sale	XXX		
			XXX	XXX
	(b) Non-current investments		XXX	XXX
	(c) Deferred tax assets (net)		XXX	XXX
	(d) Long-term loans and advances		XXX	XXX
	(e) Other non-current assets		XXX	XXX
2	**Current assets**			
	(a) Current investments		XXX	XXX
	(b) Inventories		XXX	XXX
	(c) Trade receivables		XXX	XXX
	(d) Cash and cash equivalents		XXX	XXX
	(e) Short-term loans and advances		XXX	XXX
	(f) Other current assets		XXX	XXX
	TOTAL		XXX	XXX
	See accompanying notes forming part of the financial statements			

Source: Guidance Note on Schedule III to the Companies Act 2013.

Illustration 1. How will you explain the following items in the Balance Sheet of a Company?

i) 9% Debentures

ii) Proposed Dividend

iii) Loose Tools

iv) Capital Redemption Reserve

Answer1.

SlNo	Items	Definition	Main Head	Sub-Head
1	9% Debentures	It is a long-term debt to the business usually not secured by any collateral. 9% is the coupon rate for the long-term loan.	Non-Current Liabilities	Long-Term Borrowings
2.	Proposed Dividend	The Board of Directors have approved the proposal of dividend to be distributed in future but not distributed yet.	Current Liabilities	Short Term Provisions
3.	Loose Tools	These are the assets used in a company for various production activities, hence it is helpful in conversion of raw material to finished goods.	Current Assets	Inventories
4.	Capital Redemption Reserve	It is a reservation out of profit over the years kept in company for either redemption or purchase of companies own shares.	Shareholders' Funds	Reserve and surplus

5.8 CASH FLOW STATEMENT

Cash is the blood of business, proper circulation of blood is very important for human to survive and in the similar way proper cash circulation is very important for a business to sustain. Before we move further to understand cash flow lets understand what is cash and cash equivalent.

Cash includes cash in hand, cash at bank, demand deposits with banks and cash equivalent means liquid investments made by the company with a maturity period less than three months.

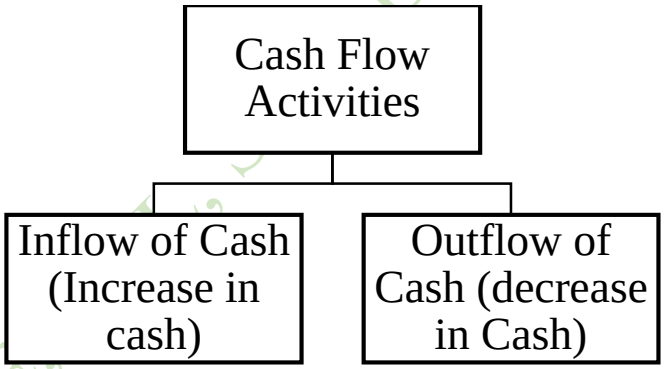
Cash= Cash in Hand+ Cash at Bank+ Demand deposit at Bank

Cash Equivalent= Short Term Highly Liquid Investment (less than three months)

Cash Flow Statement: it is the periodic statement showing the inflows and outflows of Cash and Cash equivalents from Operating, Investing and Financing activities during a particular period which is usually a financial year.

Cash Flow Statement of a company exhibits the flow of incoming and outgoing cash in the business during a specific period (usually a financial year). It helps in ascertaining the ability of the business to generate cash and its utilization.

It is also helpful in determining the solvency of a business. According to guidelines of Accounting Standard 3 issued by ICAI, a cash flow mandatory all companies with a turnover of Rs 50 crore. Companies Act 2013 directs all companies to prepare cash flow statement except one person company, dormant company and small company. However, Schedule III of Companies Act 2013 do not prescribe any format for a Cash Flow Statement and hence it should be prepared as per the AS-3 issued by ICAI under direct/indirect Method. The change in position of cash for a specific period is calculated by considering the 'source' and 'application' of cash and cash equivalent.



Sources of Cash: to identify the source of cash we check the inflow/increase in cash in the business.

a) Issue of Shares (equity or preference), debentures, bonds and long term loan.
b) Operating Cash Profit of the Business
c) Sale of fixed asset.
d) Sale of Investments.

Application of Cash: to identify the source of cash we check the outflow/decrease in cash in the business.

a) Repayment of Bank loan or redemption of Debentures
b) Payment of income tax, dividend, interest.
c) Operating Loss of the Business (Cash)

d) Purchase of any fixed asset.

Source of cash can be internal and external both. Internal sources usually cash from operations of the business. So, it is important to identify operating and non-operating activities in the business such.

Non-operating activities are one-time event in a business which may impact on revenue but falls outside of daily routine of the business and hence, excluded while calculating cash flow statements (loss/profit on sale of fixed asset, amortization of intangible asset).

The net profit calculated by the profit and loss account will have to be adjusted for non-operating items. Also, all non-cash items (depreciation, creation of reserve, provision of bad debts) already considered during computation of profit and loss account will have to be adjusted for calculation of cash flow statements.

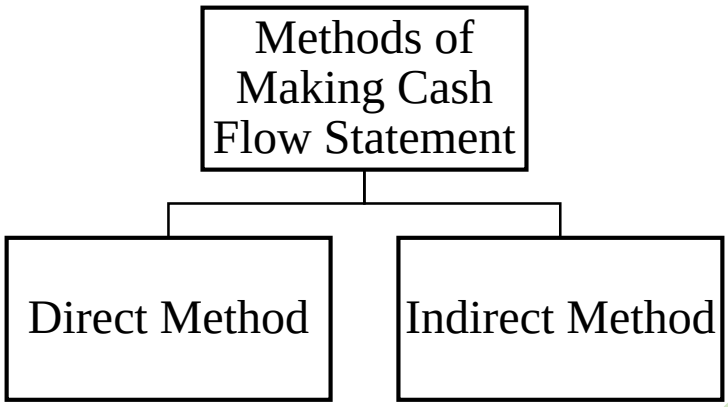
Classification of Cash Flow activities: As per As-3, the cash flow can be classified into three broad categories: Cash Flow from Operating, Investing and Financing activities. The Operating activity is principal revenue generating activity of the business, the Investing Activity is summary of acquisition and disposal of investments and fixed assets in the business and financing activity summaizes change in the size of composition of owners capital and borrowings in the business.

A. **Operating Activity:** Operating activities are daily activities related to producing and selling of product for generation of revenue to the business (sales, direct expenses, marketing expenses etc.) and it should be considered while calculating cash inflow and outflow of the business. It records both inflow and outflow of cash. The Net cash flow is reported as 'Cash Flow from operating activities'. Examples:
    a) Cash payment made to suppliers for goods and services.
    b) Cash receipts from sales of goods/ services.
    c) Cash received from royalties, fees and other revenue.

B. Investing Activities: Investing Activity is summary of acquisition and disposal of investments and fixed assets in the business. Examples:
    a) Cash paid for acquisition of fixed asset, investments, bonds, research and development.
    b) Cash received from sale of property.
    c) Purchase of government securities
    d) Interest/ dividend received from investment made.
    e) Cash advances or loans given to other parties.

C. Financing Activity: financing activity summarizes change in the size of composition of owners capital and borrowings in the business. Example:
    a. Bank loan repayment
    b. Cash proceeds from issue of shares/ debentures
    c. Cash payment by lessee for outstanding liabilities related to finance lease.

Calculation of Cash Flow Statement: A businessmen can be calculated the cash flow using direct/ indirect method.



1. **Direct Method:** In the direct method of cash flow statement, we calculate operating cash profit by taking all cash gross receipts and payment which are operating in nature. All non- operating and non-cash items are ignored under Direct method of cash flow statement.

   Proforma for assessment of 'Cash Flow from Operating Activities' using Direct Method

Particulars	Amount
Cash Receipts from:	xxx
Cash sales	
Recovery of cash from debtors for credit sales	
Recovery of cash on account of Bills Recievables for credit sales	
Sale of scrap	
Less : Cash Payments for:	
Salaries and Wages	
Rent	
Electricity expense	
Suppliers	
Cash Purchases	(xxx)
Payment to Suppliers	
Cash generated from Operations	xxx
Less: Income Tax Paid during the current year	(xxx)
Cash Flow before adjustment for Extra-ordinary Items	xxx
Adjustments for Extra-ordinary items	xxx
Net Cash utilised in/ generated from Operating Activities	xxx

Source: ICAI Study Material

2. **Indirect Method:** Under indirect method of calculation of cash flows, the net profit is taken as the base and starting point and exclude all non-operating and non-cash item. The main motive remains same using both the method i.e. calculation of operating cash profit from the business. Hence, non-operating items such as profit/loss on sale of fixed

asset and investments, amortization of intangible asset and all non-cash items such as deprecation, provision for tax, provision for Bad-debts, transfer to general reserve is adjusted to net profit of the business.

Format for calculation of 'Cash Flow from Operating Activities' as per Indirect Method

Particulars	Amount
Net Profit before Adjustments for Non Cash items, Non Operating items, Tax and Extra-ordinary items	xxx
Adjustments for Non Cash and Non Operating Activities	
Add: Depreciation provided during the year	xxx
Add: Loss due to Foreign Exchange rate fluactuations	xxx
Add: Loss on sale Investments	xxx
Less: Gain due to Foreign Exchange rate fluactuations	xxx
Less: Gain on sale Investments	xxx
Less: Dividend Received	xxx
Less: Interest Received	xxx
Operating Profit before Working Capital Adjustments	xxx
Adjustments for Working Capital Changes	
Add: Decrease in the amount of Current Assets during the year	xxx
Add: Increase in the amount of Current Liabilities during the year	xxx
Less: Increase in the amount of Current Assets during the year	xxx
Less: Decrease in the amount of Current Liabilities during the year	
Cash generated from Operations	xxx
Less: Interest Paid	(xxx)
Less: Income Taxes paid	(xxx)
Cash before Extra-Ordinary Items	xxx
Adjustment for Extra-ordinary items	xxx
Net Cash Flow from Operating Activities	xxx

Source: ICAI Study Material

5.9 SUMMARY

The Main objective of the financial statement is to evaluate the position and performance of the business. As we know that a company has neumorous stake holders and it is very important to protect the interest of the stakeholders. The publication of such relevant financial statement as per guidelines of Companies Act, MCA, ICAI gives the power to these stakeholders to interprate and take decisions accordingly.

A financial statement is collection of all the financial information about financial position and performance of an organization.

The financial statement under **Section 2(40)** of Indian Companies Act 2013 includes the followings:

v) Balance Sheet reports the financial position of a business at a certain point in time.
vi) Profit &Loss Account/ Income Expenditure Account shows the financial performance throughout the time frame.
vii) Cash Flow Statement encapsulates the total cash inflow and outflow for the period from operating, investing and financing activities.
viii) Statement of Changes in Equity summarizes how equity in the organization (if applicable).

Users of Financial Statements

Users	Category of User	Information need of the user
Internal	**Owners/Proprietor/ Shareholders**	Return on investment, Net profit, financial position of the company/business, growth rate.
	Management	Rate of return from different segments, products and investments.
	Employees	Profitability of the employer to bargain wages rates and bonus, dues (PF, ESI, etc.) are being deposited regularly.
External	**Potential investors**	Business and financial risk, EPS, future prospects of the business.
	Creditors/Suppliers	Short term liquidity: creditors are interested in knowing financial capability and ability of the business to pay its debts on time.
	Lenders	Repaying capacity, credit worthiness, short term liquidity and long term solvency.
	Tax Authorities	Assessment of income and expenses, tax dues, true and fair disclosure of accounting information.
	Others	Customers, researchers seek different in-formation for different own customised interests and reasons.

Financial Statements of companies are to be prepared as per the Schedule III of the Companies Act 2013. Financial statements report the information about entity's:

vii) Assets
viii) Liabilities
ix) Equity
x) Income and Expenses, including loss and gain:
xi) Contribution made by the Owner (Contribution/Distributions made by owner and his/her capacity in the business as owner)
xii) Cash flow in the organization

Statement of Profit and Loss account: The Statement of Profit and Loss account reports the financial performance of the business during a specific period taking revenue and expenses as a key variable usually a fiscal quarter or a year.

Balance Sheet: The balance sheet of the company is a summarized statement of its financial position. It represents assets, liabilities and other essential things of the company. The old format of balance sheet was a represented in horizontal form also known as T-Shaped balance sheet. However, the method of preparation of Balance Sheet and its format has been revised in Companies Act 2013 and the new format is in statement form also known as vertical format of balance sheet.

The balance sheet of the company has two sections i.e., the asset and liabilities where the former shows what a company owns and the later reports what the company owes.

Cash Flow Statement: it is the periodic statement showing the inflows and outflows of Cash and Cash equivalents from Operating, Investing and Financing activities during a particular period which is usually a financial year.

Sources of Cash: to identify the source of cash we check the inflow/increase in cash in the business.

e) Issue of Shares (equity or preference), debentures, bonds and long term loan.
f) Operating Cash Profit of the Business
g) Sale of fixed asset.
h) Sale of Investments.

Application of Cash: to identify the source of cash we check the outflow/decrease in cash in the business.

e) Repayment of Bank loan or redemption of Debentures
f) Payment of income tax, dividend, interest.
g) Operating Loss of the Business (Cash)

Classification of Cash Flow activities: As per As-3, the cash flow can be classified into three broad categories: Cash Flow from Operating, Investing and Financing activities.

Operating Activity: Operating activities are daily activities related to producing and selling of product for generation of revenue to the business (sales, direct expenses, marketing expenses etc.)

Investing Activities: Investing Activity is summary of acquisition and disposal of investments and fixed assets in the business.

Financing Activity: financing activity summarizes change in the size of composition of owners capital and borrowings in the business.

5.10 ANSWERS TO IN-TEXT QUESTIONS

1. Registered Head Office and its Branches (if any)

2. Cash Book
3. True
4. Heads and Subheads under Equity and Liabilities:
   a) Bills Payable-Current Liablilities-Trade Paybles
   b) Premium on Redemption of Debentures-Non-Current Liabilities- Long Term Borrowings
   c) Sundery creditiors- Current Liabilities- Trade Paybles
   d) public Deposits-Non-Current Liabilities- Long term Borrowings
5. a)Bills Receivable-Current Assets-Trade Receivables
   b)Mortgage Loan-Non-Current Liabilities – Long Term Borrowings
   c) Goodwill- Non-Current Assets-Fixed Assets Intangible Assets
   d)Patent Rights-Non-Current Assets-Fixed Assets Intangible Assets
   e)Surplus i.e. Balance of Statement of Profit and Loss Account- Shareholders Funds-Reserves and Surplus

5.11 Abbrivations

- AS- Accounting Standards
- ICAI-Institute of Chartered Accountants of India.
- MCA- Ministry of Corporate Affairs
- Ind-AS-Indian Accounting Standards

5.12 SELF-ASSESSMENT QUESTIONS

1. What do you understand by the term Financial Statements and the method of preparing the financial statements under Compnaies Act 2013.
2. What do you mean by statement of profit and loss account. How is it helpful in ascertaining financial performance of the business, also explain the advantages of profit and loss accounts to the business.
3. Explain the purpose of making cash flow statements. Also give details about direct and indirect method of making Cash Flow Statement.

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5.14 SUGGESTED READINGS

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LESSON 6

GLOBAL ACCOUNTING STANDARDS / IFRS

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STRUCTURE

6.1 LEARNING OBJECTIVES

The objective of the lesson is to make the learners know about the accounting standards, why there is a need to have globally accepted standards, understand the difference between adoption and convergence, how the international standards are beneficial and the salient features of IFRS or Ind-AS. The learners are expected to have a thorough understanding of the accounting standard, its implementation and role of global accounting standards.

6.2 INTRODUCTION

Accounting standards are the written statements that are issued by institutions of the accounting profession to provide a guide for presentation of financial statements and developing

worldwide acceptance. Accounting standards provides guidelines for financial measurements and disclosures that are required to build fair and honest financial statements. They can be called as a system of measurement and disclosures.

A.C. Littleton explains standard as, "A standard is an agreed upon criteria of what is proper practice in a given situation, a basis for comparison and judgement; a point of departure when variation is justifiable by the circumstances and reported as such. Standards are not designed to confine practice within rigid limits but rather to serve as guideposts to truth, honesty and fair dealing." Accounting standards provide the best practice or the solution for a particular situation, however, they are not meant to put accounting in a straight jacket. They provide flexibility i.e., if in a given situation particular standard is not suitable, then the business can adopt alternative practices that are more suitable. Thus, accounting standard brings both "uniformity and flexibility" in accounting practice.

6.2.1 MEANING OF GLOBAL ACCOUNTING STANDARDS / INTERNATIONAL FINANCIAL REPORTING STANDARDS (IFRS)

Global accounting standards or International Financial Reporting Standards (IFRS) are the set of rules that govern how different items are to be reported in financial statements with an aim to attain consistency, transparency and comparability of financial statements world-wide. IFRS enables users of financial statements to understand and compare financial performance and position of public listed companies across different countries. IFRS are developed by "International Accounting Standards Board (IASB)". IASB has given international accounting standards with an objective to:

- To provide a single set of high-quality standards that are understandable and enforceable across international boundaries enabling reporting of transparent and comparable information in books of accounts
- To advocate use and application of these standards for financial reporting
- To bring convergence of various national accounting standards and international accounting standards

IASB came into existence in 2001 by replacing erstwhile IASC (International Accounting Standard Committee) which was formed in 1973. Often IFRS are confused with International Accounting Standards (IAS) which are older standards that were issued by IASC and since 2001 when IASB was formed, IAS were replaced by IFRS.

IFRS are principle-based rather than rule-based. Principle based accounting standards describe general guidelines, rules and regulations for preparing accounts. Users of financial statements, auditors and accountants are considered accountable for using and explaining the standards applied in a given situation. IFRS are kept dynamic or flexible that they can be applied as per the requirements. They are not strict rule based. Though rule-based standards increase accuracy and provide standardised financial reporting but they tend to be rigid as specific requirements are to be followed. Hence, to promote dynamic application, IFRS are kept principle-based.

IFRS are adopted by more than 160 countries of the world, including, Canada, Brazil, South Africa, South Korea, India, Russia, Chile and all the nations of the European Union. However,

US and China do not use IFRS, instead they have their own national standards. US has rule-based accounting standard system known as "Generally Accepted Accounting Principles (GAAP)".

As of now there are 17 International Financial Reporting Standards (IFRS) issued by International Accounting Standard Board (IASB) which are used with existing 41 International Accounting Standard (IAS). The table below provides the list of IFRS that are issued so far:

IFRS Number	IFRS Name	Date of issue
IFRS 1	First time adoption of International Financial Reporting Standards	24th November 2008
IFRS 2	Share-based payment	19th February 2004
IFRS 3	Business combinations	10h January 2008
IFRS 4	Insurance contracts	31st March 2004
IFRS 5	Non-current Assets held for Sale and Discontinued operations	31st March 2004
IFRS 6	Exploration for and Evaluation of Mineral Resources	9th December 2004
IFRS 7	Financial Instruments: Disclosures	18th August 2005
IFRS 8	Operating Segments	30th November 2006
IFRS 9	Financial Instruments	24th July 2014
IFRS 10	Consolidated Financial Statements	12th May 2011
IFRS 11	Joint Arrangements	12th May 2011
IFRS 12	Disclosure of Interests in Other Entities	12th May 2011
IFRS 13	Fair value Measurements	12th May 2011
IFRS 14	Regulatory Deferral Accounts	30th January 2014
IFRS 15	Revenue from Contracts with Customers	28th May 2014
IFRS 16	Leases	13th January 2016
IFRS 17	Insurance Contracts	18th May 2017

Source: https://www.ifrs.org/issued-standards/list-of-standards/

IN-TEXT QUESTIONS

1. What is the full form of IFRS.
2. IFRS are issued by _____.
3. IFRS came into existence by replacing _____.
4. IFRS are rule-based accounting standards. True/False

6.3 NEED FOR GLOBALISATION OF ACCOUNTING STANDARDS

Globalisation is the integration of an economy with the world economy. It refers to cross-border flow of goods and services, capital, technology, information, ideas and jobs. Globalisation has led to increase in number of financial transactions among different economies of the world. Today companies are involved in raising capital internationally, transact with companies from different countries, have subsidiaries in different parts of the world and even investors are looking for diversification and better investment opportunities across the world. The reporting of these cross-border activities by the companies becomes

complicated if it is done by following the national accounting standards. Use of national accounting standards for international or cross-border transactions makes the financial reporting complex and ambiguous and leads to risk for both, the companies and the end users of the financial statements as there is no standardisation in the financial statements prepared using national accounting standards

With globalisation of world economies, there is a need for globalisation of accounting standards as well. Globalisation of accounting standards means adopting a single set of global accounting standards that can be used for reporting of domestic transactions as well as international transactions (Fosbre et al., 2009). Adoption of global accounting standards makes the financial reporting uniform, easy to understand, unbiased and standardised that can be used across the world. The need for global accounting standards can be explained as follows:

Globalisation of Business – There is a need to have a common language for preparing financial statements as with the expansion of trade and other business activities' boundaries among the countries, it is important that same terms should be used for communication. Hence, there is requirement for one set of global accounting standards world-wide.

Globalisation of Capital Markets – Along with globalisation of trade of good and services, there has been international flow of capital as well. Now, investors seek better investment opportunities across countries and companies also seek to raise capital internationally that are available at lower costs. Use of globalised accounting standards will help the investors world-wide to compare and analyse the performance of the companies from different countries easily and take an informed decisions regarding their investments.

Transparency – The globalisation of accounting standards brings transparency in the books of accounts as the reporting of transactions is done following the same rules and are presented in the same manner. It brings comparability and trust among the participants of market for financial statements of a company presented using global accounting standards.

Accountability – Global accounting standards bring a sense of accountability among the provider of financial information that they have reported correct and trustworthy records that can be compared with countries from different economies. They help in reducing the information gap between the two parties involved i.e., provider of information (companies who raise capital) and receiver of information (investors who put their money in companies). Thus, global accounting standards enhances accountability.

Efficiency – Globalised amounting standards helps in increasing efficiency for both investors and businesses. They help the market participants to take optimum decisions for example, investors tend to invest in low risk and high return avenues internationally and businesses raise capital globally where they can incur low costs. This is possible only when financial information needed for decision making is standardised and can be compared.

Facilitates comparability – Adoption of global accounting standards increases reliability of the international financial information and helps the market participants to compare the financial information of companies from different countries.

Need for developing countries – The developing countries that do not have their own domestic standards can adopt global standards easily. If required international standards can be modified before adoption. Thus, in presence of global accounting standards there would not be any need for developing nations to produce their own standards.

IN-TEXT QUESTIONS

5. Use of global accounting standards makes the preparation of financial statements more complex. True/False
6. Use of global accounting standards enhances transparency, accountability, efficiency and comparability of financial records. True/False

6.4 ADOPTION VERSUS CONVERGENCE OF ACCOUNTING STANDARDS

Accounting standards are needed for disclosing important financial information to end users in a uniform way. They help in adoption of appropriate accounting rules, principles or methods for financial reporting. With increase in globalised operations of the companies across the world, it is now important for countries to follow IFRS (International Financial Reporting Standards). IFRS has now become the need of the hour. The countries can either adopt IFRS or converge with IFRS. IFRS adoption and IFRS convergence are mostly used interchangeably, but there is a difference between the two ways of following IFRS by a country.

IFRS adoption is concerned with implementing IFRS in the same way as issued by IASB. It is 100% adoption of the standards as guided by IASB. In adoption of IFRS, a country does not make any changes or modification to the existing standards to suit the environment of their economy. Adoption of IFRS ensures the uniformity with the global reporting norms and facilitates comparability of accounting statements.

IFRS convergence means implementing IFRS with modification. Countries going for IFRS convergence uses standards issued by IASB but develop compatible accounting standards as per the systems of their own country. As IFRS are global standards that do not take into account environment and system of each country; therefore, it is needed that IFRS should not be adopted blindly instead it should be modified. However, convergence with IFRS should be performed with minimum deviations. If the countries converge with IFRS with significant deviations then the whole purpose of implementing IFRS will be distorted as there will be no uniformity in accounting standards and the companies will face difficulty in preparation of

financial statements especially when consolidated financial statements are to be prepared with subsidiaries operating in different countries.

India is an example of IFRS convergence. We have not adopted IFRS as it is, we have modified IFRS and implemented with deviations to suit the economic and legal environment of the country. IFRS has been converged in the form he Indian Accounting Standards (Ind AS) which are developed by National Advisory Committee on Accounting Standards (NACAS) along with The Institute of Chartered Accountants of India (ICAI) and Ministry of Corporate Affairs (MCA). It was decided in 2007 to converge Indian accounting standards with IFRS and on 1st April 2015 new standards (Ind AS) were announced for implementation effective from 1st April 2016.

IN-TEXT QUESTIONS

7. Implementing IFRS as it is as stated by IASB without any modification is known as _____.
8. India has _____ Indian standards with IFRS.
9. The new global standards of India are known as _____.

6.5 NEED FOR CONVERGENCE OF INDIAN ACCOUNTING STANDARDS WITH IFRS

India had their own domestic accounting standards also known as Generally Accepted Accounting Principles (GAAP) developed by Accounting Standard Board (ASB) along with ICAI. In 2007, however, it was decided to come par with international accounting practices by converging the globally accepted standards IFRS with Indian standards. India being one of the fastest growing economies with increasing integration with developed economies of the world, felt the need for having a uniform and consistent accounting language to make the financial statements easy to understand and standardised. To cater to this requirement, Indian Accounting Standards (Ind AS) were issued that are developed by converging the Indian GAAP with IFRS. The question that arises here is, why there is a need for convergence of Indian GAAP with IFRS that is explained in the following points:

Common accounting language: IFRS are used world-wide and it provides a common global accounting language to be used by businesses. Convergence with IFRS helped India to adopt that common language but with little deviations. It facilitated ease in preparation of books of account for companies having subsidiaries in different locations and better understanding of financial statements for Indian companies by overseas investors.

Facilitates better understanding of accounting practices: The use of international best practices for preparation of financial statements helped the Indian companies and investors to

have a better understanding of the world's best practices in accounting field. It also enables the foreign investors and companies to understand the Indian accounting procedures and practices.

Generates reliability and comparability: India is a developing country having ties with developed and other emerging nations. At this stage of development, it is necessary for Indian companies to report reliable and transparent information so as to attract the investors and other companies and build a sense of trust among them. Thus, coming at par with the international standards for disclosure of vital financial information ensures reliability and helps in comparison for the end users.

Standardization: Earlier the companies having operations in home country as well as in foreign countries used to follow dual accounting standards, one of the home country's and other of the foreign counterparts and then consolidate them. This led to lack of standardisation in the reporting of financial information. Thus, converged accounting standards provides standardised financial statements that saves time and cost of the multinational companies

Attracts foreign investment: Foreign investment is very crucial for a growing country like India. Preparation of financial statements based on global standards generates trust among the users of accounting information specially investors. Thus, converging Indian standards with IFRS will give confidence to international investors for authenticity of the financial information of the companies and hence helps the companies to attract foreign investment.

Generates employment: Due to standardised accounting procedures many foreign companies intend to set up their operations in India where low-cost resources are available. This will lead to employment generation in India and hence will help in boosting the economy.

Time and cost saving: Building own national accounting standards and their implementation by multinational companies involves a lot of time and cost. Instead of developing domestic standards, convergence with international standards helps in brining foreign practices while keeping domestic requirements and hence saves time and cost for the companies.

The Indian Accounting Standards (Ind-AS) issued by converging IFRS with Indian GAAP are a total of 39 standards that include some of the earlier accounting standards that were used in India and some of the IFRS that are adopted to suit the needs of ecosystem of the country. The following table provides the details of new developed Ind-AS:

Ind AS	Description
Ind AS 101	First time adoption of Indian Accounting Standards
Ind AS 102	Share-based payments
Ind AS 103	Business combinations
Ind AS 104	Insurance contracts
Ind AS 105	Non-current assets held for sale and discontinued operations
Ind AS 106	Exploration for and Evaluation of Mineral Resources
Ind AS 107	Financial Instruments Disclosures
Ind AS 108	Operating Segments

Ind AS 109	Financial Instruments
Ind AS 110	Consolidated Financial Statements
Ind AS 111	Joint Arrangements
Ind AS 112	Disclosure of Interests in other entities
Ind AS 113	Fair Value Measurement
Ind AS 114	Regulatory Deferral Accounts
Ind AS 115	Revenue from Contracts with Customers
Ind AS 116	Leases
Ind AS 1	Presentation of Financial Statements
Ind AS 2	Inventories
Ind AS 7	Statement of Cash Flows
Ind AS 8	Accounting Policies, Changes in Accounting Estimates and Errors
Ind AS 10	Events after the reporting period
Ind AS 12	Income Taxes
Ind AS 16	Property, Plant and Equipment
Ind AS 19	Employee Benefits
Ind AS 20	Accounting for Government Grants and Disclosure of Government Assistance
Ind AS 21	The Effects of Changes in Foreign Exchange Rates
Ind AS 23	Borrowing Costs
Ind AS 24	Related Party Disclosures
Ind AS 27	Separate financial Statements
Ind AS 28	Investments in Associates and Joint Ventures
Ind AS 29	Financial Reporting in Hyperinflationary Economies
Ind AS 32	Financial Instruments Presentation
Ind AS 33	Earnings Per Share
Ind AS 34	Interim Financial Reporting
Ind AS 36	Impairment of Assets
Ind AS 37	Provisions, Contingent Liabilities and Contingent Assets
Ind AS 38	Intangible Assets
Ind AS 40	Investment Property
Ind AS 41	Agriculture

Source: https://www.mca.gov.in/content/mca/global/en/acts-rules/ebooks/accounting-standards.html

IN-TEXT QUESTIONS

10. Ind -AS came into existence by converging _____ with _____.
11. Convergence of national accounting standards with global accounting standards helps in bringing foreign investment and generate employment for the country. True/False
12. How many Ind-AS are there as of now?
13. Name the Ind-As 2

6.6 BENEFITS OF ACHIEVING CONVERGENCE WITH IFRS FOR DIFFERENT STAKEHOLDERS IN INDIA

As discussed in the previous section, convergence of Indian GAAP with IFRS is needed to promote better understanding, comparability, reliability, consistency of the financial statement reporting. It is beneficial for all the stakeholders of the businesses that are directly or indirectly related to the performance of the business. Harmonisation with global accounting standard provides benefits to different stakeholders that are explained as follows:

Investors: The investors would get benefitted from convergence of Indian standards with IFRS as it would be easier for foreign investors to understand the accounting process and practices of Indian companies. It would bring uniformity in the books of accounts and thus increases confidence of the investors to make investments world-wide. With harmonisation there will be efficient allocation of financial resources and informed decision-making by the investors.

Accounting and auditing professionals: Harmonisation of Indian accounting standards with global standards would provide a common platform or level playing field to the accounting and auditing professionals to offer their services and have discussions. It enhances their capacity to showcase their skills and due diligence around the globe and draw useful insights about the companies from different parts of the world.

Multinational companies: The major beneficiary of harmonised international standards has been the multinational companies having operations in more than one country. The multinational companies face issues while preparing financial records as accounting standards vary from country to country. But with adoption of IFRS by many countries, their burden of accounting requirements has reduced making it simple for them to prepare individual and consolidated financial statements. In India multinational companies also get benefitted from convergence of accounting standards and attracted many more international companies to set up their operations in India.

Tax authorities: This group would get benefitted from convergence of accounting standards indirectly as it will make the work of tax authorities less cumbersome with the ease of calculating foreign income of the companies. As companies have standard disclosures for their units in different countries, tax authorities can easily know the total income of the companies and hence perform tax calculations. Though taxation rules of every country also play an important role here, but standard accounting practices make preliminary calculations easier for tax authorities.

Industry: Internationally aligned accounting standards will generate a factor of trust on the companies outside the financial domain as the accounting practices that are to be followed by the companies would be on the standardised lines. Hence, the whole industry is benefitted with increased investment opportunities as a result of transparent and authentic disclosures.

Economy: With adoption of international accounting practices there will be increased interest of multinational companies to set up their operations in India, increased opportunities for

auditing professionals, more investments and employment generation. Thus, the convergence of Indian accounting standards with IFRS will boost the growth of Indian economy.

6.7 SALIENT FEATURES OF IND-AS/IFRS

1.7.1 Details about Salient features

Ind-AS are developed by converging IFRS with Indian GAAP and it has features of both the standards. The salient features of Ind-AS/IFRS are explained as follows:

1. **Principle based standards:** The International Financial Reporting Standards (IFRS) are principle-based standards. They provide a set of principles to be followed while reporting accounting transactions that can be adjusted as per the requirement of a particular company. It provides flexibility unlike rule-based accounting standards that are rigid and are to applied as stated.

2. **Substance over form:** IFRS and Ind-AS promotes substance over form which means that the transactions must be recorded in the books of accounts as per their economic substance i.e., economic relevance for the business rather than just reporting their legal form to ensure true and fair view of transactions in the books of accounts.

3. **Fair valuation:** It is required that the assets and liabilities should be reported at their fair value i.e., the value that would be received in market when the asset is sold and the value that would have to be paid while retiring the liability. Global accounting standards promotes use of fair value accounting and wherever possible the items of the balance sheet are required to be valued at their fair prices.

4. **Time value of Money:** IFRS and Ind-AS are based on time value of money which means that the present value of a sum of money is more as compared to the future value of the same sum of money. It is important to follow time value of money and take discounted value of future inflows or outflows wherever it is material to do.

5. **Applicability on individual as well as consolidated financial statements:** IFRS and Ind-AS are to be used in preparation of both separate financial statements and consolidated financial statements. It makes the process of consolidation of financial statements less complex as standardised procedures are used to prepare the individual financial statements of a company.

6. **Disclosure of all relevant information:** It is needed that wherever needed there should be proper disclosures of all the assumptions and relevant information while preparation of books of accounts using these global standards.

7. **Acceptability:** IFRS have world wide acceptance and usage. Either through adoption or convergence the countries implementing IFRS have common language for presenting accounting information.

IN-TEXT QUESTIONS

14. IFRS provides flexibility while using them. This tells that IFRS are _____ standards.
15. Transactions should be recorded as per economic substance rather than legal form. True/False
16. IFRS or Ind-AS are used for preparation of individual financial statements, and not consolidated financial statements. True/False

1.7.2 Fair value accounting

Fair value accounting is concerned with reporting the assets in the balance sheet at the price that would be received if the assets are sold in the market and reporting of liabilities at a price that would be transferred if the liabilities are discharged. It is required that this price is determined considering the sale of asset or transfer of liability as an ordinary transaction with the participants of the market at the measurement date. It is a market-based measurement concept and not related to any specific entity.
Some of the important aspects of fair value of accounting are explained as follows:

Market based price: Fair value price is the market price at the time of sale of the asset or discharge of the liability. It is not the price at which the transaction of buying the asset or assuming liability was done. It is the price at the time of the exit i.e., sale of asset and transfer of liability. Hence, fair value accounting requires market-based price at the time of exit and it is not related to entry price.

Principal market: In order to determine the market price at the time of sale, it is required that such market should be used that has greatest volume and level of activity of the concerned asset or liability. That market is called as principal market and if there is no principal market, then the most advantageous market should be chosen. Most advantageous market is one which gives highest possible price for the sale of the asset and lowest possible price for transfer of liability.

Market participants: Fair value accounting requires unrelated market participants to use their own assumptions to price the asset or liability. The market participants should be unrelated, knowledgeable and should be able to price the asset or liability independently to arrive at the fair value.

Characteristics of asset and liabilities: It is required to consider all the characteristics of the assets and liabilities in the question. The fair value of assets should be determined by considering location, condition and charges against the asset while fair value of liabilities should be determined by considering all the risk of non-performance.

IN-TEXT QUESTIONS

17. Fair value price is the entry price i.e., when asset is purchased or liability is assumed. True/False
18. If principal market is not available, then _____ should be used for determining fair value.

1.7.3 Substance over form

Substance versus form is one of the salient features of IFRS. It means that the financial statements and other disclosures should reflect the economic substance of the transactions rather than just their legal form. A true and fair picture of the financial statements is depicted when the transactions are recorded as per their economic and financial substance and not just the legal form to show the objective picture of the transactions as stated in standards. This calls for subjective judgement at the discretion of the company which is possible due to the principle-based nature of IFRS. Hence, all the information that is important for users and have economic relevance should be reported and not just their legal form.

The following example will explain meaning of substance over form:

Mr. A bought a machinery and gave it to Mr. X for production of goods. Mr. X will produce goods using the machinery and will sell them to earn the income. So, here legal owner of the machinery is Mr. A and Mr. X is using the machinery, producing income and taking risks associated with machinery. Mr. X has the economics of the machinery connected to him.

In this situation, the question that arises is that in whose books, Mr. A (legal owner) or Mr. B (associated economic substance), the machinery and the associated income and losses should be recorded. As per the principle of substance over form, whenever this conflict arises where legal owner and economic substance lies with different entities, then the economic substance should be preferred over legal form. Hence, the machinery related information will be recorded in Mr. X's books of accounts as he is actually using the asset and generating income whereas Mr. A, the legal owner, has nothing to do with income and losses of the machinery. So economic substance would prevail over legal form.

1.7.4 Time value of money

Time value of money means that a rupee today worth more as compared to the same rupee received at a future date. It is a finance concept wherein it is required to bring all the future cash flows to their present value in order to know the correct worth of the proposal or investment. To incorporate time value of money, present value is calculated for future course of actions to know its worth today.

Financial reporting using IFRS requires calculation of present value of assets and liabilities and report it. In present value technique, the future cash flows are needed to be discounted using the discounting factor to arrive at an equivalent cash flows at present. Two inputs are needed to calculate time value of money:

- Estimated time, amount and uncertainty involved with future cash flows
- Discount rate calculation to know the present values of the cash flows

Under the Indian GAAP time value of money was not followed and there was no need to discount any flow of income or cash flows. However, IFRS and Ind-AS suggests discounting of all provisions that are made in the books of accounts or discounting of any other item for which time value of money is material. Hence, time value of money should be practiced while preparing financial statements to calculate the real worth of future cash flows for the current period.

IN-TEXT QUESTIONS

19. Substance over form says that legal form prevails over economic substance in case of conflict. True/False
20. An amount of money today worth more as compared to the same amount of money in future, this is known as _____.

6.8 SUMMARY

- International Financial Reporting Standards (IFRS) are the set of rules that govern how different items are to be reported in financial statements with an aim to attain consistency, transparency and comparability of financial statements world-wide.
- IFRS are developed by "International Accounting Standards Board (IASB)"
- Globalisation of accounting standards means adopting a single set of global accounting standards that can be used for reporting of domestic transactions as well as international transactions

- IFRS adoption is concerned with implementing IFRS in the same way as issued by IASB. It is 100% adoption of the standards as guided by IASB whereas IFRS convergence means implementing IFRS with modification
- Investors, accounting and auditing professionals, multinational companies, tax authorities, industry and economy are different stakeholders that get benefits from convergence of Indian GAAP with IFRS
- Salient features of IFRS/Ind-AS are: Principle based standards, substance over form, fair valuation, time value of money, disclosure of all relevant information and world-wide acceptability
- Fair value accounting is concerned with reporting the assets in the balance sheet at the price that would be received if the assets are sold in the market and reporting of liabilities at a price that would be transferred if the liabilities are discharged
- Substance over form means that the financial statements and other disclosures should reflect the economic substance of the transactions rather than just their legal form.
- Financial reporting using IFRS needs to be done using time value of money concept wherever material and suggests calculating present value of assets and liabilities for reporting.

6.9 ANSWERS TO IN-TEXT QUESTIONS

1. International Financial Reporting Standards	10. Indian GAAP, IFRS
2. International Accounting Standard Board (IASB)	11. True
3. International Accounting Standard (IAS)	12. 39
4. False	13. Inventories
5. False	14. Principle-based
6. True	15. True
7. IFRS adoption	16. False
8. Converged	17. False
9. Indian Accounting Standards (Ind-AS)	18. Most advantageous market
	19. False
	20. Time value of money

6.10 SELF ASSESSMENT QUESTIONS

1. What do you understand by global accounting standards? Explain IFRS
2. Why globalisation of accounting standards is important?
3. Differentiate between IFRS adoption and IFRS convergence. Explain the case of India in this regard.
4. What are the benefits for Indian economy from convergence of Indian GAAP with IFRS
5. Explain the salient features of Ind-AS/IFRS
6. What are the important aspects of fair value accounting?

7. Explain the concept of substance over form with example

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LESSON 7

INTRODUCTION TO ACCOUNTING STANDARDS

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STRUCTURE

7.1 LEARNING OBJECTIVES

The learning objectives of this sessions will be-

1. Basic Understanding of Indian Accounting Standards
2. To Analyse Applicability of Indian Accounting Standards to Indian Industries
3. To Understand Indian Accounting Standards – 1 in Brief.
4. To Understand Indian Accounting Standards -7 in Brief.
5. To Understand Indian Accounting Standards – 109 in Brief.

7.2 INTRODUCTION

IFRS have converged standards known as Indian AS (Ind AS). They have the same names and numbers as their corresponding IFRS. The Ministry of Corporate Affairs was advised to adopt these standards by the National Advisory Committee on Accounting Standards (NACAS). Indian AS are made applicable to Indian corporations by the Ministry of Corporate Affairs (MCA). There have been 40 Indian AS issued thus far.

With effect from April 1, 2019, NBFCs with net worth greater than or equivalent to INR 250 crore but less than INR 500 crore have to adopt IND AS for Financial Reporting.

The lesson will also include basic brief understanding of Indian Accounting Standard 1- Presentation of financial statements, Indian Accounting Standard 7- Cash flow statement and Indian Accounting Standard 109- Fiancial Instruments.

7.3 INTRODUCTION TO ACCOUNTING STANDARDS (IND-

7.3.1 Development of Indian Accounting Standards

In these globally connected times, the ICAI acknowledges the necessity for a universal standard. As a result, the Government of India and ICAI opted against adopting the IFRS in its current form. In its place, it debuted the Indian AS, often known as Ind AS. Let's look into Indian AS in detail, including its history and some of its key ideas.

7.3.2 Indtroduction to Indian AS

The organisation that establishes the Accounting Standards in India is the Institute of the Chartered Accountants of India (ICAI). The transition to the International Financial Reporting Standards was started by ICAI in 2006. (IFRS). The IFRS are published by the International Accounting Standards Board (IASB). The ICAI is moving towards IFRS in order to improve the financial statements of Indian corporations' acceptance and transparency on a worldwide scale.

The requirements of IFRS were initially carefully examined by the government and ICAI. They then made the decision to converge it. The Indian AS has been created by the Accounting Standards Board (ASB). It has made every effort to maintain compliance with IFRS. Only adjustments that were absolutely necessary were made.

In collaboration with the National Advisory Committee on Accounting Standards, the Central Government of India released Indian Accounting Standards (NACAS). It did so while being supervised and controlled by the ICAI's Accounting Standards Board (ASB).

IFRS have converged standards known as Indian AS (Ind AS). They have the same names and numbers as their corresponding IFRS. The Ministry of Corporate Affairs was advised to adopt these standards by the National Advisory Committee on Accounting Standards (NACAS). Indian AS are made applicable to Indian corporations by the Ministry of Corporate Affairs (MCA). There have been 40 Indian AS issued thus far.

7.3.3 The significance of Indian Accounting Standards

Based on, Ind AS They make cross-border money transfers, global listing, and cross-border financial statement comparison easier. In turn, this encourages international investment and benefits participants in the capital market. It improves the investor's capacity to evaluate investments globally. This in turn lowers the chance of making poor judgements. Additionally, it does away with the expensive demands for financial statement reinstatement.

7.3.4 Applicability of Indian Accounting Standards

The Companies (Indian Accounting Standards (IND AS)) Rules 2015, which were announced by the Ministry of Corporate Affairs (MCA) in 2015, provided for the phased adoption and application of IND AS from start of Financial year 2016-17.

Since then, the MCA has amended the Companies (Indian Accounting Standards (IND AS)) Rules 2015 three times. The IND AS are converged form of IFRS and harmonised with the IFRS to increase the transparency of reporting by Indian businesses internationally.

The need to harmonise reporting standards with international standards was felt as a result of Indian enterprises now having a much greater global reach than they did previously, requiring the creation of IND AS.

Phases of Convergence

MCA introduced a phased convergence from existing accounting standards to IND AS. Depending on their net worth and listing status, some classes of corporations must use IND AS. Here is a detailed look at each of the phases:

Phase I

Mandatory implementation of IND AS for all businesses beginning on April 1, 2016, provided:

- Whether the company is listed or not
- It has a net worth of at least 500 crore rupees.

A review of net worth over the past three fiscal years is required (2013-14, 2014-15, and 2015-16).

Phase II

Mandatory implementation of IND AS from April 1, 2017 for the following entities:

- Publicly traded corporation or is attempting to do so (as on 31.03.2016)
- Its net worth exceeds or equals Rs. 250 billion but falls short of Rs. 500 billion (for any of the below mentioned periods).

A review of net worth for the past four financial years is required (2014-14, 2014-15, 2015-16, and 2016-17)

Phase III

Mandatory implementation of IND AS for all banks, nonbank financial institutions, and insurance providers as of April 1, 2018, who:

- With effect from April 1, 2018, net worth is greater than or equivalent to 500 crore Indian rupees.

With effect from April 1, 2018, IRDA (India's Insurance Regulatory and Development Authority) will announce a distinct set of IND AS for banks and insurance companies. NBFCs include venture capitalists, stock brokers, and core investment firms. The last three fiscal years' net worth must be verified (2015-16, 2016-17, and 2017-18)

Phase IV

With effect from April 1, 2019, all NBFCs with net worth greater than or equivalent to INR 250 crore but less than INR 500 crore must make IND AS mandatory to them.

Notes to keep in mind:

IND AS shall automatically become applicable to all subsidiaries, holding companies, related businesses, and joint ventures of any firm, regardless of the individual qualification of such entities, if IND AS is rendered applicable to any company. When an Indian company conducts business abroad, the compilation of stand-alone financial statements may follow local regulations and is not required to follow IND AS. However, in order to create consolidated IND AS accounts, these entities must still report their IND AS adjusted statistics to their Indian parent firm.

Net Worth Calculation

The company's standalone accounts as of March 31, 2014, or the first audited quarter ending after that date, shall be used to calculate net value. After subtracting accrued losses, postponed expenses, and other expenses that haven't been written off, net worth is the sum of paid-up share capital and all reserves from the profit & securities premium account. Only capital reserves that result from promoter contributions and grants from the government may be included. You cannot include reserves made through revaluing assets and writing back depreciation.

Voluntary adoption

For accounting periods beginning on or after April 1, 2015, businesses have the option to voluntarily include IND AS in their reporting. Where IND AS have been created to present a comparative view, such firms shall submit with a comparative report for the periods ending March 31, 2015, or later. However, once a firm has begun reporting in accordance with the IND AS, it cannot switch to reporting in accordance with earlier rules.

SEBI Clarification

The Indian Accounting Standards (IND AS) and disclosures required in the offer documents have been clarified by SEBI for all issuer businesses whose offer documents are filed with SEBI on or after 1 April 2016. As a rule, SEBI mandates that issuer companies disclose financial data for the five fiscal years immediately before to the year in which the offer document was filed, while adhering to identical accounting principles for each fiscal year. These points can be noticed for issuer organisations that have submitted an offer document:

1. All of their financial statements submitted up until March 31, 2017, may follow Indian GAAP.
2. The three financial years that immediately before the relevant financial year must be disclosed between April 1, 2017, and March 31, 2018, and must be disclosed in accordance with IND AS principles; the other two financial years may be disclosed in accordance with Indian GAAP.
3. In the three financial years that immediately preceded the relevant financial year, beginning on or after April 1, 2018, disclosures must be made in accordance with IND AS principles. For the two remaining financial years, however, disclosures may be made in accordance with Indian GAAP.
4. Disclosures for the one remaining financial year may be made in accordance with Indian GAAP between April 1, 2019 and March 31, 2020, but those for the previous four financial years immediately before the relevant financial year must be made in accordance with the IND AS principles.
5. Disclosures for the prior five financial years must be provided in accordance with the IND AS principles beginning on or after April 1, 2020.

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IN-TEXT QUESTIONS

1. _____ organization establishes the Accounting Standards in India
2. IFRS have converged standards known as _____.
3. In how many phases india adopted Ind AS?
4. Ind AS 16 represents _____
5. Ind AS 11 represents _____

7.4 UNDERSTANDING IND-AS 1: PRESENTATION OF FINANCIAL STATEMENTS

To ensure comparability with the organisation's financial statements from previous accounting periods (inter period and intra firm comparison) as well as the financial statements of other companies (inter firm comparison), IND AS 1 specifies the basis for presentation of general-

purpose financial statements which are useful for the all the stakeholders in general. It outlines general requirements for financial statement presentation, rules for their organisation, and minimum standards for their content including disclosures.

Financial Statements

This requires a company or an entity to present a full set of financial statements at least annually with the financial year ending on 31st March, with comparative amounts for the preceding year and Notes to Accounts giving details of line items in Balance Sheet and Statement of Profit and Loss including significant accounting policies

Financial Statements comprises of the following :

(a) a balance sheet;

(b) a statement of profit and loss;

(c) a statement of changes in equity;

(d) a statement of cash flows;

(e) notes to accounts, including significant accounting policies;

(f) comparative information of the preceding period; and

(g) a balance sheet as at the beginning of the preceding year (opening balance sheet).

7.4.1 Objectives of IND AS 1

The standard prescribes the basis for presentation of general purpose financial statements to ensure comparability with

1. With Previous Periods (inter period comparison)
2. With Statements from other entities (inter firm comparison)

7.4.2 Scope of IND AS 1

This applies to all the entities including:

a. Those which present consolidated financial statements as per Ind AS 110 'Consolidated Financial Statements'.

b. Those which present separate financial statements as per IND AS 27 'Separate Financial Statements'.

Except for paragraphs 15 to 35 of IND AS 1, this standard is not applicable to interim financial statements prepared as per IND AS 34.

7.4.3 Definitions under IND AS 1

1. **General purpose financial statements** – They are designed to satisfy the demands of staekholders who are unable to request the entity create customised reports or statements specifically catered to their own information needs.

2. **Impracticable**- It will be treated as impractical to apply a condition if the entity has made all reasonable attempts to implement or apply trhat condition.

3. **Material**- omissions or misstatements of items are material if they could, either individually or collectively, can influence the economic decisions that users make on the basis of the financial statements.

4. **Reclassification adjustments**- these are amounts reclassified to profit or loss in the current period which were recognized in other comprehensive income in the current or previous periods.

5. **Total Comprehensive income**- TCI= Profit/Loss for the year + Other Comprehensive Income.

7.4.4 General features of financial statements

1. **True and Free View** – The Financial statements should present a true and fair view of :

a. Financial Position of the entity as on reporting date

b. Financial Performance of the entity during the accounting period

c. Cash flow of the entity from different activities during the accounting period

2. **Compliance with IND AS** – An entity complying with all the applicable IND AS as per relevant Financial Reporting Framework shall make an explicit and unreserved statement of such compliance in the notes to accounts to financial statements.

3. **Going Concern** – Unless entity has no practical alternative to maintain the assumption of going concern, either wants to liquidate the whole firm or discontinue significant operations or undertakings, financial statements shall be prepared on a going concern basis.

Uncertainties should be disclosed in notes to accounts if management has serious concerns about the entity's ability to continue as a going concern.

4. **Accrual Basis of Accounting**- An entity shall prepare its financial statements, except cash flow statement on accrual basis of accounting.

5. **Materiality and Aggregation** – An entity shall present separately each material class of similar items. If a line item is not individually material, it is aggregated with other items.

Materiality depends on the type, quantity, or both of the information. It is the entity which determines whether information, either alone or in combination with other information, is material.

6. **Offsetting**- An entity shall not offset assets and liabilities or income and expenses, unless required or allowed by any IND AS.

7. **Frequency**- An entity shall present a complete set of financial statements (including comparative Information) at least once in a financial year.

8. **Comparative information** – An entity shall present atleast the following statements:

i. 2 Balance sheets
ii. 2 Statement of Profit and Loss
iii. 2 Statement of Cash flows
iv. 2 Statement of changes in Equity and Related Notes.

When an entity applies an accounting policy retrospectively or makes a retrospective restatement from a back date; then it shall balance sheets as at –

- The end of the current period,
- The end of the previous period or beginning of the current period and
- The beginning of the earliest comparative years.

9. **Consistency**- An entity shall consistently follow and apply the same presentation and classification of items in the financial statements from one accounting period to another.

A business must include all the owner changes in equity in a statement of changes in equity. A single statement of profit and loss must include all non-owner changes in equity (also known as statement of comprehensive income), with profit or loss and other comprehensive income. The portions must be presented collectively, with the profit or loss section coming first followed by other comprehensive income.

Entity must explicitly state in the notes that its financial statements are IND AS compliant. Financial statements cannot be referred to as compliant with IND AS unless they meet all of the requirements of all the applicable IND ASs. Financial statements that are IND AS compliant are assumed to be providing a true and fair view.

The Standard also addresses concerns related to continuing operations, balancing of assets, liabilities, revenue, and expenses, as well as modifications to presentation or categorization.

7.4.5 Structure and Content

An entity shall separate the financial statements from other information in the same published document and clearly identify them. The Balance Sheet must include certain minimum Line Items as prescribed in this standard. Additionally, it specifies the details that must be included in the statement of profit and loss, other comprehensive income section, and statement of equity movements.

Other Comprehensive Income

Items of income and expenses (including reclassification adjustments) that are not recognised in profit or loss as required or permitted by other IND AS, such as changes in revaluation surplus are included in other comprehensive income.

According to the Standard, each component of other comprehensive income must be disclosed, along with any reclassification adjustments and income tax. Reclassification adjustments are sums that have been transferred from other comprehensive income to profit or loss in the current period.

The other comprehensive income includes the following:

(a) Items of other comprehensive income categorised by nature and grouped into those that:

(i) will not be subsequently reclassified to profit or loss; and

(ii) will be subsequently reclassified to profit or loss when certain conditions are met.

(b) the portion of associates' and joint ventures' other comprehensive income that is accounted for using the equity method, broken down into the portions of items that:

(i) will not be subsequently reclassified to profit or loss; and

(ii) will be subsequently reclassified to profit or loss when certain conditions are met.

Current/non-current distinction

The Standard mandates that a business exhibit current and non-current liabilities and assets in its balance sheet as separate classifications, unless liquidity provides basis provides more accurate and reliable information. An entity must list all assets and liabilities in the order of their liquidity when that exception applies.

For each asset and liability line item that combines amounts estimated to be recovered or resolved, the Standard mandates that a business report the amount projected to be recovered or settled after more than twelve months.

A maximum of twelve months following the reporting period is allowed, but more than twelve months is also acceptable.

The Standard mandates that :

(a) An entity shall disclose the material judgments, other than those involving estimations.

(b) An entity must disclose matetrial information regarding its future projections, as well as other substantial sources of estimating uncertainty.

(c) An entity must disclose information enabling users to assess the business's goals, rules, and procedures for capital management. Any firm that classifies putable financial products as equity instruments must also make additional disclosures.

7.5 IND AS – 7 CASH FLOW STATEMENT

According to IND AS 7, a business must include a statement of cash flows as a fundamental component of its primary financial statements. Operating activities (either using the "direct" or "indirect" technique), investing activities, and financing activities are the three categories into which cash flows are categorised and presented; the latter two are typically presented on a gross basis.

7.5.1 History of IND AS 7

Table 7.2: *History of Ind AS 7*

June, 1976	Statement of Source and Application of Funds Exposure Draft E7
October, 1977	Statement of Changes in Financial Position under IAS 7
July, 1991	Draft E36 Cash Flow Statements for Public Review
December, 1992	IAS 7 Cash Flow Statements (1992)
January, 1994	the launch of IAS 7 (1992)
September, 2007	As a consequence of changes to IAS 1, the statement of cash flows was renamed from cash flow statements to statement of cash flows.
April, 2009	IAS 7 has been modified with regard to expenses that don't produce a recognised asset by Annual Improvements to IFRSs 2009.
July, 2009	Date on which IAS 27(2008) modifications relating to changes in a subsidiary's ownership take effect
January, 2010	the April 2009 amendments to IAS 7 went into effect
January, 2016	Amendments to IAS 7 as a result of the Disclosure Initiative
April, 2016	IND AS Phase 1 applies
January, 2017	Date on which the January 2016 updates to IAS 7 became effective
April,2017	IND AS Phase 2 applies

April,2018	IND AS Phase 3 applies
April,2019	IND AS Phase 4 applies

7.5.2 Objectives of IND AS 7

Users of financial statements can evaluate an entity's capacity to produce cash and cash equivalents and its requirements for utilising those cash flows using information about the entity's cash flows. The ability of an entity to generate cash and cash equivalents, as well as the timing and certainty of their generation, must be assessed in order for users to make economic decisions.

By using a statement of cash flows that divides cash flows over the period into operating, investing, and financing activities, this Standard seeks to compel the supply of information on the historical changes in cash and financial equivalents of a company.

7.5.3 Applicability of IND AS 7

The cash flow statement is applicable to all businesses, and no organisation type is immune from having to prepare and submit one. However, according to the current AS, small and medium-sized businesses are not required to have one.

7.5.4 Scope of IND AS 7

For each period for which financial statements are prepared, a business must compile a statement of cash flows in accordance with the requirements of this standard and include it as a component of those financial statements.

7.5.5 Definitions of IND AS 7

- Cash – Cash comprises cash on hand and demand deposits. (Source- Ministry of corporate affairs)

- Cash equivalents – Cash equivalents are short-term, highly liquid investments that are readily convertible to known amounts of cash and which are subject to insignificant risk of changes in value. (Source- Ministry of corporate affairs)
- Cash flows – Cash flows are inflows and outflows of cash and cash equivalents. (Source- Ministry of corporate affairs)

Note-

a. Borrowing from banks is typically regarded as a financing activity. However, bank overdrafts that are repayable immediately are included in cash and cash equivalents when they constitute a crucial part of an entity's cash management.
b. Normally, an investment can only be considered a cash equivalent if its maturity is short—say, 3 months or less—from the date of purchase.

- Operating Activities – are the principal revenue-producing activities of the entity and other activities that are not investing or financing activities. (Source- Ministry of corporate affairs)

Examples-

Cash payments to suppliers for goods and services include:

1. Cash receipts from sales of goods or provision of services;

2. Cash receipts from royalties, fees, commissions, and other sources of income; and 3. Cash receipts from other sources.

4. Securities and loans may be held by an entity for trading or dealing purposes, in which case they resemble inventories purchased particularly for resale. As a result, the cash flows from dealing or trading in securities are categorised as operating activities.

Note- Cash received to produce or purchase assets held for others' rental use and thereafter held for sale is referred to as cash flows from operational operations in paragraph 68A of Industrial AS 16. Cash flow from operating activities also includes the sums received from rent payments and later sales of the aforementioned assets.

For Calculating Operating Cash flows, there are two methods i.e., direct and indirect method. The more encouraged and commonly used method is direct but indirect method of presentation is also accepted. (IAS 7.18)

- Direct Method - Each significant type of gross cash inflows and outflows is displayed using the direct technique. Under the direct technique, the operating cash flows component of the cash flow statement might look something like this:

Cash receipts from customers	XXXX
Cash paid to suppliers	(XXXX)
Cash paid to employees	(XXXX)
Cash generated from the operations	XXXX
Interest Paid	(XXXX)
Income tax paid	(XXXX)
Cash flow from operating Activities	XXXX

- The indirect approach takes non-cash transaction effects into account when adjusting accrual basis net profit or loss. Under the indirect technique, the operating cash flows component of the cash flow statement might look something like this:

Profit before interest and income taxes		XXXX
Add back depreciation		XXXX
Add back impairment of assets		XXXX
Increase in receivables	XXXX	
Decrease in inventories		XXXX
Increase in trade payables		XXXX
Interest expense	XXXX	
Less Interest accrued but not yet paid	XXXX	
Interest paid		XXXX
Income taxes paid		XXXX

Net cash from operating activities		XXXX

- Investing Activities – are the acquisition and disposal of long-term assets and other investments not included in cash and cash equivalents. (Source- Ministry of corporate affairs)

  Examples-

  1. Payment in cash for the purchase of real estate, machinery, and equipment, as well as other long-term assets.
  2. Profits from the sale of intangibles, such as property, plant, and equipment,
  3. Making a cash purchase of stock or debt instruments
  4. Loans and cash advances to third parties
  5. Payment in cash for option, forward, and future contracts

  Format-

Purchase of property, plant, and equipment	(XXXX)
Proceeds from sale of equipment	XXXX
Cash flow from Investing Activities	XXXX

- Financing Activities – are activities that result in changes in the size and composition of the contributed equity and borrowings of the entity. (Source- Ministry of corporate affairs)

  Examples-

  1. Cash received from the sale of stock instruments such as shares.

  2. Payment in cash to shareholders in order to purchase or redeem equity shares

  3. Cash received via the sale of debt instruments such as bonds, notes, and mortgages.

  4. Cash repayment for the borrowed amount, and 5. Cash repayment from the lessee to offset the outstanding liabilities

  Format-

Proceeds from issuance of common stock	XXXX
Proceeds from issuance of long-term debt	XXXX
Principal payments under capital lease	(XXXX)
Dividends paid	(XXXX)
Cash flow from financing activities	XXXX

Note - Operating, investing, and financing cash flows may all be reported on a net basis.

Foreign currency cash flows

Cash flows resulting from transactions in a foreign currency must be recorded in the functional currency of the entity by applying the foreign currency amount to the functional currency amount at the exchange rate in effect on the date of the cash flow.

The cash flows of a foreign subsidiary must be converted using the foreign currency's exchange rate and the functional currency's exchange rate as of the cash flow dates.

Cash flows do not include unrealized gains and losses brought on by fluctuations in foreign exchange rates. To reconcile cash and cash equivalents at the beginning and end of the period, the impact of exchange rate changes on cash and cash equivalents held or payable in a foreign currency is however recorded in the statement of cash flows.

This sum includes any changes, if any, that would have existed had the cash flows from operating, investing, and financing operations been reported at end-of-period exchange rates. It is given separately from those cash flows.

Interest and dividends

Dividends and interest payments and receipts must both be broken out separately in the cash flow statement. In the case of a financial institution, cash flows from interest paid and interest and dividends received should be categorised as cash flows from operating operations. Interest paid should be treated as a cash flow from financing activities in the case of other firms, whereas interest and dividend payments should be classified as

cash flows from investing activities. It is appropriate to classify dividend payments as cash flows from financing activities.

For a financial organisation, operating cash flows are often defined as interest paid, interest and dividends received, and interest paid. On how to classify these cash flows for other organisations, there is no agreement, nevertheless. Some contend that since they affect whether a business makes a profit or loses money, interest paid and interest and dividends received may be categorised as operating cash flows. Although interest represents a cost of getting financial resources or returns on investments, it is more acceptable to classify interest paid and interest and dividends received as financing cash flows and investing cash flows, respectively.

Some contend that in order to help consumers assess an entity's capacity to pay dividends out of operating cash flows, dividends paid may be included as a component of cash flows from operating activities. However, because dividend payments involve a cost of getting financial resources, it is thought more acceptable to classify them as cash flows from financing activities.

Taxes on income

Unless they can be directly linked to financing and investment operations, cash flows from income taxes must be stated separately and are classed as cash flows from operational activities.

Taxes on income are incurred on transactions that result in cash flows that are categorised in a statement of cash flows as operating, investing, or financing activities. Even though tax expenses are sometimes easy to associate with financing or investing activities, the associated tax cash flows are frequently difficult to pinpoint and may occur at a different time than the cash flows of the underlying transaction. Taxes paid are therefore typically categorised as cash flows from operating operations. However, the tax cash flow is appropriately classed as an investing or financing activity when it is practical to link it to a specific transaction that results in cash flows that are categorised as such activities. The overall amount of taxes paid is disclosed when tax cash flows are distributed across many activity classes.

Non-cash transactions

A statement of cash flows must not include investing or financing activities that don't involve cash or cash equivalents. All pertinent information regarding these investing and financing operations related to such transactions must be disclosed elsewhere in the financial statements.

Components of cash and cash equivalents

The components of cash and cash equivalents must be disclosed, and the amounts in the statement of cash flows must be compared to the corresponding items on the balance sheet.

A company discloses the strategy it uses to determine the composition of cash and cash equivalents in order to comply with IND AS 1, Presentation of Financial Statements, and in light of the diversity of cash management practises and banking arrangements around the world.

7.5.6 Difference between Ind AS 7 and AS3

Table 1.3: *Difference between Ind AS 7 and AS3*

IND AS 7	AS 3
Specifically includes bank overdrafts which are repayable on demand as a part of cash and cash equivalents	Silent on this aspect
Treatment of cash payments to manufacturer or acquiring assets for rental to others and at the same time held for sale in the course of business as cash flows from operating activities	Does not contain such requirements
No mention on the treatment of extraordinary items	Cash flows associated with extraordinary activities to be separately classified as arising from operating, investing and financing activites

7.6 IND AS- 109 FINANCIAL INSTRUMENTS

The classification, recognition, de-recognition, and measurement requirements for all financial assets and liabilities are covered by IND AS 109 Financial Instruments. The stakeholders will be able to evaluate the timeliness and uncertainty of a business's future cash flow thanks to the standards provided by this standard for accounting and reporting of Financial Instruments (FI).

7.6.1 Objectives of Ind AS 109

This Standard aims to define guidelines for the financial reporting of financial assets and liabilities that will provide readers of financial statements with pertinent and helpful information for their evaluation of the quantities, timing, and uncertainty of an entity's future cash flows.

7.6.2 Scope of Ind AS 109

1. All entities shall apply this Standard to all categories of financial instruments, with the exception of:
    a. those investments in associates and joint ventures that are reported in accordance with Ind AS 28 Investments in Associates and Joint Ventures, Ind AS 27 Separate Financial Statements, or Ind AS 110 Investments in Subsidiaries, Associates, and Joint Ventures. To account for an interest in a subsidiary, associate, or joint venture in accordance with any or all of the requirements of this Standard, however, may be required or permitted in some circumstances by Ind AS110, Ind AS 27, or Ind AS 28. Unless the derivative complies with the definition of an equity instrument of the entity in Ind AS 32 Financial Instruments: Presentation, entities must also apply this Standard to derivatives on an interest in a subsidiary, associate, or joint venture.
    b. Rights and responsibilities under leases covered by Ind AS 17 Leases. However, the de-recognition and impairment criteria of this Standard apply to lease receivables that have been recognised by a lessor; The de-recognition requirements of this Standard apply to finance lease payables that are acknowledged by a lessee,

and the embedded derivatives requirements of this Standard apply to derivatives that are included in leases.

c. rights and responsibilities of employers with regard to employee benefit plans, as defined by Ind AS 19 Employee Benefits.

d. Financial instruments issued by the entity that satisfy Ind AS 32's definition of an equity instrument (including warrants and options) or that must be categorised as an equity instrument in accordance with Ind AS 32's paragraphs 16A and 16B or 16C and 16D. However, the holder of such equity instruments must treat them in accordance with this Standard unless they fall under one of the exceptions in (a).

e. rights and obligations arising under I a contract that falls under the purview of Ind AS 104 Insurance Contracts because it has a discretionary participation feature, with the exception of an issuer's rights and obligations arising under an insurance contract that satisfies the definition of a financial guarantee contract. However, if the derivative is not a contract within the purview of Ind AS104, this Standard still applies to the derivative that is contained in the contract. Additionally, an issuer of financial guarantee contracts may choose to apply either this Standard or Ind AS104 to such financial guarantee contracts if the issuer has previously stated explicitly that it views such contracts as insurance contracts and has used accounting that is appropriate for insurance contracts Contract by contract, the issuer may make that choice; but, each contract's choice is final.

f. any forward agreement between an acquirer and a selling shareholder to purchase or sell an acquire that, at a later acquisition date, results in a business combination covered by Ind AS103 Business Combinations. The term of the forward contract should not be longer than is ordinarily required to complete the transaction and acquire any relevant approvals.

g. promises to lend money aside from those later described. However, if a loan promise falls beyond the parameters of this Standard, the issuer must still apply the standard's impairment requirements to it. Additionally, this Standard's derecognition rules apply to all loan obligations.

h. Financial commitments made as part of share-based payment transactions are covered by Ind AS102 Share-based Payment.

i. rights to payments from third parties to cover expenses incurred by the company to resolve liabilities that it has recognised as provisions under Ind AS 37 Provisions, Contingent Liabilities, and Contingent Assets, or for which it has previously recognised provisions under Ind AS 37.

j. Contracts with Customers that contain rights and responsibilities covered by Ind AS 115 that are financial instruments, except from those that Ind AS 115 specifically mentions, are reported in compliance with this Standard.

2. For the purpose of recognising impairment profits or losses, the rights that Ind AS115 stipulates are accounted for in accordance with this Standard shall be subject to the impairment requirements of this Standard.
3. The loan commitments listed below fall under the purview of this Standard:
   a. obligations for loans that the firm classifies as financial liabilities and values at fair market value. Applying this Standard to all of its loan obligations in the same class is required of a company that has a history of disposing the assets arising from its loan commitments soon after origination.
   b. loan commitments that are repayable in full in cash, in the form of another financial instrument, or both. These contracts to lend money are derivatives. A loan commitment isn't considered resolved net just because it's paid off in instalments (like a mortgage construction loan that's disbursed in instalments in accordance with the construction's progress).
   c. Promises to offer a loan at a rate that is lower than the market rate
4. With the exception of contracts that were entered into and are still held for the purpose of the receipt or delivery of a non-financial item in accordance with the entity's anticipated purchase, sale, or usage requirements, this Standard shall apply to those contracts to buy or sell a non-financial item that can be settled net in cash or another financial instrument, or by exchanging financial instruments. The contracts, however, that an entity identifies as measured at fair value through profit or loss in line with the next paragraph shall be subject to this Standard.
5. A agreement to buy or sell any non-financial item that can be settled net in cash or another financial instrument, or by exchanging financial instruments, as they were a financial instrument, may be irrevocably designated as measured at fair value through profit or loss, even if it was made in accordance with the entity's anticipated needs for purchase, sale, or usage.

Only if it completely eliminates or significantly reduces a recognition inconsistency (also known as a "accounting mismatch") that would otherwise be caused by failing to recognise the contract because it is not covered by this Standard is it possible to make this designation at the time the contract is signed.A contract to buy or sell a nonfinancial object may be settled net in a number of ways, including in cash, another financial instrument, or by swapping financial instruments.

A contract that falls under subparagraphs (b) or (c) is one that is made without regard to the entity's anticipated needs for the purchase, sale, or use of the non-financial item and is thus covered by this Standard.

Other contracts covered by paragraph 2.4 are examined to see if they were signed and are still in effect for the purpose of receiving or delivering the non-financial item in accordance with the entity's anticipated needs for purchases, sales, or other uses, and if so, whether they fall under the purview of this Standard.

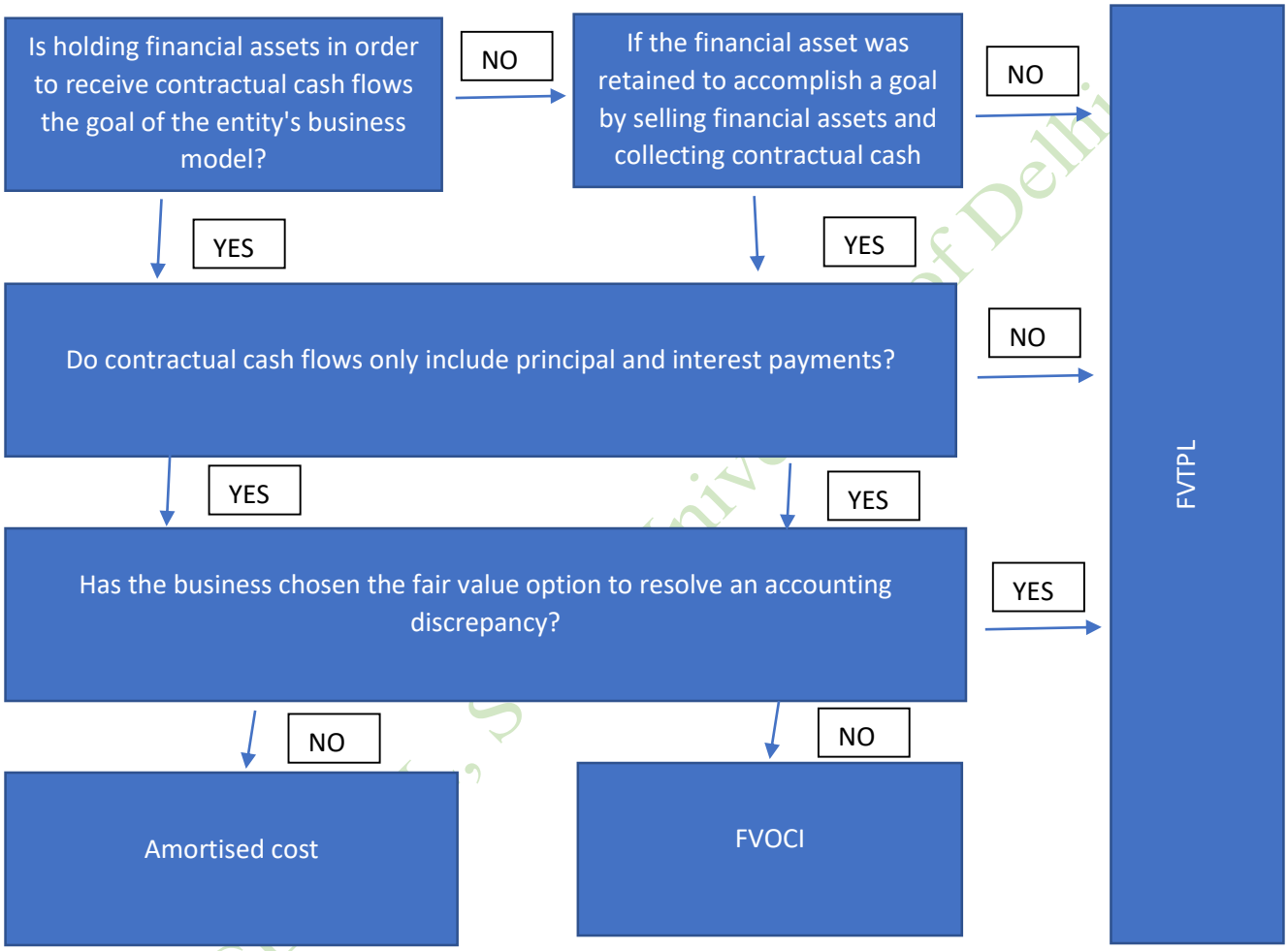
7.6.3 Classification of financial assests and financial liabilities

Classification of financial assets

An entity must categorise its financial assets as per its strategy for managing them or the contractual cash flow pattern of financial assets that will then be assessed at:

S.No.	Business Model	Measurement
1	The financial asset is kept to fulfil contractual obligations, and it generates cash flows on predetermined periods that are limited to payments of principal and interest on the outstanding principal amount.	Amortised cost
2	Financial assets are held through the sale of financial assets and the collection of contractual cash flows. The financial asset generates cash flows that are only payments of principle and interest on the outstanding principal amount due on the stated dates.	Fair Value Through Other Comprehensive Income

3	If the requirements for the first two techniques are not met, residual	Fair Value Through Profit & Loss



Classification of financial liabilities

With the exception of: (a) At FVTPL, all financial liabilities are later measured at fair value. Transfers that are ineligible for derecognition (b) (continuing involvement approach) Contracts to offer financial guarantees (c) Loan commitments made at below-market interest rates (d) (e) Changes in contingent consideration must be reported in profit or loss and evaluated at fair value.

Measurement under IND AS 109 Financial Instruments

In the absence of fair value (transaction value), the direct transaction cost of the FI is taken into account for first recognition. The following describes the Effective Interest Rate (EIR) method:

S.No.	Nature of Financial Asset	Interest Revenue calculation
1	Normal	EIR to Gross Carrying Amount
2	Purchase Credit Impaired	credit adjusted EIR Used
3	Became Credit Impaired	EIR in subsequent period Used
4	Modified contractual cash flow	Recalculate GCA and modify gain or loss in P&L

Recognition of Financial Instruments

Only until the entity has signed the contract containing the instrument will it be able to record an asset or liability in its balance sheet. Either the trade date accounting or the settlement date accounting can be used to acknowledge and de-recognize a regular acquisition or sale of financial assets.

De-recognition of financial assets

Since this idea is used at the level of the consolidated entity, an entity must first consolidate all of its subsidiaries in line with IND AS 110. Subject to certain restrictions, de-recognition may be applied to a specific portion, the full asset, or a group of related assets. Only when the contractual rights to the financial asset's cash flows expire or the financial asset is transferred and the transfer is eligible for de-recognition, must an entity de-recognize the financial asset. When an entity transfers a financial asset, it must assess the degree to which it still bears the risks and benefits of ownership.

S.No.	All Risk and Rewards of ownership	Results

1	Substantially - Transfers	Recognize the liabilities established or retained in the transfer separately and de-recognize the financial asset.
2	Substantially – Retains	Keep appreciating the financial asset
3	Neither Transfers nor retains substantially	Check to see if the entity still maintains control over the financial asset.

De-recognition of financial liabilities

A financial liability (or portion thereof) may only be discharged by an entity once it has been extinguished (Contract obligation is discharged or cancelled or expires).

Let's examine the various accounting procedure situations:

S.No.	**Event**	**Accounting Process**
1	Exchange with material changes between the current borrower and the lender	Extinguishment of the original financial liability and the recognition of a new financial liability
2	Upon expiration or transfer to a third party (entirely or part)	To be recognised in profit or loss is the difference between the carrying amount and the consideration received (including any non-cash assets).
3	Repurchase a portion of an obligation	Based on the fair values as of the repurchase date, divide the previous carrying amount between the portion that is still recognised and the portion that is de-recognised.

Embedded derivatives

An embedded derivative is a part of a hybrid contract that also contains a host contract that is not a derivative. Some of the combined instrument's cash flows fluctuate similarly to a stand-alone derivative. It is not an embedded derivative but rather a distinct FI when a derivative is

linked to a FI but is legally transferable apart from that instrument or has a different counter party.

Hybrid contracts with financial asset hosts

A hybrid contract has both derivative and non-derivative components that cannot be transferred separately from the host contract. An embedded derivative in a hybrid contract with a host that is not an asset must be distinguished from the host and recorded as a derivative only if:

- The embedded derivative's economic characteristics and risks are not very closely tied to the host.
- The definition of a derivative includes a distinct instrument having the same terms as the embedded derivative.
- In order to account for changes in fair value, the hybrid contract is not valued at fair value. If it is impossible to distinguish and measure the embedded derivative from its host, the entire hybrid contract should be designated as being at FVTPL. If the fair value cannot be accurately determined, the difference between the fair values of the hybrid contract and the host is taken into account; otherwise, it is classified as FVTPL.

Reclassification

Reclassify any financial assets that are impacted when an entity modifies its business model for managing financial assets. Any financial responsibility cannot be reclassified by an entity. Since classification is dependent on specific principles, it must be redone if those principles change. Measurement must be completed on the reclassification date.

Initial	**Revised**	**Accounting**
Amortised Cost	FVTPl	FV regarding the reclassification date and PL discrepancy
Amortised Cost	FVOCI	FV on the reclassification date and the OCI difference
FVOCI	Amortised Cost	FV is carrying value as of the reclassification date. OCI's cumulative gain/loss adjusted for FV

FVOCI	FVTPL	Asset taken into account at FV. OCI-adjusted cumulative gain/loss in PL
FVTPL	FVOCI	Considering an asset at FV
FVTPL	Amortised Cost	FV is carrying value as of the reclassification date. EIR was updated

Write-off

Net Carrying When there are no realistic prospects of recovering a financial asset in full or in part, the amount of that asset is directly lowered.

Impairment – Expected Credit Loss (ECL)

Expected Credit Loss (ECL) model is used to underpin the requirements and acknowledgment of impairment. It is necessary to use the ECL approach to: 1. FI calculated using amortised cost 2. FI as determined by FVOCI 3. Contract assets, trade receivables, and lease receivables 4. Financial guarantee contracts subject to Ind AS 109 but not taken into account by FVTPL 5. No loans made have been measured at FVTPL

S.No.	Name	Explanation
1	General Approach	The 12 month ECL is employed if there hasn't been a significant increase in credit risk since initial detection. Life-time ECL is utilised if credit risk has dramatically escalated. Future impairment losses are based on 12 month ECL if credit quality improves to the point where there is no longer a significant rise in credit risk.
2	Simplified Approach	The recognition of an impairment loss based on lifetime ECLs at each reporting date eliminates the need to track changes in credit risk. If there is no significant financial component, this is required by IND AS 115 for trade receivables or contact receivables. Provision is made in accordance with prior due dates.

Hedging Instruments (HI)

A hedged item can be a known asset or liability, an unacknowledged firm commitment, a predicted transaction, or a net investment in an overseas business. The object being hedged can be a single item or a collection of items that are consistently measured or likely. Only if all of the following conditions are met does a hedging relationship meet the requirements for hedge accounting:

- There are just qualified HI and eligible hedged items in it.
- The entity's risk management purpose is included in official designation, documentation, and other information.
- satisfies each of the following criterion for hedge effectiveness:

  Relationship between the hedged item's and HI's finances

  The value changes are not primarily driven by the impact of credit risk. and

  The amount of the HI that the entity actually uses to hedge that quantity of the hedged item and the hedge ratio in the hedging relationship are both the same.

7.6.4 Accounting treatment of hedging relationships

A. Fair value hedge:

- The increase or decrease in the HI's profit or loss

- The hedged item's gain or loss is adjusted to the GCA. Profit or loss includes any gain or loss on financial asset evaluated at FVTCI.

- An equity instrument known as a hedged item adopts changes to FVOCI while remaining in OCI.

- The cumulative change in fair value of a hedged item, which is an unacknowledged firm commitment, is recognised as an asset or a liability and a corresponding gain or loss is reported in P&L.

B. Cash flow hedge:

- The lower of the following is used to adjust the cash flow hedge reserve:
  the total gain or loss on the HI since it was created
  the total change in the HI's fair value
- OCI records the gain or loss on the HI up to the amount that is deemed to constitute an effective hedge.
- The P&L accounts for any lingering gain or loss on the HI due to the hedge's ineffectiveness.

C. A hedge of a net investment in a foreign operation:

- OCI records the portion of the gain or loss on the HI that is assessed to be an efficient hedge.

- In P&L, the ineffective portion is noted.

7.7 SUMMARY

The main points and themes covered in the lesson must be reviewed and highlighted at the end of the lesson in the form of a summary. Please note that 'this is not a conclusion: rather it will help the learners in remembering the main points of the lesson and therefore it is written at the end of the lesson. It should be one paragraph and should not be too long. Further, if the author feels the need, key points can be given as a numbered or bulleted list or a diagram chart.

7.8 ANSWERS TO IN-TEXT QUESTIONS

1. Institute of the Chartered Accountants of India (ICAI)
2. Indian AS (Ind AS)
3. 4

7.9 SELF-ASSESSMENT QUESTIONS

1. Explain the significance and applicability of Indian Accounting Standards.
2. What is financial statements under Ind AS 1?
3. What are the objectives and scope of Ind AS1?
4. Write a short note on Cash flow statement?
5. Define Operating, financial and dividend activites under Ind AS 7.
6. What is the difference between inderct and direct method to calculate cash flow from operating activities.
7. Define Non cash transactions.
8. What is the difference between Ind AS 7 and AS 3 on CFS.
9. Expain Scope and Objectives of Ind AS 109.
10. Explain conceptualisation of classifying financial assests and liabilities.

7.10 SUGGESTED READINGS

1. Narayanaswamy R. Financial Accounting: A Managerial Perspective. PHI Learning Private Limited, Delhi.

2. Robert N. Anthony, David F. Hawkins, Kenneth A. Merchant. Accounting- Text and Cases. McGraw Hill Education (India) Private Limited, New Delhi.

3. Garg CA Kamal, and Sehrawat Neeraj Kumar. Beginner`s Guide to Ind-AS & IFRS. Bharat Law House Pvt. Ltd., New Delhi.

4. Maheshwari S.N., Maheshwari Suneel K., and Maheshwari Sharad K. An Introduction to Accountancy. Vikas Publishing House Private Limited, Noida.

LESSON 8

ANALYSIS OF ACCOUNTING INFORMATION

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STRUCTURE

8.1 LEARNING OBJECTIVES

After reading this lesson, students will be able to understand:

- The concept of Ratio and Ratio Analysis
- Forms of expressing ratios

- Significance of Ratio Analysis
- Liquidity Ratios
- Long term Solvency Ratios
- Profitability ratios
- Activity ratios

8.2 INTRODUCTION

The users of financial statements (shareholders/owners/investors, management, employees, lenders, competitors, government and regulatory agencies, auidtors, etc.) are always interested in understanding and interpretating the meaning of financial information contained in the financial statements, which is possible only by understanding the relationships between various financial variables contained in balance sheet and statement of profit and loss. Such analysis is known as the **Accounting Ratio Analysis**.

Ratios analysis helps in identifying the patterns and trends in income, expenses, sales growth and helps to predict the future financial position and results (profit or loss).

8.3 UNDERSTANDING ACCOUNTING RATIO AND ANALYSIS OF ACCOUNTING RATIOS

Ratio: It is a mathematical expression of indicating relationship between two interdependent quantities which can be financial items or variables in the financial statements or two accounting figures.

Accounting Ratio: when ratio is calculated between two financial or accounting variables on the basis of information given in the financial statements, balance sheet, profit and loss account such as profit, sales, assets, liabilities, debtors, creditors, etc

Accounting Ratio Analysis: it the mechanism of studying relationship among various financial variables (such as profit, sales, assets, liabilities, debtors, creditors) with the help of accounting ratios. It is a process of determining and interpreting relationships between financial variables given in the financial statements to obtain an understanding of trends and making future predictions of the financial performance and position of a business enterprise.

8.2 EXPRESSING ACCOUNTING RATIOS IN DIFFERENT FORMS

Accounting ratios can be expressed in the following forms:

1. **Pure:** ratio is expressed as a quotient such as current ratio, quick ratio, etc.
2. **Percentage:** ratio is expressed in the form of percentage such as net profit ratio, gross profit ratio, return on investment, etc.
3. **Times:** ratio is expressed in number of times a financial variable in terms of another financial variable such as debtors turnover ratio, creditors turnover ratio, inventory turnover ratio etc.

8.3 OBJECTIVES OF RATIO ANALYSIS

Ratio analysis is done with the following objectives:

1. Making understanding of financial information presented in the financial statement very simple and precise.
2. Facilitating determination of both liquidity and long-term solvency of the business enterprise.
3. Assists in determining the operating efficiency.
4. Facilitating analysis of profitability.
5. Comparative study which can be either intra-firm (of the same entity over different periods) or inter firm (from one entity to another) comparisons.

8.7 SIGNIFICANCE OF RATIO ANALYSIS

Ratio Analysis offers the following advantages:

1. **Determining Operating Efficiency:** ratio analysis heps in assessing and evaluating liquidity (short term solvency), solvency and profitability of a business enterprise.
2. **Inter-firm comparison and Intra-firm comparison of performance:** When performance is compared with performance other business organisations in the same industry, it is called Inter-firm Comparison. while, if the performance of same organisation over different years is compared or performance of different divisions or segments within the same organisation is compared, it is called Intra-firm Comparison. Accounting ratios facilitates both inter firm and intrafirm comparisons.
3. **Helps in Analysis of Financial position and performance:** Through ratios users of financial information can analyse the financial statements to know financial position and performance of a business enterprises. There are many stakeholders such as bankers, regulators, investors, tax authorities, creditors, owners, management, etc. who are interested in knowing the financial performance and postion of the business enterprise.
4. **Helps in making Forecasts :** Accounting ratios helps to identify the trends in financial performance or activities of the organisation which helps in future planning and

forecasting.

5. **Simplifies Accounting Information:** Ratios summarises the results of detailed and complicated information in a very precise manner.
6. **Spotting/locate Weak Areas:** Accounting ratios can be used to locate the weak areas where the business is not performing well as compared to past years or others in the industry. Therefore management can take prompt corrective actions to improve the performance in those areas.

8.8 LIMITATIONS OF RATIO ANALYSIS

Besides many advantages, ratio analysis suffers from the following disadvantages

1. **No Standard Ratio:** There is no benchmark against which actual ratios can be compared determine whether a ratio is favourable or adverse.
2. **Reliability issues:** Ratios are calculated on the basis of information given in the financial statement which is not futuristic but realtes to past only, further if the information available is not then ratios will be incorrectly calculated. Therefore, one cannot completely rely on ratios to make any future economic decisions.
3. **Qualitative Aspects are ignored:** Rratios considers only quantitative factors and all the qualitative factors such as efficiency of management, customer satisfaction level, etc. are ignored, which are also to be considered future decision making.
4. **Uncomparable in case of different Financial Reporting Framework:** Different entities within the same industry may follow different Financial Reporting Framework having different policies and procedures for preparing and presenting financial statements. Due to which amount of financial items such as sale, profit, current assets, etc would also differ. Thus, accounting ratios of different business organisation cannot be compared as they based on information derived from different accounting policies and methods.
5. **Ignores changes in Price Level:** Since accounting is based on the historical cost concept, the assets are carried at historical cost minus accumulated depreciation and not on their current market value prevailing in the relevant market.
6. **Scope for Manipulations and Window Dressing:** Accounting cannot prevent the inherent risk of window dressing by the internal management to modify the financial performance and position to gain undue advantage at the cost of users, thus manipulative information will make ratios inaccurate leading to incorrect calculation of ratios affecting the economic decisions taken on the basis such incorrect ratios.
7. **Personal Judgement:** Since, recording of transactions and events, preparation of financial statements is largely influenced by personal judgments of management. Therefore, accounting ratios calculated on the basis of such information on comparable and are biased.

8.9 TYPES OF RATIOS

Ratios are classified into the following types:

1. **Liquidity or Short-term solvency ratios:** These are the ratios which are concerned with evaluating the ability of a business orgnanisation to meet its short-term financial obligations or current liabilities (which are to be settled within normal operating cycle or 12 months from the reporting date) on time. It includes the following ratios:

1. Current Ratio (which relationship between Current Assets and Current Liabilities)
2. Liquid Asset/ Acid Test/ Quick Ratio (relationship between liquid or Quick Assets and Current Liabilities)

2. Solvency or long-term solvency ratios: These are the ratios which are concerned with evaluating the long-term financial leverage and solvency of the business organisation. They depict the ability of business to repay the long-term financial obligations such as debentures, long term bank loan, public deposits. It includes the following ratios:

1. Debt to Equity or Debt Equity Ratio (DE) (relationship between shareholders funds and debt)
2. Total Assets to Debt Ratio (relationship between total assets and debt)
3. Proprietary Ratio (relationship between shareholders fund and total assets)
4. Interest Coverage Ratio (relationship between interest and earnings before interest)

These ratios are concerned with assessment of capital structure, sources and application of funds.

3. Activity/Turnover ratios: These are the ratios which are concerned with evaluating how efficiently the entity has utilised the resources in the the business operations. It includes the following ratios:

1. Inventory Turnover Ratio (relationship between cost of revenue from operation and average inventory)
2. Debtor/Trade Receivables Turnover Ratio (relationship between net credit sales or credit revenue from operations and Average Trade Recievables)
3. Creditor/Trade Payables Turnover Ratio (relationship between net credit purchases and Average Trade Payables ivluding creditors and bills payable)
4. Working Capital Turnover Ratio (relationship between net sales and working capital)

4. Profitability: These are the ratios which are concerned with evaluating the earning capacity of the business organisation as a return on the resources used. It includes the following ratios:

1. Gross Profit Ratio (relationship between Gross profit and sales)
2. Operating Ratio (relationship between operating cost and sales)
3. Operating Profit Ratio (relationship between operating profit and sales)
4. Net Profit Ratio (relationship between net profit and sales)
5. Return on Investment (relationship between profit and capital employed)

8.10 LIQUIDITY (SHORT-TERM SOLVENCY) RATIOS

Liquidity ratios are concerned with determinig the ability to meet its short-term financial obligations or current liabilities (which are to be settled within normal operating cycle or 12 months from the reporting date) on time. It includes th following ratios:

1. Current Ratio: It is a ratio which is concerned with explaining the relationship between the current assets and current liabilities.

It evaluates the ability of a business organisation to meet or settle its short-term financial obligations or current liabilties on time from the realisation of current assets. It is expressed in the form of pure ratio.

Current ratio can be expressed as follows:

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Ideal or acceptable Current Ratio is 2 : 1, cuurent assets must be atleast double the amount of current liabilities so as to provide a suuficient cover for current liabilities.
High Current Ratio indicates better liquidity however very high current ratio indicates poor credit worthiness among the suppliers and creditors and poor operational efficiency.

Current Assets: these are the assets which are expected to be uitlised, realised or converted into Cash and Cash Equivalents within normal operating cycle or within 12 months from the reporting date which ever is higher. It includes:

1. Short-term loans and advances
2. Current Investments (shares and secourities of other entities)
3. Inventories (excluding Loose Tools and Stores and Spares) in the form of raw material, work in progress, finished goods, stock in trade
4. Trade Receivables (sum of bill receivables and sundry debtors)
5. Cash and Cash Equivalents (credit balance in current account with bank, cash in hand, time deposits of upto three months, cheques/drafts in hand and other marketable securities)
6. Other Current Assets (advance given to sppliers of raw material, prepaid expenses, accrued interest, etc.)

Current Liabilities: these are the liabilities which are expected to be settled or repayable through outflow of economic resources within 12 months from the reporting date or within the period of normal operating cycle. It includes:

1. Short-term borrowings (short term bank loans, cash credit, bank overdraft)
2. Short-term provisions (provison for discount on debtors, provision for income taxation, provision for doubtful debts, etc)

3. Trade Payables (sum of bills payable and sundry creditors)
4. Other Current Liabilities (not included in th above categories)

Other Current Liabilities includes the following:

- Current maturities of long term loans or borrowings
- Accrued interest (earned) but not due and not recieved
- Interest accrued and due (earned but not recieved)
- Outstanding expenses (outstanding salary, outstanding rent, etc)
- Unpaid dividend
- Calls-in- advance (advance received for call money on shares), etc.

Operating Cycle: It is the time span between the acquisition of resources (raw material, stock in trade, labour) for processing or production of goods and their conversion into Cash and Cash Equivalents after sale and receipt of cash from debtors.

Note: If the normal operating cycle cannot be determined or not given in the question, then take it as 12 months for classifying assets and liabilities as current and non current.

Working Capital: The amount of capita which is used in meeting day to day expenses and payment to suppliers. It refers to amount by which Current Assets exceeds Current Liabilities.
Formula for Working Capital is given as:

Working Capital = Current Assets - Current Liabilities

Example : From the following information calculate Current Ratio:

Particulars	Amount	Particulars	Amount
Debtors	3,60,000	Bills Payable	40,000
Insurance (prepaid)	80,000	Creditors	2,00,000
Cash at bank	1,00,000	Long term bank loan	8,00,000
Treasury bills	1,00,000	Raw material	1,60,000
Plant and Machinery	10,00,000	Outstanding salary	1,60,000

Solution:

Current Assets = Debtors + Insurance (prepaid)+ Cash at bank + Treasury bills + Raw material

= 3,60,000 + 80,000 + 1,00,000 + 1,00,000 + 1,60,000

= 8,00,000

Current Liabilities = Bills Payable + Creditors + Outstanding salary

= 40,000 + 2,00,000 + 1,60,000

= 4,00,000

Current ratio = Current assets/Current liabilities

=8,00,000/4,00,000

=2:1

Here current ratio is equal to the ideal current ratio

2. Quick or Liquid ratio or Acid Test Ratio: This ratio is concerned with evaluating the cuurent ability of the business organisation to meet its short-term financial obligations or current liabilities which arises within normal operating cycle or 12 months from the reporting date. It studies the relationship between liquid assets and current liabilities. It a better, more prudent and strict indicator of liquidity or short trem solvency as compared to the current ratio because it does not takes into account blocked assets such as prepaid expenses and inventory which cannot be used to pay the current liabilities. It is expressed in the form of a pure ratio.

Liquid or Quick Ratio or Acid test Ratio

$$= \frac{\text{Liquid or Quick Assets (Current Assets- Prepaid expenses- Inventory)}}{\text{Current Liabilities}}$$

Idle Ratio: 1 : 1, Liquid assets must be atleast equal to amount of current liabilities to make their payment on time.

Liquid Assets: These assets are more liquid as compared to current assets and constitutes mainly Cash and Cash Equivalents or assets which can be converted into Cash and Cash Equivalent within the normal operating cycle or 12 months whichever is higher.

Liquid Assets or Quick Assets = Current Assets- Prepaid expenses- Inventory.
Prepaid expenses and inventory are deducted from current assets to obtain the amount of liquid assets because inventories takes time in production and sale to convert in cash and cash equivalents after recovery from trade recievables and prepaid expenses are already been paid to outsiders and cannot be used to pay the outsiders and cannot be readily converted into cash.

Liquid Assets includes the following assets:

- Short-term Loans and Advances,
- Current Investment (into the shares and securities of other entities),
- Trade Receivables (sum of sundry debtors and trade recievables),
- Cash and Cash Equivalents (cash in hand, credit balance in current account at bank, time deposits of upto three months, cheques/drafts in hand and other marketable securities),
- Other Current Assets other than Prepaid Expenses.

Example:
Consider the following information:
Current Assets 12,00,000; Inventories 2,40,000; Working Capital 10,08,000. Determine Quick Ratio.

Solution:
We know that, Quick Assets = Current Assets- – Inventories (other than loose tools and spares)- prepaid expenses
= 12,00,000 - 2,40,000- 0

= 9,60,000
Current Liabilities = Current Assets- Working Capital
= 12,00,000-10,08,000 = 1,92,000
Quick Ratio = Quick Assets or Liquid Assets / Current Liabilities
=9,60,000/1,92,000 = 5:1

Current Ratio vs Quick Ratio:

Basis of Distinction	**Current Ratio**	**Quick Ratio/Liquid Ratio/Acid test Ratio**
Relationship	between Current Assets and Current Liabilities.	between the Liquid Assets/Quick Assets and Current Liabilities.
Evalution	Shows ability to pay current liabilities out of current assets which are to be settled within a period of 12 months from the reporting date 931st March) or within the period of normal Operating Cycle which ever is higher.	ability to meet Current liabilities immediately out of liquid assets.
Ideal Ratio	Ideal Ratio is 2:1.	Ideal Ratio is 1:1.
Measure	the short-term financial position or liquidity.	better and more prudent than Current Ratio as it excludes blocked current assets such as inventory and prepaid expenses.

8.11 SOLVENCY RATIOS

Solvency Ratios are also known as Long term liquidity ratios as these are concerned with assessment of capital structure, sources and application of funds.

These are the ratios which are concerned with evaluating the long-term financial leverage and solvency of the business organisation. They depict the ability of business to repay the long-term financial obligations such as debentures, long term bank loan, public deposits. It includes the following ratios:

1. Debt to Equity or Debt Equity Ratio (DE) (relationship between shareholders funds and debt)
2. Total Assets to Debt Ratio (relationship between total assets and debt)
3. Proprietary Ratio (relationship between shareholders fund and total assets)
4. Interest Coverage Ratio (relationship between interest and earnings before interest)

Debt-to Equity Ratio: This ratio is widely used in the industry and is concerned with analysing the relationship between borrowed funds or long-term external debts (includes long-term loans, debentures, public deposits and long-term provisions) and Owners' fund or Equity (Proprietory funds / Equity/Shareholders' Funds consisting of share capital and reserves and surplus).

It determines the capital structure-the mix of outside debts (borrowed funds) and owner's funds invested in the total resources of the orgainsation. It assesses long-term financial soundness of the business enterprise and indicates dependency of business enterprise on external borrowed funds for financing its resources. It is expressed in the form of Pure Ratio.

$$\text{Debt to Equity Ratio} = \frac{\text{Debt (Non current liabilities)}}{\text{Equity (Shareholder's Funds)}}$$

Debt includes the following items:

1. Long term Borrowings (debentures, public deposits, loans from bank)
2. Long term Provisions (provision for Gratuity, leave encashment)
3. Deferred tax Liabilities
4. Other Non Current liabilities

Long term Borrowings:

- These are the borrowings that are due to be settled beyond 12 months from the reporting date (31st March) or after the operating cycle period which ever is higfher.
- Part of Long Term Borrowings payable within 12 months from the reporting date or normal operating cycle period which ever is higher, then such borrowing is termed as 'Current Maturities of Long Term Debts' shown under the head Current Liabilities and will not be considered as Debt while calculating Debt to Equity ratio.

Long term Provisions: These are the provisions for liabilities to settled after 12 months from Balance Sheet date or normal Operating Cycle period whichever is higher. These are shown as line item under the head Non-current liabilities in the balance sheet.

Debt = Long-term Borrowings + Long-term Provisions+ deferred tax liabilities + other long term liabilities

Or

= Total of Equity and liabilities – Non current liabilities -Current Liabilities

Or

= Capital Employed – Equity (shareholders fund)

Equity = Share Capital + Reserves & Surplus

Capital Employed = Non Current liabilities + Shareholder fund (Share Capital + Reserves and Surplus)
Non-Current Assets = Tangible Fixed Assets (Property Plant Equipment) + Intangible Fixed Assets + Non-Current Trade Investments+ Deferred tax Assets + Long-term Loans and Advances + Other non Currents Assets.

Working Capital = Current Assets – Current Liabilities

Note: If there exists Negative Balance of profit in Statement of Profit & Loss under Reserves and Surplus is deducted from Reserves and Surplus to calculate the Shareholders' Funds.

Example: Consider the following information:

Particulars	**Amount**
Property Plant and Equipment	16,80,000
Accumulated Depreciation on Property Plant and Equipment	2,80,000
Non-current Investments in shares and securities	28,000
Long-term Loans and Advances to related parties	1,12,000
Current Assets	7,00,000
Current Liabilities	5,60,000
16% Long-term Borrowings	8,40,000
Long-term Provision for gratuity	2,80,000

Determine Debt to Equity Ratio

Solution:
Debt = 16% Long-term Borrowings + Long-term Provision for gratuity
= 8,40,000+2,80,000 = 11,20,000
Equity = Total Assets - Total external Debts
= (16,80,000 -2,80,000+28,000+1,12,000+7,00,000) -(4,20,000-1,40,000 -2,80,000)
= 5,60,000
Debt /Equity Ratio = Debt (Non Current Liabilities)/Equity (Shareholders Funds)
=11,20,000/5,60,000=2:1

Total Assets to Debt Ratio: It is the ratio which is concerned with explaining relationship between total assets (Current as well as Non Current) and Non Current Liabilities of the business enterprise.
It determines the proportion to which payment of Long term debt or borrowing is covered by the total assets both current and non current assets. It calculates the 'Safety Margin or cover' available to the lenders or outside debt holders to recover their debts.
A high total assets to debt ratio indicates higher safety margin for lenders and vice versa. It is expressed in the form of a Pure Ratio.
Formula for Total Assets to Debt Ratio is given as follows:

Total Assets to Debt Ratio = Total Assets(Non current Assets + Current Assets)
Debt (Long-term Debts)

Total Assets: These include both Non-current and Current assets which are as follows:

Non-Current Assets: This includes the following assets:

- Fixed assets or Property Plant and Equipment and Intangible Assets (tangible and intangible fixed assets, capital work in progress, intangible assets under development)
- Non-Current Investments (in shares and securities of other entities)
- Deffered Tax Assets (net of Deffered Tax Assets and Deffered Tax Liabilities)
- Long term Loans and Advances
- Other non current assets (not included in above)

Current Assets: This includes the following assets:

1. Current Investments (in shares and securities of other entities)
2. Inventories (including spare parts and loose tools)
3. Trade Receivables (sum of sundry debtors and trade recievables)
4. Cash and Cash Equivalents (cash in hand, credit balance in current account with bank, time deposits of upto three months, cheques/drafts in hand and other marketable securities)
5. Short-term Loans and Advances (advance or loan given to directors, mansgers, employees)
6. Other Current Assets (such as prepaid insurance, prepaid rent, etc.)

Debts: This will include:

1. Long-term Borrowings
2. Deferred Tax liabilities
3. Long-term Provisions
4. Other non current liabilities

Proprietary Ratio: this ratio is concerned with explaining the relationship between proprietor's fund (Shareholders' Funds or Equity) and total assets of the business enterprise showing the financial strength and financial risk or leverage of the business. It shows the proportion of total assets funded by the shareholders' money in the form of shareholders funds. Lenders and banks use it identify the portion of shareholders' funds and external borrowed funds in the total assets employed to measure safety margin or cover available to them aginst their funds invested in the form of loans.

A very high Proprietary ratio indicates that management is not using the concept of trading on equity and there is improper mix of owner' funds and borrowed funds leading to lower return on investment to equity owners. However it indicates the safety margin for creditors and lenders while, lower ratio means inadequate cover for lenders of funds.

Proprietary Ratio = Proprietor's Funds or Shareholders' Funds or Equity
Total Assets (Current Assets + Non Current Asset)

Proprietors' Funds/ Shareholders' Funds: This can be calculated using two

approaches:

1. Liabilities Approach: In this approach,

Proprietors' funds = Share Capital (Equity Share Capital+ Preference Share Capital) + Reserves and Surplus (General Reserve, Securities Premium reserve, credit balance of Surplus).

2. Assets Approach: In this approach,

Proprietors' funds = Non-current Assets + Working Capital (Current Assets – Current Liabilities) – Non-current Liabilities.

Interest Coverage Ratio: This is the most popular ratio used in the industry by professionals, credit rating agencies as it explains the relationship between Net Income before Interest and Tax and Interest on Long Term borrowings or other fixed financial charges. It evaluates profit available to provide as cover against fixed financial service obligations or interest on long term debts including preference dividend. It is expressed in number of times.
A high Interest Coverage Ratio provides a signal of high cover of profit to meet the interest payments, thereby creating a confidence among the lenders about the financial strengtb and earning capacity of the entity.

Formula for Interest Coverage Ratio is given as:

$$\text{Interest Coverage Ratio} = \frac{\text{Profit before Interest and Tax}}{\text{Interest on Long-Term Debt + Prefernce Dividend}}$$

8.12 ACTIVITY RATIOS

Inventory Turnover Ratio (ITR):

a. It shows relationship between Cost of Goods Sold and Inventory.
b. It determines whether the investment in stock is effieciently utilised to generate sales.
c. It depicts the number of times a business organisation sells and replaces its inventory during a year.
d. A high ratio indicates more sales per rupee of investment in the inventories.

$$\text{ITR} = \frac{\text{Cost of Revenue from Operations (Cost of Goods Sold)}}{\text{Average Inventory (Opening Inventory + Closing Inventory)}}$$

Calculation of Cost of Revenue from Operations or Cost of Goods Sold:

In case of a trader:

Cost of Revenue from Operations = Opening Inventory+ Net Purchases (Purchases-Purchase return) + Direct Expenses (Carriage Inward + Wages) - Closing Inventory

In case of a Manufacturer:

Cost of Revenue from Operations = Cost of Raw Materials Consumed + Purchases of Stock-in-Trade + Changes in Inventories of Finished Goods, Work in Progress & Stock-in-Trade +

Direct Expenses(Carriage Inward + Wages)

Direct Expenses: if no direct expenses are given in question, then assume it to be nil.
Average Inventory: (Opening Inventory + Closing Inventory) ÷ 2

Example: Consider the following information:
Revenue from Operations: 32,00,000
Average Inventory: 4,40,000
Gross Loss Ratio 10%
From the above information, calculate Inventory Turnover Ratio
Solution:
Gross Loss = Cost of Revenue from Operations (Cost of Goods Sold)- Revenue from Operations(sales)
Cost of Revenue from Operations = Sales +Gross Loss
= 32,00,000+1,60,000
= 33,60,000
Inventory Turnover Ratio = Cost of Goods Sold /Average Inventory
= 33,60,000/4,40,000 = 7.64 times

Example: Consider the following information:

Particulars	Amount in Rs.
Sales	8,00,000
Gross Profit	2,00,000
Closing stock	2,40,000
Excess of Closing Inventory over Opening Inventory	80,000

Calculate Inventory Turnover Ratio from the above information.
Solution:

Sales	= 8,00,000
Gross Profit	= 2,00,000
	= Sales − Gross Profit
	= 8,00,000 − 2,00,000
Cost of Goods Sold	= 6,00,000
Let Opening Inventory	= x
Closing Inventory	= x + 80,000
2,40,000	= x + 80,000
x	= 1,60,000
Opening Inventory	= 1,60,000

Average Inventory= (1,60,000+2,40,000)/2
Average Inventory= 2,00,000
Cost of Goods Sold = Revenue - Gross Profit
Cost of Goods Sold = 8,00,000 - 2,00,000=6,00,000

Inventory turnover Ratio (ITR) = Cost of Goods Sold or Cost of revenue from operation/Average inventory

ITR =6,00,000/2,00,000
Inventory turnover Ratio = 3 Times

Example: Consider the following financial information of Abhishek limited:

Particulars	**2021-22**	**2022-23**
Closing Inventory on 31st March	14,00,000	34,00,000
Sales during the year	1,00,00,000	1,50,00,000

Gross Profit is 25% on Cost of Goods Sold
In the year 2021-22, inventory increased by 4,00,000.
Calculate the Inventory Turnover Ratio for the years 2021-22 and 2022-23 from the above information

Solution:
Gross Profit=1,00,00,000×25/125=20,00,000
Cost of goods sold=1,00,00,000-20,00,000 =80,00,000
Opening Inventory=14,00,000-4,00,000=10,00,000
Average Inventory=(10,00,000+14,00,000)/2=12,00,000
Inventory turnover Ratio(2021-22)= 80,00,000/12,00,000
Inventory turnover Ratio(2021-22)= 6.67 Times

Gross Profit=1,50,00,000×25/125=30,00,000
Cost of goods sold=1,50,00,000-30,00,000 =1,20,00,000
Average Inventory=(14,00,000+34,00,000)/2=24,00,000
Inventory turnover Ratio (2022-23)= 1,20,00,000/24,00,000
Inventory turnover Ratio (2022-23)= 5 Times

Debtor/ Trade Receivables Turnover ratio: This is one of the most popular and widely used ratio which is concerned with explaining the relationship between Credit Revenue from Operations (Net Credit Sales) and Average Trade Receivables (Average debtors + Average bills receivable).
It shows the number of times debtors are turned over or realized in a year with respect to credit sales. i.e how efficiently and readily trade receivables are realised or converted into Cash and Cash Equivalents It indicates the efficiency in recovery and collection of cash from debtors.
A higher ratio indicates that debts are collected more frequently and strict credit policy as less credit period is involved or less investment in debtors is bloacked.

Formula for Trade Receivable Turnover Ratio (DTR) is given as:

$$DTR = \frac{\text{Credit Revenue from Operations (Credit Sales)}}{\text{Average Trade Receivables(Average debtors + Average bills receivable)}}$$

It is expressed in Times

Note 1: Note: provision for doubtful debts is not to be deducted from sundry debtors.

Credit Revenue from Operations (Net Credit Sales) = Credit Sales – Sales Return

Or

= Revenue from Operations – Cash Revenue from Operations

Average Trade Receivables = (Opening Trade Receivables + Closing Trade Receivables)/2

Average Trade Rec. = (Opening Debtors + Closing Debtors + Opening B/R + Closing B/R)/2

Example: Consider the following information:

Closing Trade Receivables 8,00,000

Cash Sales being 25% of Credit Sales

Excess of Closing Trade Receivables over Opening Trade Receivables 4,00,000;

Revenue from Operations or Net Sales 30,00,000.

Calculate Trade Receivables Turnover Ratio from the above information.

Answer:

Let Credit Sales be	$= x$
Cash Sales	=25% of Credit Sale
	$=x\times25/100$
Cash Sales	$=25x/100$
Total Sales	= Cash Sales + Credit Sales
30,00,000	$=25x/100+x$
Or, 125x/100	=30,00,000
Or, x	$=30,00,000\times100/125=24,00,000$
Opening Trade Receivables	= Closing Trade Receivables − 4,00,000
	= 8,00,000 − 4,00,000 = 4,00,000
Average receivables	= Opening Receivables +Closing Receivables/2
Average receivables	= (4,00,000+8,00,000)/2=6,00,000
	=Net Credit Sales/Average Trade Receivables
Trade Receivables Turnover Ratio	=24,00,000/6,00,000
	=4

Therefore, Trades Receivable Turnover Ratio is 4 Times

Debt Collection Period: It shows the average time taken in collection of cash from debtors.

$$\text{Debt Collection Period} = \frac{365 \text{ Days/ 12 months}}{\text{Trade Receivables Turnover Ratio}}$$

Lower Debt Collection Period is better. It is expressed in number of days or months.

Trade Payables Turnover Ratio:

a. It explains the relationship between the net credit purchases and trade payables
b. It indicates the number of times the trade payables are turned over as compared to credit purchases.
c. A high ratio implies that the enterprise has high credit worthiness among creditors and high bargaining power with suppliers\
d. It is expressed in Times.

$$\text{Trade Payables Turnover Ratio} = \frac{\text{Net Credit Purchases}}{\text{Average Trade Payables}}$$

$$\text{Average Trade Payables} = \frac{(\text{Opening Trade Payables} + \text{Closing Trade Payables})}{2}$$

Or

Average Trade Payables = (Opening Creditors + Closing Creditors + Opening B/P + Closing B/P) ÷ 2

Average Payment Period or Average Age of Payables:

It shows the credit period enjoyed by the enterprise in paying creditors.

$$\text{Average Payment Period} = \frac{\text{Average Trade Payables}}{\text{Net Credit Purchases}} \times \text{Number of Months/Days}$$

or

$$\frac{\text{Months or Days in a Year (12/365)}}{\text{Trade Payables Turnover Ratio}}$$

Example: Consider the following information:

Opening Creditors 1,25,000

Opening Bills Payable 10,000

Closing Creditors 90,000

Closing bills Payable 5,000

Purchases 9,50,000

Cash Purchases 1,00,000

Purchases Return 45,000.

Determine the Trade payables Turnover Ratio from the above information.

Solution:

Net Credit Purchases = Purchases – Cash Purchases – Purchase Return

= 19,00,000 -2,00,000-90,000 = 16,10,000

Average Trade Payables = (Opening Creditors & Bills payables + Closing Creditors & Bills payables) / 2

= 2,50,000 + 20,000 + 1,80,000 + 10,000/2

= 2,30,000

Trade Payables turnover ratio = 16,10,000/2,30,000 = 7 times

Example: Closing Trade Payables 10,80,000, Net purchases `86,40,000, Cash purchases `21,60,000. Calculate Trade Payables Turnover Ratio

Solution: Trade payable turnover ratio= credit purchases/ average trade payable

Trade payable turnover ratio =64,80,000 / 10,80,000= 6 Times
Credit purchases= net purchases - cash purchases
64,80,000 = 86,40,000- 21,60,000

Working Capital Turnover ratio:

a. It explains the relationship between working capital and net sales.
b. It shows the number of times a unit of rupee invested in working capital generates sales.
c. It determines whether working capital is effectively used in generating sales.
d. A higher ratio implies overtrading with less use of current assets.

$$\text{Working Capital Turnover Ratio} = \frac{\text{Revenue from Operations/COGS}}{\text{Working Capital}}$$

It is expressed in number of times.

Revenue from Operations:

It is the revenue earned by the company from its Operating Activities.
If Revenue from Operations is not given, then take Cost of Goods Sold.
Working Capital: = Current Assets – Current Liabilities

Consider the following information:
Cost of Revenue from Operations (Cost of Goods Sold) 10,00,000

Current Assets 500,000

Current Liabilities 3,00,000
Determine Working Capital Turnover Ratio from the above information:
Solution:

Working Capital = Current Assets - Current Liabilities

= 5,00,000 - 3,00,000

= 2,00,000

Therefore,

Working Capital Turnover ratio = Cost of Revenue from Operations(or Cost of goods sold)/ Working Capital

= 10,00,000/2,00,000

= 5 times

Example: Consider the following financial information:

Cash Sales 10,00,000

Credit Sales 12,00,000

Sales Return 2,00,000. Current Assets 6,00,000;

Current Liabilities 2,00,000.

Determine Working Capital Turnover Ratio from the above information.

Solution:

Net Sales = Cash Sales + Credit Sales − Sales Returns

= 10,00,000 + 12,00,000 − 2,00,000 = 20,00,000

Working Capital= Current Assets - Current Liabilities

Working Capital Turnover= Net sales/ Working Capital

=20,00,000/4,00,000

= 5 Times

8.13 PROFITABILITY RATIOS

Gross Profit Ratio: It shows the relationship between the Gross Profit and Revenue from Operations (Net Sales). It shows the average gross margin on goods sold or the services rendered in the ordinary course of business. It indicates the efficiency with which production and/or purchase operations and selling operations are carried on. It is used fixing selling prices and determining the efficiency of trading activities.

Gross Profit Ratio= Gross Profit x 100

Revenue from Operations

It is expressed as percentage percentage of net sales.

Gross Profit: It is calculated as follows:

Gross Profit = Revenue from Operations (i.e. Net Sales)– Cost of Revenue from Operations (COGS)

Cost of Revenue from Operations: It is calculated using the following:

Cost of Revenue from Operations = Opening Inventory (excl. Spare parts & loose tools) + Net Purchases + Direct Expenses – Closing Inventory (excl. Spare parts & loose tools)

Or

= Cost of Materials Consumed+ Purchases of Stock-in-Trade+ Change in Inventories of FG, WIP & SIT + Direct Expenses

Or

Revenue from Operations-Gross Profit

Reasons for decline or increase in Gross Profit Ratio:

Increase: This ratio increases because of the following reasons:

a. If the selling price increases and the cost of revenue from operations is constant.
b. If the Cost of revenue from operations decreases and the selling price is constant.
c. If there exists a combination of above two situations.

Decrease: This ratio decreases if the above reasons are reversed.

Operating profit Ratio: It shows the relationship between Operating Costs incurred in running the business and realted Sales.It is the proportion of Cost of Revenue from Operations and Operating Expenses to Sales. It helps in determining the operational efficiency of the business. It is expressed as the percentage of Sales or Revenue from Operations that is utilized in the Operating costs.

A low operating ratio indicates higher profit margin to meet non-operating expenses such as dividend, etc. On the other hand, a high operating ratio indicates reduction in the efficiency of business operations.It is expressed as percentage of sales or revenue from operations.

$$\text{Operating Ratio} = \frac{\text{Operating Cost}}{\text{Revenue from Operations (Net Sales)}} \times 100$$

$$\text{Operating profit Ratio} = \frac{\text{Operating profit}}{\text{Revenue from Operations (Net Sales)}} \times 100$$

Operating Profit = Gross Profit + Other Operating Income-Other Operating Expenses

Or

Operating Profit = Net Profit Before Tax + (Non-operating Expense/Losses) -(Non-Operating Incomes)

Or

Operating Profit = Revenue from Operations -Operating Cost

Relationship between Operating Profit and Operating Ratio

Operating Ratio + Operating Profit Ratio = 100%

Net Profit Ratio: It shows the relationship between Net Profit and Revenue from Operations i.e., Net Sales. It helps in determining the operating efficiency of the business operations. It indicates the actual earning performance of business activities.

A higher Net Profit Ratio indicates higher profitability. An increase in the ratio over the past period shows improvement in the operational efficiency. It is expressed in percentage.

Net Profit Ratio = Net Profit After Tax X 100
Revenue from Operations i.e. Net Sales

Net Profit = Revenue from Operations or Net sales – Cost of Revenue from Operations – Operating Expenses – Non-Operating Expenses + Non-Operating Income – Tax.

Return on Investment or Capital Employed: It shows the relationship between Net Profit/Earnings before interest and tax with capital employed. It measures the efficiency with which the resources are being used. It is a measure of the profitability for comparison with the other businesses in the same industry. It assesses the overall performance based on the total long term fund employed in the business. It is expressed as percentage of capital employed.

ROI = Net Profit before Interest, Tax and Dividend X 100
Capital Employed

Computation of Capital Employed: It can be computed through following two approaches:

1. **Liabilities Approach:** Under this approach, Capital employed is calculated by adding the following:

i. Shareholders Funds/Equity (Share Capital + Reserves and Surplus) and
ii. Non-current Liabilities (Long-term Borrowings (debenture, public deposits) + Long-term Provisions + Deferred Tax Liabilities + Other Non Current Liabilities)

Capital employed = Share Capital + Reserves and Surplus + Long-term Borrowings + Long-term Provisions + Deferred Tax Liabilities + Other Non Current Liabilities

Note: if balance of surplus in Statement of profit and loss is negative, it is deducted to calculate Shareholders' funds.

2. **Assets Approach:** Under this approach, Capital employed is calculated adding the following:

iii. Non-current Assets (Fixed Assets (Tangible & Non-Tangible) + Deferred Tax Asset + Non-current Trade Investments + Long-term Loans and Advances +Other Non Current Asset)

iv. Working Capital (Current Assets – Current Liabilities)

Capital employed = Non-current Assets+ Current Assets – Current Liabilities

8.14 SUMMARY

Accounting Ratio Analysis: It is concerned with studying relationship among various financial variables in a business with the help of accounting ratios. It is a mechanism of determining and interpreting relationships between financial variables given in the financial statements to obtain an understanding of the financial performance and position of a business enterprise.

Ratio: It is a mathematical expression of relationship between two interdependent quantities which can be financial items or variables in the financial statements or two accounting figures.

Accounting Ratio: It is a ratio which is calculated on the basis of accounting information given in the financial statements, balance sheet, profit and loss account such as profit, sales, assets, liabilities, debtors, creditors, etc

Forms of Expressing Accounting Ratios:

- Pure
- Percentage
- Times

Advantages of Ratio Analysis:

- Tool for analysis of Financial Statements
- Simplifies Accounting Data
- Assessment of Operating Efficiency of Business
- Assists in Forecasting
- Identifies Weak Areas
- Facilitates Inter-firm and Intra-firm Comparison

Limitations of Ratio Analysis:

- Reliability of Ratios
- Only Quantitative Factors considered
- No Standard Ratio
- Non Comparable
- Price Level Changes Ignored

- Window Dressing
- Personal Bias

Types of Ratios:

1. Liquidity (short-term solvency): show the ability of the enterprise to meet its short-term financial obligations. It includes:

i. Current Ratio
ii. Quick Ratio

2. Solvency (long-term solvency): assess the long-term financial position of the enterprise. They assess the ability to meet the long-term financial obligations of the enterprise. It includes:

i. Debt to Equity Ratio
ii. Total Assets to Debt Ratio
iii. Proprietary Ratio
iv. Interest Coverage Ratio

3. Activity/Turnover: shows how efficiently the enterprise resourcesare being used for the business operations. It includes:

i. Inventory Turnover Ratio
ii. Trade Receivables Turnover Ratio
iii. Trade Payables Turnover Ratio
iv. Working Capital Turnover Ratio

4. Profitability: show the profitability of the enterprise. It includes:

i. Gross Profit Ratio
ii. Operating Ratio
iii. Operating Profit Ratio
iv. Net Profit Ratio
v. Return on Investment

8.15 GLOSSARY

Capital: It is amount of resources invested by the owners into the business organisation either in the form of cash or cash equivalents or in kind or assets. The amount can be invested in the form of cash, goods, or any other asset. For Business Entity, capital is a liability towards the owners which is to be settled only in the event of closure or transfer of the business. In case of corporates it is called as share capital.

Drawings: It represents an amount of cash, goods or any other assets which the owner withdraws from business for personal use. e.g. if the life insurance premium of proprietor is paid from the business bank account, goods withdrawn for personal use. It will result in reduction in the owners' capital.

Asset: Asset is a resource controlled by the business entity from which probable future

economic assets will flow to the entity by using it for generating future profits. Assets can be Tangible and Intangible.

Tangible Assets: are the assets which have some physical existence. They can be seen, touched and felt such as:

- Plant and Machinery
- Furniture and Fittings
- Land and Building
- Books and periodicals
- Computers and laptops
- Vehicles

Intangible assets: Assets which have no physical existence (cannot be seen or felt although they help to generate revenue in future) and whose value is determined and restricted by the rights and expected future benefits that their possession confers upon the owner such as

- Goodwill
- Patents
- Trade-marks
- Copyrights
- Brand equity
- Industrial designs
- Other intellectual property rights, etc.

Assets can also be classified into Current Assets and Non-Current Assets.

Current Assets – Asset which satisfies any of the following :

e. It is expected to be realised in, or is intended for sale or consumption in the company's normal operating cycle,

f. It is held primarily for the purpose of being traded ,

g. It is due to be realised within 12 months after the reporting date, or

h. It is cash or cash Equivalent unless it is restricted from being exchanged or used to settle a liability for at least 12 months after the reporting date.

Current Asset includes:

- Inventory
- Trade recievables (sundry debtors and bill recievables)
- Prepaid expenses
- Current investments
- Cash and cash equivalents
- Short term loans and advances

Non-Current Assets – All other assets which are not classified as current assets are non-current assets such as:

- Plant and Machinery

- Furniture and Fittings
- Land and Building
- Patent
- Trade-mark
- Copyright

Non-Current Liabilities – All other liabilities not classified as current liabilities shall be classified as Non-current liabilities such as:

- Debentures
- Public deposits
- Long term bank loan
- Inter corporate loans
- Long term loan from director

Internal Liability: It refers to owner's equity, i.e. all the amounts which proprietors are entitled such as:

- Capital
- General reserve
- Deneture redemption reserve
- Undistributed profits, etc.

Working capital: The assets which are held to maintain the flows of revenue from operation in the form of current assets such as:

- Cash required to pay for expenses or to the creditors
- Inventories required to smoothen production and sale
- Accounts receivables (debtors and bills receivable) to increase the sales .
- Cash at bank
- Prepaid expenses

The total of current assets constitute the working capital of a firm which is termed as Gross working capital.

Gross working capital = Total current assets = long term internal liabilities + long term debts + the current liabilities – Non current assets.

Net working capital is the excess of current assets over current liabilities. It is the amount of current assets that remain in a firm if all its current liabilities are paid. This aspect of working capital is a more realistic concept.

Working capital (net) = Current assets – Currents liabilities.

8.16 SELF-ASSESSMENT QUESTIONS

1. Explain the concept of Ratio and ratio Analysis
2. What are the Objectives of Ratio Analysis.

3. What is the significance of ratio Analysis
4. Discuss the various types of Lquidity and Short term Solvency ratios
5. Write a Short Note on Debt Equity ratio, Creditors's turnover Ratio and inventory turnover ratio.
6. Consider the following information of ABC ltd:

Particulars	**Amount (in Rs)**
Revenue from Operation	20,00,000
Sales Return	2,00,000
Gross Profit	3,60,000
Closing Stock	4,00,000
Excess of Closing Inventory over Opening Inventory	80,000

Calculate Inventory Turnover Ratio from the above information
7. From the following information, calculate Revenue from operation:
Quick Ratio 2,
Current Ratio 3
Total Current Assets 40,00,000
Inventory Turnover Ratio 6 Times.
Goods are sold on 25% Profit on Sales

8. Consider the following information:
Fixed Assets: 1,50,00,000
Current Assets: 80,00,000
Current Liabilities: 54,00,000
14% Debentures: 1,60,00,000
Net Profit before Interest, Tax and Dividend: 29,00,000.
From above information, calculate:
(a) Return on Investment and
(b) Total Assets to Debt Ratio
9. From the following information, calculate Return on Investment (or Return on Capital Employed):

Particulars	**Amount**
Share Capital	10,00,000
Reserves and Surplus	5,00,000
Property Plant and Equipment	45,00,000
Long term Investments in shares	5,00,000
Current Assets	22,00,000
16% Long-term Borrowings	40,00,000
Current Liabilities	17,00,000

8.17 SUGGESTED READINGS

Latest editions of the following text books to be used:

1. Narayanaswamy R. Financial Accounting: A Managerial Perspective. PHI Learning Pvt. Ltd., Delhi
2. Robert N. Anthony, David F. Hawkins, Kenneth A. Merchant. Accountancy-text and cases. McGraw Hill Education (India) Private Limited, New Delhi.
3. Garg CA Kamal, and Sehrawat Neeraj Kumar. Beginner`s Guide to Ind AS & IFRS. Bharat Law House Pvt. Ltd., New Delhi
4. Maheshwari S. N., Maheshwari Sunil K., and Maheshwari Sharad K, An Introduction to Accountancy, Vikas Publishing House Pvt. Ltd.

LESSON 9

PREDICTING FINANCIAL DISTRESS, EARNINGS MANAGEMENT AND BEYOND BALANCE SHEET ANALYSIS

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STRUCTURE

9.1 LEARNING OBJECTIVES

After reading this chapter, readers will be able to understand:

- Altman's Z-Score Model in predicting Financial distress
- LC Gupta Model in predicting corporate failure.
- How to manage Earnings.

- Approaches to manage Earnings.
- How to analyse the Finacial position using beyond Balance Sheet Analysis.

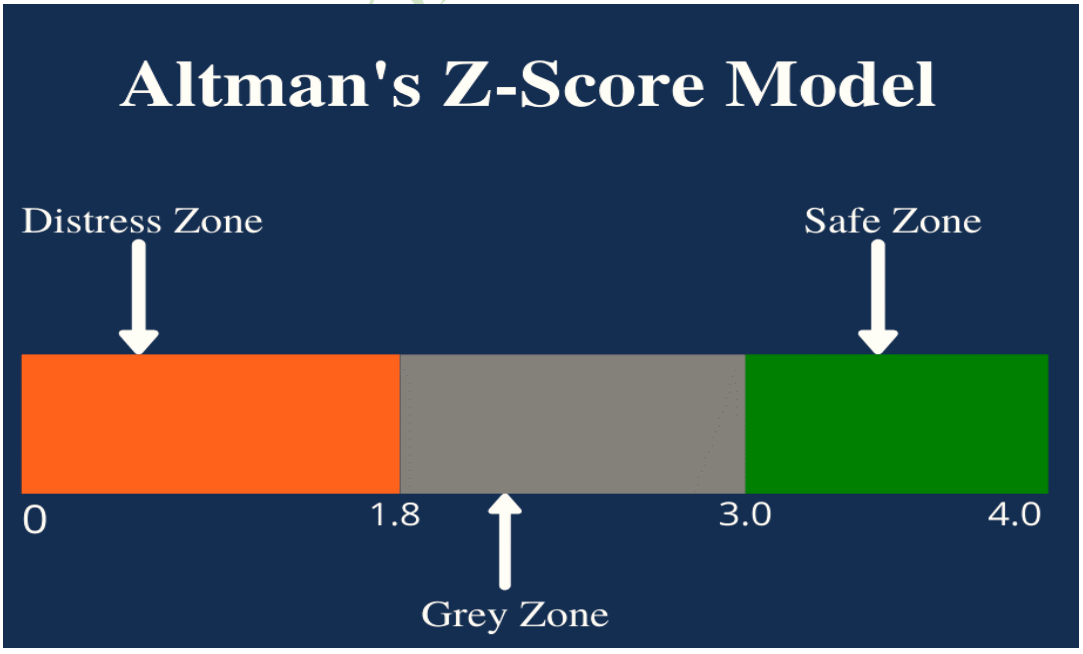
9.2 INTRODUCTION

Insolvency refers to a situation where a person or entity is unable to discharge or pay the debts it owes to others because Assets owned are less than liabilities.

Legal declaration of insolvency by the court of law is known as **Bankruptcy**. Once the bankruptcy is declared efforts are made in the form of compromise, arrangement, negotiations among the creditors, lenders and shareholders, etc to revive and rehabilitate the entity, the process of negotiations, arrangements and compromises is known as **Insolvency Resolution**. If Insolvency is not resolved then the entity have to go for liquidation which involves realisation, sale or disposal of assets, payment to creditors and lenders, distribution of surplus(which occurs rarely in insolvency cases) among the shareholders.

9.3 ALTMAN'S Z-SCORE MODEL

Altman's Z-Score model provides a mechanism for numeric measurement to predict the chances of a Bankruptcy (situation when an enitity is declared insolvent by court of law) of a business enterprise in the coming next two yearsfrom the date of assessment. The model was given by Edward Altman, an American finance professor in 1968 to measure of the long term solvency or financial stability of companies.



Source: https://corporatefinanceinstitute.com/resources/knowledge/credit/altmans-z-score-model/

Altman's Z-score model helps to predict situation financial distress of a business enterprise by analysing various items of Balance sheet and Income statement. Altman start developing the model during Great Depression, when there was sudden increase in the number of businesses going bankrupt.

The Z-score model predicts the probability that a particular business enterprise would collapse in the next two years from the date of assessment of Z-score. The model have a good track record of accurately predicting bankruptcy in many cases with accuracy of 72% in predicting bankruptcy two years prior to its occurrence, and it provide a false positive opinion of 6%.

Altman used a weighted average of various financial ratios to predict the chances of a business enterprise going bankrupt.

Altman developed three different Z-scores for different categories of business enterprises. The original model came in 1968, specifically designed for public manufacturing companies with assets of above $1 million.

In 1983, he developed two other models Model A and Model B for smaller private manufacturing companies.

Model A Z-score was developed specifically for private manufacturing companies.

Model B was created for non-publicly traded companies.

The Z-score model is based on the weighted average of following five financial ratios:

i. Working Capital/Total Assets ratio
ii. Retained Earnings/Total Assets ratio
iii. Earnings Before Interest and Tax/Total Assets ratio
iv. Market Value of Equity/Total Liabilities ratio
v. Total Sales/Total Assets ratio

The model uses information given in the 10-K report the increase the model's accuracy to measure the financial health of a company and probability of its bankruptcy.

The Altman's Z-score can be expressed in the form of a linear equation which is as follows:

$\zeta = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E$

Where:

Zeta (ζ) is the Altman's Z-score
A is the Working Capital/Total Assets ratio

B is the Retained Earnings/Total Assets ratio
C is the Earnings Before Interest and Tax/Total Assets ratio
D is the Market Value of Equity/Total Liabilities ratio
E is the Total Sales/Total Assets ratio

What Z-Scores Mean?

The Z-Score can be interpreted in terms of its numeric value. Different ranges of Z-Scores indicates different risk levels of bankruptcy which is discussed as below:

a) **Z-score < 1.8:** If the Z-score is low, then it indicates higher chances of a company going for bankruptcy. A Z-score lower than 1.8 implies that the company is in deep financial distress and there exists higher chances of company going bankrupt.
b) **Z-score ≥1.8 and <3:** A score of between 1.8 and 3 implies that the company is in a grey area and face a moderate risk of filing for bankruptcy. In other words, there is no immediate problem or danger to face inability to meet long term debt obligations.
c) **Z-score ≥3:** A Z-score of 3 and above implies that the company is in a safer zone and there are very less chances to file for bankruptcy.

Altman's Z-score is used by investors to decide whether to buy or sell a company's stock, depending on the financial strength. If thers is a company with a Z-score near to 3, investors will be purchasing the company's stock because there is very less risk of the company going bankrupt in the coming two years.

If a company shows a Z-score closer to 1.8, the investors will sell the company's stock to avoid losing their investments because such a lower score implies a high probability of going bankrupt.

The Five Financial Ratios in Z-Score

The following are the key financial ratios that make up the Z-score model:

1. Working Capital/Total Assets

Working capital is the difference between the current assets and current liabilities or it is the excess of current assets over current liabilities. Working capital determines short-term solvency of an entity. A positive working capital implies that a company can meet its short-term financial obligations. While negative working capital means that a company will face difficulty to meet its short-term financial obligations.

2. Retained Earnings/Total Assets

This ratio indicates the amount of retained earnings or losses in an entity. A low retained earnings to total assets ratio implies that it is financing its expenditure using borrowed funds rather than from its own retained earnings. It increases the probability of a company going

bankrupt, while a higher retained earnings to total assets ratio implies that a company uses its retained earnings to finance its capital expenditure. It shows that the company has achieved profitability over the years, and it does not need to rely on borrowings.

3. Earnings Before Interest and Tax/Total Assets

EBIT is a measure of profitability and ability of a company to generate profits solely from its business operations. The EBIT/Total Assets ratio indicates an entity's ability to generate enough revenues to stay profitable and provide finance for ongoing operations and repay its debts on time.

4. Market Value of Equity/Total Liabilities

The market value also known as market capitalization, is the value of a company's equity. It indicates the worth of total equity shares held by the shareholders. It is calculated by multiplying the number of outstanding shares by the current price of stocks.

Market value = Total no. of Equity Shares x Current Market Price per share

The market value of the equity/total liabilities ratio indicates the degree to which a company's market value would decline when it goes bankrupt before the value of liabilities exceeds the value of assets on the balance sheet. A high market value of equity to total liabilities ratio implies high investor confidence in the company's financial strength.

5. Sales/Total Assets

The sales to total assets ratio shows how efficiently and optimaly the management uses assets to generate revenues as compared to the competitors in the industry. A high sales to total assets ratio is translated to mean that the management uses a small investment to generate high sales, thereby increasing the overall profitability and return on investment.

A lower sales to total assets ratio means that the management is using more resources to generate enough sales, reducing the profitability and return on investment.

9.4 L.C. GUPTA MODEL OF FINANCIAL DISTRESS

L.C. Gupta Model also helps in determining Financial Distress. The model examine survival strength of the company. This model is evolved after a study based on Indian data and it attempt to distinguish sick and non-sick companies on the basis of financial ratios.

A sample of 41 cotton textile companies (20 sick and 21 non-sick) and 39 non-textile companies (18 sick and 21 non-sick) was taken and both type of companies were evaluated and compared on the basis of product manufactured, age and size measured in terms of paid-

up capital, assets and sales for the period of 1962-1974. This model compute 56 financial ratios for making the prediction of distress.

METHODOLOGY OF LC GUPTA MODEL

- Take a sample of Sick and Non-Sick companies.
- Arrange them in the ascending or descending order by the value of the ratios.
- Select a cut-off point dviding the array into two classes with a minimum possible number of misclassifications.
- Calculate the percentage of classification error.
- The ratio which have the least "percentage classification error" at the earliest possible time is considered to have the highest predictive power.

The model suggested a combination of the following four major ratios in order to minimize the classification error rate:

X1 = $\boldsymbol{EBDIT/Sales}$
X2 = $\boldsymbol{Operating\ Cash\ Flow/\ Sales}$
X3 = $\boldsymbol{EBDIT/\ Total\ Asset}$
X4 = $\boldsymbol{EBDIT\ /Interest+0.25\ Debt}$

OBSERVATIONS FROM LC GUPTA MODEL

- The net worth ratio are the worst predictor of bankruptcy among profitability ratios.
- Among balance sheet ratios, the solvency ratios are more reliable indicators of strength than any liquidity ratios.
- Companies with an inadequate equity base are more prone to bankruptcy.

9.5 EARNINGS MANAGEMENT

Earnings management is a practice used by the management to modify the earnings reported in financial statements to present an excessively positive view of a company's financial positions, inflating earnings. It is done to achieve a set target and is different from managing the business operations.

Earnings management is used to flatten out variations in earnings and report profits that are consistent each quarter or year. Variations in earnings may create doubts among investors, as they prefer to invest in stocks of companies that show growth and stability.

The share price of a company usually fluatuates upon the announcement whether the company meets or fails to meet earnings forecasts. The management tries to change accounting practices an policicies to meet the earnings estimates and move share prices up.

9.6 EARNINGS MANAGEMENT APPROACHES

Most common strategies used by companies for earnings management are as follows:

1. Earnings-focused decisions

Decisions taken by the management are primarily focused on achieving earnings estimates. The easiest way is to control and cut the company's operating expenses on certain activities such as research, advertising, or staff training can be suspended temporarily with the premise that the business will perform better in the upcoming periods, and the suspended activities can be resumed later.

However, for companies that are performing well in terms of sales and net earnings, the management focuses on the long-term success and does not usually resort to artificially enhancing the earnings.

2. Biased accounting judgments

Management needs to exercise prudent judgments while applying accrual accounting. There exist many formal policies, accounting manuals, and processes used by well-performing companies to ensure that the judgments are not biased. But accrual system of accounting provides room for earnings management as management can distorts judgments and mends policies to meet expected earnings.

3. Altering accounting standards and policies, principles

Accounting Standard Boards in every country frame and provide accounting standards that prescribe the different and standardised generally accepted accounting rules for the specific accounting matters. But some accounting standards allow different accounting policies for same transaction. For example, value of closing inventory and fixed asset can be determined in different but acceptable ways.

The management of big and successful corporates selectes the accounting policies that best reflects financial position and performance in true and fair manner. Earnings management happens when a company's management selects an alternative of a certain accounting standard, which will cause the earnings number to meet the expectations.

9.7 IDENTIFYING EARNINGS MANAGEMENT

Chartered Professional Accountant (CPA) companies and the Securities and Exchange Commission (SEC) revelations uncover various types of earnings management used by companies.

Investors should perform due diligence before investing in the stocks of any company. Some investors analyze a company's financial reports and can identify earnings management.

Listed below are the signs that an investor needs to look for to determine if a company is exercising earnings management to manipulate its financials:

1. The company claims an increase in revenue without a corresponding increase in cash flows.
2. The company reports an increase in earnings only in the final quarter of the fiscal year.
3. The fixed assets of the company are expanding beyond the normal standard for the industry or company.
4. The net worth of an asset is inflated by ignoring the use of the true depreciation schedule.

9.8 USE OF BEYOND THE BALANCE SHEET INDICATORS TO DETERMINE THE FINANCIAL POSITION OF AN ENTITY.

There is no single financial statement that evaluates and shows all of the quantitative and qualitative information with respect to financial position. Therefore, there is need to go beyond the balance sheet.

Balance sheet provide information relating to financial position, however it is just a basic "snapshot" of a company's financial position on a particular point in time and reflects the resource structure or capital structure showing sources of finance into liabilities and equity and application of funds in the form of assets.

The Quality of system of financial reporting and the transparency of the financial statements should also be considered in evaluating a company. Management and external auditors, with appropriate oversight from audit committees, continue to improve financial reporting and communication process so as to ensure better understanding of the assumptions used in establishing significant accounting estimates and determining values.

Many qualitative and quantitative factors that influence a company's financial position are not from financial statements which are as follows:

1. Degree of liquidity**:** Whether the company have enough cash, other liquid assets, or credit to pay its short term financial obligations on time. Whether the capital structure matches with the asset structure.
2. Nature of the business
3. Inherent risks
4. Aaccounting principles and methods
5. Judgments in the selection and method of application of accounting principles
6. Application of historical cost or fair value measurement methods.
7. The estimates and assumptions in the preparation and presentation of financial statements.
8. The possible impairment of Fixed assets.

Liquidity

Liquid assets are cash and other assets that can be easily converted to cash; liquidity is the extent to which an entity can produce cash to meet its obligations.

A high level of liquid assets is an indicator of financial flexibility, it comes at a price: cash and cashequivalent assets often produce the lowest returns. Consequently, an entity with a large cash balance may be less profitable than a similar company that has all of its assets invested in profitable business activities.

The nature of the business

The nature of a company's business and the inherent risks depends on many factors, such as the size of the company, stage of product life cycle, the geographic areas where the firm is operating, competitive landscape, risk management policies and realted strategies, business model. The nature of a company's business influences the accounting methods.

The accounting policies and management's discussion summarizes accounting methods and assumptions.

Proximity of book values to economic fair values

The quality of the fair value estimates depends upon the reasonableness of the assumptions used and the quality of the experts and the models on which the estimates are based. Valuations done as per active market are more reliable than private valuation based on models.

There are many assets and liabilities that are valued based on historical costs differing significantly from fair values. For example land, whose value has been increased since the time of its purchase.

In determining financial position, any changes in fair value should be considered.Considerable attention should be given to fair value accounting. For example goodwill and other intangibles and the useful lives should be reassessed to match with fair values.

Estimates and assumptions

There are areas of judgment that require management to make and record estimates in their financial statements. Among these areas are estimates of pension, health care, and post-retirement medical assets and liabilities. Judgment is also involved in determining allowances and reserves for a variety of items, including the collectability of receivables and loans; the utility, value, or obsolescence of inventory; the realization of deferred tax assets; and environmental, plant closing, warranty, and self-insurance reserves. These assets and liabilities are subject to estimates of recoverability or valuation, and it is important to understand the quality of the underlying estimates and the assumptions used in developing them. It is also important to understand the portion of the estimates that is based on management's assumptions. The use of third-party specialists can improve the quality of estimates and assumptions, especially in the areas of pension and benefit plan valuations, derivatives valuations, and litigation and environmental reserves.

Some areas require more judgment than others; for example, pension accounting relies on the assumptions of management and plan actuaries. Companies sponsor pension plans and incur pension obligations—the assumed future obligation to retired employees. In the long term, pension plan assets and investment returns reduce those liabilities. In the short term, if the fund's returns are projected to exceed the expected liability and associated costs, the company's pension contribution can be reduced, which can boost earnings. The higher the expected rate of return the lower the company's pension expense, resulting in greater earnings.

The assumptions underlying the estimates should be monitored from period to period and should also be reviewed against estimates and assumptions used by comparable companies in the industry.

Impairment

Understanding the possibility of impairment is also key to the quality of a company's financial position. The company should have reasonable policies in place to assess an asset's impairment, if any. The assumptions used in predicting future cash flows should be reasonable and supportable. Additionally, companies should consider economic, performance, or industry trends that may call into question the recoverability of assets at their recorded values. During the past decade, many companies bought and sold assets which resulted in values largely accounted for as "intangible" or "goodwill"; recently, many of these values have been written down through impairment losses as a result of subsequent declines in the values associated with these transactions.

Off-balance-sheet arrangements

An understanding of off-balance-sheet financing is helpful in assessing a company's financial position. These arrangements may include special-purpose entities, leasing transactions, debt guarantees, co-borrowing arrangements, securitizations, and other contingent obligations that may not require recognition on the balance sheet. An analysis of financial position should encompass factors that are likely to affect the company's ability to continue using those off-balancesheet financing arrangements. In addition, arrangements should be analyzed for their business purposes and activities, their economic substance, the key terms and conditions of any commitments, the initial and ongoing relationships with the company and its affiliates, and the potential risk resulting from the company's contractual commitments related to the arrangement.

The risk associated with special-purpose entities (SPEs) has been highlighted by recent accounting failures. An SPE is typically created for a single purpose, such as to serve as the lessor in a leasing transaction, to acquire or construct operating assets while keeping the assets and related debt off the balance sheet, or to act as a counterparty to a financial instrument contract. If undertaken for valid business reasons and accounted for properly, SPEs can be beneficial to a company, such as a securitization SPE for mutual funds. It is important to understand the business reason for undertaking these types of transactions, as well as the structure of the arrangement, because companies may employ structured-finance transactions to specifically avoid debt on the balance sheet.

Companies often guarantee the debt associated with these off-balance-sheet entities, creating the potential for additional liabilities that are not reflected on the balance sheet. Consequently, an assessment of a company's debt position should consider this debt in the complete aggregation of the company's obligations. As a result, appropriate disclosure takes on greater importance to the readers of financial statements.

Management and audit committees should also be aware of commitments, contingencies and uncertainties that are known, but are not required to be recognized in the balance sheet. For example, commitments such as operating leases may be significant, but are not obligations recorded in the balance sheet. Other examples are tobacco companies or companies that use asbestos in their products, which are likely to have much higher litigation risk than most businesses, or a company that has used hazardous materials in its production process, which may have environmental risks related to a closed plant. Although accounting rules state that contingencies should be recorded only when the loss is probable and estimable, it is important to consider the adequacy of the disclosures as well as consistent monitoring of these risks to identify losses that would need to be recorded in the near future.

In addition to the off-balance-sheet liabilities discussed previously, items should also be considered such as

- trained employees
- loyal customers

- popular brand names
- fully depreciated plant and equipment
- intellectual property rights such as trademarks, brand names, patents.
- research and development
- employee know-how
- collaborations with suppliers and distributors.

Internal controls

Controls should be pervasive throughout an organization.

CEOs and CFOs to now required to certify that they have responsibility for establishing and maintaining internal controls. Control includes

- knowledge of the accounting staff
- internal accounting function
- corporate risk officers,
- working computer systems
- external audits and reviews

Many of the account balances such as bank balances and accounts receivable can be reconciled and verified from the third parties, account balances such as inventory and fixed assets can be physically counted.

Give attention to unusual transactions such as

- sale of fixed assets outside the ordinary course of business
- mergers and acquisitions,
- unusual period-end revenues,
- launch of new period-end sales promotion programs,
- disposal of significant business segments.

Appropriate disclosure demonstrates transparency and may suggest to users of financial statements that a higher degree of control exists.

Communication between the internal audit team and the audit committee is another crucial element of control. The internal auditors act as "eyes and ears" for the audit committee in investigating areas that are of greatest concern.

Specific Questions to be considered

The following questions gives a framework to assess financial position.

General considerations

- Whether accounting principles selected in line with the industry and applicable Financial Reporting framework?
- What are significant estimates made by management?
- Whether significant accounting policies and estimates are aapropriately explained in the management's discussion and analysis, and disclosures in financial statements.
- Whether any significant assets or liabilities measured at fair value?

Related parties

Has management identified:

- ✓ all related party relationship
- ✓ related-party transactions
- ✓ special-purpose entities
- ✓ off-balance-sheet transactions

Accounts receivable:

- Whether accounts receivable increasing significantly faster than growth in revenue?
- Whether accounts receivable constitute only few significant customers?
- Whetеher significant customers experiencing financial difficulties?
- Whether seasonal factors influences the turnover of accounts receivable?
- Whether aging categories becoming older?
- Whether discount have an unfavorable impact on future sales?
- Whetеher there is major change in composition of the customers?
- Whether some customers are offered unusual payment terms?
- Whether is the reason for factoring?

Inventory: with respect to inventory, consider whether:

- Whether there is any unusual ratio between inventory and sales
- Whether carrying amounts of inventory is too high
- Whether books of accounts are adjusted after taking a physical inventory
- Whether there are reserves for inventory obsolescence, returns, and warranty claims

Fixed assets and intangibles with respect to Fixed assets and intangibles, consider:

- Whether physical counts of fixed assets are performed.
- Whether there is change in the depreciation or amortization method or useful life.
- Whether depreciation policies consistent with competitors
- Whether capital expenditures significantly differsfrom budgeted
- Whether tests were performed to detect impairment
- Whether assumptions for fair value are reasonable
- Whether disclosures adequately shows methods for calculating fair value
- Whether there is any sales or leaseback transactions

Debt covenants with respect to Debt covenants, consider:

- Whether there is any violation of debt covenants requiring disclosure and reclassification liability
- Whether additional borrowing capacity exists under debt agreements
- Whether there is any cross-default provisions
- Whether there is debt covenants relating to unspecified "material adverse changes"

Deferred taxes

- Whether there is any cumulative losses in recent years
- Whether conditions requiring valuation allowance for net deferred tax assets exists

Pensions and other post-retirement benefits

- Whether expected rate of return on pension plan is appropriate
- Whether fluctuations in asset values, changes in interest rates, increases in health care costs requires revision of the accounting estimates

Accruals and liabilities

- Whether there is any unusual trends in accruals
- Whether estimates related to warranty, environment, merger, restructuring, etc.change in the current period
- Whether all contingent liabilities been recorded

Guarantees and commitments

- Whether there is sufficient cash to meet its guarantee commitments
- Whether guarantees related to core businesses only
- Whether there is chances of exposure to credit/default risk
- Whether there exists significant purchase commitments and/or obligations?

Employee stock options

- Whether there are changes to its options plans (repricing or extending the term of options)
- Whether there is change its method of accounting for stock options

Derivatives: Consider the following questions with respect to Derivatives:

- Whether risk management policy is appropriate
- Whether derivative/hedging strategy exists and is implemented
- Whether hedging strategy is economically effecctive
- Whether risk management infrastructure is appropriate and commensurating with organisation's structure
- Whether complex derivative instruments are used

- What is the methodology for measuring derivative positions
- Whether assumptions for mark-to-market valuations are reasonable
- What is the criteria and methodology adopted for measuring counterparty credit risk

Off-balance-sheet accounting – general

Consider the following questions:

- Are assets and liabilities appropriately included in or excluded from the balance sheet Reasons of Exclusions
- Whether management reviewed transactions that may give rise to off-balance-sheet commitments and contingencies
- Were transactions deliberaltely engineered to achieve off-balancesheet treatment
- Economic or business reason for the arrangement
- Whether exposure to credit and other losses from off-balance-sheet transactions evaluated
- What factors could cause the obligation to move onto the balance sheet

Special-purpose entities

Consider the following w.r.t to SPEs:

- All structuring transactions
- Amendments to the original documents
- The nature of relationships with third parties
- Ability to control asset acquisition
- Do the voting interests in the SPE convey a controlling financial interest? •
- Does management assess party that has a relationship with an SPE?

9.11 SUMMARY

Insolvency refers to situations where a person or entity cannot pay the debts it owes to others because Assets are less than liabilities.

Bankruptcy Legal declaration of insolvency by the court of law.

9.12 SELF-ASSESSMENT QUESTIONS

1. Explain the LC Gupta model to predict Financial distress.
2. Discuss in brief Altman's Z Score to predict Bankruptcy.
3. Explain the concept of Earnings Management
4. Discuss in brief different approaches to earnings management.
5. Write a short note on beyond Balance sheet Analysis to analyse the financial position.

9.13 SUGGESTED READINGS

Latest editions of the following text books to be used:

Narayanaswamy R. Financial Accounting: A Managerial Perspective. PHI Learning Pvt. Ltd., Delhi

Robert N. Anthony, David F. Hawkins, Kenneth A. Merchant. Accountancy- text and cases. McGraw Hill Education (India) Private Limited, New Delhi.

Garg CA Kamal, and Sehrawat Neeraj Kumar. Beginner's Guide to Ind AS & IFRS. Bharat Law House Pvt. Ltd., New Delhi

Maheshwari S. N., Maheshwari Sunil K., and Maheshwari Sharad K, An Introduction to Accountancy, Vikas Publishing House Pvt. Ltd.

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DEMAND, SUPPLY AND MARKET EQUILIBRIUM

Campus of Open Learning
School of Open Learning
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LESSON 1

DEMAND, SUPPLY AND MARKET EQUILIBRIUM

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STRUCTURE

1.1 LEARNING OBJECTIVES

After studying this chapter, students will be able to:

- *Describe the nature of the demand and the supply curve.*
- *Explain the relationships between market demand and market supply and how it clears the market.*
- *Determine the equilibrium price and quantity for a product and understand how the market mechanism works.*

1.2 INTRODUCTION

Demand and supply analysis is a tool to understand the relevance of economics. It can be used to understand the impact of changing world economic conditions on market price. It is also be used to evaluate the impact of public policies, minimum wages, price supports, and subsidies, tariffs on market production.

In this chapter, we will study how demand and supply works in a market and how it reaches an equilibrium position. Further, we will understand why shortage or surplus occurs in certain markets. We will use both qualitative as well as quantitative approach to determine the equilibrium position for a particular product.

1.3 THE DEMAND CURVE

The demand curve is a graphical representation of a commodity that a consumer willing to purchase at different price levels. The demand curve slopes downward indicating that the consumer is willing to buy more when the prices are low. It therefore means that a consumer will buy larger quantities of goods when the prices are low. We write this relationship as;

$$Q_D = f(P) \qquad \ldots.(i)$$

Where quantity demand Q_D is a function of price (P). It may be noted that this negative relationship between price and quantity demanded is true only for normal goods (and not for Giffen or inferior goods). Besides price, there are other factors that also affect the consumer demand. For example, higher income gives higher purchasing capacity to the consumer and prices of substitute and complementary goods also affect the demand for a particular product. Fig. 1.1 depicts a downward sloping demand curve, showing a negative relation between price and quantity, while other things are assume to be constant.

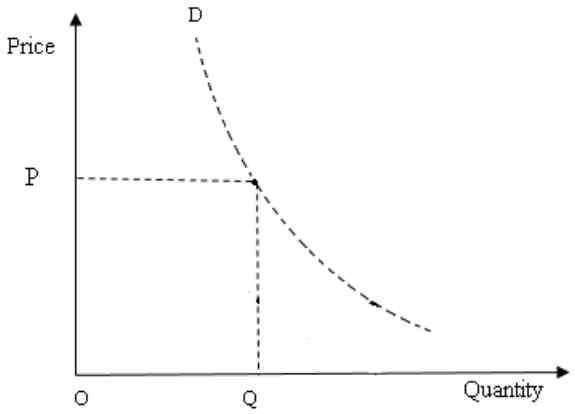

Fig 1.1: The Demand Curve

1.3.1 Individual Demand Curve:

The amount of a good that an individual is willing to buy over a specific time period depends on the price of the product, prices of other products (substitutes and complementary), the income, tastes and preferences of the person. We can determine the individual demand schedule for a commodity by varying the price of that product while keeping other things constant. We get the individual demand curve by graphically representing the individual demand schedule. Let's understand this with the help of an example.

Example 1:

The individual's demand function for commodity X is $Qd_x = 8 - P_x$ *ceteris paribus*. By substituting different prices of the commodity into this demand function, we get the individual's demand schedule (Table 1.1).

Table 1.1: Individual's Demand Schedule

Price (P_x)	Quantity (Qd_x)
0	8
1	7
2	6
3	5
4	4
5	3

6	2
7	1
8	0

Plotting each value on a graph and joining the points, we get the individual's demand curve for that commodity. The demand curve in the fig 1.2 is showing that the buyer is willing to buy one unit of the commodity when the price is 7 at a particular point of time. The demand increases to seven units when the price falls to 1. It should be noted that except for some rare cases the demand curve always slopes downward, indicating higher demand at lower price while other things remain constant. This is also called as the law of demand.

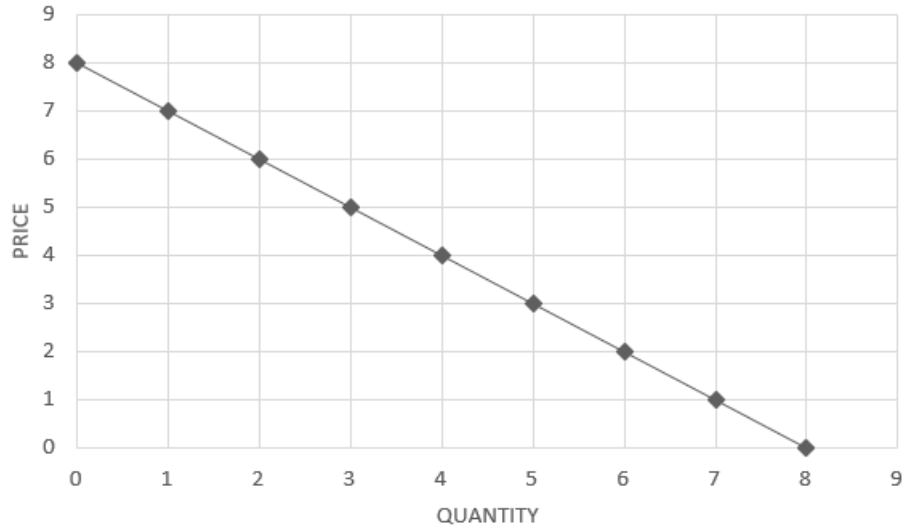

Fig 1.2: Individual's Demand Curve

1.3.2 Shifting of the Demand Curve:

In the previous section, we saw that change in price (keeping other things constant) of a commodity result in a movement along the demand curve of that commodity. In this section, we will understand what will happen to the individual demand curve for a commodity when factors other than its price change.

We know that, the demand curve shows the maximum quantities of the goods the buyer is willing to buy at various alternative prices at a particular point of time. This also means that the demand curve shows the maximum price the buyer is willing to pay in order to buy a particular unit of that good. When any of the factors other than the price changes, the entire demand curve shifts and we call this change in demand. However, when only the price of that commodity changes and other factors remains unchanged, we call this change in the quantity demanded.

In the fig. 1.3 let's assume that the income level of a buyer increases and the price remains constant at P. This will shift the demand curve to the right to D' and the quantity from Q to Q_1. This change in demand due to increase in income level works for a normal goods only (eg. Meat). There are, some goods (eg. bread and potatoes) whose demand decreases with an increase in income and demand curve usually shifts to the left due to the increase in the income of the buyer. These goods are called inferior goods.

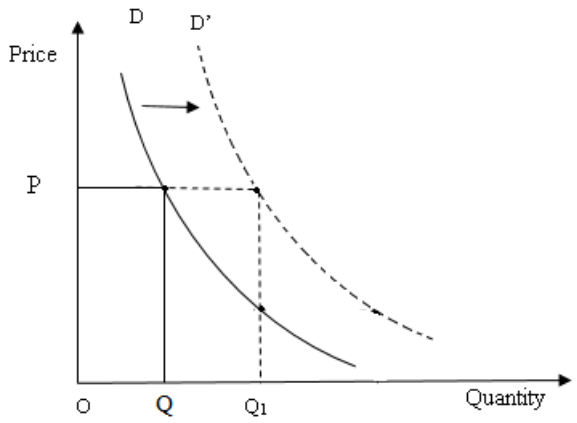

Fig 1.3: Shift in the Demand Curve

Apart from income level, other factors such as change in tastes and preferences also shift the individual's demand curve. For instance, a greater desire for consuming strawberry flavoured ice-cream would shift the demand curve for that ice-cream to the right. Similarly, a lesser desire to smoke would shift the demand curve of cigarettes to the left. Another factor that changes the demand is the price of complementary and substitute goods.

Complementary goods are goods that are consumed together. For example, bread and butter, milk and cornflakes, Shampoo and conditioner, etc. On the other hand, substitute goods are goods that are alternatives for each other i.e., tea and coffee, ghee and butter, etc. The demand curve for breads will shift to the left when the price of butter increases. Similarly, the demand curve for vegetable oil shifts to the right when the price of coconut oil increases. Several other factors may shift the demand curve for a product. For example, demand curves for Air Conditioners will shift to the right in the summer season.

1.3.3 Market Demand Curve:

The market demand is the total quantity demanded by all the individuals in a market at a particular point of time at various alternative prices. The market demand for a product depends on all the factors that determine the individual's demand and on the number of consumers in the market. Graphically, it is represented by the horizontal summation of all the individuals' demand curves for the commodity in the market.

Example 2:

Extending example 1 by assuming that there are 100 identical buyers in the market, each with the demand for X given by $Qd_x = 8 - P_x$ *ceteris paribus*. The market demand schedule is obtained by adding individual demand schedule (table 1.2) and the market demand curve is obtained by horizontal summation of individual's demand curve (fig. 1.4)

Table 1.2: Market Demand Schedule

Price (P_x)	Quantity (Qd_x)
0	800
1	700
2	600
3	500
4	400
5	300
6	200
7	100
8	0

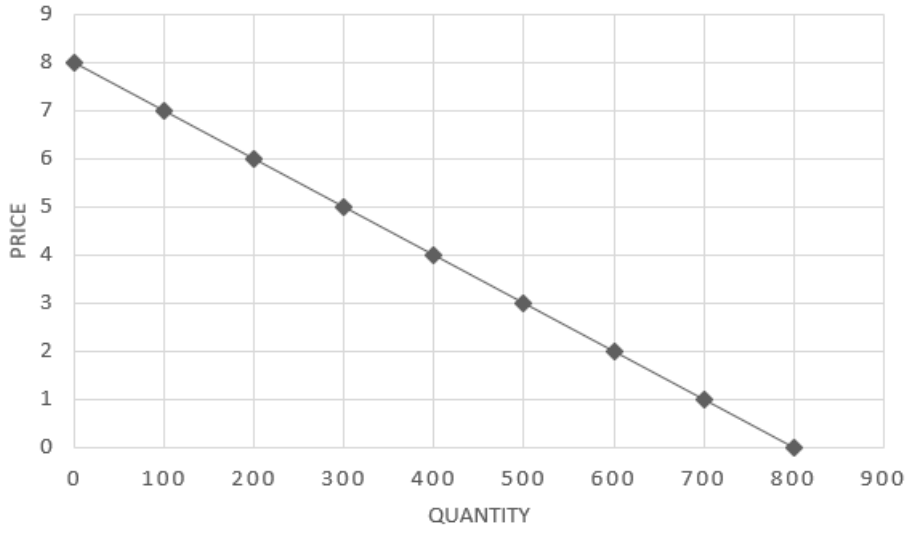

Fig 1.4: Market Demand Curve

1.4 THE SUPPLY CURVE

The supply curve shows the amount of a good that suppliers are willing to sell at a given price, keeping other factors constant. Thus, the supply curve shows a relationship between the price and quantity supplied. The relationship can be written as;

$$Q_S = f(P) \qquad \text{....(ii)}$$

Where quantity supplied Q_S is a function of price (P). Please note that the supply curve is upward sloping indicating a supplier is willing to sell higher quantity at a higher price. When the price of commodity increases, the firms increase their production by employing more raw materials and labours. This increases the cost of production. A higher price may also attract new firms to the market. They produce the commodity at a higher cost because of excess demand for raw materials and labours. Therefore, it would be unprofitable for the new firms to enter the market at a lower price.

In the fig 1.5, the vertical Y-axis shows the price of a commodity and the horizontal X-axis measures the quantity. The positively sloped supply curve is represented by S. We can see that at a higher price, the seller is willing to sell higher quantity and vice-versa.

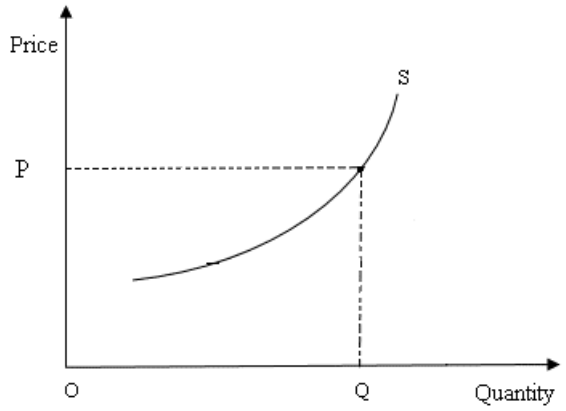

Fig 1.5: The Supply Curve

One thing is to be note here is that despite a positive relationship between price and quantity we don't have a "the law of positively sloped supply" just like the "the law of negatively sloped demand". This is due to the fact that a supply curve with zero, infinite or negative slope is also possible depending on various factors.

1.4.1 Individual Supply Curve:

The quantity of a good that a single supplier is willing to sell over a particular time period depends on the price of the good and the costs of production. The individual supply schedule and supply curve of a commodity at various price is obtained by keeping other factors that affects the costs of production constant (ceteris paribus). These factors are

technology, cost of raw materials, climate and weather conditions (in case of agricultural commodity).

Example 3:

Let's assume that there is a single supplier of a commodity with a supply function $QS_x = -40 + 20P_x$ *ceteris paribus*. The individual supply schedule is obtained by substituting different prices of the commodity into this supply function (table 1.3). Plotting the points of supply schedule on a graph gives the individual supply curve (fig 1.6).

Table 1.3: Individual's Supply Schedule

Price (P_x)	Quantity (QS_x)
2	0
3	20
4	40
5	60
6	80
7	100
8	120

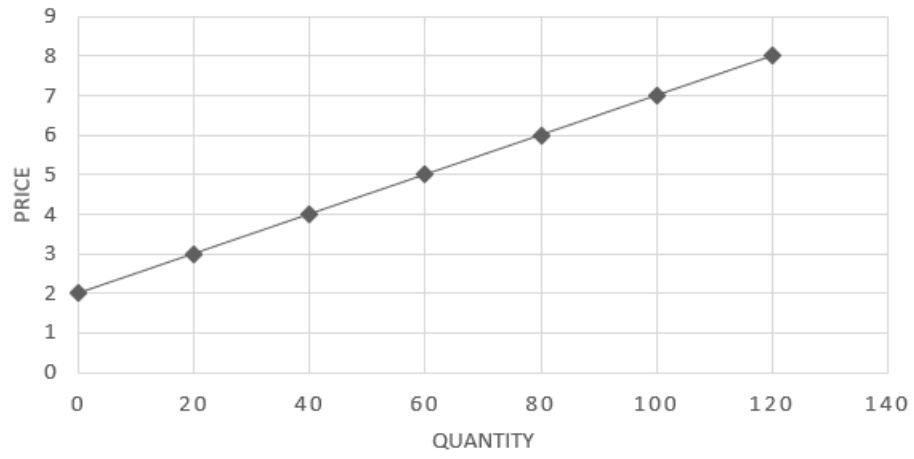

Fig 1.6: Individual's Supply Curve

1.4.2 Shifting of the Supply Curve:

Earlier, we saw that change in price (keeping other things constant) of a commodity result in a movement along the supply curve of that commodity. Now we will see what will

happen to the individual supply curve for a commodity when factors other than its price changes.

Let's assume that there is a technological improvement which decreases the cost of production of a commodity. This will shift the supply curve to the right and we call this an increase in supply. This means that the supplier is willing to sell more quantity at the same price. In the fig. 1.7, the supply curve S shifts to S' due to technological improvement. This reduces the cost of production leading to over-supply. Now the supplier will offer more quantity Q_2 at the prevailing price P_1.

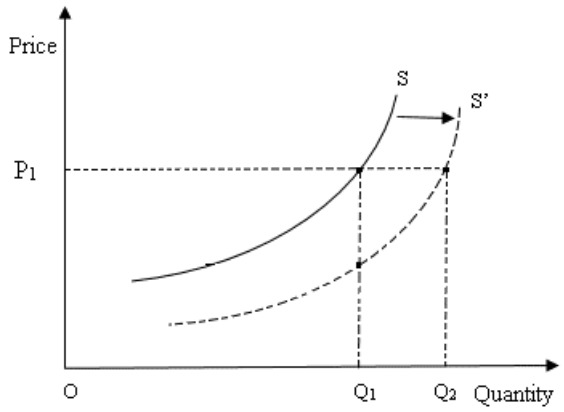

Fig 1.7: Shift in the Supply Curve

There are other factors apart from technological improvement that affect the cost of production and in turn the supply curve. These are wage rate, interests on loans and cost of raw materials or inputs. Taking another example of fall in price of raw materials. This lowers the cost of production making production of that commodity more profitable. This not only promotes existing firms to increase production but also encourages new firms to enter the market. Therefore, at the existing price P_1, we will see an increase in supply from Q_1 to Q_2. This shifts the supply curve to the right from S to S'.

1.4.3 Market Supply Curve:

The market or aggregate supply is the total quantity of a good supplied by all the suppliers in a market at various prices over a particular time period. The market supply depends on all the factors that determine the individual supply and on the number of suppliers of the good in the market. Mathematically, it is obtained by adding individual supply schedule and plotting it on a graph. Let's understand this with the help of an example.

Example 4:

Let's assume that there are 10 identical suppliers of a commodity in the market, each with a supply function given by $QS_x = -40 + 20P_x$ *ceteris paribus***.** The market supply schedule is obtained by as follows;

$$QS_x = -40 + 20P_x \text{ (Single supplier)}$$

$$QS_x = 10(-40 + 20P_x)$$

$$QS_x = -400 + 200\,P_x$$

Now by plotting the values of market supply schedule on a graph we will get our market supply curve (fig 1.8). This market supply curve will change its position when the individual supply curve shift and when the number of producers change over time.

Table 1.4: Market Supply Schedule

Price (P_x)	Quantity (QS_x)
2	0
3	200
4	400
5	600
6	800
7	1000
8	1200

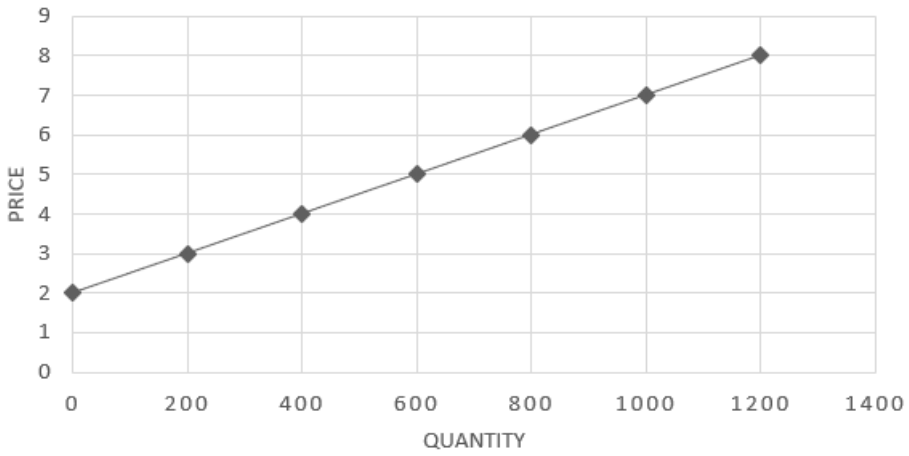

Fig 1.8: Market Supply Curve

IN-TEXT QUESTIONS

1. The law of demand states that, all but which one of the following are kept constant?

A. Income of the buyers

B. Price of related goods

C. Price of that commodity

D. Tastes and preferences of the buyers

2. A fall in the price of a product, keeping other things constant, results in

A. An increase in supply

B. A decrease in supply

C. A decrease in the quantity supplied

D. An increase in the quantity supplied

3. When the income of an individual rises while everything else remains constant, the demand for a normal good

A. Increase

B. Decreases

C. Remains unchanged

D. All of the above

4. Increase in the price of tea will _____ the demand for coffee.

5. _____ in the price of petrol would decrease the demand for cars.

1.5 EQUILIBRIUM

Equilibrium is a market situation which, once achieved, tends to persist. In economics, when the quantity demanded of a commodity equals the quantity supplied equilibrium is achieved. Graphically, this can be represented by the intersection of the market demand and supply curve. This point gives us the equilibrium price and the equilibrium quantity.

Fig. 1.9 depicts the equilibrium condition in a market. The vertical Y-axis is showing the market price of the commodity and the horizontal X-axis is showing the quantity. In this fig. we have a negatively sloped market demand curve D and a positively sloped market supply curve S. Point e on the graph is the equilibrium point where the market demand curve intersects the market supply curve. Point P_0 and Q_0 are the equilibrium price and equilibrium quantity respectively.

Distance ab and cd represents surplus and shortage of quantity supplied respectively. In a free market, there is a tendency for the price to change until the market is cleared i.e., until the quantity demanded equals the quantity supplied. This is how a market mechanism works. At the equilibrium point, there is no excess demand and excess supply, hence there is no pressure for the price to change further. It is to note that demand and supply might not be always in equilibrium depending on the situation.

Let's understand this with the help of the fig 1.9. Suppose the market price are initially above the equilibrium level at P_1. We know that at higher price suppliers are willing to sell more quantity than the buyers are willing to purchase. At a higher price level, the situation of surplus will occur where the quantity supplied exceeds the quantity demanded. To sell this excess quantity the suppliers would have to lower the price. As the price falls by the law of demand this will create additional demand in the market. The price would continue to fall till it reaches the equilibrium level P_0.

Let's see the opposite situation where the initial price is at P_2. Since the price is lower than the equilibrium price, the quantity demanded will be higher than the quantity supplied. This creates the problem of shortage in the market and the buyers would not be able to buy as much they want. This will put an upward pressure on the price as the buyer would try to pay higher price to buy that much of quantity. The price will increase and the suppliers would sell higher quantities at higher price. The price will eventually reach to the equilibrium level P_0.

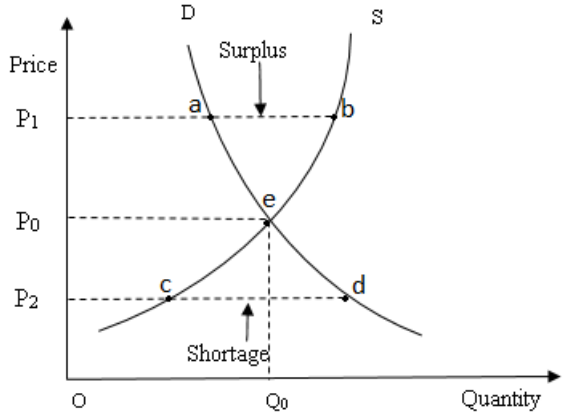

Fig 1.9: Equilibrium

Example 5:

Let's see how we can determine the equilibrium price and the quantity from market demand and market supply. From our example 4 and example 6 we have already calculated the market demand and market supply curve. Using both the market demand and market supply schedule we can see that at market price of Rs 2 the quantity demanded is 600 units and the quantity supplied is zero. Similarly, at market price of Rs 6 the quantity demanded is 200 units and quantity supplied is 800 units. But at market price of Rs 4 the quantity demanded is equal to the quantity supplied at 400 units. This point is our equilibrium point and there is no shortage or surplus of the commodity in the market. This market position will continue to persist until and unless some outside force pushes the demand or supply away from the equilibrium position.

Table 1.5: Market Demand and Supply Schedule

Price (P_x)	Quantity (Qd_x)	Quantity (QS_x)
2	600	0
3	500	200
4	**400**	**400**
5	300	600
6	200	800

The equilibrium position is also depicted in the fig 1.10 below.

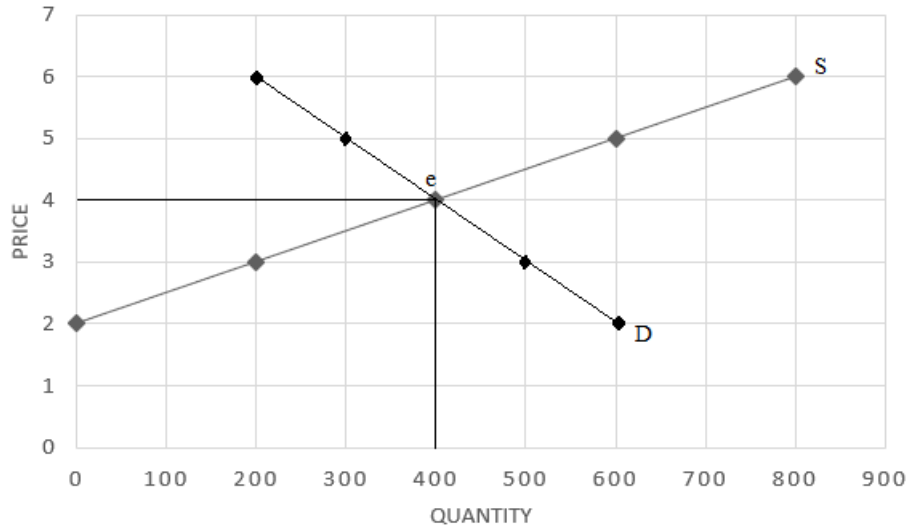

Fig 1.10: Equilibrium

Generally, there are two types of equilibrium conditions; stable and unstable. In a stable market equilibrium, any deviation from equilibrium position will bring into operation market forces which push the market back toward equilibrium. As opposed to this under unstable market equilibrium, any deviation from equilibrium position will bring into operation market forces which push the market further away from the equilibrium.

1.5.1 Changes in Market Equilibrium:

Till now, we have seen how demand and supply respond to a change in various factors such as price, cost of production, technological improvements, tastes and preferences. We have also seen how we can determine the equilibrium position from demand and supply curves and how market forces operate. Now we will understand how equilibrium position changes due to shift in the demand and supply curves.

Shift in the Supply Curve

First, we will see how an equilibrium would respond to a shift in the supply curve. In the fig 1.11, the initial demand and supply curves are D and S respectively and the equilibrium position is at point e. This gives us equilibrium price and quantity at P_0 and Q_0 respectively. Now assuming the supply curve shifts rightwards to S' due to certain reasons (say- fall in the price of raw materials). Please note that only the supply curve has shifted and the demand curve remains unchanged. This will give us new equilibrium position e' which is to the right of previous equilibrium position. A rightward shift in the supply curve leads to a fall in the equilibrium price and a rise in the equilibrium quantity P_1 and Q_1 respectively.

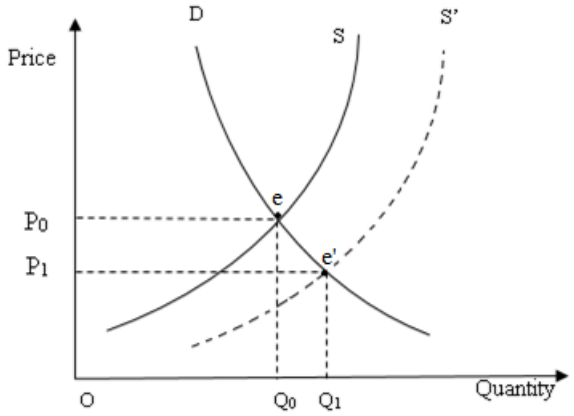

Fig 1.11: Shift in Equilibrium due to Shift in the Supply Curve

Shift in the Supply Curve

Now we will see how the equilibrium position reacts to a shift in the demand curve. In the fig 1.12, the initial demand and the supply curves are D and S respectively. Both these curves intersect at point e giving P_0 and Q_0 level of equilibrium price and quantity. Let's assume that due to increase in the level of incomes of consumers the demand curve shifts to right at D'. Since, the supply curve remains unchanged the new equilibrium position is at e' which is to the right of the initial position. At the new equilibrium position, both the equilibrium price and quantity have increased to P_1 and Q_1 respectively.

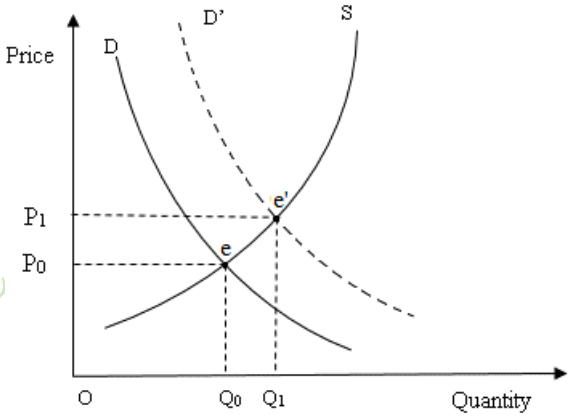

Fig 1.12: Shift in Equilibrium due to Shift in the Demand Curve

Shift in both the Demand and Supply Curve

Now what happens to the equilibrium position when both the demand and the supply curves shift simultaneously? In the fig 1.13 we have assumed a rightward shift in both the curves. The demand curve shifts from D to D' and supply curve from S to S'. This would change the equilibrium position from e to e'. We can see that the new equilibrium price and

quantity (P_1 and Q_1) are at higher level than the initial ones. But this change in the price and quantity depends on the level of shifts in the demand and the supply curves and their shapes.

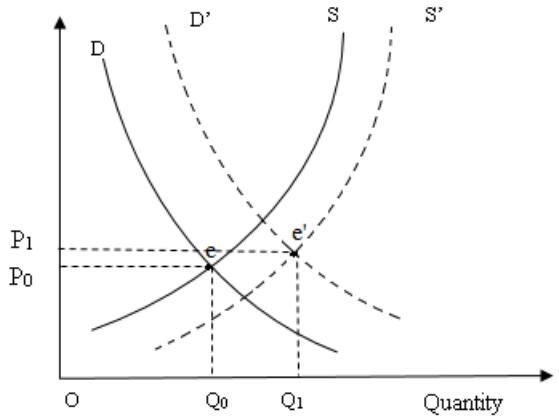

Fig 1.13: Shift in Equilibrium due to Shift in both the Demand and Supply Curve

IN-TEXT QUESTIONS

6. An increase in the income level of a buyer would _____ the demand for an inferior good.

7. Technological improvement that decreases the cost of production would result in

A. Decrease in supply

B. Increase in supply

C. Supply remains unchanged

D. Any of the above

8. A positively sloped supply curve represents _____ relationship between price and quantity supplied.

9. The point at which the demand and the supply curve intersects gives _____.

1.6 SUMMARY

The demand and the supply are the main pillars of economics. Demand and supply analysis helps us understand how a market operates, the logic behind price change, and what are the impacts of economic changes on the markets.

Demand is the quantity of a commodity that a buyer is willing to and able to buy at various market prices. When we sum all the individual's demand schedule, we obtain a market demand for a commodity. A demand curve for a normal goods is negatively sloped that means there is a negative relationship between price and quantity demanded. When the prices are higher the demand will be lower and vice-versa keeping other things constant. This is called the law of demand. Other factors that affect the demand are income level, price of other goods, tastes and preferences. A change in these factors results in a shift in the demand curve.

Supply is the quantity of a commodity that a supplier is willing to sell at various market prices. A horizontal summation of all the individual's supply schedules gives us the market supply schedule. Plotting these points on the graph will gives us the market supply curve. A supply curve is generally positively sloped meaning a positive relationship between price and quantity supplied. At higher price it is profitable for a firm to sell more quantity and vice-versa. However, it should be noted that the slope of a supply curve can be zero, infinite or negative. There are various factors other price that affect the supply curve. These are technology, cost of production, price of raw materials etc. A change in any of these factor shifts the supply curve to either side.

The equilibrium position is a situation which once achieved will tend to persist. At the equilibrium position there is no shortage or surplus and it is obtained by the intersection of the market demand and supply curve. The equilibrium price and the quantity are determined exclusively by the interaction of the forces of demand and supply only in a perfectly competitive market. In the coming chapters we will understand how equilibrium is reached in a competitive and non-competitive markets. We have seen how interferences with the market forces could prevent the attainment of equilibrium leading to an unstable equilibrium.

At last, we have seen how a shift in the demand and the supply curve shifts the equilibrium position in the market. The direction of change in the equilibrium price and quantity due to the shift in the demand and supply curves depends on the magnitude of the shifts and the shape of the curves.

1.7 GLOSSARY

Change in demand: A shift in the demand curve of a goods due to change in the factors other than its price.

Change in the quantity demanded: A movement along a demand curve of a goods due to change in its price.

Change in the quantity supplied: A movement along a supply curve of a goods due to change in its price.

Change in supply: A shift in the supply curve of a goods due to change in the factors other than its price.

Complementary Goods: An increase in the price of one result in a decrease in the quantity demanded of the other. For example, computers and computer software.

Equilibrium: The market condition when the quantity demanded equals the quantity supplied.

Law of demand: It states that when the price of a commodity decreases it's quantity demanded increases keeping other things constant.

Stable equilibrium: The situation where any deviation from equilibrium activates market forces which push the market toward equilibrium.

Substitute Goods: An increase in the price of one results in an increase in the quantity demanded of the other. For example, beef and chicken.

Unstable equilibrium: The situation where any deviation from equilibrium activates market forces which push the market further away from equilibrium.

1.8 ANSWERS TO IN-TEXT QUESTIONS

1. C	6. Decrease
2. C	7. B
3. A	8. Direct
4. Increase	9. Equilibrium Point
5. Increase	

1.9 SELF-ASSESSMENT QUESTIONS

1. What is an individual's demand schedule? How we can calculate a market demand schedule from it.

2. Suppose the demand curve for a product is given by Q = 300 - 2P + 4I, where I is the average income measured in thousands of rupees. The supply curve is Q = 3P - 40.

a. If I = 20, find the equilibrium price and quantity.

b. If I = 40, find the equilibrium price and quantity.

c. Draw a graph to illustrate your answers.

3. What is an individual's supply schedule? How we can calculate a market supply schedule from it?

4. Suppose the supply curve for a product is given by Q = 4P-60 and the demand curve is Q = 450 - 3P + 3I, where I is the average income measured in thousands of rupees.

a. If I = 25, find the equilibrium price and quantity.

b. If I = 45, find the equilibrium price and quantity.

c. Also draw a graph to illustrate your answers.

5. Define equilibrium. Explain how a market attains an equilibrium position.

6. Differentiate between stable and unstable equilibrium.

1.10 REFERENCES

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LESSON 2

Elasticity of Demand and Supply

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STRUCTURE

2.1 LEARNING OBJECTIVES

After studying this lesson, students will be able to understand:

- The concepts of elasticity of demand and elasticity of supply.
- The types of elasticity of demand viz., price elasticity, cross elasticity and income elasticity of demand.
- The calculation of the coefficient of elasticity of demand.
- The applications of elasticity of demand used by firms to maximise their revenue.

- The calculation of the coefficient of elasticity of supply.

2.2 INTRODUCTION

In the previous lesson the concepts of demand & supply discussed in detail. Both demand of a commodity and supply of the commodity show the relationship between price of a commodity and its quantity demanded or supplied. This lesson is the further extension of previous chapter and here we will discuss the elasticity of demand and supply in detail. The purpose of elasticity of demand and supply is to determine the responsiveness of demand and supply of a commodity with respect to change in a variable affecting them (especially price).

Elasticity of demand and supply is also a very important tool for the business firms at the time of making their pricing strategies or setting the Revenue goals. In this chapter we are going to cover in detail the measures of elasticities and their applications.

2.3 Elasticity of Demand

Elasticity of demand is defined as a measure of the degree of responsiveness of demand of a commodity with respect to change in one of the variables on which demand depends. In other words, elasticity of demand means a change in the percentage of quantity demanded of a commodity divided by a change in the percentage of a variable on which demand depends. There are many variables which affect the demand of any commodity but we are going to consider three variables viz., price of the commodity, price of other related goods and income of the buyers. Three measures of elasticity of demand we are going to cover in this chapter viz., price elasticity of demand, cross elasticity of demand and income elasticity of demand. Elasticity of demand is the most common measure of price elasticity of demand. Price elasticity of demand is generally referred as elasticity of demand, therefore it is to be noted that when we talk elasticity of demand it is price elasticity of demand, unless and until mentioned otherwise.

2.4 Price Elasticity of Demand

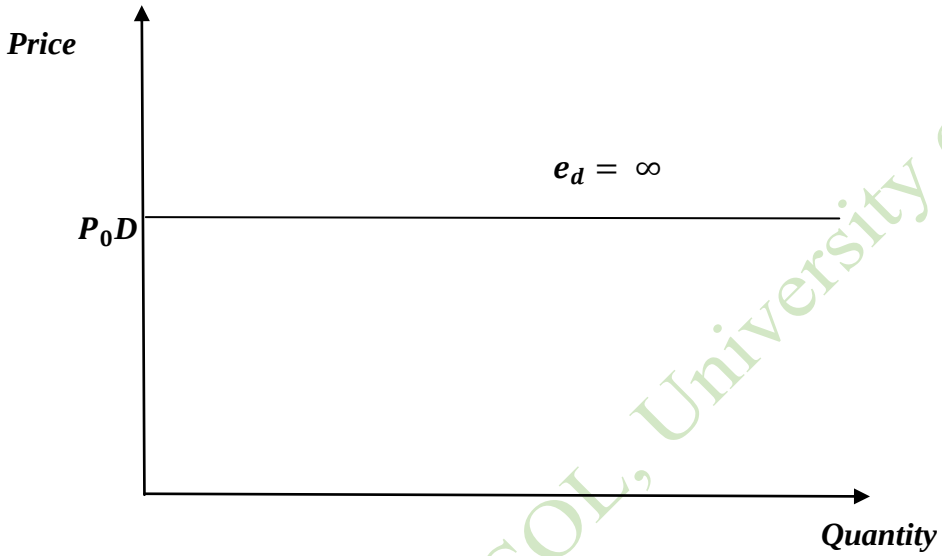
Price elasticity of demand is defined as a measure of the degree of responsiveness of demand of a commodity with respect to change in its price. In other words, it means a percentage change in the quantity demanded of a commodity divided by a percentage change in its price.

$$(-)e_d = \frac{Percentage\ change\ in\ quantity\ demanded\ of\ good\ X}{Percentage\ change\ in\ price\ of\ good\ X}$$

From the above equation, it may be noted that a minus sign (-) is inserted before the price elasticity of demand (e_d). Price of a commodity and its demand generally share an inverse relationship i.e., if price of a commodity fall its demand usually increases and vice-versa. Either of the two, percentage change in quantity demanded or percentage change in price will be a negative value.

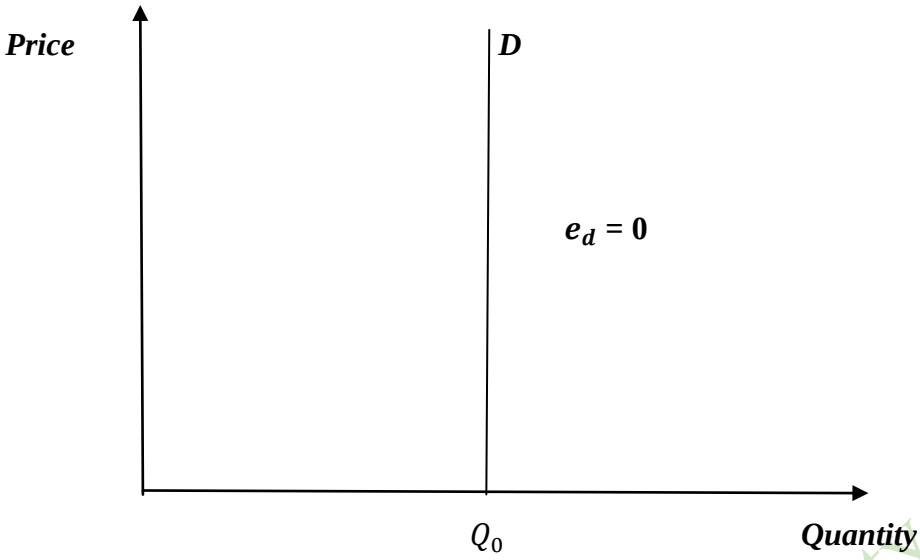
2.4.1 Degrees of price elasticity of demand

1. **Perfectly elastic demand ($e_d = \infty$)**: Demand of a commodity is said to have a perfectly elastic demand when there is no change in its price but still demand changes. When there is a very small change in the price which leads to an infinite change in demand also considered as perfect elastic demand. In other words when percentage change in price is zero or equivalent to zero but there is change in demand. The elasticity of demand in this case will be equals to infinity. Perfectly elastic demand curve will be a straight horizontal line.



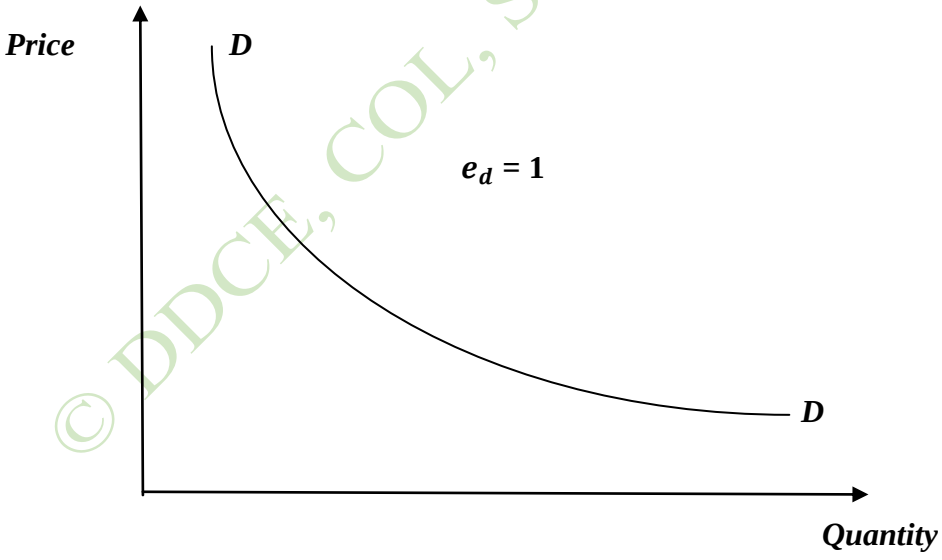
Perfectly Elastic Demand

1. **Perfectly inelastic demand (e_d = 0)**: Demand of a commodity is said to have a perfectly inelastic demand when irrespective of any change in its price, its demand remains same. In other words when percentage change in quantity demanded is zero even when price changes. The elasticity of demand in this case will be equals to zero. Perfectly inelastic demand curve will be a straight vertical line.



Perfectly Inelastic Demand

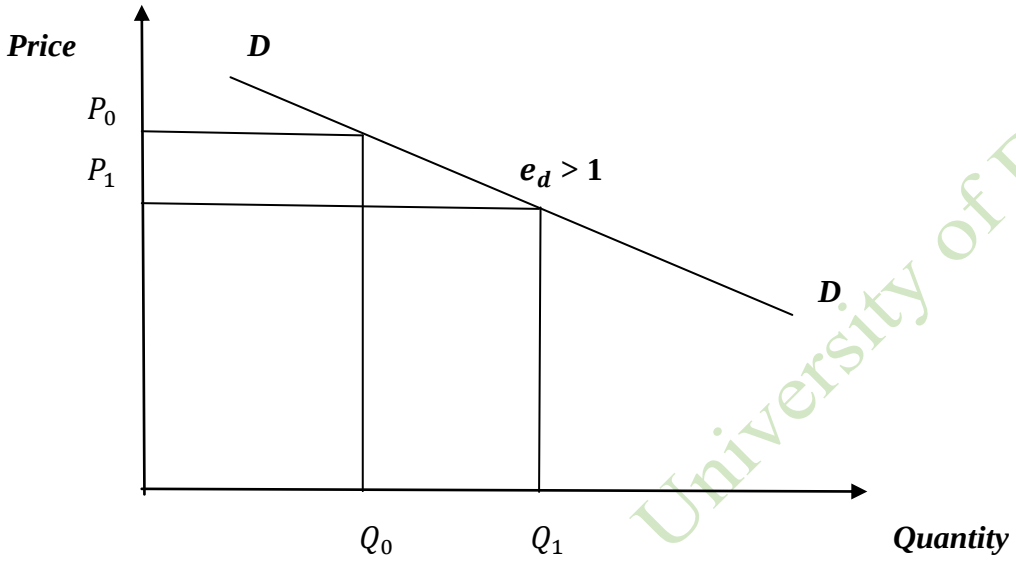
2. **Unit elastic demand (e_d = 1)**: Demand of a commodity is unit elastic when change in price of a commodity leads to an equal change in its demand. In other words, demand is unit elastic when percentage change in quantity demanded of a commodity is same as the percentage change in price of that commodity. The value of elasticity of demand will be equals to one in this case. The demand curve will be a rectangular hyperbola for a commodity having unit elastic demand.



Unit Elastic Demand

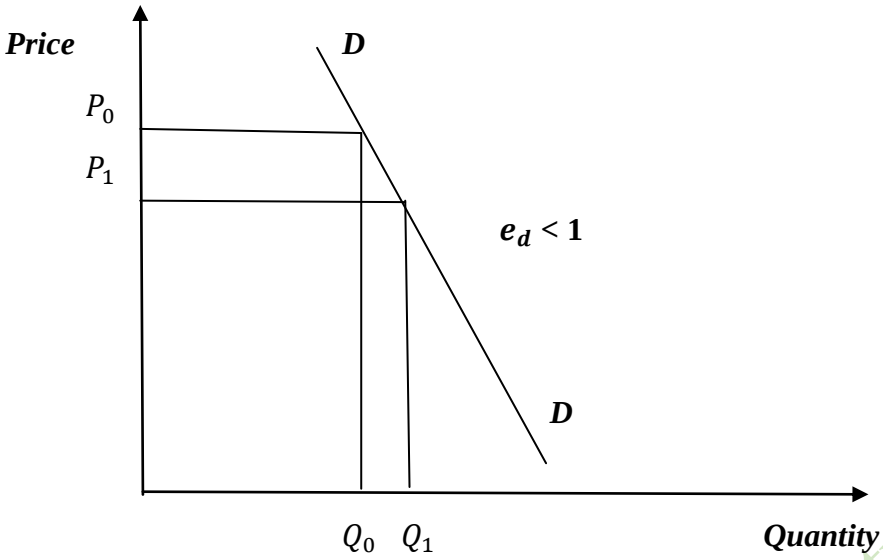
3. **More than unit elastic demand (e_d > 1)**: Demand of a commodity is said to have more than unit elastic demand when a small change in its price leads to a higher change in its demand. In other words, demand is more than unit elastic or elastic

when percentage change in quantity demanded of a commodity higher than the percentage change in price of that commodity. In the curve below you can see the change in quantity demanded (Q_0Q_1) is greater than the change in prices (P_0P_1). The elasticity of demand in this case will be more than one. The shape of demand curve in this case will be a flatter one. More than unit elastic demand is also referred as elastic or relatively elastic demand.



Elastic Demand

4. **Less than unit elastic demand ($e_d < 1$):** Demand of a commodity is said to have less than unit elastic demand when a change in its price leads to a very small change in its demand. In other words, demand is less than unit elastic or inelastic when percentage change in quantity demanded of a commodity lesser than the percentage change in price of that commodity. The elasticity of demand in this case will be less than one. In the curve below you can see the change in quantity demanded (Q_0Q_1) is lesser than the change in prices (P_0P_1). The shape of demand curve in this case will be a steeper one. Less than unit elastic demand is also referred as inelastic or relatively inelastic demand.



Inelastic Demand

Price Elasticity of Demand		
Numerical Measure of e_d	**Description**	**Terminology**
Zero (e_d = 0)	Quantity demanded remains same as price changes	Perfectly inelastic demand
More than zero but less than one (0 < $e_d < 1$)	Change in quantity demanded is less than change in price	Inelastic demand
One (e_d = 1)	Change in quantity demanded is same as change in price	Unit elastic demand
More than one but less than infinity (1 < $e_d < \infty$)	Change in quantity demanded is more than change in price	Elastic demand
Infinity ($e_d = \infty$)	Quantity demanded changes although there is no change in price	Perfectly elastic demand

After studying the degrees of price elasticities of demand, it is now clear that what is elastic demand and inelastic demand. Perfectly elastic demand and perfectly inelastic demand are two extreme situations and hardly found in real worlds. Generally, goods are either having elastic demand i.e., a small change is price of a commodity leads to higher change in its demand or inelastic demand i.e., a change is price of a commodity leads to a very small change in its demand.

2.4.2 Factors affecting Elasticity of Demand

There are various factors which makes the demand of commodity elastic or inelastic. These factors are the reason behind the responsiveness of change in demand of a commodity with respect to change in its price. Below are the factors affecting elasticity of demand of a commodity:

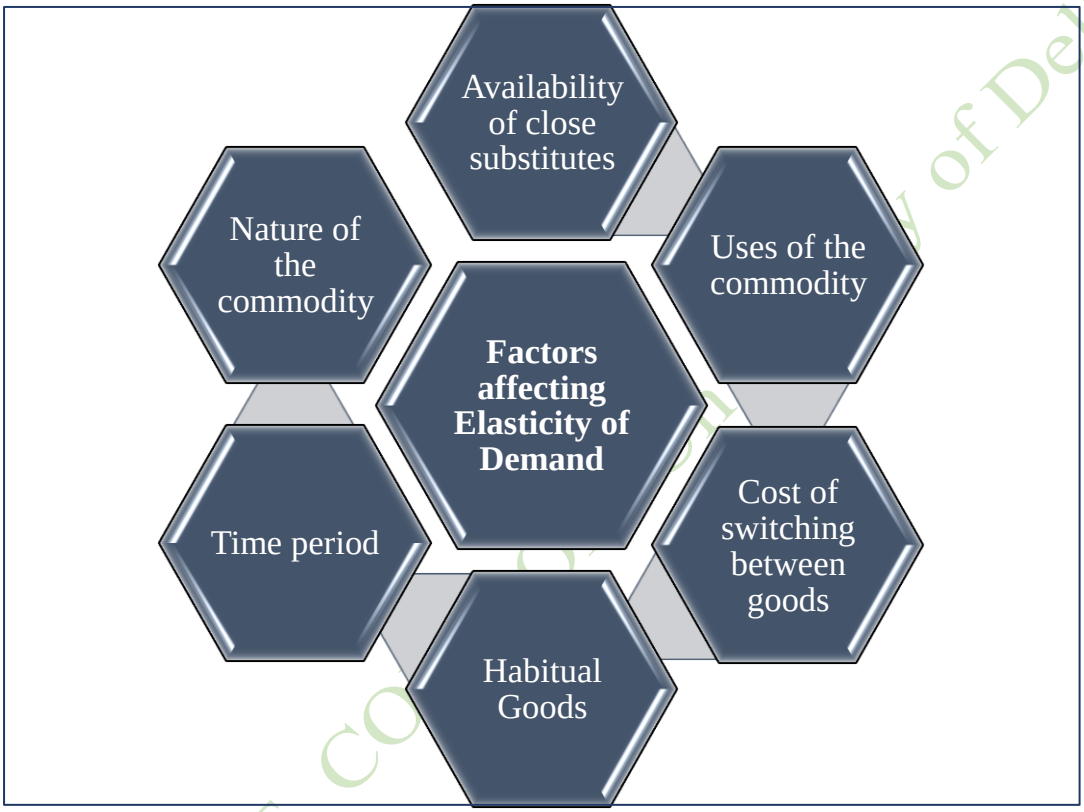


Fig 2.1: Factors affecting Elasticity of Demand

1. **Availability of Close Substitutes:** Availability of close substitutes in the market affects the elasticity of demand of a product. If large number of close substitutes available in the market consumers find it easy to switch from one commodity to another, hence more elastic demand. Similarly, a smaller number of close substitutes implies less elastic demand. For e.g., mid-range mobile phones have close substitutes in the market as a result having elastic demand for these phones, this is one of the reasons behind mobile phone companies are more interested in adding up more features in their mid-range mobile phones rather change in the price.

2. **Uses of a commodity:** Commodities with a large number of uses tend to have more elastic demand whereas commodities with limited uses have less elastic demand. When price of a commodity falls and if that commodity has large number of uses then consumers start buying more of that commodity even if the change in the price is very small and vice-versa.

3. **Switching Cost between goods:** There may be costs involved in switching. Switching cost means the cost which a consumer has to bear when he/she shifts from one good to another. For e.g., when you buy a recharge from your telecom operator for six months or twelve months you are tied with that particular operator for the aforesaid period and if you shift in between the amount you have paid for the remaining period is your switching cost. Demand tends to be inelastic if switching cost is there.

4. **Habitual Goods**: Demand for habitual goods is generally inelastic. A change in price of habitual goods hardly impacts the demand of that good. For e.g., if you are habitual to consume a particular good you will become less sensitive to the price of that good.

5. **Time Period:** Demand of a commodity is inelastic in short run and elastic in long run. In short run consumers have less time to respond with respect to change in price of a commodity whereas in long run consumers have sufficient time to search for cheaper substitutes with less or no switching cost. For e.g., if your telecom operates increase the prices it is difficult for you to shift to another telecom operator but in long run you will find a telecom operator best suits you.

6. **Nature of the commodity:** Elasticity also depends on the nature of commodity. Necessity goods have inelastic demand. A change in price of necessity good is not going to impact its demand much. For e.g., demand for salt, medicines are inelastic. Comfort goods such as TV, Cooler, etc. have elastic demand. Luxury goods also have elastic demand.

IN-TEXT QUESTIONS

1. Music society of a college decides to increase the ticket price of a concert to increase its society's funds. The music society is assuming that demand for concert ticket is:
    a) Elastic
    b) Inelastic
    c) Perfectly elastic
    d) Perfectly inelastic
2. The demand elasticity for necessity goods such as water, electricity, milk tend to be:
    a) Perfectly elastic
    b) Unit elastic
    c) Perfectly inelastic
    d) Relatively inelastic
3. A demand curve parallel to x-axis is
    a) Perfectly elastic
    b) Unit elastic
    c) Perfectly inelastic
    d) Relatively inelastic
4. When quantity demanded of a commodity is irresponsive to price, demand is _____.
5. Elasticity of demand is _____when demand curve is rectangular hyperbola.

2.4.3 Methods of Measuring Elasticity of Demand

We have discussed conceptually about the elasticity of demand and its degrees. There are two main measures of elasticity of demand which we are going to discuss in this section. The elasticity can be measured between two points on a demand curve, called arc elasticity or can be measured at a point on a demand curve, called point elasticity.

2.4.3.1 Arc Elasticity

Arc elasticity is a measure of elasticity of demand between two finite points (which makes an arc) on a demand curve. The general formula of elasticity of demand can only be used when the direction of change in price is given. When direction of change in price is not given arc elasticity method is used. In arc elasticity method we take average of price and quantity instead of base price and base quantity while calculating the elasticity coefficient. Arc elasticity of demand is measures as:

$$(-)e_d = \frac{\Delta Q}{\Delta P} \times \frac{(P_1+P_2)/2}{(Q_1+Q_2)/2}$$

The above formula gives the same elasticity coefficient irrespective of the direction of the price change.

Illustration: What will be the elasticity of demand of commodity X when its price increases from Rs. 5 to Rs. 6 results in a fall in quantity demanded from 100 to 60 units.

$$(-)e_d = \frac{\Delta Q}{\Delta P} \times \frac{(P_1+P_2)/2}{(Q_1+Q_2)/2}$$

$$= \frac{40}{1} \times \frac{(5+6)/2}{(100+60)/2}$$

$$= 2.75$$

2.4.3.2 Point Elasticity

Point elasticity is used for calculating elasticity of demand when change is price is very small. It is used for calculating elasticity of demand at a finite point of a demand curve.

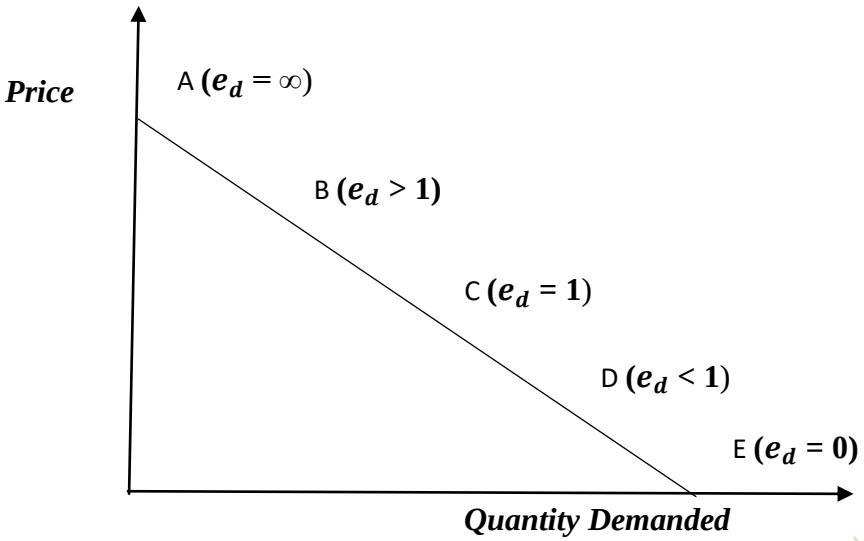
$$(-)e_d = \frac{dQ}{dP} \times \frac{P}{Q}$$

Point elasticity on a linear curve is the ratio of the lower portion to the upper portion of the demand curve.

$$e_d = \frac{Lower\ Portion}{Upper\ Portion}$$

Using the above formula elasticity of demand can be calculated on a linear demand curve given below AE. The demand curve is divided in four equal parts and then elasticity of demand is calculated on all the five points which are lying on the demand curve. Elasticity of demand at each point is calculated using the above formula:

- e_d at A = $\frac{AE}{0} = \infty$
- e_d at B = $\frac{BE}{AB} > 1$
- e_d at C = $\frac{CE}{AC} = 1$
- e_d at D = $\frac{DE}{AD} < 1$
- e_d at E = $\frac{0}{AE} = 0$



We can use the equation of demand function to determine the point price elasticity of demand. Let us assume that demand function is,

P = 50 - .10Q or Q = 50 – 10P

And we have to find the price elasticity of demand at a point where price is 10 and quantity demanded is 200.

$$(-)e_d = \frac{dQ}{dP} \times \frac{P}{Q}$$

$$(-)e_d = -10 \times \frac{10}{200}$$

$$= 0.5$$

2.4.3.3 Relationship between price elasticity and total revenue

It is important for firms to understand the relationship between price elasticity and total revenue. Firm aiming at increasing its total revenue would be interested in knowing whether increasing or decreasing the price of the commodity would achieve the goal. The elasticity coefficient at different level of prices would answer this question. The relationship between change in price, price elasticity of demand and change in total revenue (TR) is:

- If demand is elastic ($e_d > 1$), then there is direct relationship between price change and change in TR i.e., if price increases TR also increases vice-versa.
- If demand is inelastic ($e_d < 1$), then there is inverse relationship between price change and change in TR i.e., if price increases TR decreases vice-versa.

Going back to our question where the firm is aiming at increasing its total revenue, the firm will see whether the demand of their product is elastic or inelastic. If elatic, then decreasing the price would increase the TR and if inelastic, then increasing the price would increase the TR.

2.5 Cross Elasticity of Demand

Cross elasticity of demand is a measure of the change in demand of a commodity with respect to change in price of other commodity (substitute or complementary goods). In other words, cross elasticity of demand is calculated as a percentage change in the quantity demanded of good A divided by a percentage change in the price of good B.

$$Cross\ elasticity = \frac{Percentage\ change\ in\ quantity\ demanded\ of\ good\ A}{Percentage\ change\ in\ price\ of\ good\ B}$$

Or

$$= \frac{dQ_A}{dP_B} \times \frac{P_A}{Q_B}$$

Cross elasticity is usually calculated to see the impact of change in price of substitute or complementary good on the demand of a commodity. Demand of a commodity increase when price of substitute good increases and vice versa. As a result, cross price elasticity is positive for substitute goods. Demand of a commodity increase when price of complementary good decreases and vice versa. Therefore, in case of complementary goods either the change in demand of one good or the change in price of another good would be negative. As a result, cross price elasticity is negative for complementary goods.

2.6 Income Elasticity of Demand

Apart from price of the commodity and price of related goods (substitute and complementary goods) income is another basic determinant of demand of a commodity. The relationship between income level and demand of a commodity is positive in nature unlike the price-demand relationship. The demand for most commodities increases with an increase in the level of the consumer's income and vice versa. Income elasticity of demand is a measure to find the change in demand of a commodity when income of the consumer changes. In other words, income elasticity of demand is a percentage change in quantity demanded of good Y divided by a percentage change in consumer's income.

$$Income\ elasticity\ (e_y) = \frac{Percentage\ change\ in\ quantity\ demanded\ of\ good\ Y}{Percentage\ change\ in\ income}$$

Or

$$= \frac{dQ}{dY} \times \frac{Y}{Q}$$

There are two types of goods viz., normal goods and inferior goods. Normal goods are those goods whose demand has a direct relationship with the level of consumer's income i.e., if income of the consumer increases, then his/her demand for normal good also increases and if income of the consumer decreases, then his/her demand for normal good also decreases. For normal goods income elasticity is always positive ($0 < e_y < 1$). Normal goods may be further classified as necessity goods and luxury goods. Necessity goods such as rent, food, education, electricity etc. are relatively less sensitive to income change and has income elasticity less than one. A commodity classified as luxury is very sensitive to income change and has income elasticity greater than one. Inferior goods are goods whose demand has an inverse relationship with the level of income i.e., if income increases demand for inferior good decreases and vice versa. Income elasticity is negative ($e_y < 0$) for normal goods

Income elasticity is determined by these:

- The initial level of GDP of a country, for e.g., AC is a luxury good in an underdeveloped economy while it is a necessity good in a developed economy.
- Time period, consumption patterns changes when income changes but with a time-lag.
- The nature of the commodity, for e.g., as income increases percentage of income spent on food declines.

IN-TEXT QUESTIONS

6. The responsiveness of demand of a commodity with respect to income is known as _____.
7. The cross elasticity of demand for substitute goods is _____and for complementary goods is _____.
8. A seller sells cookies for Rs. 1 each. If he raises the price by even by 1 paisa, then all the customers will shift to some other alternatives. Thus, the demand curve for cookies is_____.
9. Income elasticity of demand is negative for ____ goods.
10. How would a fall in price affects the total revenue when demand is inelastic:
    a) Total revenue would increase
    b) Total revenue would decrease
    c) Total revenue remains same
    d) None of the above
11. Cross elasticity of demand between Coke and Pepsi is _____.
12. During recession which goods are most adversely affected:
    a) Goods with relatively low-income elasticity of demand.
    b) Goods with relatively high-income elasticity of demand.
    c) Goods with positive cross elasticity of demand.
    d) Goods with negative cross elasticity of demand.

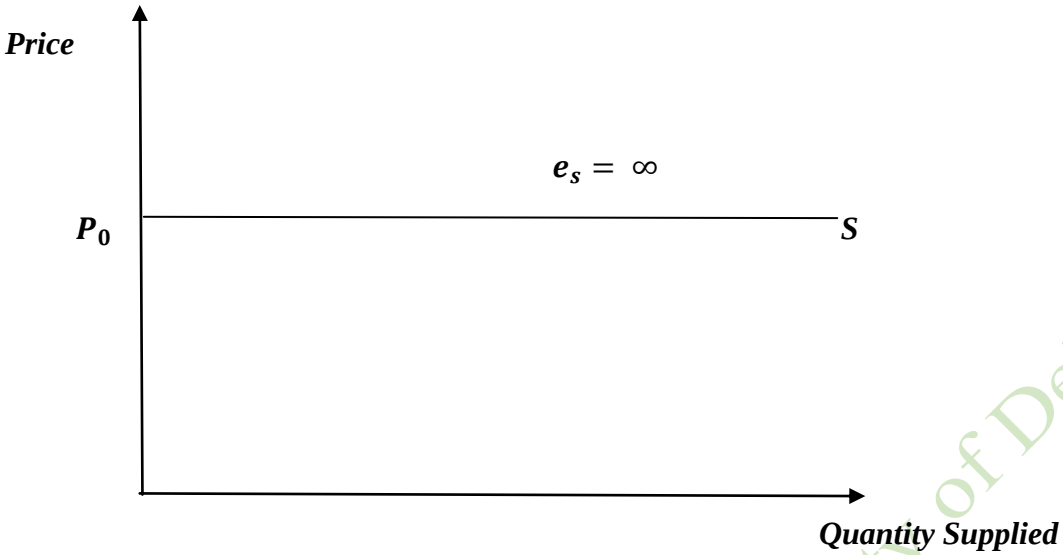
2.7 Elasticity of Supply

Elasticity of supply is a measure to find the change in supply of a commodity when price of that commodity changes. In other words, elasticity of supply means a percentage change in the quantity supplied of a commodity divided by a percentage change in its price.

$$(-)e_s = \frac{Percentage\ change\ in\ quantity\ supplied\ of\ a\ commodity\ X}{Percentage\ change\ in\ price\ of\ commodity\ X}$$

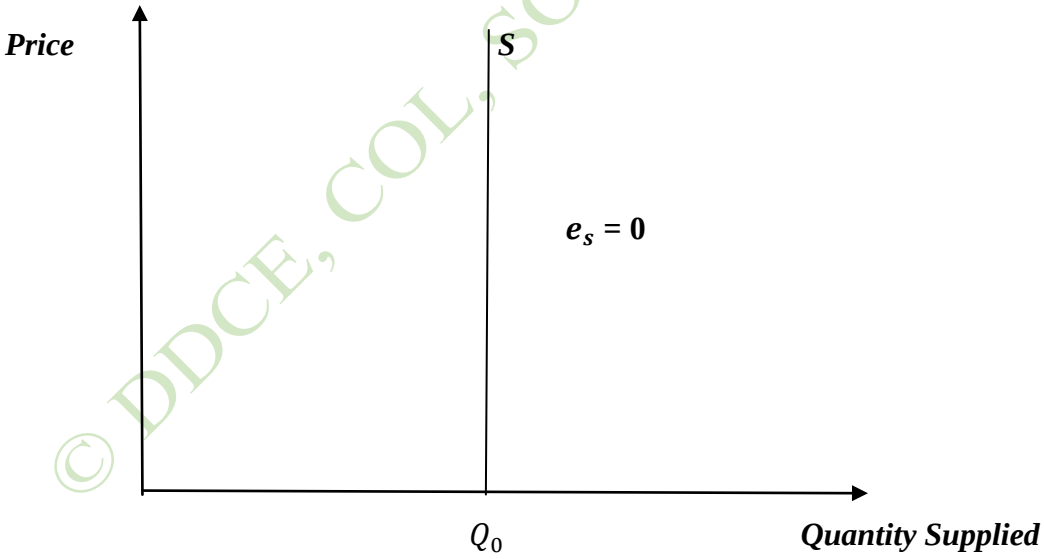
2.7.1 The elasticity of supply can be classified as following:

1. **Perfectly elastic supply ($e_s = \infty$)**: Supply of a commodity is said to have a perfectly elastic supply when there is no change in its price but still supply changes. When there is a very small change in the price which leads to an infinite change in quantity supplied, also considered as perfect elastic supply. In other words when percentage change in price is zero or equivalent to zero but there is change in quantity supplied. The elasticity of supply in this case will be equals to infinity. Perfectly elastic supply curve will be a straight horizontal line.



Perfectly Elastic Supply

2. **Perfectly inelastic supply (e_s = 0)**: Supply of a commodity is said to have a perfectly inelastic supply when irrespective of any change in its price, its supply remains same. In other words when percentage change in quantity supplied is zero even when price changes. The elasticity of supply in this case will be equals to zero. Perfectly inelastic supply curve will be a straight vertical line.

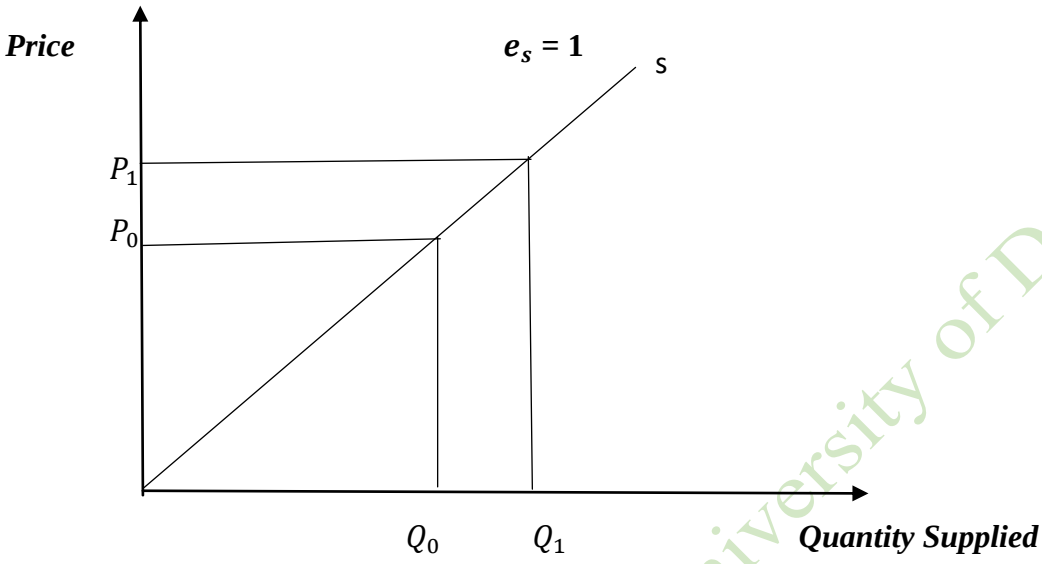


Perfectly Inelastic Supply

3. **Unit elastic supply (e_s = 1)**: Supply of a commodity is said to have a unit elastic supply when proportionate change in its price leads to an equal proportionate change

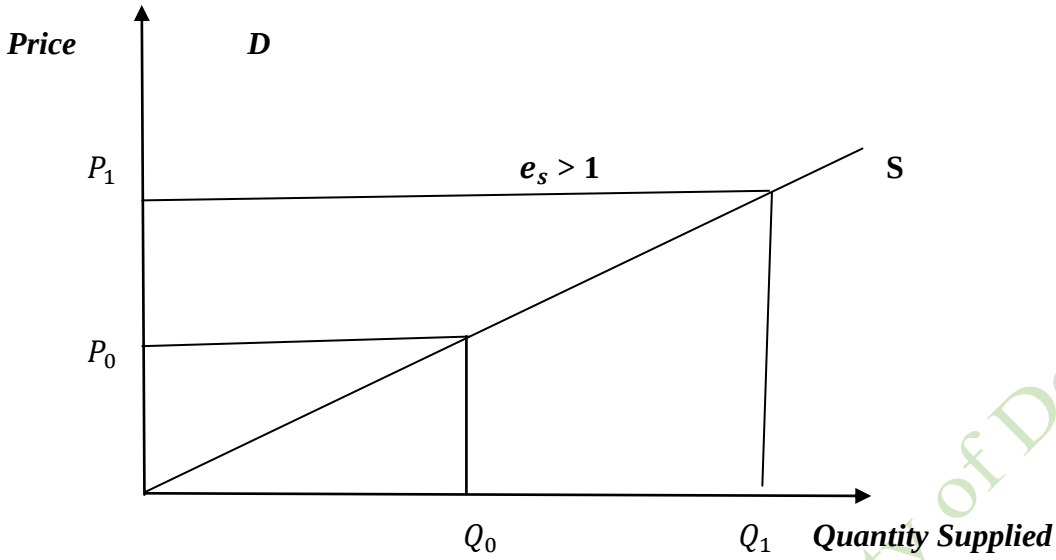
in its supply. In other words when percentage change in quantity supplied is equals to percentage change in price. In the fig. below it is very much clear that the change in price (P_0P_1) is same as change in quantity supplied (Q_0Q_1). The elasticity of supply in this case will be equals to one.

5.



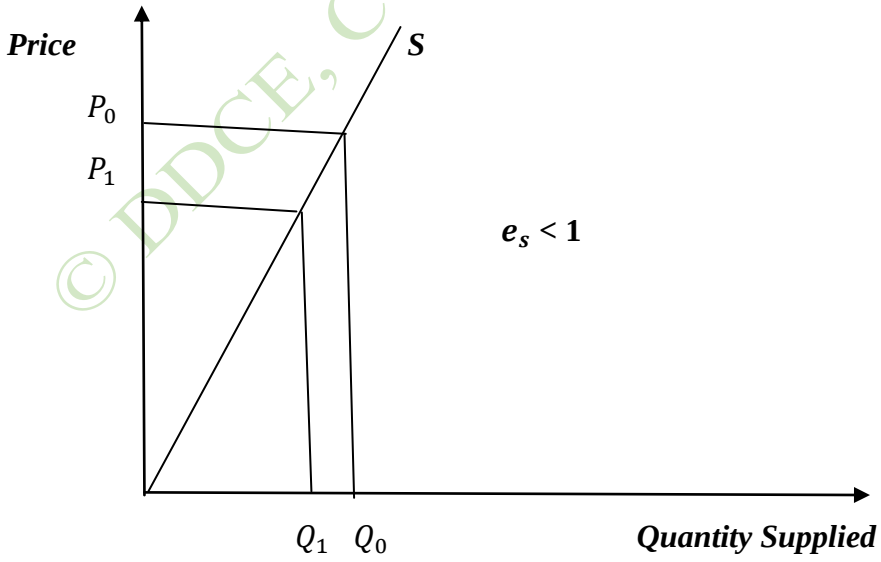
Unit Elastic Supply

4. **More than unit elastic supply ($e_s > 1$)**: Supply of a commodity is said to have more than unit elastic supply when a small change in its price leads to a higher change in its quantity supplied. In other words, more than unit elastic supply means when percentage change in quantity supplied of a commodity is higher than the percentage change in its price. In the curve below you can see the change in quantity supplied (Q_0Q_1) is greater than the change in prices (P_0P_1). The elasticity of supply in this case will be more than one. More than unit elastic demand is also referred as elastic or relatively elastic demand. The shape of supply curve in this case will be a flatter one.



Elastic Demand

5. **Less than unit elastic supply ($e_s < 1$):** Supply of a commodity is said to have less than unit elastic supply when a change in its price leads to a very small change in its supply. In other words, less than unit elastic supply means when a percentage change in the quantity supplied of a commodity is lesser than a percentage change in its price. The elasticity of supply in this case will be less than one. In the curve below you can see the change in quantity supplied (Q_0Q_1) is lesser than the change in prices (P_0P_1). The shape of supply curve in this case will be a steeper one. Less than unit elastic supply is also referred as inelastic or relatively inelastic supply.



Inelastic Supply

Price Elasticity of Supply		
Numerical Measure of e_s	**Description**	**Terminology**
Zero (e_s = 0)	Quantity supplied remains same as price changes	Perfectly inelastic supply
More than zero but less than one (0 < $e_s < 1$)	Change in quantity supplied is less than change in price	Inelastic supply
One (e_s = 1)	Change in quantity supplied is same as change in price	Unit elastic supply
More than one but less than infinity (1 < $e_s < \infty$)	Change in quantity supplied is more than change in price	Elastic supply
Infinity ($e_s = \infty$)	Quantity supplied changes although there is no change in price	Perfectly elastic supply

2.7.2 Methods of Measuring Elasticity of Supply

We have discussed conceptually about the elasticity of supply and its degrees. Elasticity of supply is measured the below formula:

$$(-)e_s = \frac{Percentage\ change\ in\ quantity\ supplied}{Percentage\ change\ in\ price}$$

Or

$$= \frac{\Delta Q}{\Delta P} \times \frac{P_0}{Q_0}$$

IN-TEXT QUESTIONS

13. The elasticity of supply is the percentage change is _____ due to percentage change in _____.
14. The price elasticity of supply for good X is 0.2. If price of good X increases by 40%, what would happen to the quantity supplied of good X.

2.8 SUMMARY

Elasticity is a measure of relationship between two variables, where we find the impact of one variable on another variable. Elasticity of demand measures the change in demand of a commodity due to a change in a variable affecting demand. There are three main measures of elasticity of demand. First, price elasticity of demand which measures the change in demand of a commodity due to a change in its price. When the demand is price elastic it means demand is more responsive to price and inelastic demand means demand is less responsive to price. Second, cross price elasticity of demand which measures the change in demand of a commodity due to a change in price of another commodity. It is positive in case of substitute goods and negative in case of complementary goods. Third, income elasticity of demand which measures the change in demand of a commodity due to a change in consumer's income. It is positive in case of normal goods and negative in case of inferior goods. Elasticity of demand is very useful for firms while policy formulation and pricing decisions.

Elasticity of supply is a measure to find the change in supply of a commodity when price of that commodity changes. It means a percentage change in quantity supplied of a commodity divided by a percentage change in its price. When the supply is price elastic it means supply is more responsive to price and inelastic supply means supply is less responsive to price.

2.9 GLOSSARY

Elasticity: Responsiveness of one variable with respect to another variable.

Elasticity of demand: It is a measure of change in demand of a commodity due to a change in the price of that commodity.

Elastic demand: When a little change in price of a commodity has a larger impact on its quantity demanded.

Inelastic demand: It is a measure of change in demand of a commodity due to a change in the consumer's income.

Cross elasticity of demand: It is a measure of degree of responsiveness of demand of a commodity with respect to change in price of a related commodity.

Income elasticity of demand: It is a measure of degree of responsiveness of demand of a commodity with respect to change in income of the consumer.

Elasticity of supply: It is a measure of degree of responsiveness of supply with respect to change in price.

Elastic supply: When a little change in price of a commodity has a larger impact on its quantity supplied.

Inelastic supply: When a change in price of a commodity has a very little impact on its quantity supplied**.**

2.10 ANSWERS TO IN-TEXT QUESTIONS

1. b) inelastic
2. d) relatively inelastic
3. a) perfectly elastic
4. perfectly inelastic
5. equals to 1
6. income elasticity of demand
7. positive; negative
8. highly elastic
9. inferior goods
10. b) total revenue would decrease
11. negative
12. b) goods with relatively high income elasticity of demand
13. quantity supplied; price
14. 80%

2.11 SELF-ASSESSMENT QUESTIONS

1. Explain determinants of price elasticity of demand.
2. Discuss various types of elasticity of demand.
3. Discuss in detail income elasticity of demand in case of normal and inferior goods.
4. What is the difference between Arc elasticity and point elasticity method of measuring elasticity of demand.
5. Explain total outlay method of finding elasticity demand of the commodity.
6. Suppose a milk vendor sells 100 cartons of milk every day and price elasticity of demand is 1.7. What will be the new quantity of milk he will sell when he decreases the price of milk by 10%.
7. Price of a medicine is increased by 50% but there is no change in the quantity demanded. What is the price of price elasticity of medicine and why?
8. Explain the reasons why a commodity's demand might be inelastic.
9. What will be the elasticity of demand at a point when price is Rs. 20 and quantity demanded is 200 units, when the demand function is $P = 50 - .25P$.

UNIT: 02

THEORY OF CONSUMER BEHAVIOUR

Campus of Open Learning
School of Open Learning
University of Delhi

LESSON 3

THEORIES OF DEMAND

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Structure

3.1 Learning Objective

- To introduce the Demand concepts and function
- To define Utility and Revealed preference hypothesis
- To understand the use of demand forecasting and demand schedule curve in managerial economics

3.2 INTRODUCTION

This unit will contain an analysis of demand, indifference curve and demand forecasting. At the end of this chapter, the reader will understand that demand evaluation is an essential phase of economic and financial analysis. The producers produce and provide items to meet demand. Demand and supply are market forces which offer dynamism to the financial stipulations of the country. The demand is not continually static. The adjustments in demand or elasticity of demand offer room for managerial choice making like what to produce, how to produce, when to produce, and the place to distribute the products.

3.3 THEORY OF DEMAND

The demand for anything, at a given price, is the amount of it that will be bought per unit of time at that price. Demand means always demanding something at a price. Demand means always demanding something at a price; the term has no significance unless a price is stated or implied.

According to Chapman, 'Demand is the quantitative expression of preferences'.

According to Hansen, "quantity of a commodity that will be purchased at a particular price and not merely the desire of a thing"

Clearly, demand may be defined as the quantity of goods or services desired by an individual, backed by their ability and willingness to pay. It may be noted that demand is not the same as desire or need. Doubtless, many people who cannot afford a motor car would like one, and doubtless many children need more milk than they get, but unless desire or need is backed up by ability and willingness to pay, it does not affect the volume of sales. The demand for a thing at a given price is the amount of it that would in fact be bought at that price.

Types of Demand:

1 **Direct and indirect demand**: The demand for consumer's good which satisfy human wants is called as direct demand .For instance, let us take the case of food for which demand is direct, another example is demand for T-shirts On the contrary when same good satisfies human wants indirectly, is known as indirect demand hand demand for goods that are used by producers for producing goods and services. (example: Demand for cotton by a textile mill)

2 **Joint demand and composite demand**: The demand for one commodity leading to the demand for another commodity is known as joint demand. For example, demand for ink and paper is joint demand. On the other hand, demand is said to be composite when a thing is demanded for two or many other purposes. The demand of coal and rubber is composite as they are used for several purposes.

3 **Price demand**: Price demand refers to the various quantities of the commodity which the consumer is willing to buy per unit of time and at certain price (other things remaining

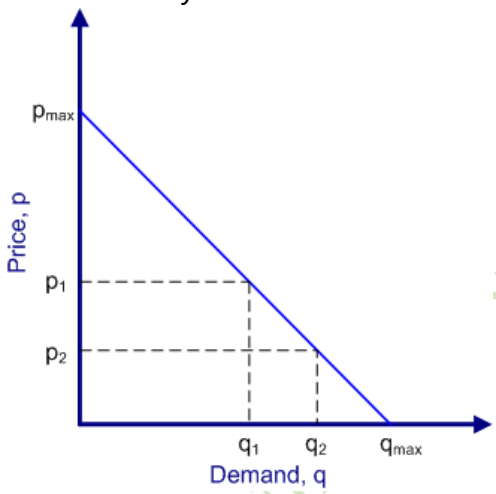
the same). The quantity demand changes with the change in price. The quantity demand increases with a fall in price and the quantity demand falls with an increase in price. In other words we can say that quantity demanded and price have a negative correlation as

$D_A = f(P_A)$,

Where D_A = Demand for Commodity A

f = function

P_A= Price of commodity A



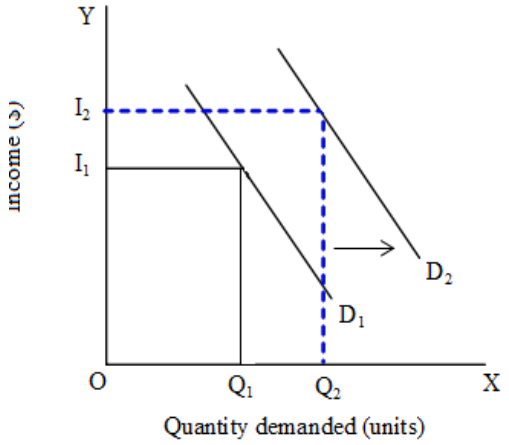
4 **Income demand (Normal Goods):** Income demand indicates the relationship between income and demand of the consumer. The income demand shows how much quantity a consumer is willing to buy at different levels of his income. Generally there is a positive relationship between income and demand of the consumer.

$D_i = f(Y_i)$,

where D_i = Demand for Commodity i

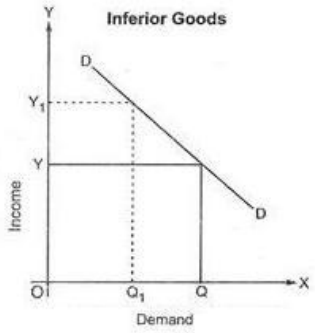
f = function

Y_i = Income of commodity i

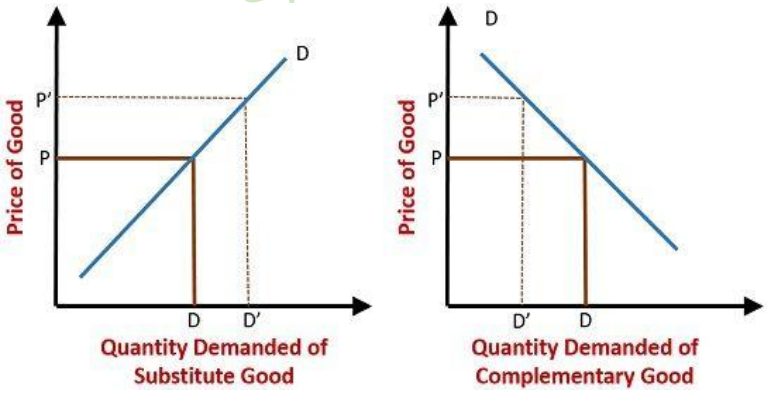


As per the above figure indicates that as the income of the consumer increases demand also increases when income falls demand also decreases

Inferior Goods: In case of Inferior goods, the relationship between Income and demand becomes negative. It is only due to the reason that so long as the income of the consumer remains below a particular level of minimum subsistence, he will continue to buy more of inferior goods even when his income increases by small increments. But when his income starts rising above the subsistence level he reduces his demand for inferior goods.



5 **Cross Demand**: Cross demand refers to the relationship between quantity demanded of good 'A' and price of related good 'B' other things being equal. In simple words, from cross demand we mean the change in the quantity demanded of a commodity without any change in its price, due to change in the price of related goods i.e, B commodity. The related goods can either be substitute good or complementary good. The demand curve in the case of substitute goods will be upward sloping while the demand curve in case of complimentary goods will be downward sloping.



3.4. Law of Demand

Law of demand is one of important laws of economic theory. This law is based on the law of diminishing marginal utility. This law states the relationship [p between the quantity demanded and price.

Marshall explains the law as, '' The amount demanded increases with a fall in price and diminishes with a rise in price''

It means that the quantity demanded expands with a fall in price and vice versa. In other words, when the price of a commodity falls, the demand for the commodity increases and when the price rises, the demand for the commodity decreases. However it can be explained as:

$$D_X = f(P_x, P_n, Y, T)$$

Where, DX = Demand for commodity X

Px = Price of the commodity x

Pn= Price of the related commodities

Y = Income of the Consumer

T = Taste

Assumption

According to Stigler and Boulding, the law of demand is based on the following assumptions:

- There should be no change in the income of the consumers
- There should be no change the taste of preferences of the consumers
- Price of the related commodities should remain unchanged
- There should be no change in the size of population
- The commodity in question should be a normal one
- There should be perfect competition in the market

Explanation of the law

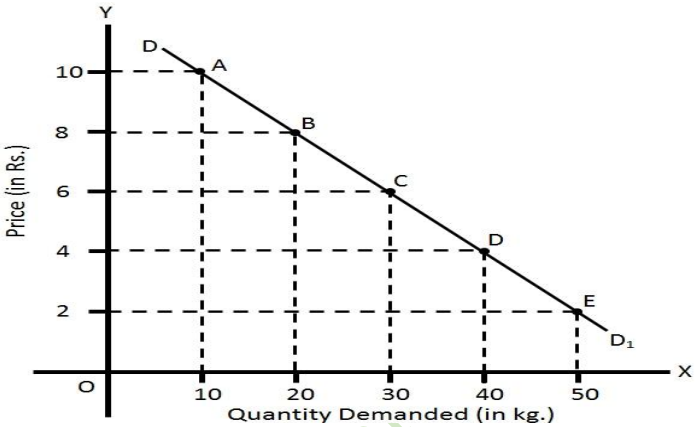
The law of demand states that there is inverse relation between the price and demand for a commodity. The demand of a commodity is more at a lower price and less at a higher price. Although, this relationship is not proportional yet it does not mean that when price falls by one-half the demand for good will be doubled. It simply shows the direction of change in demand as a result of change in price.

a) Tabular representation

Price/kg.(in Rupees)	Quantity Demanded (in Kgs.)
10	10
8	20
6	30

4 2	40 50

It is clear from the above table that with the fall in the price per kg. Quantity demand rises and as the price goes on rising, quantity demanded goes on falling, e.g. when the price of Apple is Rs. 8 per kg. , the quantity demanded of apples to 10 kg., and as the price falls from Rs. 8 to 2 , the quantity demand of apples increases from 10 to 50 kg, thereby establishing a negative relationship between price and quantity demanded.



In this figure along X-axis represents the quantity demanded of apples and Y axis represents the, prices of apples. if price decreases then quantity increases.

Why does the Demand Curve slope downward?

There are several reasons for the inverse price and quantity demanded relationships. These have explained below:

1. **Law of Diminishing Marginal Utility**: The law of demand is based on the law of diminishing marginal utility which states that as the consumer purchases more and more units of a commodity, the utility derived from each successive unit goes on decreasing. It means as the price of the commodity falls, consumer purchases more of the commodity such that his marginal utility from the commodity is equal to the reduced price and vice versa.
2. Another reason for law of demand is the price effect, which is made up of substitution and income effect **Substitution Effect**: Substitution effect also leads to an increase in quantity demanded of a commodity when it becomes relatively cheap. As the price of a commodity falls, price of its substitute goods remaining the same, the consumer will buy more of that commodity. For instance, tea and coffee are substitute goods. If the price of tea goes down, the consumer may substitute tea or coffee, although price of coffee remains the same. Therefore, with a fall in price, the demand will increase due to favorable substitution effect.
3. **Income Effect**: As the price of the commodity falls, the real income of the consumer goes up. An increase in real income increases the demand for that commdity.
4. **Psychological Effects:** When the price of a commodity falls, people favour to buy more which is natural and psychological. Therefore the demand increases with the

fall in prices. For example, when the price of silk falls, it is purchased for all family members.

Importance of the Law

The law of demand has great theoretical and practical importance in economics as:

1. **Price Determination**: The law of demand is useful to the monopolist to fix the price of their products. The monopolist get know that how much quantity of the commodity will increase or decrease with the change in price.
2. **Importance of the Consumer**: The law of demand tells us that with the fall in price the consumer will buy more of the commodity. On the other hand with the increase in price , he will buy less of that commodity. Thus, the consumer maximizes his satisfaction
3. **Importance to finance minister**: The finance minister while imposing the tax keeps in mind the law of demand. It is the law through which he comes to know the effect of tax on amount demanded of various commodities.
4. **Importance for Planning**: The law of demand has a great importance for the planning commission. The Planning commission while framing the policies the plan keeps in mind not only the demand schedule but also the effect of price on a commodity.
5. **Importance for producers**: The law of demand provides guidelines to the producers regarding the production of those goods whose prices have reduced. Generally, the law of demand states that other things being equal with the rise in price, quantity demand falls and with the fall in price, quantity demand increases. Therefore, it is for the welfare of the producers to concentrate on the production of those goods which prices have been reduced.
6. **Importance for Farmers**: The farmers also through the law of demand come to know how a good or bad crop affects the economic condition of the country. If there is good crop, the price will certainly go down and the farmers will not be benefited more but the rest of society will be benefited

3.2. Utility Function

3.2.1 Utility

The term 'utility' refers to that quality of a commodity by virtue of which our wants are satisfied. In other word, power of a good to satisfy the wants is called utility. Utility can also be defined as the satisfaction which one gets from the consumption of a good i.e its value-in-use. Commodities when they are used, also give pleasure or pain to the consumer. Whatever the effects of goods may be, they satisfy human wants. As long as goods satisfy human wants , they are said to possess utility. It has been observed that intangible goods like the services of doctors, teachers, and artist satisfy human wants as much as tangible goods. Thus both tangible goods and intangible services yield utility to the consumer.

According to **Prof. Hibdon**, 'Utility is the ability of a good to satisfy a want'

According to **J.S.Nicholson, '**Utility may be the quality which makes a thing desirable.

3.2.2 Concepts of Utility

The concepts of utility can be explain on the basis of the consumption of a commodity as-

1. **Initial Utility**:

Initial utility means the utility derived from the consumption of its first unit. In other words, when the consumer consumes a commodity and the consumer gets the utility at the first stage, it is known as initial utility. It is always positive. For instance, when a man starts taking chapti or roti, the utility from the first unit obtained is the initial utility.

2. **Marginal Utility**:

It refers to the additional utility on account of the consumption of an additional unit of a commodity. According to prof. Boulding, 'The marginal utility which results from a unit increase in consumption'. Prof. Chapman says, 'Marginal Utility is addition made to total utility by consuming one more unit of a commodity'. Marginal utility can be expressed as

$MU_{nth} = TU_n - TU_{n-1}$

Where, MU_{nth}= Marginal utility of nth unit

TU_n= Total Utility of n units

TU_{n-1}= Total utility of n-1 units

For example- When a consumer consumes one roti, he gets total utility equal to 10 units. By consuming second roti total utility becomes 18 units i.e. 10+8. Therefore, marginal utility of the second roti is 8 units i.e.8= 18-10

There are three types of marginal utility:

- **Positive Marginal Utility**: When total utility increase with the consumption of a commodity, it is called positive marginal utility. Let us suppose. When one eats roti, one gets utility from every successive unit as 10,18,24,28,30------- we see that total utility increase constantly. This is a case of positive marginal utility.
- **Zero Marginal utility:** Zero Marginal utility occurs when there is no addition to the total utility by the consumption of an additional unit.. In the above example as total utility reaches 30 by using the fifth unit of an article (roti). One gets the same total utility i.e. 30 at the next unit (sixth unit). Thus here the consumer gets zero marginal utility.
- **Negative Marginal Utility**: In the above examples, when the consumer uses the 7^{th} unit, the total utility diminishes by using one more unit i.e. from 6^{th} unit to 7^{th} unit, total utility is 28 units. Therefore, at this stage, the consumer gets negative marginal utility after obtaining maximum satisfaction from the commodity i.e. Roti (28-20 = -2)

3. **Total Utility:**

Total utility refers to the total satisfaction received by the consumer by the consumption of all units taken together at a time. According to Leftwitch, 'Total utility refers to the total satisfaction from consuming various quantities of a commodity'. In mathematical terms, total utility is a positive function of the number of units of a commodity. It can be written as

$TU_X = f(Q_X)$

Where TU_x = Total utility of a commodity X

f= function of Qx

Q_X = Quantity of a commodity X

Relations between Total Utility and Marginal Utility

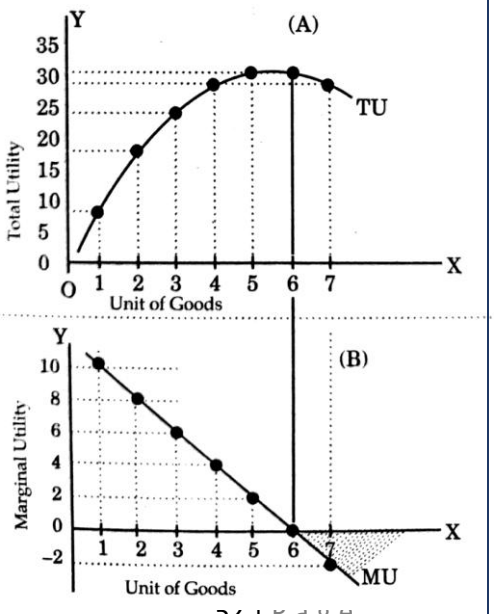
Qunatity	Total Utility	Marginal Utility	
1	10	10	Initial Utility
2	18	18-10=8	
3	24	24-18 = 6	Positive
4	28	28-24 = 4	
5	30	30-28 = 2	
6	30	30-30 = 0	Zero
7	28	28-30 = -2	Negative

It is clear from table that total utility increases with very successive unit consumed by the consumer. At the first unit total utility is equal to 10 which is initial utility and further, it is increase to 18,24,28,30. Here we must remember that this increase is at a diminishing rate, but still it is positive utility. At 6th unit, total utility is constant i.e. 30 units and after that starts declining at an increasing rate. At 7th unit, total utility is recorded as 28 units. Therefore, we can say that total utility goes on increasing as long as the marginal utility of a commodity remains positive.

On the other hand, at the first unit of consumption marginal utility is equal to 10 and with successive units; it goes on falling till 5th unit of commodity is consumed. At 6th unit, marginal utility becomes zero, the point of maximum satisfaction or point of saturation. Here consumer gets maximum satisfaction. At 7th unit, marginal utility is -2 i.e. negative. This means the point of over satisfaction.

Diagrammatic Representation of Total Utility and Marginal utility

The relationship between total utility and marginal utility can be shown with the help of this diagram. In this figure, on the X-axis, units of commodity while on Y-axis, marginal utility and price have been measured. Point 'A' indicates initial utility i.e. utility obtained from the first unit. Total Utility goes on increasing from A to M i.e, up to 5th unit. Corresponding to this, marginal utility (MU) falls at 6th unit where it becomes zero at point P, after that MU becomes negatives (-2). Total utility is maximum at point M when marginal utility is zero. After M, total starts falling and so marginal utility becomes negative i.e, below X-axis. Therefore, we can say that total utility (TU) and marginal utility (MU) start from the same point. Similarly, when total utility falls, marginal utility becomes negative.



3.2.3. Approaches of the consumer Behavior

There are two approaches of consumer behavior i.e.

a) Cardinal Approach – Marshallian View
b) Ordinal Approach – Hickian View

Cardinal approach

Under cardinal approach there are two main laws i.e. i) law of Diminishing Marginal Utility ii) Law of Equi-Marginal Utility

i)Law of Diminishing Marginal Utility

This law was first of all given by French engineer, Gossen. According to this law as an individual goes on consuming a commodity, the marginal utility obtained from its additional units goes on diminishing, for example, when one man is hungry and starts to get the roti. The utility is maximum at first unit of roti. He gets lesser utility when he consumes the second unit Roti. This process goes on and utility at every step goes on diminishing. Therefore, it is called Gossen's First law. Dr. Marshall explained the law in a better way. He says that 'the additional benefit which a person derives from a given increase of his stock of thing diminishes with every increases in the stock that he already has'.

According to **Chapman,** 'The more we have of thing, the less we want additional increments of it or the more we want not to have additional increment of it'

According to **Anatol Murad**, 'The law states that other things being equal, the marginal utility of a stock decreases as the quantity of the stock increases.

According to **Samuelson**, 'As the amount consumed of a good increases, the marginal utility of the good leads to decrease'

Assumptions:

The main assumptions of the law are as stated as:

- Utility can be measured in cardinal number like 1,2,3……..n units.
- The utility of a commodity depends on its own quantity rather than the quantities of other commodities.
- The law applies only when the commodity is continual consumed
- All units consumed by the consumer are same in all respect i.e. same color, shape, and taste etc.
- Marginal utility of money remains constant
- There is no change in the price of the commodity and its substitute.
- There is no change in the taste, habits, fashion of the consumer.

Explanation of the law

Units	Total Unity	Marginal utility
1	12	12 Initial utility
2	20	8
3	26	6
4	30	4 Positive utility
5	32	2

6	32	0
7	30	-2
8	26	-4 Negative

Above table shows that total utility is 12 from first unit and as more and more units are consumed a total utility increase 20, 26, 30, 32…….up to 5th unit at a diminishing rate. At 6th unit total utility is constant and after that it total utility starts diminishing. On the other hand, marginal utility refers to the successive increment in total utility. It is clear from the table that the first units yield 12 of marginal utility. This will satisfy the want to consumer to some extent and the intensity of want will come down. At the second unit, one gets lesser marginal utility than the first unit. Similarly, at the 3rd unit, one gets lesser marginal utility as compared to second unit. This process will go up to fourth and fifth unit. The sixth unit zero marginal utility. Now if consumer is forced to take seventh unit, it will upset the entire system and the consumer gets zero utility. In other words, the consumer will get the negative marginal utility. At seventh unit one gets negative i.e. -2 and followed by -4 marginal utility. In short, we may conclude from the above analysis that as the consumer buys more and more units of a commodity, the marginal utility from each successive unit will go on decreasing.

Diagrammatical Representation of the law

In this figure, units of a commodity are measured on X-axis where as marginal utility on Y-axis.

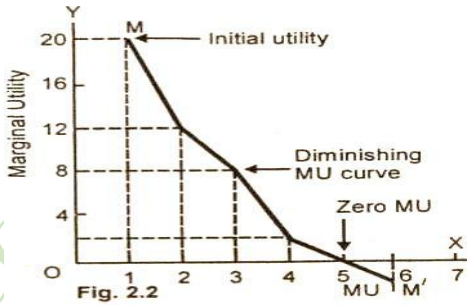


Fig. 2.2

MU is the marginal utility curve which slopes downward from left to right. It shows that the first unit of the commodity yields 20 units and second 12 units and so on. At 5th unit one gets zero marginal utility. Here the MU curve touches the X-axis at point MU. At 6th unit, one gets negative marginal utility and therefore, the MU curve goes below the X-axis.. It proves that marginal utility from an additional unit goes on decreasing and so on.

Exceptions of the law

The law is universally applicable if all assumptions are fully met with. But in practical life, it is not so. Therefore, there are exceptions which are briefly discussed below:

- **Rare Things**: The foremost exception of the law is that it doesnot apply in the case of certain rare things like stamps, coins etc. But this exception cannot be regarded genuine because the assumption of homogeneity is violated.

- **Initial Stages**: When the initial units of commodity are used in less than appropriate quantity, the marginal utility from additional units increases.
- **Public Goods:** In case of public utility goods, marginal utility from additional increases. But this assumption is contrary to the law of diminishing marginal utility.
- **Misers:** It is stated that as the stock of money with a miser increases, the greed for acquiring more and more money increases. It means the law of diminishing marginal utility does not apply in the case of misers.
- **Ostentatious**: The present law is also not applicable in the case of display. For instance, in case of fashion and taste, the law is not properly applicable.
- **Discontinuous Consumption**: The law of diminishing marginal utility does not apply if there is time lag between the uses of commodity. It requires the continuous consumption for its application.

ii) Law of eqi-marginal Utility

The law of eqi-marginal utility was propounded in 19th century by a French engineer named Gossen. The law is nothing but an extenstion of the law of diminishing marginal utility. The law of diminishing marginal utility applies in the case of single commodity. In reality, the consumer doesnot consume one commodity but a number of commodities at a given time. Therefore, for this purpose, we have to extend the law of diminishing marginal utility to multiple commodities which we call the Law of Eqi-Marginal Utility. It is also called Gossen's second law. Moreover, different economists have called it differently. Dr. Marshall has called it 'Law of Maximum Satisfaction'. Similarly, Prof. Hibdon named it 'Law of Rational Consumer' and Robbins 'Law of Economics' etc.

Statement of the Law

The law of equi-marginal utility may be defined as under:

$MU_a/P_a = MU_b/P_b = MU_n/P_n$

According to **Samuelson**, 'A consumer gets maximum satisfaction when the ratio of marginal utilities of all commodities and their price is equal.

According to **Lipsey**, 'The household maximizing its utility will so allocate its expenditure between commodities that the utility of the last penny spent on each is equal'

According to **Hicks,** 'Utility will be maximized when the marginal unit of expenditure in each direction brings the same increment of utility'.

Assumption:

The law of equi-marginal utility is based on the following assumptions:

- Every consumer wants to maximize his satisfaction
- Price of the commodity remains constant. No change in the prices of substitutes or complimentary goods.
- Income of the consumer remains constant.
- Commodities can be divided and sub-divided into the required commodities.
- Marginal Utility of money remains constant.

- Consumer has a rational behavior.
- No change in money, taste, fashion, habits and customs of the consumer.

Explanation of the law

Let us suppose that the consumer has to spend Rs. 5 on two different commodities viz. mangoes and oranges. Further, we assume that price of each of the commodities is Rs. 1. Marginal utilities of different units of mangoes and oranges are shown in the table:

Unit Rs.	M.U. of mango	M.U. of Orange
1	8(2)	10(1)
2	6(4)	8(3)
3	4	6(5)
4	2	4
5	1	2

Let us assume that at one time, the consumer spends his income on two commodites. The consumer spends first rupee on oranges which yields him 10 units of marginal utility. From the second rupee, he gets utility equal to 8 units. Now as one goes on spending more and more, the marginal utility goes on falling. On the other hand, if the consumer spends first rupee on mangoes, he gets 8 unit of utility. But as one goes on spending more and more on oranges, the marginal utility of oranges goes on diminishing. Moreover, if the consumer spends Rs. 5 on oranges then he will buy only oranges, which gives 30 units of utility (10+8+6+4+2=30).

Modern Statement of the Law

Modern economists have given a new name to this law as 'Law of Proportionality'. According to them, a consumer yields maximum satisfaction only when the ratio of marginal utilities derived from different goods and their prices is equal. For example: the price of commodity-X is paise 50 and the consumer buys 10 units. The consumer gets 10 units of marginal utility from 10^{th} unit. In the same way, if the price of the commodity-X is paise 25 and the consumer buys 12 units, he gets 3 units from the 12^{th} unit. The formula to calculate the marginal utility according to modern economists is as under:

$$MU_a/P_a = MU_b/P_b = \ldots\ldots\ldots MU_n/P_n$$

Importance of the law

Let us explain the significance of the law from the following points:

1. **Consumption**: Every consumer wants to get maximum satisfaction from one's limited income. The income of the consumer is limited while his wants are multiple. Therefore, if a consumer spends his limited income on different commodities in such a way that marginal utility per rupee spent is same for all commodities, then he will get maximum satisfaction.
2. **Public Finance:** The law of substitution has also its importance in the sphere of public finance. By public finance, we mean the revenue and expenditure activities of the government. At the time of levying taxes, Finance minister takes help. He levies

taxes in such a way that the marginal social sacrifice (MSS) of each tax payer is equal.

3. **Exchange:** The law also applies to exchange. Exchange means replacing of goods which gives him less utility for another which yields more utility.

Limitations or Exceptions of the Law

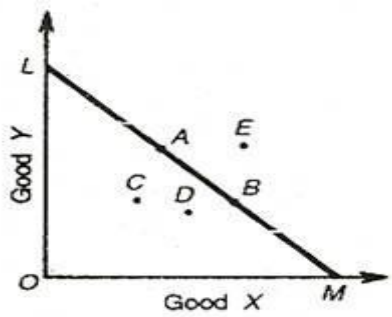
The following are the limitations of the law:

1. **Irrational Behavior of the Consumer**: This law is based on the assumption that every consumer is rational but in real sense, consumer acts in irrational manner. His behavior is greatly influenced by habits, advertisements, fashions etc. Under these cases, he fails to avail maximum satisfaction.
2. **Utility is subjective**: The law stands nowhere as consumer's behavior is based on his psychology. It is difficult to measure one's psychology or utility as it is possible in case of heat or energy.
3. **Unrealistic Assumption**: This law is based on false unrealistic assumptions like homogeneous products, constant fashion, taste, habits etc. But this is wrong as they go on changing in a dynamic world.
4. **Marginal Utility of money is not constant**: The law of equi-marginal utility is based on the assumption that marginal utility is constant. In real life, it is not so. The utility of money goes on decreasing with the passage of time, when there is a change in the price of a commodity.
5. **Ignorance of the consumer**: It is a fact that a common consumer does not possess complete knowledge of all commodities and their prices in the market. Moreover prices are subject to change. Therefore, ignorance of the consumer is a biggest hindrance, so the law does not apply properly.
6. **Indivisible Good**: Another limitation of the law is that it is not applicable in case of indivisible goods. There are certain goods which cannot be divided or sub-divided i.e. T.V., car, freeze etc. If these commodities are divided, they will loose their utility. In such cases this law is not applicable.
7. **Durable Goods**: Still another limitation of the law persists as it is difficult to measure the utility in respect of durable goods such as car and machinery.
8. **Scarcity of the Good**: In the present world, there is acute shortage of some commodities and the consumer is compelled to purchase an alternative or substitute goods in the market. In such cases, it is very difficult to measure the utility of such commodities.

3.3 Revealed Preference Theory

Prof. Samuelson's Revealed Preference Theory is a behaviorist ordinal utility analysis as distinct from the introspective ordinal utility theory of Hicks and Allen. It is the third root of the logical theory of demand, and has been called by Hicks as the Direct Consistency Test under strong ordering. This theory analyses consumer's preference for a combination of goods on the basis of observed consumer behavior in the market.

Samuelson's theory is based on the premise that choice reveals preference. Keeping this fact into view, a consumer buys a combination of two goods either because he likes this combination in relation to others or this is cheaper than others. Suppose the consumer buys combination A rather than combination B. C or D. It means that he reveals his preference for combination A. He can do this for two reasons. First, combination A may be cheaper than the other combinations B, C, D. Seconds combination A may be dearer than others and even then he likes it more than other combinations. In such a situation, it can be said that A is revealed preferred to B, C, D or B, C, D are revealed inferior to A.



Given the income and prices of the two goods X and Y, LM is the price-income line of the consumer which shows the various combinations of X and Y on the given price-income situation LM. In other words, the consumer can choose any combination between A and B on the line LM or between C and D below this line. If he chooses A, it is revealed preferred to B. Combinations C and D are revealed inferior to A because they are below the price-income line LM. But combination E is beyond the reach of the consumer being dearer for him because it lies above his price-income line LM. Therefore, A is revealed preferred to other combinations.

Assumptions:

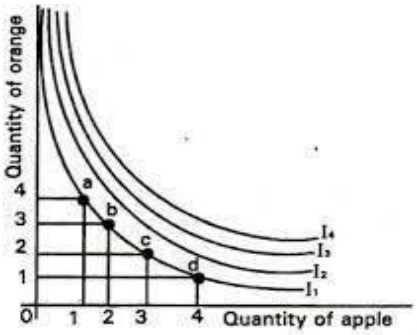
The revealed preference hypothesis is based on the following assumptions:

- The consumer's tastes do not change
- His choice for a combination reveals his preference for that.
- The Consumer chooses only one combination at a given price income line
- He prefers a combination of more goods to less in any situation
- It assumes consistency of consumer behavior. If A is preferred to B in one situation, B cannot be preferred to A in the other situation.
- This theory is based on the assumption of transitivity. Transitivity, however, refers to the three- term consistency. If it is preferred to B, and B to C, then the consumer must prefer A over C. This assumption is necessary for the revealed preference theory if consumer is to make a consistent choice from given alternative situations.

3.4 Indifference Curve

The indifference curve analysis assumes that utility is ordinal and cannot be measured. It explains consumer behavior in terms of his preferences or rankings for different combination of two goods, say X and Y. An indifference curve is drawn from the indifference schedule of

the consumer. The latter shows the various combinations of the two commodities such that the consumer is indifferent to those combinations. An indifference schedule is a list of combination of two commodities, the list being so arranged that a consumer is indifferent to the combination , preferring none of any other.



A curve which is a diagrammatic presentation of indifference set. It shows different combination of two commodities (like apples and oranges) between which a consumer is indifferent. Each combination offers him the same level of satisfaction.

Assumption of the law

The indifference curve analysis remains some of the assumptions of the cardinal theory, rejects others and formulates its own. The assumptions of the ordinal theory are the following:

i) The consumer acts rationally so as to maximize satisfaction.
ii) These are two goods X and Y.
iii) The consumers possess complete information about the prices of the good in the market.
iv) The prices of the two goods are given.
v) The consumer's taste, habits and income remain the same throughout the analysis.
vi) The consumer arranges the two goods in a scale of preferences which means that he has both 'preference' and 'indifference' for the goods.

3.5 Income Effect and Substitution Effect

Income Effect

As the price of the commodity falls, the real income of the consumer goes up. Real income is that income which is measured in terms of goods and services. For example, A consumer has Rs. 20, he wants to buy oranges whose price is Rs. 20 per dozen. It means the consumer can buy one dozen of oranges with his fixed income. Now suppose the price of oranges fall to Rs. 5 per dozens which leads to an increase in his real income to Rs. 4. In this case, either the consumer will buy more quantity of oranges than before or he will buy some other commodity with his increased income.

For most goods, the income effect asserts that as a product's price declines (increases), an individual's real income (purchasing power) increases (decreases). The increase in real purchasing power resulting from a fall in prices enables the individual to consume greater quantities of a commodity, while the oposite is true for an increase in prices. In other words, an increase in real purchasing power generally (although not always) leads to increase in quantity demanded. The goods of the types for which this phenomenon holds are referred to as normal goods. Unfortunately, the income effect does not always have the expected positive effect on the quantity demanded of a good. In some cases, as an individual's purchasing power increases, the quantity demanded for that good falls. Goods of these types are called inferior goods. Examples of such goods may be potatoes, bus tickets, soup bones, and bologna. We will return to this issue shortly when considering separately the effect of changes in money income on the demand for goods and services.

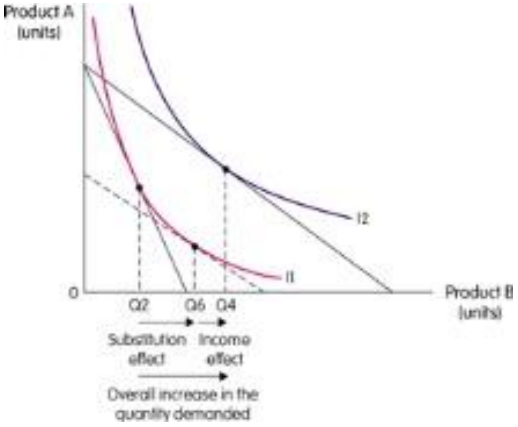
Substitution Effect

Substitution effect also leads the demand curve to slope from left downward to right. As the price of a commodity falls, prices of its substitute goods remain the same, the consumer will buy more of that commodity. For instance, tea and coffee are the substitute goods. If the price of tea goes down, the consumers may substitute tea for coffee, although price of coffee remains the same. Therefore, with a fall in price, the demand will increase due to favorable substitution effect. The substitution effect reflects changes in consumers' opportunity costs. The substitution effect states that as a product's price declines, consumers will substitute the now relatively less expensive product for similar goods that are relatively more expensive.

In the majority of cases, the income effect and the substitution effect complement and reinforce each other. That is, declines in the price of a good will not only have a positive substitution effect, but will have a positive income effect as well. As a result, the ordinary demand curve will be downward sloping. Even in the case of inferior goods, where the income effect is negative, the ordinary demand curve will exhibit a downward slope because the substitution effect, which is always positive with a drop in price, outweighs the negative income effect.

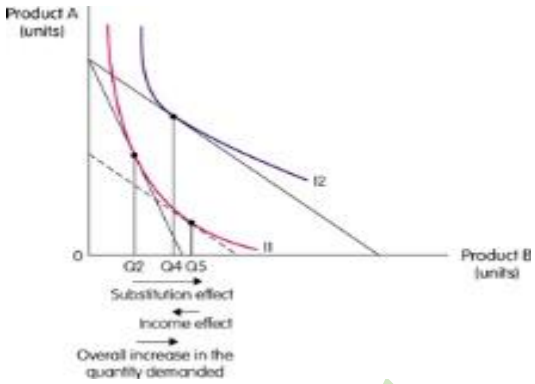
Therefore, the substitution and income effects will generally work in the same direction, causing consumers to purchase more as the price falls and less as the price rises. The indifference curve can be used to separate these two effects.

In the case of a normal good, higher real income leads to an increase in quantity demanded, this complements the increase due to the substitution effect. This change shown in the diagram below:



In the case of an inferior product, the income effect leads to a fall in the quantity demanded, which will work against the substitution effect. In the following diagram the substitution effect is Q2 to Q5; the income effect is Q5 to Q4. However, the substitution effect outweighs the income effect and overall the

quantity demanded rises. The overall change in quantity demanded results in an increase of Q2 to Q4. This means the demand curve is downward-sloping, because a price fall increases the quantity demanded.



When a good is inferior and the income effect outweighs the substitution effect, it is called a **Giffen good**. This is, however, unlikely, because the substitution effect is almost always stronger than the income effect.

3.6 Demand Functions

Demand function is a function that describe how much of a commodity will be purchased at the prevailing prices of that commodity and related commodities, alternative income levels, and alternative values of other variables affecting demand. Price is not the only factor which determines the level of demand for a good. Other important factor is income. The rise in income will lead to an increase in demand for a normal commodity. A few goods are named as inferior goods for which the demand will fall, when income rises. Another important factor which influences the demand for a good is the price of other goods. Other factors which affect the demand for a good apart from the above mentioned factors are:

Changes in Population
Changes in Fashion
Changes in Taste
Changes in Advertising

A change in demand occurs when one or more of the determinants of demand change and it is expressed in the following equation.

$Q_d X = f (P_x, P_r, Y, T, E_y, E_p, Adv.)$

Where,

$Q_d X$ = quantity demanded of good 'X'

P_x = the price of good X

P_r = the price of a related good

Y = income level of the consumer

T = taste and preference of the consumers

Ey = expected income

E_p = expected price

Adv = advertisement cost

The above mentioned demand function expresses the relationship between the demand and other factors. The quantity demanded of commodity X varies according to the price of income (Y), commodity (Px), the price of a related commodity (Pr), expected income (Ey) ,taste and preference of the consumers (T), and advertisement cost(Adv) spent by the organization.

3.6.1 Determinants of Demand:

There are many economic, social and political factors or determinants which greatly influence the demand for a commodity. Some of these factors are as follows:

1. **Price of a commodity**: The foremost significant factor which influences the demand is the price of the commodity. As the price of a commodity changes, it causes an inverse change in the demand for commodity.
2. **Price of Related Goods**: Demand for commodity is also influenced by the change in the price of related goods. These goods are of two types viz. substitute goods or complementary goods. Substitute goods are those which can replace each others in use like tea and coffee while the complimentary goods arer those which are jointly demanded as petrol and car etc. Explain the relationship between pr of related good and quantity demanded.
3. **Income of the consumer**: Income of the consumer is another factor which influences demand. Generally there is direct relation between income of the consumer and his demand. The demand for normal goods rises with an increase in income and falls with a fall in income. In the case of inferior goods, the demand falls with an increase in income and rises with decrease in income.
4. **Distribution of wealth**: The amount demanded of a commodity is also influenced by the distribution of wealth in society. If there is an equal distribution of income in the society, the demand will be higher and incase of inequality demand will be less.
5. **Tastes and preferences**: Taste and preferences of the consumer also influence the demand to a great extent. They include fashion, habits, customs, advertisement, climate, new inventions etc.
6. **Government Policy**: Government policy is also responsible to influence the demand for the commodity. The government imposes taxes on various commodities which lead to increases in the price of commodities. As a result demand goes down.
7. **Population Growth**: The growth of population is another determinant to influence the demand of a commodity. Increase in population leads to an increase in demand for all types of goods whereas decrease in population means less demand for such commodities.
8. **State of Business**: The demand for commodities also depens on business conditions prevailing in the country or region

3.6.2 Elasticity of Demand

In economics, the term elasticity means a proportionate (percentage) change in one variable relative to a proportionate (percentage) change in another variable. The quantity demanded of a good is affected by changes in the price of the good, changes in price of other goods, changes in income and changes in other factors. Elasticity is a measure of just how much of the quantity demanded will be affected due to a change in price or income. Elasticity of Demand is a technical term used by economists to describe the degree of responsiveness of the demand for a commodity due to a change in its price. A fall in price leads to an increase in quantity demanded and vice versa. The elasticity of demand may be as follows:

- Price Elasticity
- Income Elasticity and
- Cross Elasticity

i)Price Elasticity

The response of the consumers to a change in the price of a commodity is measured by the price elasticity of the commodity demand. The responsiveness of changes in quantity demanded due to changes in price is referred to as price elasticity of demand. The price elasticity of demand is measured by dividing the percentage change in quantity demanded by the percentage change in price.

Price Elasticity = Proportionate change in the Quantity Demanded /Proportionate change in price

= Percentage change in quantity demanded/Percentage change in price

$(\Delta Q/Q)/ (\Delta P /P)$

ΔQ = change in quantity demanded

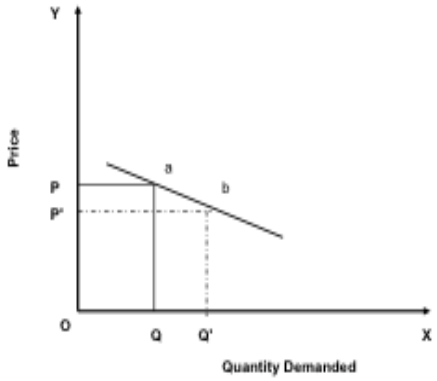
ΔP = change in price

P = price

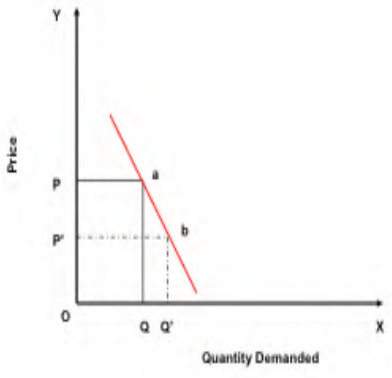
Q = quantity demanded

The following are the possible combination of changes in Price and Quantity demanded. The slope of each combination is depicted in the following graphs.

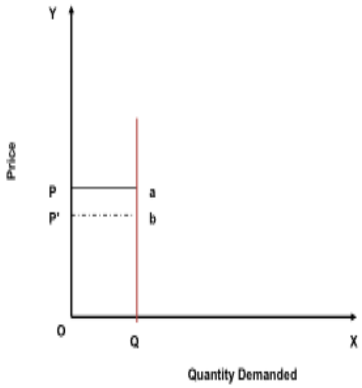
1. Relatively Elastic Demand (Ed >1) a small percentage change in price leading to a larger change in Quantity demanded.



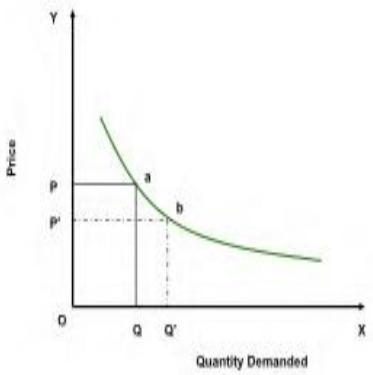
2.Perfectly Elastic Demand (Ed = ∞) a small change in price will change the quantity demanded by an infinite amount.



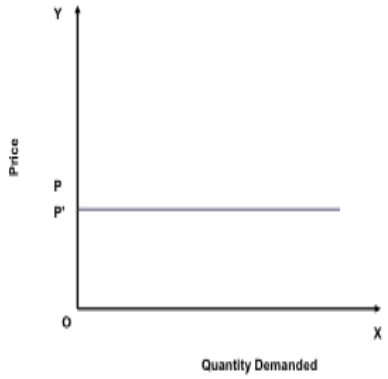
3.Relatively Inelastic Demand (Ed < 1) a change in price leads to a smaller percentage change in quantity demanded.



4.Perfectly Inelastic Demand (Ed = 0) the quantity demanded does not change regardless of the percentage change in price.



5.Unit Elasticity of Demand (Ed =1) the percentage change in quantity demanded is the same as the percentage change in price that caused it.



ii)Income Elasticity

According to Stonier and Hauge: 'Income elasticity of demand shows the way in which a consumer's purchase of any good changes as a result of change in his income'.

It shows the responsiveness of a consumers purchase of a particular commodity to a change in the quantity demanded to the percentage change in income .

$$\text{Income Elasticity of Demand} = \frac{\text{Percentage Change in Quantity Demand } (\Delta D/D)}{\text{Percentage Change in Income } (\Delta I/I)}$$

$$\text{Income Elasticity of Demand} = \frac{(D_1 - D_0) / (D_1 + D_0)}{(I_1 - I_0) / (I_1 + I_0)}$$

The following are the various types of income elasticity:

Zero Income Elasticity: The increase in income of the individual does notvmake any difference in the demand for that commodity. (Ei = 0)

Negative Income Elasticity: The increase in the income of consumers leads to less purchase of those goods. (Ei < 0).

Unitary Income Elasticity: The change in income leads to the same percentage of change in the demand for the good. (Ei = 1).

Income Elasticity is Greater than 1: The change in income increases the demand for that commodity more than the change in the income. (Ei > 1).

Income Elasticity is Less than 1: The change in income increases the demand for the commodity but at a lesser percentage than the change in the Income. (Ei < 1).

iii) Cross Elasticity

It is the ratio of proportionate change in the quantity demanded of Y to a given proportionate change in the price of the related commodity X. It is a measure of relative change in the quantity demanded of a commodity due to change in the price of its substitute complement. It can be expressed as-

$$\textbf{Cross Price Elasticity} = \%\ \textbf{change in a quantity of Good A} \mid \%\ \textbf{change in the price of a Good B}$$

If two commodities are unrelated goods, the increase in the price of one good does not result in any change in the demand for the other goods. For example the price fall in salt does not make any change in the demand for car.

Use of Elasticity Of Demand:

1. Useful for Business: It enables the business in general and the monopolists in particular to fix the price.
2. Fixation of Price: It is very useful to fix the price of jointly supplied goods
3. Fixation of Wages: It guides the producers to fix wages for labourers.
4. In the sphere of international trade: It is of greater significance in the sphere of international trade.
5. Effect on employment: The effect of machines on employment opportunities depends on elasticity of demand for the goods produced by such machines.

3.7. DEMAND FORECASTING

Demand forecast refers to the prediction or estimation of a future situation under given constraint. In a sense, the knowledge of future demand is crucial for both new firms and those planning to expand the scale of production. Since output is to be sold virtually nothing can be produced overnight, sales forecasts are required to decide the quantity of production. Therefore, forecast is a prediction of future event. It implies measurement of that event which may not cent percent correct since that much accuracy is not possible in view of the uncertainties of future. Demand forecast will help the manager to take the decisions effectively.

Objectives of Demand Forecasting:

The major short run decisions are:	The major long run decisions are:
• Purchase of inputs • Maintaining of optimum • level of inventory • Setting up sales targets • Distribution network • Management of working capital • Price policy • Promotion policy	• Expansion of existing capacity • Diversification of the product mix • Growth or acquisition • Change of location of plant • Capital issues • Long run borrowings • Manpower planning

Requirements for good demand forecasting

Demand forecasting for a commodity cannot be made merely through guess work. It requires a detailed understanding of the current and future conditions of the market in which the firms producing the commodity operate. Such understanding can be obtained through market research. For easy understanding, we may list the elements of basic requirements of demand forecasting as below:

(A) Elements Connected to Consumers

- Total number of consumers
- Distribution of consumer Products
- Total purchasing power and per capita/household income
- Income elasticites
- Consumer tastes, Social customs
- Consumer Marketing details: where they do buy and when etc
- Effect of design, colour, etc. on consumers' preferences.

(B) Element Concerning the Suppliers

- Current level of sales
- Current Stock of goods
- Trends in sale and stocks
- Market share
- Pattern of seasonal fluctuations
- Research and Development trends
- Company strength and weakness
- New product possibilities

(C) Elements Concerning the Market

- The effect of price change i.e price elasticity
- Product characteristic
- Identification of competitive and complementary products
- Number and nature of competitors
- Forms of market competition
- General price levels
- Prices of similar goods

Steps involved in Demand Forecasting

In order to have an efficient, accurate and meaningful forecasting, the management should proceed according to a systematic plan. The various steps involved on demand forecasting, are discussed as under:

1. **Clarity of objectives:** To have an efficient forecasting, one should have a clarity of objectives. It will remove the difficulties involved in the way of forecasting. A firm may use the concept to determine various things viz; allocation of funds for sale promotion, fixation of price, inventory control etc. The forecasting will differ for each and every approach.
2. **Selection of Goods:** Before forecasting, the entrepreneur might have to select the goods for which forecasting has to be made whether, it is for consumer and capital goods for existing goods.
3. **Selection of Method:** Another step involved in demand forecasting is the selection of method according to which forecasting has to be made. In fact, the scope and success of a particular method depends upon the area of investigation, degree of accuracy required, availability of data etc.
4. **Interpreting the Results:** The last but not least is the interpreting of the results. It is based on certain assumption. If there happens to be a change in the assumptions involved in forecasting, the revision of forecast will become almost inevitable.

Methods or Techniques of Demand Forecasting

Demand forecasting is a difficult exercise as consumer's behavior is most unpredictable. It is motivated and influenced by multiplicity of factors. Economists and statisticians have tried their best to develop several methods of demand forecasting. These methods are explained:

A) Consumer's Survey Method

This method uses the most direct approach to demand forecasting by directly asking the consumers about their future consumption plan. In this method, the burden of forecasting goes to the buyers. This method is very simple and free from statistical burden. It is of three types:

i)Complete Enumeration Survey
ii) Sample Survey
iii)End-Use Method

i) **Complete Enumeration Survey**: In the complete enumeration survey, the probable demands of all the consumers for the forecast period (as given by consumers themselves) are summed up to have the sales forecast for the forecast period. For example, if there are n consumers and their probable demands for commodity X in the forecast period are $X_1, X_2, X_3 \ldots\ldots\ldots X_n$, the sales forecast would be

$$X = X_1 + X_2 + X_3 \ldots\ldots\ldots + X_n$$

ii) **Sample Survey**: Under the sample survey method, the probable demand expressed by each selected unit summed up to get the total demand of sample units in the forecast period. It is then blown up to find the total demand in the market. That is, the

total sample demand is multiplied by the ratio of number of consuming units in the sample.

This method when carefully applied gives good results especially for the new products and brands. Proper care should be taken in choosing a sample size which should not be too big.

The advantages of sample survey over complete enumeration method are:

- This method is simple
- This method is less costly
- Less possibility of data error

iii) **End Use method**: The sale of a product under consideration is projected on the basis of demand survey of the industries using this product as an intermediate product. Demand for the final product is the end-use demand of the intermediate product used in the production of this final product. However, an intermediate product may have many end-uses (like steel can be used in agricultural machinery, construction, etc.). It may have demand in both domestic and international markets. The demands for final consumption and exports net of imports are estimated through some other forecasting method and its demand for intermediate use is estimated through a survey of its user industries regarding their production plans and input-output co-efficient. Then the sum of final consumption demand and exports demand net of imports of any commodity can be obtained with the help of an input-output model.

B) **Opinion Poll Method**: The opinion poll methods aim at collecting opinions of those who are supposed to possess knowledge of the market, eg, sales representatives, sales executives, professional marketing experts and consultants. The opinion poll method consist:

- Expert- opinion method
- Delphi-method
- Market studies and experiments

C) **Statistical Methods**: In the theory of demand forecasting, the statistical techniques have proved to be useful. Statistical techniques are used to maintain objectivity as well as precision in demand forecasting. Here, statistical methods have been explained which utilize historical and cross-section data for estimating long-term demand. Statistical methods are considered to be superior techniques of demand estimation for the following reasons.

- The element of subjectivity in this method is minimum
- Method of estimation is scientific
- Estimation is based on the theoretical relationship between the dependent and independent variables.
- Estimates are relatively more reliable
- Estimation involves smaller cost

Merits of Consumer Survey Method:

The advantages of this method are as under:

- This method does not require mathematical calculations
- This method is based on the first-hand knowledge of the salesman.
- It is useful to forecast the sales of new products
- This method does not require any historical data

Demerits:

Although, this method has certain advantages yet it suffers from the following disadvantages as:

- It is only a subjective approach
- It is suitable only for short-term forecasting
- Salesman lack vision and may not foresee the influence of several unknown factors
- Individual industry will have to depend on some other method to estimate the future demand of its product for final consumption.

Qualities of a good Demand Forecasting

The world is changing rapidly with the introduction of new techniques of production and highly developed infrastructure. As there are several methods of demand forecasting, it is essential to notice some qualities of a good forecasting. However, following criteria should be adopted for forecasting:

1. **Simplicity:** Any mathematical techniques of demand forecasting may be simple so that it may deliver better results.
2. **Accuracy:** For forecasting, statistical data is prerequisite. Therefore, data may be undertaken which is accurate, correct and dependable.
3. **Easy availability:** The results of a demand forecast must be easily available and well understood.
4. **Economy:** Another quality of a good demand forecast is that it must be economical. Generally, a firm keeps a balance between the benefits and the extra cost of providing the improved forecasting.

Importance of Demand Forecasting

Demand forecasting is of great significance for decision making in modern business. The main points of importance are summarized below:

1. **Planning of Production**: It is a pre-requisite for planning of production in a firm. A firm has to expand its capacity according to the likely demand for its output. Otherwise the capacity will be wasted
2. **Sales Forecasting**: Sales forecasting depends much on the demand forecast. Promotional efforts of the firm should be based on demand forecasting.
3. **Control on Business Activities**: For Satisfactory control of business inventories (raw materials, intermediate goods, semi-finished products and finished products) need regular estimates of future requirements which can be derived only from the demand forecasts.

4. **Decision/Policy making**: Demand forecasting is necessary for deciding about the growth rate of the firm, its long-term investment programmes and financial planning.
5. **Useful for Stability**: Demand forecasting is useful for stabilizing the production and employment within the firm. If dependable demand forecasts are available for the firm, then the firm can more easily design its business operation to counter the cyclical and seasonal changes in the demand for its good.

To select the appropriate forecasting technique, the manager/forecaster must be able to accomplish the following:

- Define the nature of the forecasting problem
- Explain the nature of the data under investigation
- Describe the capabilities and limitations of potentially useful forecasting techniques.
- Develop some predetermined criteria on which the selection decision can be made.

3.8 GLOSSARY

- **Demand**: it refers to various amounts of a commodity that a consumer is ready to buy at different possible prices of the commodity.
- **Individual demand schedule:** this is a table showing various quantities of a commodity which a consumer is ready to buy at different possible prices of the commodity at a point of time.
- **Market demand schedule**: it is a schedule showing various quantities of a commodity which all the buyers in the market are ready to buy by at different possible prices of the commodity at a point of time.
- **Demand curve**: this is a graphic representation of demand schedule.
- **Law of demand**: expresses inverse relationship between price of a commodity and its quantity demanded. It means that other things being equal, the demand of a commodity falls with a rise in its price and rises with a fall in its price. Geometrically, it is represented by a downward sloping demand curve.
- **Exception of the law of demand** occurs in case of i) articles of distinction ii) giffen goods and iii) ignorance of the buyers.
- **Shift in demand curve** occurs when demand for a commodity is related to factors other than price of the commodity. When more is demanded at the same price there is forward Shift in demand curve when less is demanded at the same price, there is backward shift in demand curve. Forward Shift in demand curve is a situation of increase in demand. Backward Shift in demand curve is a situation of decrease in demand.
- **Normal good** is that good whose income effect is positive and price effect is negative.

- **Giffen good:** a special case of inferior good. In case of such goods a fall in price induces reduction in quantity demanded (because of a very strong negative income effect)
- **Inferior good:** a product whose consumption decreases as income increases (i.e. its income elasticity is negative)
- **Income effect:** it refers to change in quantity demanded of a commodity when real income of the consumer changes owing to change in on price of the commodity.
- **Indifference curve**: The locus of points representing the combination of the two goods all of which give equal satisfaction to the consumer.
- **Marginal rate of substitution:** the rate at which the consumer is prepared to give up one good for acquiring another good.
- **Derived demand:** the demand for products or factors that are not directly consumed but go into the production of a final product. The demand for such a product or factor exits because there is demand for the final product.
- **Substitute good**: A product that is similar to another and can be consumed in place of it. Two goods are substitute if the quantity consumed of one increases when the price of other increases.
- **Complementary good:** a product consumed in conjunction with another product two goods are complementary if the quantity demanded of one increases when the price of other decreases.
- **Price effect:** change in the consumption of the good due to change in the price of the good.
- **Utility**: the amount of satisfaction by consuming a good or service.
- **Substitution effect**: an increase in quantity of the good whose price falls after income has been so 'adjusted' that the real purchasing power of the consumer remains the same as before.

3.9 SUMMARY

This unit has presented the basic elements of demand, consumer preference pattern and utility function, demand forecasting. The law of demand states that other factors held constant, the quantity demanded is inversely related to price. Other factors that affect demand are: i) income of consumers; ii) price of related product; iii) tastes and preferences; and iv) number of buyers. The law of demand also verified with the help of marginal utility and indifference curve analysis. The main points highlighted in this unit are:

- A change in the quantity demanded refers to a movement along a particular demand curve caused by a change in the price of the good. It is also known as extension and contraction of demand.
- A change in demand refers to a shift of demand curve the resulting from change in consumer preferences, income or prices of related goods.
- When increase in the price of one good results in increased demand of other goods, then the two goods are said to be substitutes

- When increase in the price of one good result in decrease demand of other goods, then the two goods are said to be complements.
- When the price of one good increases/decreases but the demand of other good does not change, then the two goods are unrelated.
- When the consumer consumes additional units of a goods, the marginal utility of that good declines. This is known as the law of diminishing marginal utility.
- As an additional unit of a good provides lesser and lesser utility to the consumer, the consumer will buy these additional units only at a lower price. Hence, the law of demand states that more is demanded at a lower price.
- A consumer maximize his total utility by allocating his income among goods on the basis of the law of equi-marginal utility which states that for best allocation of income the marginal utility per rupee in each good must be equal.
- An indifference curve is the locus of points representing all such combinations of the two goods which gives equal satisfaction.
- Indifference curves have the properties of negative slope, convexity and non-intersection. A higher indifference curve means higher utility.

3.10 SELF-ASSESSMENT QUESTIONS

MCQ Questions:

1. When there is a change in demand leading to a shift of the Demand Curve to the right, at the same price as before, the quantity demanded will-
   a) Decrease b)Increase c)Remain the same d) Contract
2. An exceptional demand curve is one that moves-
   a) Upward to the right b)Downward to the right c) Horizontally d) Vertically
3. Revealed Preference Theory was propounded by-
   a) Adam Smith b) Marshall c) P.A.Samuelson d) J.S.Mill
4. If two commodity are complements, then their cross-price elasticity is
   a) Zero b)Positive c) Negative d)Imaginary Number
5. 'Law of Demand' implies that when there is excess demand for a commodity then—
   a) Price of commodity falls
   b) Price of Commodity remain same
   c) Price of Commodity rises
   d) Quantity demanded of the commodity falls
6. Which one of the following factors does not shifts the demand curve for a product to the right?
   a) Successful advertising
   b) A fall in the price of its complements
   c) A rise in the price of its substitutes
   d) A fall in the price of the product itself
7. A movement along the demand curve of a non-economic good?
   a) Income of the consumer b)Its own Price c)Taste of the consumers
   d) Expectations of the Consumer

8. The term optimum allocation on consumer's expenditure on consumer's expenditure on various goods and services is used in-
   a) Giffen paradox b) Law of demand c) Law of equi-marginal utility d)Law of diminishing marginal utility
9. A high value of cross-elasticity indicates that the two commodities are-
   a) Very good substitutes b)Good complements c)Poor substitutes d) Poor complements
10. Marginal Utility has no place in a ordinal theory because it is-
    a)Not observable b) Subjective c)Introspective d)Additive
11. Total Utility of a commodity can be found by-
    a) Multiplying price by number of units
    b) Adding up the marginal utility of all units
    c) Multiplying the number of units by marginal utility
    d) None of these
12. In the case of an inferior commodity, the income elasticity of demand is
    a) Infinity b) Unitary c) Negative d) Positive
13. Income elasticity of demand will be zero when a given change in income brings about-
    a) The same proportionate change in demand
    b) A more than proportionate change in quantity demanded
    c) A less than proportionate change in quantity demanded
    d) No change in demand
14. Indifference curve is downward sloping from left to right since more X and less Y give
    a)Less satisfaction b)More Satisfaction c)Equal Satisfaction d)Maximum Satisfaction
15. The indifference curve which is 'L' shape represents
    a)Perfect Complementarity b) Perfect Substitutability c)No Substitutability d)Non complementarity

Answers

1. b 2.b 3.c 4.c 5.c 6.b 7.b 8.c 9.a 10. d 11. b 12.c 13.d 14.c 15.a

Short Question

1. List the types of demand.
2. Point out any two determinants of demand.
3. Write down the main assumption of law of demand
4. Explain the following: Marginal Utility, Initial utility, Total Utility
5. What do you mean by utility?
6. Briefly explain Revealed Preference hypothesis.
7. Define Income elasticity?
8. Define cross elasticity of demand?
9. Describe the qualities of a good demand forecasting
10. Discuss the various methods of demand forecasting

Long Question

1. State the law of demand.
2. What are the assumptions of the law of diminishing marginal utility?
3. Give the relationship between marginal utility and total utility.
4. Examine the law of diminishing Marginal Utility. What are its assumption, expectations and importance?
5. Explain the law of equi-marginal utility. What are its assumptions, limitations and usefulness?
6. What is Price elasticity of Demand and how is it measured?
7. Define the concept of Demand forecasting. Explaining its objectives in economic theory.
8. Explain Law of demand. Explain the exceptional situation when the demand for a commodity may increase even when its price increases.
9. Discuss the various methods of demand forecasting.
10. Define indifference curve and its assumption with income and substitution effect.
11. What is elasticity of demand? Draw the various degrees of it with diagrams.

3.11. References

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UNIT: 03

PRODUCER AND OPTIMAL PRODUCTION CHOICE

Campus of Open Learning
School of Open Learning
University of Delhi

LESSON 4

THEORY OF PRODUCTION

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STRUCTURE

4.1 LEARNING OBJECTIVES

The objective of this lesson is to introduce students to the concept and working of Production in both the short run and long run. This lesson will equip students with the necessary theory and techniques and the ability to apply them to inform and enhance managerial decision-making along with the use of Economic tools to explain the optimal allocation of resources within the firm and also use the tools of economic theory to obtain optimal production.

4.2 INTRODUCTION

In previous lessons, we have looked at demand, supply and how the interaction of demand and supply affects market price. According to the Law of Supply, firms are willing to produce and sell more when the price is higher and hence the supply curve is upward sloping. This lesson will examine firm behaviour and supply-side decision-making.

We will understand firms and their profit-maximizing goals. we will identify the most profitable level of production for a firm and how its costs vary with output. Firstly, we will have a look at short-run production, when a firm can vary only one factor of production which is called the law of diminishing returns. The second part deals with the long run when all the factors of production are variable. We will also discuss how firms make decisions to achieve maximum profits.

Many forms are operating in an economy at different scales, some are large-scale firms operating within the country, some are multinational organizations and some are small-scale firms. Every firm uses a different proportion of factor of production according to the scale of an operation like there might be several Pizza outlets like Domino, Pizza Hut etc. in your city but there might be only one dry cleaner shop. Many firms in a particular area determine their pricing and efficiency.

Managerial decision-making involves four types of production decisions:

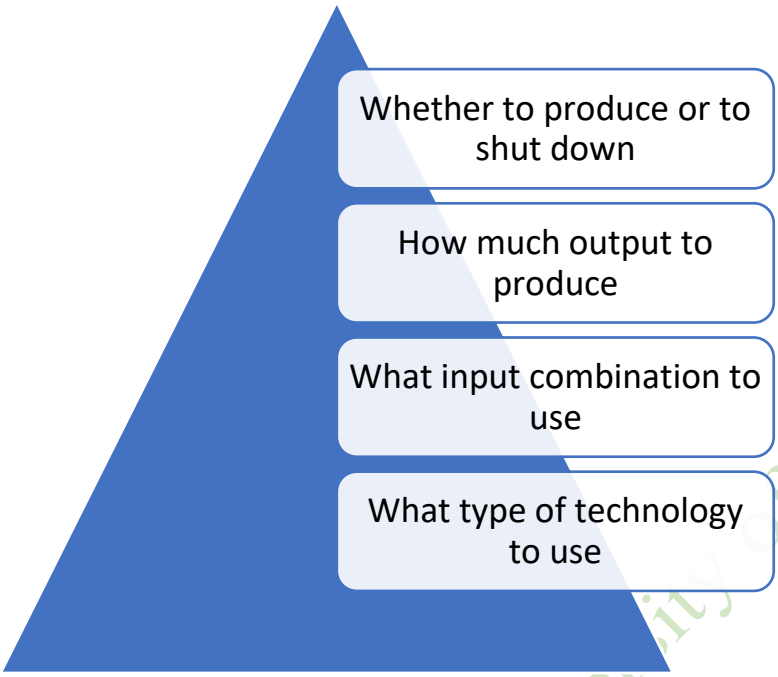


Figure 4.1 Production Decision Making (Sloman, 2006)

4.3 Production Function

4.3.1 Definition:

Production and Cost

Production is the total amount of goods and services produced in a given year and the cost incurred to produce these goods and services is called costs of production.

Production Function

It is the relationship between inputs i.e. factors of production (Land, labour, capital and entrepreneur) to produce a certain level of output.

Q= f (Land, Labour, Capital, Entrepreneurship)

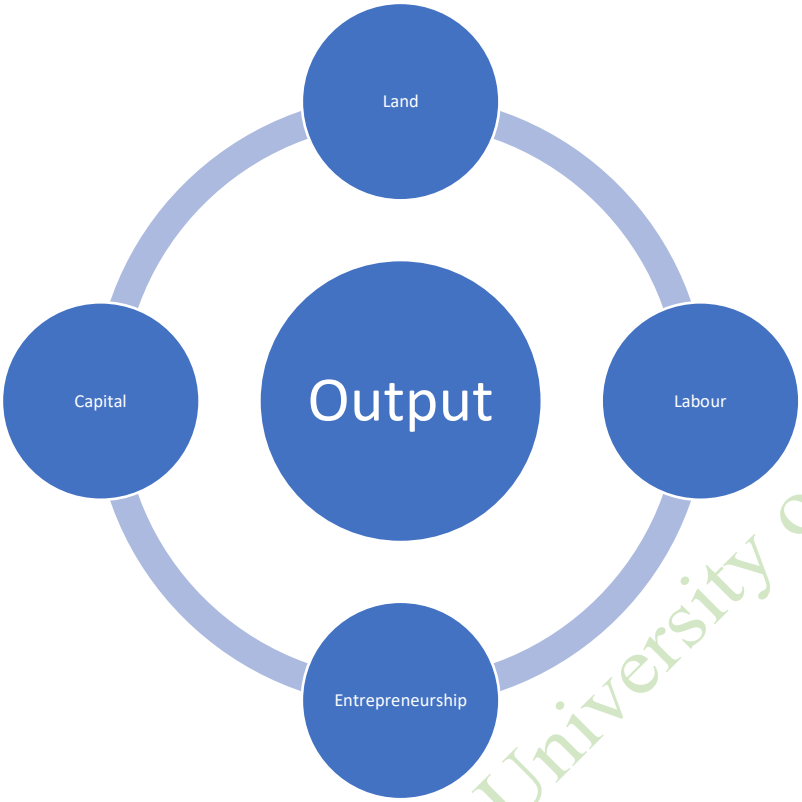


Fig 4.2: Production Function (*self*)

Figure 4.2 explains the four factors of production namely Land, Labour, Capital and Entrepreneurship and their relationship with output.

Production Function in Long Run and Short Run

The Long Run is a period long enough for all inputs or factors of production to be variable as far as an individual firm is concerned. The Output will be increased by changing both labour and capital.

The Short Run is a period so brief that the amount of at least one input is fixed and others are variable say if capital is a fixed input and labour is a variable. Hence, an increase in production during this period is possible only by increasing the variable input.

The length of time necessary for all inputs to be variable may differ according to the nature of the industry and the structure of a firm

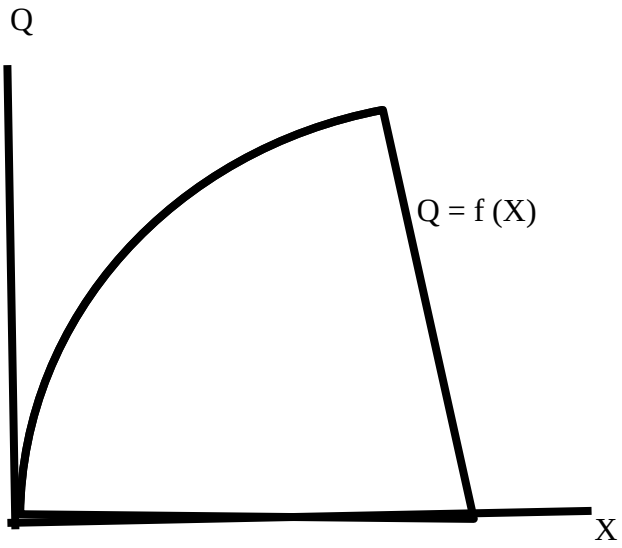


Figure 4.3 Production Function

Figure 1.3 depicts the production function. The X-axis represents the input and Y-axis represents the output. The curve shows the relationship between input and output, given the state of technology

The production function.

$Q = f(X_1, X_2, \ldots\ldots X_n)$

where Q stands for the output of a good per unit of time, X1 for labour, X2 for land (or natural resources), X3 for capital, X4 for a given technology, X5 for Entrepreneurship and F refers to the functional relationship function with many inputs cannot be depicted on a diagram.

Hence, economists use a two-input production function. If we take two inputs, labour and capital, the production function assumes the form.

Q = F (L, K)

ACTIVITY

If a farmer plants no seeds on his farm, he gets no harvest. If he plants 1 bag of seeds, he gets 3 units of rice. If he plants 2 bags, he gets 5 units. If he plants 3 bags, he gets 6 units. A bag of seeds costs Rs 250, and seeds are his only cost. Use these data to graph the farmer's production function and Explain its shape.

4.3.2 Concepts of Production

Total Product: It refers to the maximum amount of output that can be produced by combining one variable factor with a fixed factor of production.

Average Product: It refers to the ratio of the total product to the total units of the variable factor employed in producing a certain level of output.

AP = TP/L

Marginal Product: It refers to the change in total output by employing one additional unit of a variable factor.

MP = Change in TP / Change in variable factor = ΔTP/ΔL

Labour	Total product	Average product= TP/L	Marginal product = **ΔTP/ΔL**
1	10	10	-
2	24	12	14
3	39	13	15

4	52	13	13
5	61	12.2	9
6	66	11	5
7	66	9.4	0
8	64	8	-2

Table 4.1 – Total Product, Average Product and Marginal Product

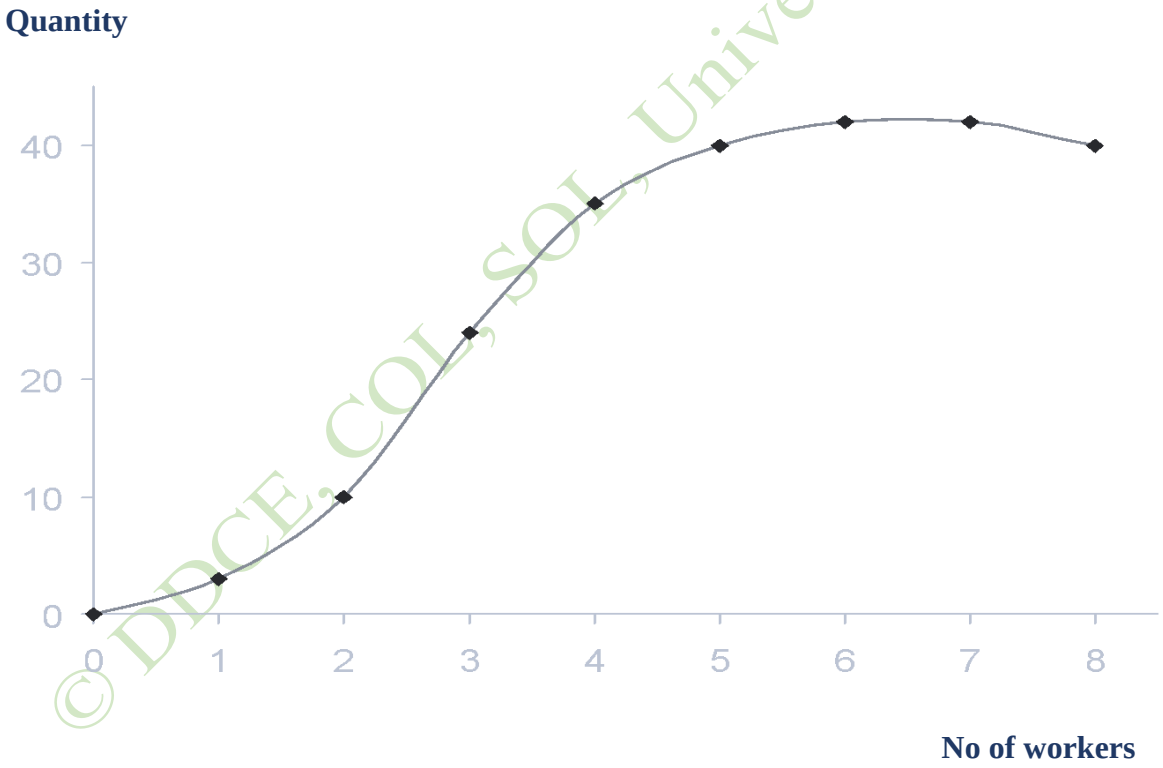


Figure 4.4 Total Product

The total product (TP) curve represents the total amount of output that a firm can produce with a given amount of labour. As the number of labour changes, total output changes. The total product curve is a short-run curve, meaning that technology and all inputs except labour are held constant. This assumption is keeping the other factors constant. In figure 1.4, X-axis

is a number of workers and the Y- axis is the quantity. The S-shaped total product curve has an economic meaning. At the lower end, where the number of workers and quantity is low, the curve is convex. Convexity means that when the number of workers is added, production increases at an increasing rate. This happens as more workers are added at low production levels, they can specialize in tasks and more can work more efficiently using the fixed inputs as specialisation is possible. In the middle production range, the slope of the total product curve gets flattered and the shape of the curve becomes concave. Concavity means that production increases but at a decreasing rate. The economic interpretation of concavity is that as more workers are added, there is less and less specialization available and the workers are less and less efficient in using the fixed inputs. Finally, the total product curve hits a maximum point after which output decreases with each additional worker. After the maximum is reached, additional employees don't add anything valuable and are not productive and unable to use the fixed inputs efficiently. This pattern can be observed in figure 1.4 and Table 1.1.

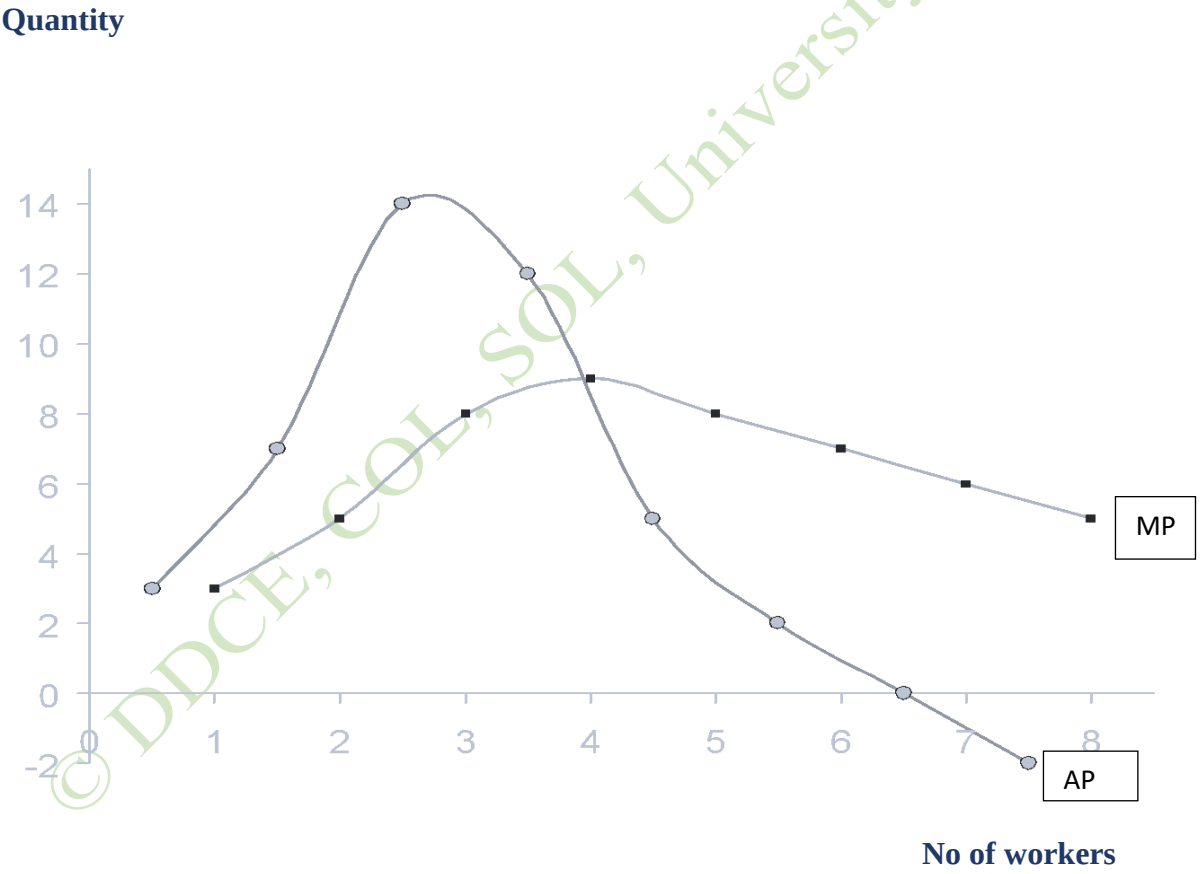


Figure 4.5 Average Product and Marginal Product

Average Product

The average product (AP) is output per worker. It can be defined as the total product divided by the quantity of the variable input (i.e., the number of workers) employed. In Table 1.1 different values of labour are given and they can be determined at different levels of input. Thus, the average product of labour is maximum at 5 units of labour. Figure 1.5 graphically illustrates the average product of labour. The average product of the labour shows the efficiency of the input factor.

The first unit of labour produces 10 units of output and the second unit of labour (when combined with the first unit and the fixed resources used) produces 24 units and so on. Thus, the average product for one unit of labour is 10 and for two units of labour is 12. An important point to note in this context is that when two units of labour are employed, the average product of labour increases. This shows two units of labour are more efficient than one unit. This does not necessarily mean that the second unit of labour is more efficient than the first unit.

The increase in average labour productivity when the second unit of labour is employed in the production process is a result of more efficient use of both the fixed factor of production and the first unit of labour. The reason could be an increase in productivity and the production process becoming more specialized. This can also help managers in measuring the productivity of each labour and they can accordingly reward labour because of higher per capita productivity.

Marginal Product

The marginal product may be defined as the rate of change in total output associated with the employment of one additional unit of the variable factor. The marginal product of labour (MP_L) can be computed as

$$MPL=dQ/dL$$

The marginal product of labour is measured by the slope of the total product curve at a particular point, dQ/dL. The slope of the total product curve is initially positive meaning positive MP_L, then zero MP_L where the total product is constant and finally negative MP_L.

Alternatively, marginal product per unit of labour input can be calculated over an input range by simply relating the absolute change in output (ΔQ) to the absolute change in the variable (factor) input (ΔL). Thus when the second unit of labour is employed, MP_L per unit is :

Average M P_L = $\Delta Q/\Delta L$ = (24-10)/(2-1)= 14

Thus, over the range from one to two units of labour, the average marginal product is 14 units.

This distinction between the marginal value at a single point on a curve and the marginal value between the two points on a curve can play important role in making managerial decisions related to cost and output.

4.3.3 Relationship between Marginal Product and Average Product

1. When Marginal Product > Average Product, Average Product rises.

Till the point the marginal product curve lies above the average product curve, the average product curve will rise. The implication is that the average efficiency of the variable factor is increasing.

2. When Marginal Product < Average Product, Average Product falls.

3. When marginal product must be equal to average product, they both are at their maximum.
4. The point at which average product reaches its maximum is the point of maximum efficiencythat can be achieved in the short run but this may not necessarily be the point at which profits will be maximized for that cost need to be considered as well.

IN-TEXT QUESTIONS

Q.1 What is the marginal product of the third worker?

8.Q.2 What is the total output of four workers?

Q.3 What is the total output of five workers?

Q.4 What is the marginal product of the sixth worker?

Q 5 The marginal product of labour can be defined as the change in

4.4 Production in the Short run

4.4.1 Law of Variable Proportion

Holding all factors constant **except one,** the law of diminishing returns says that:

As additional units of a variable input are combined with a fixed input, at some point the additional output (i.e., marginal product) starts to diminish.

Assumptions

- A Production function is associated with a specific period.
- The level of technology is constant.
- The factors of production are divisible.
- There are only two factors of production namely labour and capital.
- The Supply of factors is inelastic in the short-run.

RETURNS TO VARIABLE FACTOR

The three phasesof the law of variable proportions are as follows:

1. Increasing marginal returns- is the range of production for which increases in variable input lead to an increase in the marginale product.

2. Diminishing marginal returns - is the range of production for which increases in variable input lead to a decrease in the marginalge product while it t remains non-negative.

3. Negative marginal returns – is the range for which the use of variable input corresponds to negative marginal product

THREE STAGES OF LAW OF VARIABLE PROPORTIONS

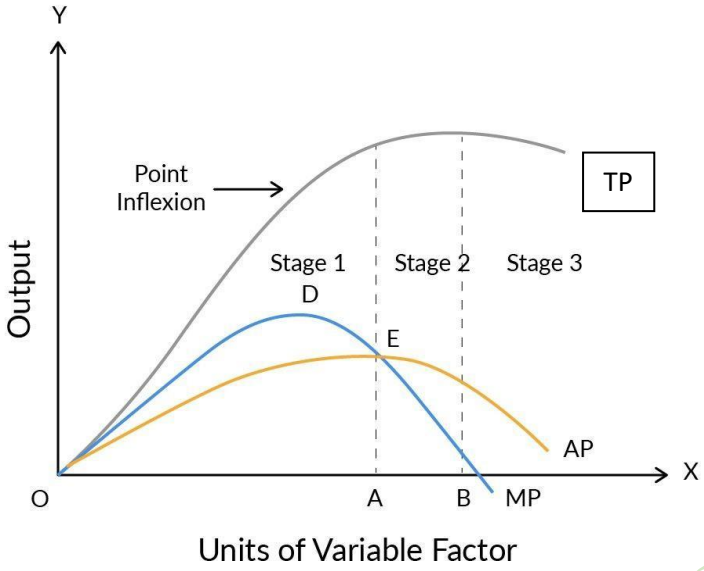


Figure 4.6 Law of Variable Proportion

In figure 1.6, the X- axis represents labour (Units of variable factor) and Y-axis represents Output. TP is the total product curve. Up to point A, the total product is increasing at an increasing rate. Between points A and B, it is increasing at a decreasing rate. Here marginal product has started falling. At point B, the total product is maximum while, the marginal product is zero. Thereafter, it begins to diminish correspondingly to a negative marginal product. In the lower part of the figure, MP is the marginal product curve. Up to point D marginal product increases and after that, the marginal product begins to decrease and then the marginal product becomes zero and turns negative. AP curve represents the average product. Before point E, the average product is less than the marginal product. At point E average product is maximum and then the average product increases but after that, it starts to diminish.

First Stage

The First stage starts from point O and ends up to point A. At point E average product is maximum and is equal to the marginal product. In this stage, the total product increases

initially at an increasing rate up to point A. Between A and B it increases at a diminishing rate. Similarly, marginal product also increases initially and reaches its maximum at point D. In this stage, marginal product exceeds average product (MP > AP).

Second Stage

It begins from point A. In this stage, the total product increases at a diminishing rate and is at its maximum and marginal product diminishes rapidly and becomes zero. The Average product is maximum at point E and thereafter it begins to decrease. In this stage, the marginal product is less than the average product (MP < AP).

Third Stage

This stage begins beyond point B. Here total product starts diminishing. The average product keeps on declining and the marginal product becomes negative. In this stage ideally, firms will try to stop production. This happens because the marginal product of the labour becomes negative implying that additional labour will give negative returns.

Causes of Increasing and Diminishing return:

Initially, due to the underutilization of resources and high efficiency, an increase in variable factors adds more to output. As we keep on increasing variable factors and as factors of production are imperfect substitutes for each other so they cannot be replaced with other factors of production.

The Law of variable proportion can be applied universally in both primary and secondary sectors.

4.4.2 Economies of scale of Production:

When a firm increases the scale of production, they achieve economies of scale till a point and then economies start to convert into diseconomies of scale.

Economies of Scale are two types:

Internal Economies of Scale- These economies are internal to the growth of a firm such as technical, managerial, financial etc.

External Economies of Scale are external to the firm and they happen as a result of changes in the external environment such as localization, vertical disintegration etc.

Diseconomies of Scale When the firm over utilises the used machinery, labour, increased plant size etc leading to an increase in cost of production and hence the efficiency declines. This happens due to lack of coordination, depreciation of machinery etc. When the factors are external to a firm such as an increase in prices of inputs, taxes, lack of funds etc then they are called external diseconomies of scale.

IN-TEXT QUESTIONS

6 The law of diminishing returns states that _____.
A. As a firm uses more of a variable resource, given the number of fixed resources, the average product of the firm will increase True/false
B. As a firm uses more of a variable resource, given the number of fixed resources, the marginal product of the firm will eventually decrease
C. In the short run, the average total costs of the firm will eventually diminish
D. In the long run, the average total costs of the firm will eventually diminish

7. In the short run, capital is held _____.
A. Constant
B. Varying
C. None of the above

8. An active factor of production is _____.
A. Capital
B. Labour
C. Land
D. None of these

9. Which of the below best defines a Marginal product?
A. Increase in output that arises from an additional unit of input
B. Slope of the production function
C. Both A&B

10. External economies of scale are obtained by which of the below?
A. A firm

B. A group of firms
C. Small production
D. Society

4.5 PRODUCTION IN THE LONG RUN

4.5.1 Returns to Scale

The returns to scale is a long-run concept. It shows the possibilities of different input combinations. In the long run all factors of production are variable. No factor is fixed. Accordingly, the scale of production can be changed by changing the quantity of all factors of production.

Increasing Returns to Scale: a production function for which any given proportional change in all inputs leads to a more than proportional change in output. Increasing returns to scale refers to a situation when all factors of production increase but output increases more than the increase in inputs It means if all inputs are doubled, the increase in output will be more than double. Hence, it is called increasing returns to scale. This increase is due to many reasons like the division of external economies of scale.

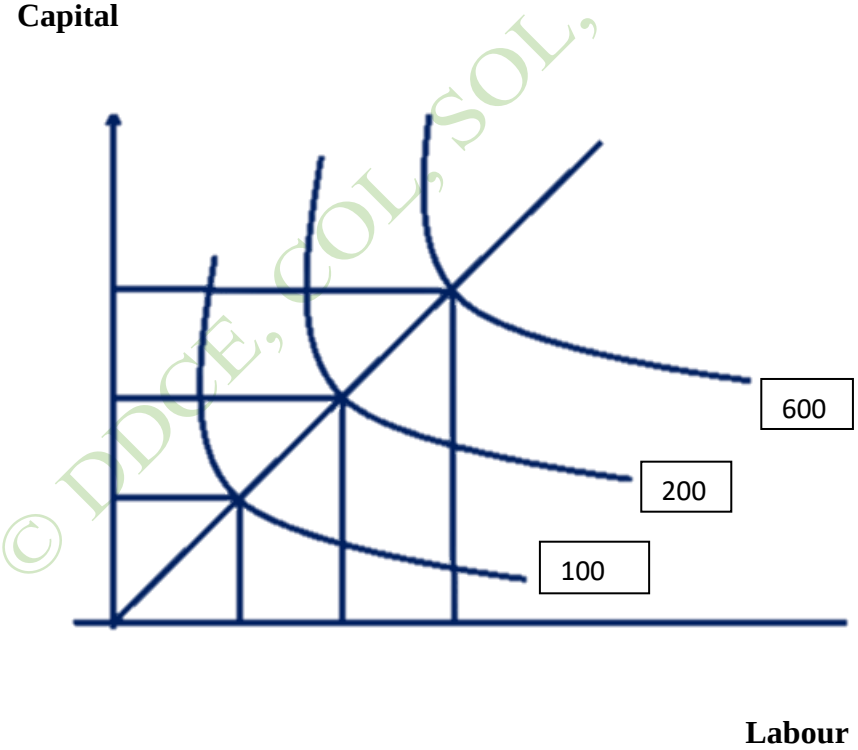


Figure 4.7 Increasing Returns to Scale

In figure 1.7, the X- axis represents labour and Y-axis represents capital. The increase in f both the factors will produce more output as can be seen in the diagram from point 100 to 200 to 600 units.

Constant Returns to Scale: a production function for which a proportional change in all inputs causes output to change by the same proportion. Constant returns to scale refer to the production situation in which output increases exactly in the same proportion as the ratio of inputs is increased meaning if inputs are doubled output will also be doubled.

In constant return to scale internal and external economies are exactly equal to internal and external diseconomies. This situation arises when after reaching a certain level of production, economies of scale are balanced by diseconomies of scale.

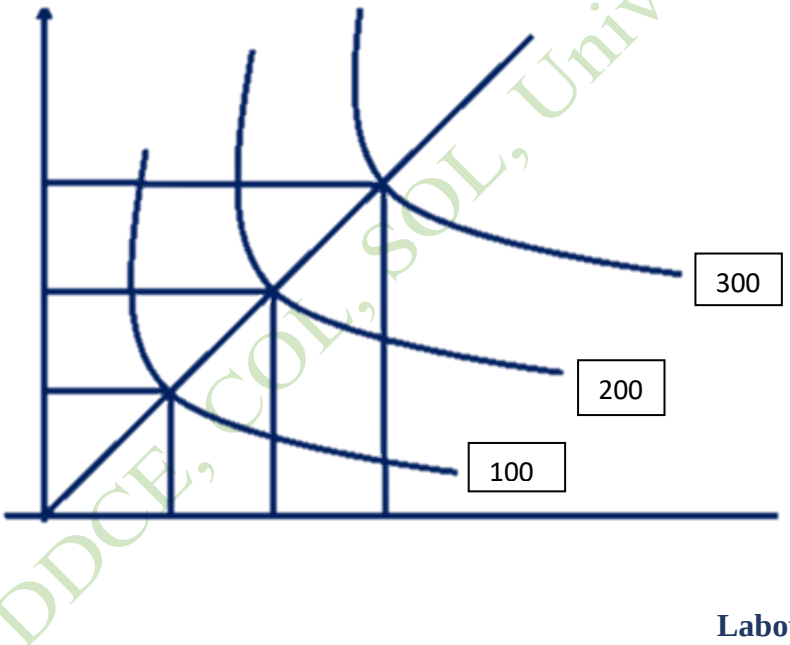


Figure 4.8 Constant Return to Scale

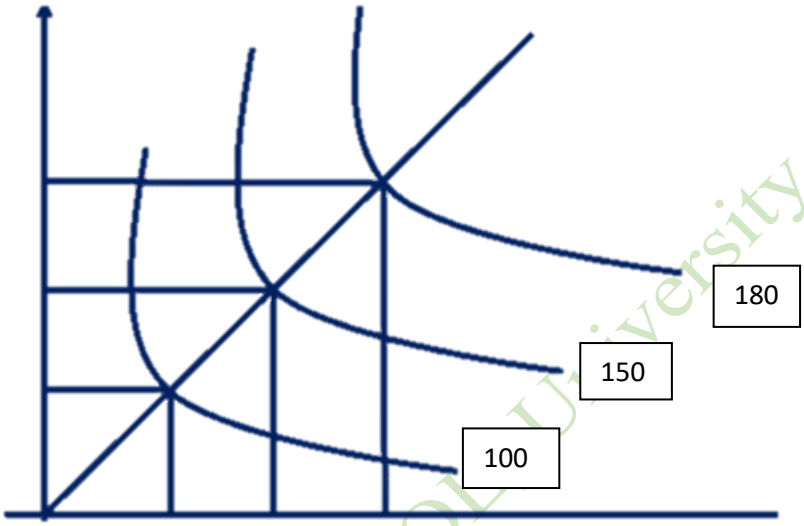
In figure 4.8, X-axis represents labour and Y-axis represents capital. Diagram suggests that an increase in factors of production i.e. labour and capital are equal to the ratio of increase in output. Hence, we get constant returns to scale.

Decreasing Returns to Scale: a production function for which a proportional change in all inputs causes a less than proportional change in output. It means, that if inputs are doubled,

the output will be less than doubled. If inputs are increased by 20 per cent, the increase in output is 10 per cent.

The main cause of the decreasing returns to scale is that internal and external economies are less than internal and external diseconomies.

Capital



Labour

Figure 4.9 Decreasing Returns to Scale

In this diagram 4.9, X-axis represents labour and Y-axis represents capital. When inputs increase from 1 to 3 units, the increase in output is proportionately lesser from 100 to 150 to 180.

4.5.2 Isoquants

All inputs are now considered to be variable (both L and K in our case)

How to determine the optimal combination of inputs?

An isoquant is a curve showing all possible combinations of inputs physically capable of producing a given level of output.

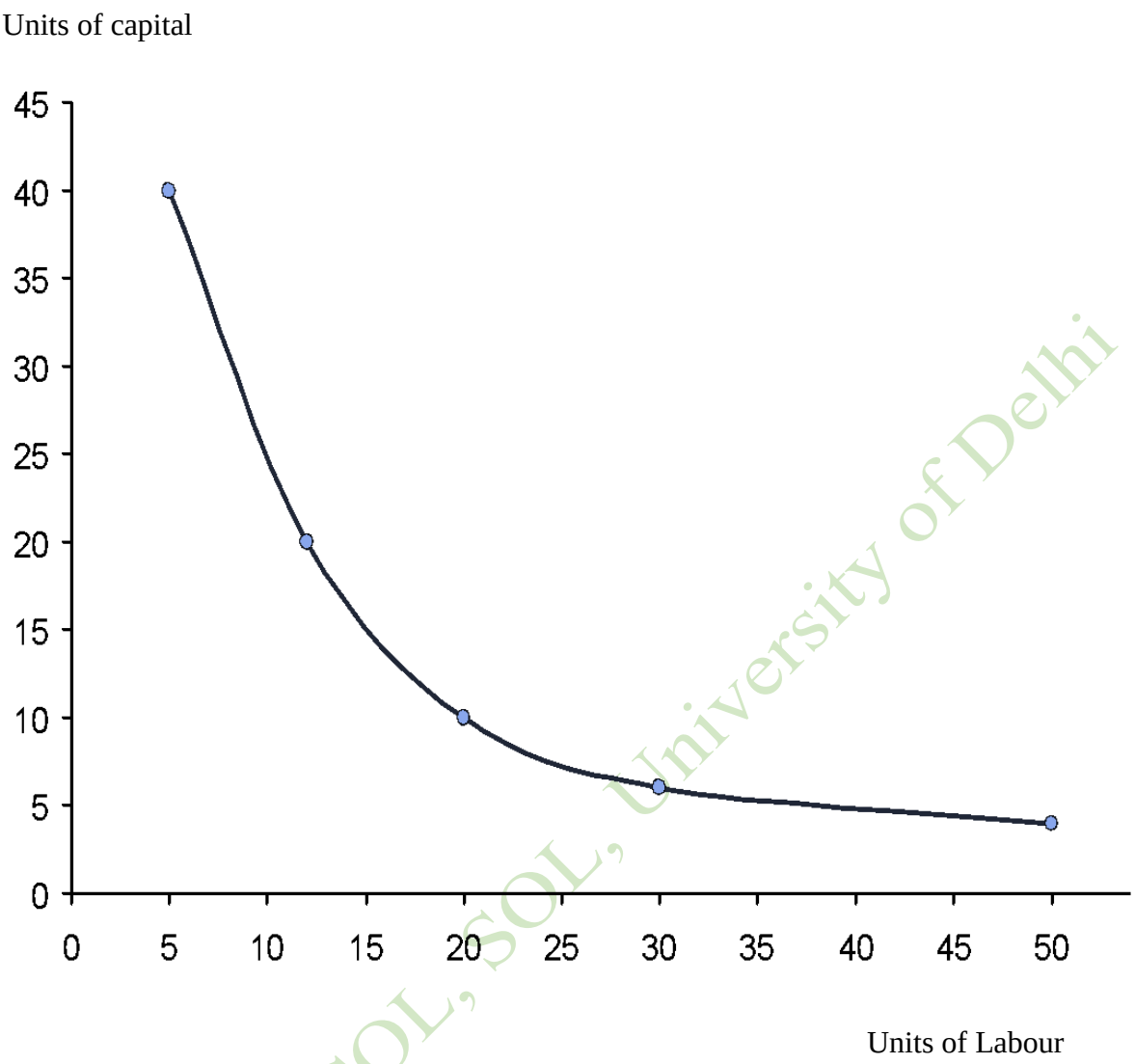


Figure 4.10 Isoquant Curve

In Figure 4.10, X-axis represents labour and the Y-axis represents capital. Different points along the curve show combinations of labour and capital that yield the same level of output As the usage of labour increases, the usage of capital decreases to produce a certain level of output.

An Isoquant is a curve that shows the various combinations of two inputs that will produce a given level of output

The slope of an isoquant indicates the rate at which factors K and L can be substituted for each other while a constant level of production is maintained.

The slope is called Marginal Rate of Technical Substitution (MRTS)

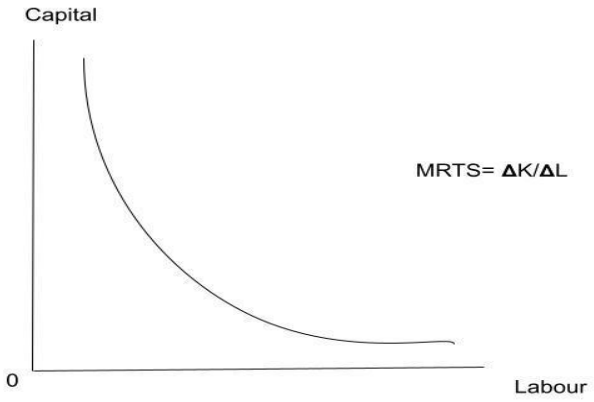


Figure 4.11 Marginal Rate of Technical Substitution

In Figure 4.11 the slope of the isoquant depicts the Marginal rate of technical substitution. The X-axis represents labour and the Y-axis represents capital. The changes in the ratio of capital to labour used to produce a certain level of output are shown.

The absolute value of the slope of the isoquant is the marginal rate of technical substitution between two factors.

Thus, the MRTS is the rate at which labour can be substituted for capital without affecting output, when more capital and less labour are used, the marginal productivity of labour is relatively large and the marginal productivity of capital relatively small. Hence, one unit of labour will substitute for a relatively large amount of capital.

Anywhere along the isoquant, the marginal rate of technical substitution of labour for capital equals the marginal product of labour divided by the marginal product of capital, which also equals the absolute value of the slope of the isoquant.

$MRTS = MP_L / MP_C$

Properties of Isoquant

- There is a different isoquant for every output level and r further the isoquant from the origin thr higher is the output.that it depicts

- Isoquants have negative slopes indicating the quantity of labour employed is inversely related to the quantity of capital employed.,output remaining the same.

- Isoquants do not intersect. Since each isoquant refers to a specific level of output, an intersection would indicate that the same combination of resources could, with equal efficiency, produce two different amounts of output.

- Isoquants are usually convex to the origin. So, an isoquant gets flattered as we move down along the curve.

Exceptions to Isoquant Curve:

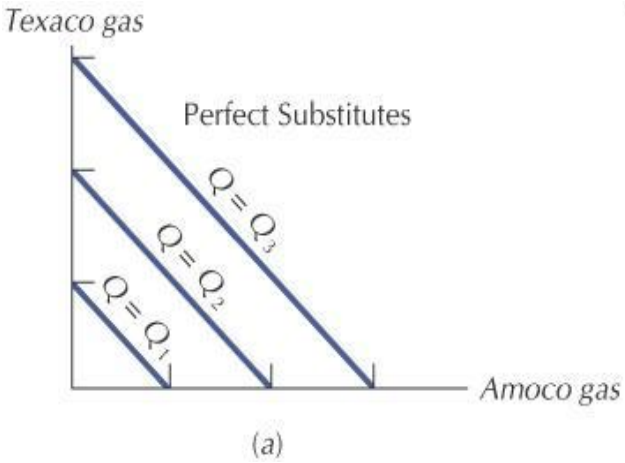
There are exceptions to the isoquant curve and it can have three general types of shapes.

Perfect Complements -The isoquants are right angles, indicating that inputs a and b must be used in fixed proportions and therefore are not substitutable.

For Example - Nuts and bolts

Perfect Substitutes – Input a can be substituted for another input say b at a fixed rate as indicated by the straight-line isoquants (which have a constant slope and MRS)

For Example - Jaggery and brown sugar are often nearly perfect substitutes



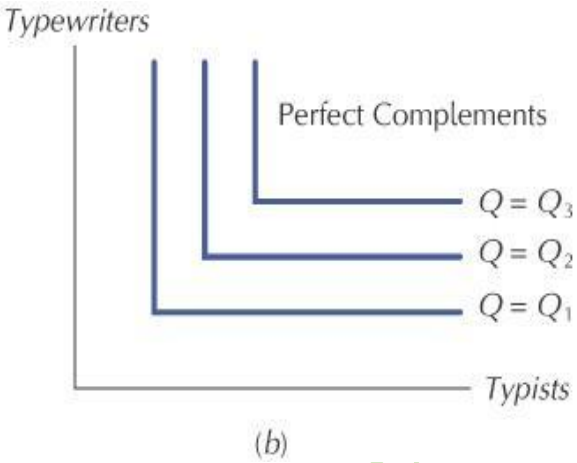


Figure 4.12 Perfect Substitutes **Figure 4.13 Perfect Complements**

Figure 4.12 depicts Perfect Substitutes. The X-axis represents Amoco gas and Y-axis represents Texaco gas. As both as perfect substitutes for each other, so whether theproduceruses Amoco or Texaco does not make a difference. Hence, the curves are straight lines.

Figure 4.13 depicts Perfect complements. The X-axis represents typists and Y-axis represents Typewriters. Both inputs should be used in fixed proportions as they cannot be substituted. Hence, the curve will be right angles.

Imperfect Substitutes –It is the rate at which input b can be given up in return for one more unit of input a while maintaining the same level of output as the number of inputs increases.
For Example - In farming, harvesters and labour for harvesting grain provide an example of a diminishing MRS considering capital and labour are imperfect substitutes.

4.5.3 Choice of Input Combination

The Input combination used can be shown with the help of Isocost lines.

Isocost lines show different combinations of inputs which give the same cost. It shows the various combinations of two inputs that can be bought for a given cost.outlay

The slope of the isocost line is given by -w/r

Where w= price of labour

r= price of capital

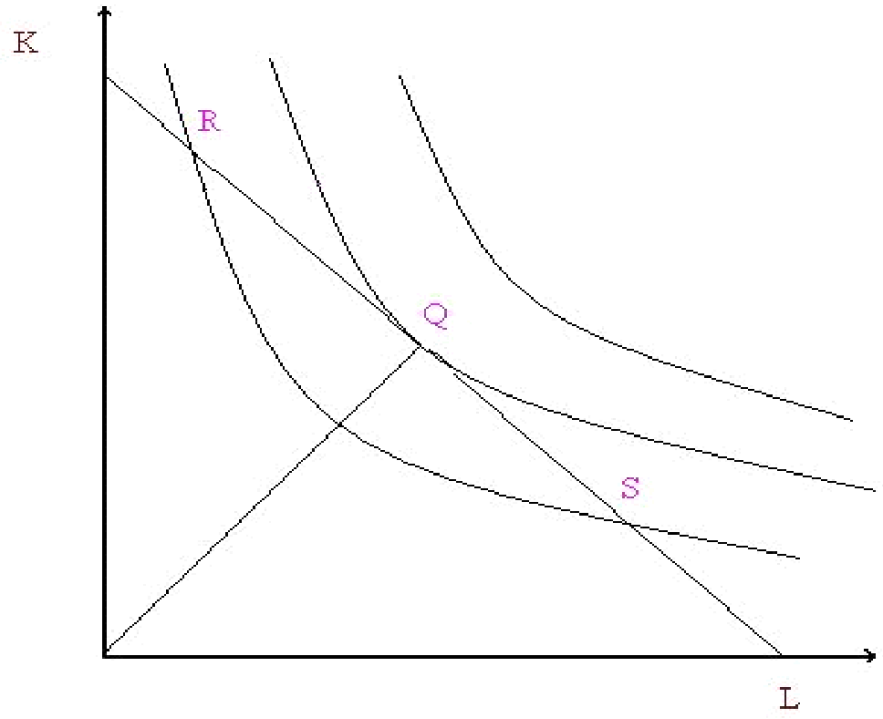
The equation for an isocost line is:

$C = L.-w_L + K.r$

$$MRTS_{LK} = \frac{MP_L}{MP_K} = \frac{w}{r}$$

A producer aims at either maximizing output for a given cost or minimizing cost subject to a given output.

Case 1:



LABEL THE ISOQUANTS

Figure 4.14 Maximizing Output for a given cost

In figure 4.14, the x-axis represents labour and the y-axis represents capital. An isocost line which is the budget line for the producer is drawn along with different isoquants representing different levels of output. The Higher the isoquant, the higher the level of output but the maximum output will be at a point where the isoquant is tangent with the isocost line i.e. Q. The producer will achieve maximum output at this point.

Case2 :

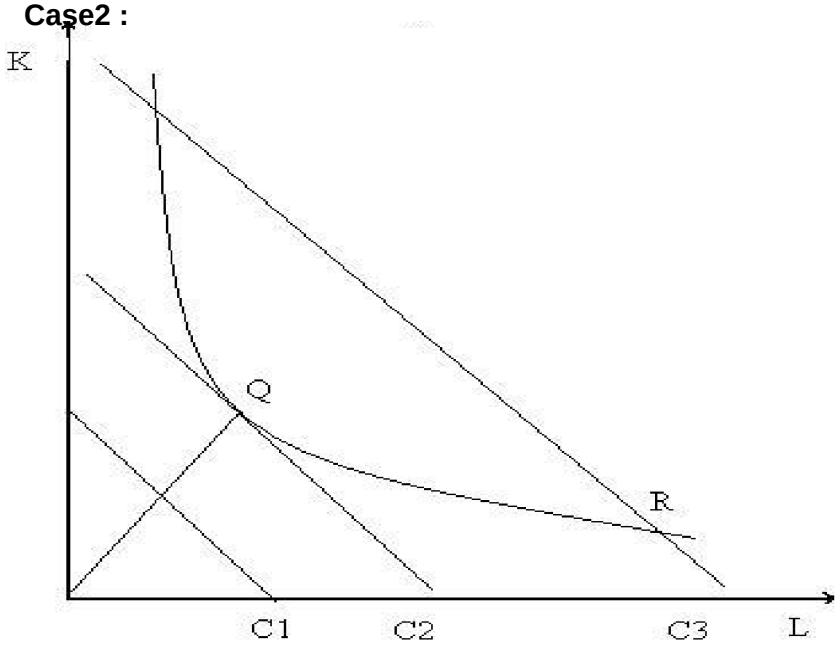


Figure 4.15: Minimizing Cost subject to given Output

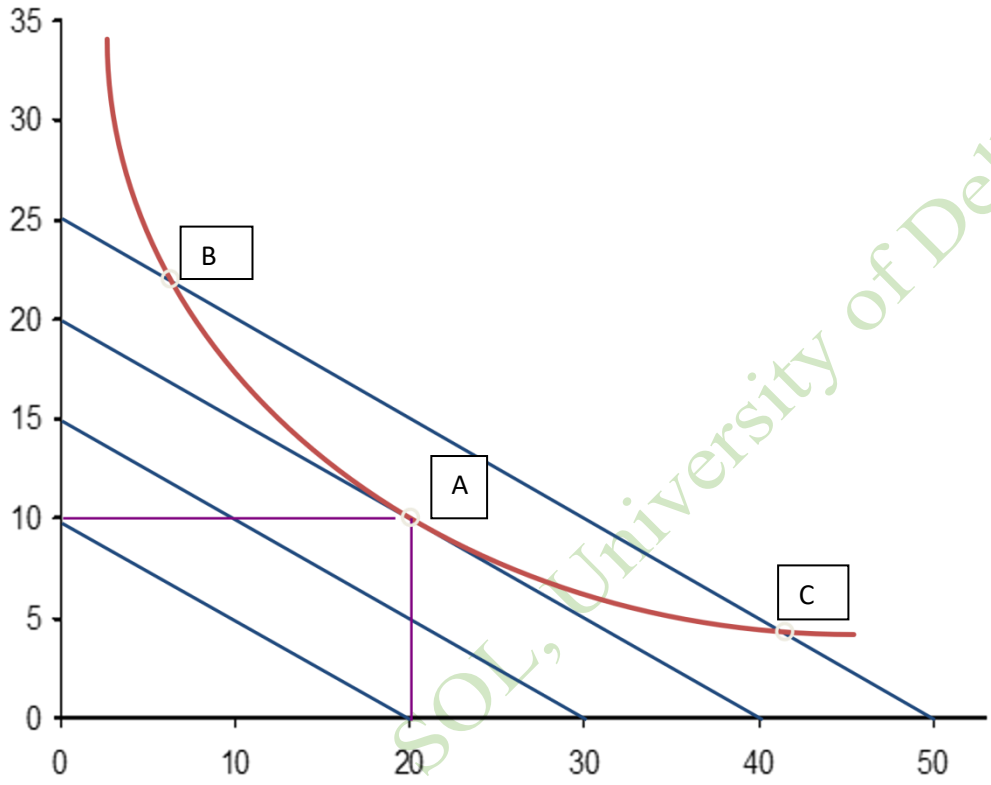
In figure 4.15, The x-axis represents labour and the y-axis represents capital. An isoquant which shows a different combination of factors that can be used by the producer to produce the given output is drawn along with different isocost lines representing different cost outlays.The point at which the producer will minimise costs will be where isoquant is tangent to isocost line i.e. Q.

The producer will choose the best input combination as per the costs and availability of factors

Choosing the Economically Efficient Point of Production

The least cost combination of inputs for a given output occurs where the isocost curve is tangent to the isoquant curve for that output and where the output is highest.

UnitsofCapital



Units of Labour

Figure 4.16: Least Cost Combination of Production

In figure 4.16, X-axis represents Labour and Y-axis represents capital. The Least Combination is at Point A where the isoquant curve is tangent to the isocost line. The point and B and C are on higher isocost lines but are not tangent. Hence, the equilibrium can't be reached.

IN-TEXT QUESTIONS

11. Assume a certain firm regards the number of workers it employs as variable but regards the size of its factory as fixed. This assumption is often realistic

a. in the short run but not in the long run.

b. in the long run but not in the short run.

c. both in the short run and in the long run.

d. neither in the short run nor in the long run.

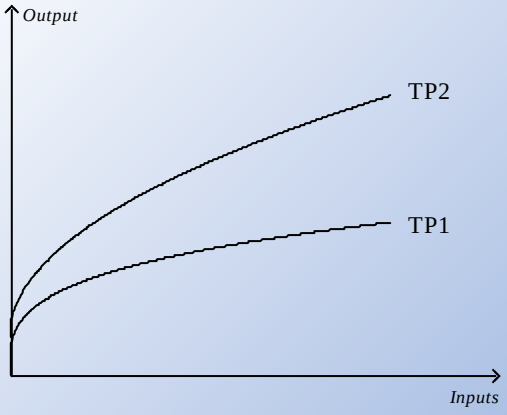
12. If a firm uses labour to produce output, the firm's production function depicts the relationship between

a. the number of workers and the quantity of output.

b. marginal product and marginal cost.

c. the maximum quantity that the firm can produce as it adds more capital to a fixed quantity of labour.

d. fixed inputs and variable inputs in the short run.



Q 13-14

13. Which of the following could explain why the total product curve would shift from TP1 to TP2?

a. There is less capital equipment available to the firm.

b. Labour skills have become rusty and outdated in the firm.

c. The firm has developed improved production technology.

d. The firm is now receiving a higher price for its product.

14. Suppose the production function shifts from TP2 to TP1. Such a shift in the total product curve is most likely due to a decrease in the firm's

a. costs of production.

b. product price.

c. market share

d. Productivity

IN-TEXT QUESTIONS

15. As Bubba's Bubble Gum Company adds workers while using the same amount of machinery, some workers may be underutilized because they have little work to do while waiting in line to use the machinery. When this occurs, Bubba's Bubble Gum Company encounters

a. economies of scale.

b. diseconomies of scale.

c. increasing marginal product.

d. diminishing marginal product.

4.6 SUMMARY

1. A Production function shows the relationship between the number of inputs used and the amount of output produced in a given period.
2. In the short run, one of the factors of production is fixed.
3. Production in the short run is subject to diminishing returns, as the quantity of variable input or factor increases, the marginal product diminishes.
4. In the long run, all the factors are variable
5. An Isoquant curve shows the combination of different factors at a particular level of output.
6. Isocost is the cost incurred or budget of the producer
7. For the efficient outcome, Isoquant should be tangent to the isocost line.

4.7 GLOSSARY

Diminishing marginal product is the property whereby the marginal product of an input declines as the quantity of the input increases

An Efficient scale is the quantity of output that minimizes the average total cost

Equilibrium is a situation in which the market price has reached the level

at which quantity supplied equals quantity demanded

The Equilibrium price is the price that balances the quantity supplied and the quantity demanded

Equilibrium quantity is the quantity supplied and the quantity demanded at the equilibrium price

Efficiency is the property of society getting the most it can from its scarce resources

Factors of production the inputs used to produce goods and services

Law of supply other things equal, the quantity supplied of good rises when the price of the good rises

Marginal changes are small incremental adjustments to a plan of action

The Marginal rate of substitution is the rate at which a consumer is willing to trade one good for another

Quantity demanded the amount of a good that buyers are willing and able to purchase

A Supply curve is a graph showing relationship between the price of a good and the quantity supplied

4.8 ANSWERS TO IN-TEXT QUESTIONS

1.450 - 350 = 100 units 2. 450 + 50 = 500 units 3. 500 + 25 = 525 units. 4. 530 - 525 = 5 units. 5. B 6. B 7. A 8. B	9. C 10. B 11. A 12. A 13. C 14. D 15. D

4.9 SELF-ASSESSMENT QUESTIONS

1. Choose a particular industry. Identify factors used in that particular industry that are fixed and variable in the short run and plot a curve showing different returns to factor.
2. Why do you think that firms do not always make profits? Discuss with the help of an example.
3. What would be the shape of the isoquant curve if there are increasing returns to scale and decreasing returns to scale?

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LESSON 5

Theory of Cost

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STRUCTURE

5.1 LEARNING OBJECTIVES

After studying this lesson, student shall be able to

- Understand the cost of production and related cost concepts.
- Learn about the traditional and modern theories of costs.
- Plot various cost curves.
- Comprehend the relationship between different cost curves

5.2 INTRODUCTION

Cost of production refers to the expenses incurred when producing or obtaining items and services that bring in money for a business. Costs incurred by a company during the production of its goods and services are a crucial factor in decision-making. It includes both direct and indirect costs. Direct costs are those that can be linked directly to the production of a product, such as labour and material costs, whereas indirect costs are those that cannot be linked directly to the product, such as overhead.

Profit is every business' ultimate goal, and a company's capacity to generate consistent profits determines how prosperous it will be in the long run. The profit margin of a business concern is determined by total cost and total revenue. A company works to raise revenue and cut expenditures in order to maximise profits. The profit margin of a business concern is determined by total cost and total revenue. A company works to raise revenue and cut expenditures in order to maximise profits. While a corporation often has no influence over the selling price, it does have control over a number of costs. Therefore, the business should strive to minimise and control costs. Since costs are taken into account in every business decision, it is essential to comprehend the meaning of various terms in order to think strategically.

Significant cost estimates that are helpful for managerial choices can be obtained from an analysis of economic costs when supplemented with information derived from the company's accounting records. If management intends to arrive at cost estimates that are relevant for planning purposes, the reasons causing cost changes must be acknowledged and taken into account. Cost concepts and classifications, cost output relationships (traditional and modern theories) are the main topics covered in cost analysis in this chapter.

5.3 COST CONCEPTS

Costs are very important in managerial decisions that involve choosing between alternative courses of action. It aids in the quantitative specification of various alternatives. The type of

cost to be used in a specific situation is determined by the business decisions to be made. Costs factor into almost every business decision, and it is critical to conduct proper cost analysis. As a result, it is critical to comprehend what these various cost concepts are, as well as how they can be defined and operationalized.

Figure 2 : Types of Costs

5.3.1: Accounting Costs

Accounting is a historical concept that records what happened in the post. Accounting costs are the expenses that are recorded in the books of account such as the balance sheet and profit and loss statements for the company's legal, financial, and taxation purposes. The accounting cost concept encompasses actual cost. Actual or explicit costs are those incurred by the firm in payment for labour, materials, plant, building, machinery, equipment, travelling and transportation,

advertising, and so on. For all practical purposes, the total money expenses recorded in the books of accounts are the actual costs.

5.3.2 Economic Costs:

There are some costs do not take the form of cash outlays and are not recorded in the accounting system. These are referred to as implicit or imputed costs. An important example of implicit cost is opportunity cost. Assume an entrepreneur does not use his services in his own business and instead works as a manager in another firm on a salary. He foregoes his salary as manager if he starts his own business. This salary loss represents the opportunity cost of income from his own business. This is an unspoken cost of his own company. Thus, implicit wages, rent, and interest are the wages, rent, and interest that an owner's labour, building, and capital can earn from their second-best use, respectively. Implicit costs are not considered when calculating the business's loss or gain, but they are an important consideration when deciding whether or not to keep a factor in its current use. The economic cost is the sum of the explicit and implicit costs.

Economic Cost = Accounting Cost (Explicit Cost) + Implicit Cost

5.3.3 Opportunity Costs:

The concept of opportunity cost plays a critical role in modern economic analysis. The opportunity costs or alternative costs are the returns from the firm's second-best use of resources that it foregoes in order to reap the benefits of the best use of resources. For example, a farmer who grows sugarcane can also grow wheat using the same factors. As a result, the opportunity cost of a quintal of sugarcane is the amount of wheat output sacrificed. As a result, the opportunity cost of anything is the next best alternative that could be produced instead by the same or an equivalent group of factors at the same cost. This definition must include two points. First, the opportunity cost of anything is simply the loss of the next best alternative. Second, important thing is the consideration of “an equivalent group of factors costing the same amount of money" in the above definition. The concept of opportunity cost is extremely important in economics –

a) **Assists in determining relative prices of goods:** The concept of opportunity cost is useful in explaining how relative prices of different goods are determined.

b) **Assists in determining a factor's normal remuneration:** The opportunity cost determines the value of a productive factor for its best alternative use. It implies that if a productive factor is to be retained in its next best alternative

use, it must be compensated for or paid at least as much as it can earn from that use.

c) **Decision support and efficient resource allocation:** The concept of opportunity cost is critical in rational producer decision making. Opportunity cost is a useful economic tool for analysing optimal resource allocation and rational decision making.

ACTIVITY

Identify three imputed costs for the business concern.

Mr. John has invested Rs. 10,00, 000 in his shoes manufacturing business and has also bought a new land for setting up a factory apart from the cash investments. Identify if there is any opportunity cost.

5.3.4 Sunk Costs:

Sunk costs are those that are not affected by changes in the level of production or nature of business activity. It will remain constant regardless of activity level. The most common example of sunk cost is depreciation, amortisation of past expenses. It will remain constant regardless of the level of activity. Sunk Costs are also known as unavoidable costs. Even if business activity is reduced, there will be no reduction in this cost. The cost of the idle machine capacity, for example, is an unavoidable cost. Sunk costs are investments that have no opportunity cost.

5.3.5 Historical Costs:

The historical cost of an asset is its original cost. Historical cost refers to the cost of acquiring productive assets in the past, such as land, a building, machinery, and so on. The cost of an asset is shown as the original price paid for the asset acquired in the past in historical cost valuation. Financial accounts are based on historical valuation.

5.3.6 Replacement Costs:

A replacement cost is the amount of money that would have to be paid today to replace the same asset. During periods of significant price change, historical valuation provides a poor projection of future costs intended for managerial decisions. When financial statements have to be adjusted for inflation, a replacement cost is an important thing to consider.

5.3.7 Incremental Costs:

Incremental costs are defined as the change in overall costs caused by specific decisions. Fixed and variable costs are both included in incremental costs. In the short term, incremental cost will consist of variable costs — costs of fuel, power, additional labour, additional raw materials, etc. — incurred as a result of the firm's new decision. Because these costs can be avoided by not changing the scale of operations, they are also known as avoidable costs or escapable costs.

Incremental costs are similar to the concept of marginal cost, but have a broader connotation. While marginal cost refers to the cost of an additional unit of output (typically one unit), incremental cost refers to the total additional cost associated with decisions to expand output or add a new variety of product, etc.

5.3.8 Book Costs:

Certain actual business costs do not involve cash payments, but a provision is made in the books of account and they are taken into account when the profit and loss accounts are finalised. These are referred to as book costs. Book costs include unpaid interest on the owner's own funds and depreciation on assets.

5.3.9 Out of Pocket Costs:

Out-of-pocket costs, also known as explicit costs, are those that require immediate cash payment. Out-of-pocket costs are items of expenditure that involve cash payments or cash transfers, both recurring and non-recurring. This category includes all explicit costs (e.g., wages, rent, interest, material and maintenance costs, transportation expenses, electricity and telephone expenses, and so on). On the other hand, Book costs, also known as implicit costs, do not require immediate cash payments. Book costs include salary of owner, depreciation, unpaid interest on owner's capital.

5.3.10 Private Costs:

Private costs are those that are actually incurred or provided for by an individual or a business for its business activity. Private cost is the cost of production incurred and provided for by an individual firm engaged in the production of a commodity.

This cost has nothing to do with society. It includes both explicit and implicit costs. A company tries to reduce its private cost.

5.3.11 Social Costs:

The social cost, on the other hand, is the total cost to society of producing a good. As a result, the economic costs include both private and public costs. The social cost of producing a commodity is the cost to society as a whole. It takes into account all costs borne by society, whether directly or indirectly. The firm bears no social cost. It is rather passed on to people

who are not directly involved in the activity. The concept of social cost is much broader than the private cost.

Social Cost = Private Cost + External Cost

5.3.12 Shut Down Costs:

Shut-down costs must be incurred when production operations are suspended. When a plant is permanently shut down, some costs must be incurred to dispose of the fixed assets. These are known as abandonment costs.

IN-TEXT QUESTIONS

_____ costs do not take the form of cash outlays and are not recorded in the accounting system.

The historical cost of an asset is its original cost. True / False

The addition to total cost associated with decisions to expand output are called:

a) Books Costs b) Incremental Costs

c) Sunk Costs d) Out of Pocket Costs

The total cost to society of producing a good is called _____.

Out of Pocket Costs are also known as Implicit Costs. True/False

5.4 TRADITIONAL THEORY OF COST

The production function expresses a technological relationship between physical inputs and physical outputs. Further, the cost function shows the relationship between the firm's cost and firm output given the state of technology. The cost function combines the production function's information with the prices of the factors of production. Cost functions are thus derived functions from production functions. Depending on the time period under consideration, the firms have different production functions.

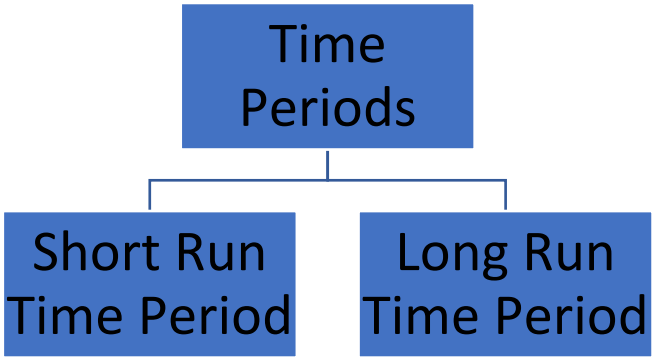

Figure 3: Different Time Periods

5.4.1 Cost-Output Relationship in the Short Run

A short run is a time period in which some factors remain constant while others change. As a result, in the short run, the firm can only change its variable factors to change output. The short run costs of a firm are the costs of employing variable units of production plus the costs of fixed factors. Thus, the use of both fixed and variable factors incurs costs in the short run.

5.4.1.1 Total Fixed Costs

Fixed costs are those that are not affected by changes in output. Even if output is zero, they must be incurred. Fixed costs are also known as overhead costs. These include charges such as depreciation on asset, interest on debt, rent of premises, insurance, maintenance costs, property taxes, interest on capital invested, and some administrative costs such as salary of permanent employees, wages of permanent staff, etc. Thus, fixed costs are those incurred in hiring fixed factors of production whose amounts cannot be changed in the short run. These costs are also known as overhead costs, supplementary costs, and unavoidable costs.

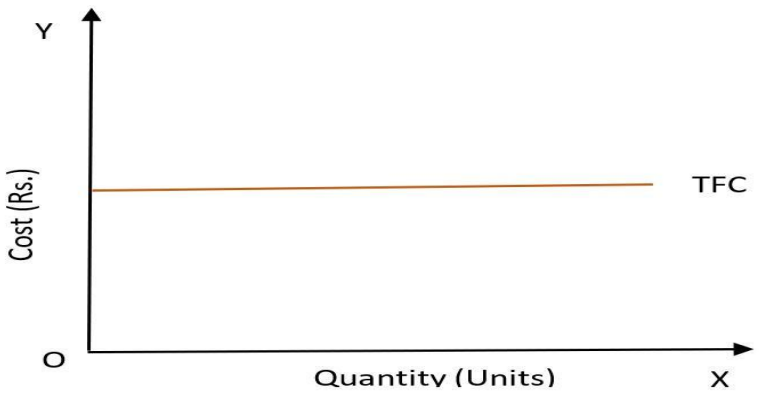

Figure 4: Total Fixed Costs

In the above figure 3, TFC is a straight line parallel to the X-axis depicting that the fixed costs do not vary with the change in the level of output.

5.4.1.2 Total Variable Costs

Variable costs, are the costs associated with the use of variable factors of production, the amount of which can be changed in the short run. As a result, in the short run, the total variable costs vary with changes in output. When the output is zero, the total variable costs are zero. These costs include payments such labour wages, the cost of raw materials, fuel and power used, transportation expenses, and so on. Variable costs are also referred to as prime costs.

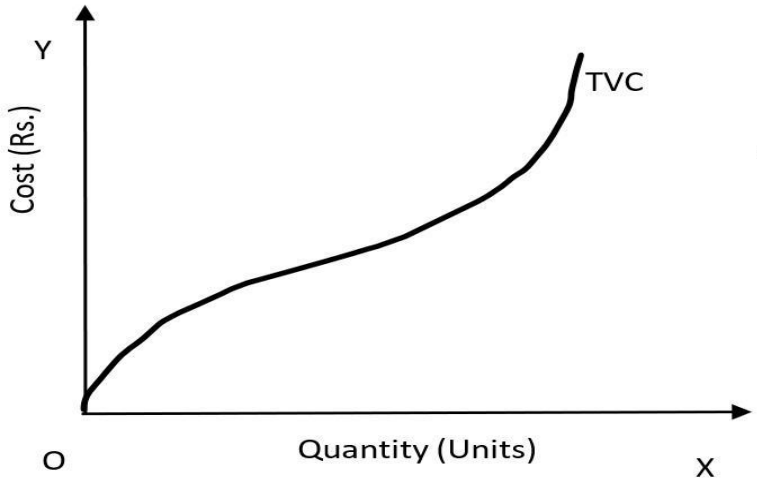

Figure 5: Total Variable Costs

The TVC curve is an inverted S shape, it reflects the law of variable proportions, which corresponds to a short run period only.

5.4.1.3 Total Costs

It is the actual cost that must be incurred to produce a given quantity of output in the short run, using both fixed and variable inputs. It is the sum of total fixed costs and total variable costs.

Total Cost = Total Fixed Cost + Total Variable Cost

It is the actual cost of producing a given quantity of output in the short run using both fixed and variable inputs. It is the total of fixed and variable costs.

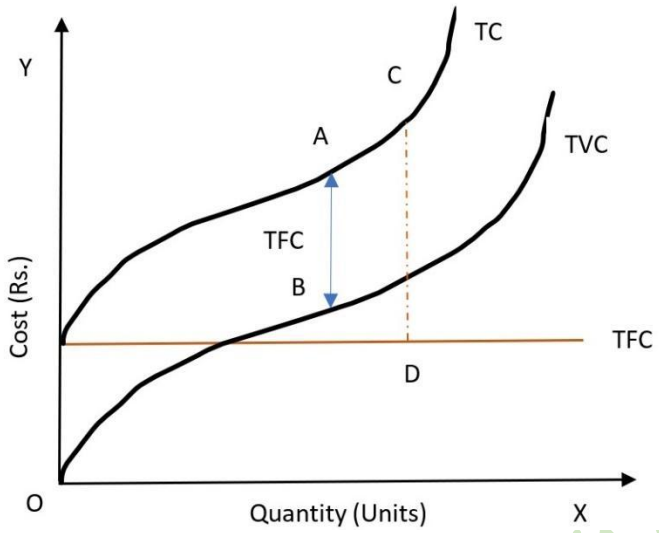

Figure 6: Total Costs

The difference between total cost and total variable cost is the total fixed cost.

Apart from total cost analysis, it is critical in managerial decision making to have information on per unit costs in order to make objective decisions. As a result, average costs or per unit costs are explained below.

5.4.1.4 Average Fixed Costs

The average fixed cost is calculated by dividing the total fixed cost by the number of units of output produced. Therefore,

$$AFC = TFC/Q$$

where TFC = Total Fixed Cost and Q= Units of Output

The total fixed cost is constant. Therefore, the average fixed cost per unit of output decreases as output increases.

The AFC is represented graphically as a rectangular hyperbola. S since, the TFC is spread over a large number of units, therefore, AFC decreases steadily as output increases. Because the AFC is a rectangular hyperbola, it approaches both axes asymptomatically, that is, it gets closer and closer to the axes until it touches them at infinity.

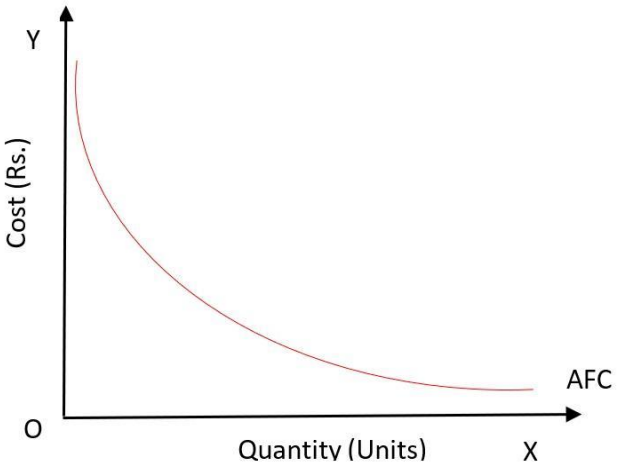

Figure 7: Average Fixed Costs

5.4.1.5 Average Variable Costs

The average variable cost is calculated by dividing the total variable cost by the number of units of output produced. Therefore,

$$AVC = TVC/Q$$

where TVC = Total Variable Cost and Q= Units of Output

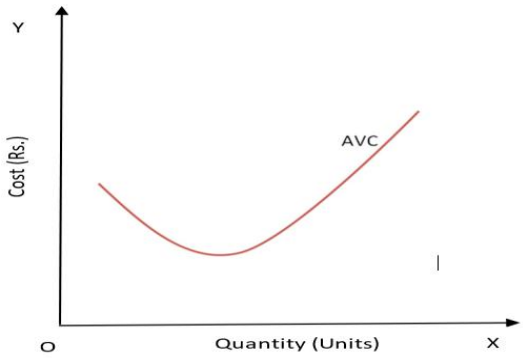

Figure 8: Average Variable Costs

The AVC curve initially falls as the variable factor's productivity rises, resulting in higher returns. It then reaches a minimum at the point where the optimal combination of fixed and variable factors is in place. As the output is increased further, the AVC begins to rise as the variable factor's efficiency decreases from its maximum level, and the combination of fixed and variable factors becomes sub-optimal.

5.4.1.6 Average Costs

The average total cost, or simply average cost, is the total cost divided by the number of output units produced. Therefore,

$$AC = \frac{\text{TC}}{\text{Q}}$$

where TC = Total Cost and Q= Units of Output

Since the total cost is the sum of total variable cost and total fixed cost, the average cost is also the sum of average variable cost and average fixed cost.

$$\boldsymbol{TC = \text{TFC} + \text{TVC}}$$

Dividing both sides by Units of Output (Q)

$$\boldsymbol{TC = \frac{\text{TFC}}{\text{Q}} + \frac{\text{TVC}}{\text{Q}}}$$

$$AC = \text{AFC} + \text{AVC}$$

ACTIVITY

Draw short-run average variable costs and average cost curves according to traditional theory of costs.

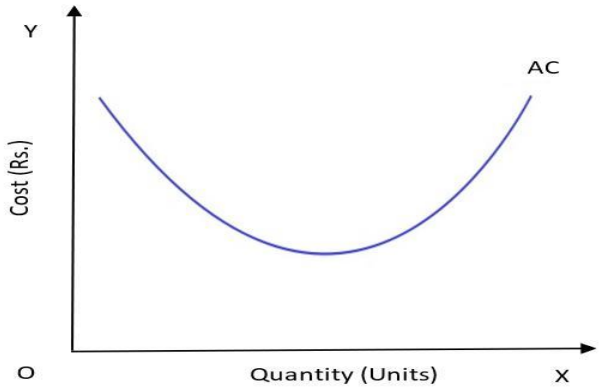

Figure 9: Average Costs

Graphically, The shape of the AC curve is determined by the shape of the AFC and AVC curves. AC initially falls, reaches a minimum at the plant's optimal utilisation level, and then rises again.

5.4.1.7 Marginal Costs

The marginal cost is the cost added to the total cost when one more unit of output is produced. In other words, marginal cost is the difference between cost of producing n units and n-1 units.

$$MC_n = TC_n - TC_{n-1}$$

If change in output is greater than one unit, then the marginal cost can be found over a range of output as well.

$$MC = \frac{\Delta TC}{\Delta Q}$$

The MC curve is a U-shaped curve. It initially falls with increasing output due to more efficient use of the variable factor as output increases, and then it slopes upward as further increase in output negatively impacts the variable factor's efficiency.

Figure 10: Short Run Marginal Costs

5.4.1.8 Relationship Between Average Cost and Average Variable Cost

• AC and AVC are both U-shaped, illustrating the law of variable proportions.

• The MC curve intersects the AVC and AC curves at their minimum points. The minimum point of AC comes after the minimum point of AVC. The minimum point of AC is to the right of the minimum point of AVC.

• The behaviour of the AC curve is determined by the behaviour of the AVC and AFC curves.

• Initially, both AVC and AFC are falling, resulting in a drop in AC. The AVC begins to rise after reaching its minimum point. The AFC is still declining. The rate of fall of AFC is greater than the rate of rise of AVC until the minimum point of AC.

• Beyond that level of output, the rate of rising AVC offsets the rate of falling AFC, causing the AC to rise. It is also possible to observe the AVC approaches the AC asymptomatically. This is due to the AFC, which continues to decrease as output increases, which in turn shrinks the distance between AC and AVC.

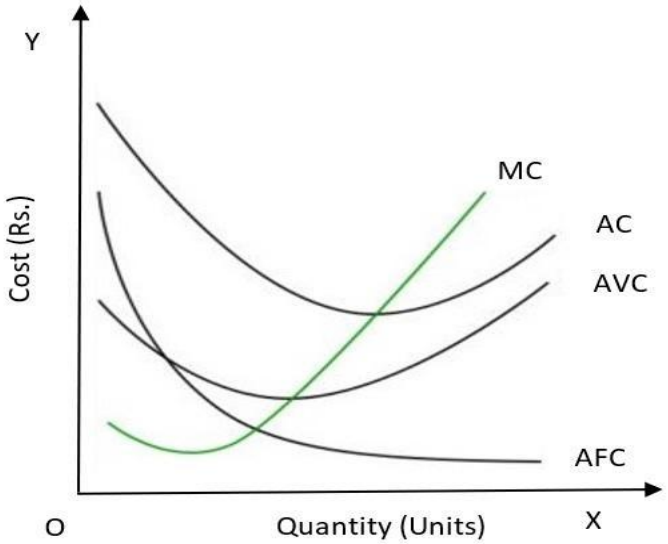

Figure 11: Short Run Cost Curves

5.4.1.9 Relationship Between Average Cost and Marginal Cost

- When AC falls, MC is less than AC and lies below AC.
- At the minimum point of the AC curve, the slope of AC is zero. At this minimum point of the AC curve, AC = MC.
- When the slope of AC exceeds zero (AC is rising), MC will be greater than AC and will lie above it.

IN-TEXT QUESTIONS

A short run is a time period in which some factors remain constant while others change. True / False

_____ is the total cost divided by the number of output units produced.

The cost added to the total cost of producing one more unit of output is known as:

a) Marginal Costs b) Average Costs

c) Fixed Costs d) Average Variable Costs

The combination of fixed and variable factors becomes optimal at the minimum point of _____costs.

AC and AVC are both U-shaped, illustrating the law of variable proportions. True/False

5.4.2 Cost-Output Relationship in the Long Run

The long run is a time period in which the firm can vary all of its inputs. None of the inputs are fixed and can be changed to change the output. Long run is a period long enough to allow changes in the plant, such as capital equipment, machinery, land, and so on, in order to expand or contract output. The long run cost of production is the lowest possible cost of producing any given level of output when all inputs, including plant size, are variable. There is no fixed factor of production and thus no fixed cost in the long run. Because the scale of production may change during this period, the long run cost curves will be subject to Returns to Scales.

5.4.2.1 Long Run Total Cost

The long run total cost curve shows us the cheapest way to produce any level of output. Each point on the long run total cost curve is obtained by a point on the short run total cost curve representing the most appropriate plant to produce that output (the plant that provides the lowest possible cost to produce the specific level of output). The long run total cost curve is the one that is tangent to the short run total cost curve at that particular level of output. There can never be a portion of the STC curve that is lower than the LTC curve derived from the STC curves. Because there are no fixed costs in the long run, the LTC curve is S-shaped and begins at the origin.

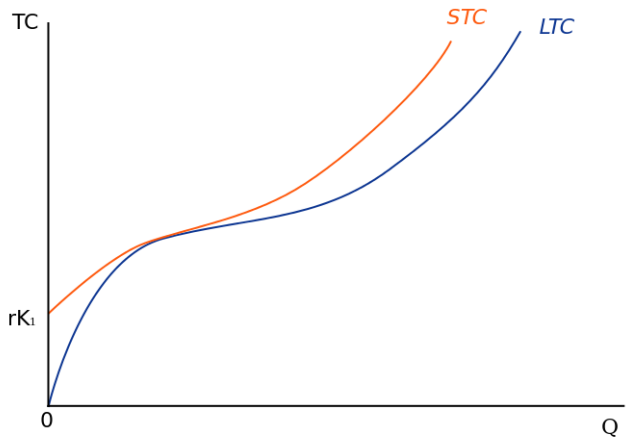

Figure 12: Long Run Total Costs

5.4.2.2 Long Run Average Cost Curve

In the long run, all of the production factors are variable, and the firm has a number of options for determining the size of the plants and the production factors to employ. Different short run average cost curves represent the various plant sizes available to a firm. We can obtain the long run average cost curve by combining all of the short run average cost curves. The long run average cost curve encompasses all of the short run average cost curves contained within it. It's also known as a 'Envelope Curve' or a 'Planning Curve'.

The long run average cost curve is also a flat U-shaped curve, as illustrated in the diagram below:

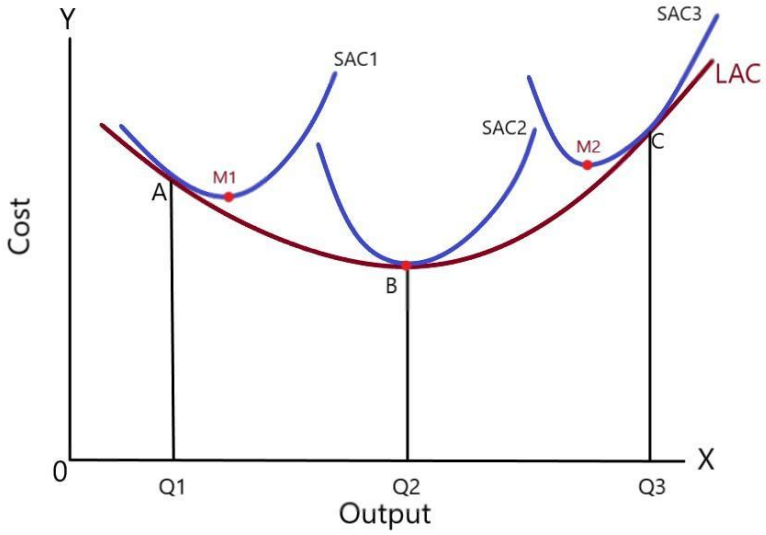

Figure 13: Long Run Average Costs

Characteristics of LAC curve

(i) LAC is called the "envelope curve" as it envelops the SAC curve since LAC is derived from the short run cost curves.

(ii) No portion of LAC can be above any portion of SAC's

(iii) Each point on the LAC is the point of tangency with the corresponding SAC curve.

(iv) The firm chooses that short run plant which allows it to produce the expected output at the minimum cost in the long run. Therefore, the LAC helps the firm in decision making and is called the "planning curve".

(v) Each point on the LAC curves shows the least cost for producing the corresponding level of output. Any point above LAC curve is inefficient because it represents higher per unit cost of production. Any point below the LAC is desirable but unattainable.

(vi) The U shape of the LAC curve reflects the law of returns to scale.

(vii) The LAC touches the minimum of SAC only in the special case- where the optimal plant size is reached.

(viii) The LAC is U shaped, but the sides are flatter than the U shaped SACs.

5.4.2.3 Long Run Marginal Cost Curve

The LMC curves are derived from the SMC curves. The LMC is derived from the points of intersection of SMC with vertical lines drawn from the points of tangency of the corresponding SAC and LAC curves to the X axis.

When output is increased by one unit, the LMC shows the lowest additional long-run total cost.

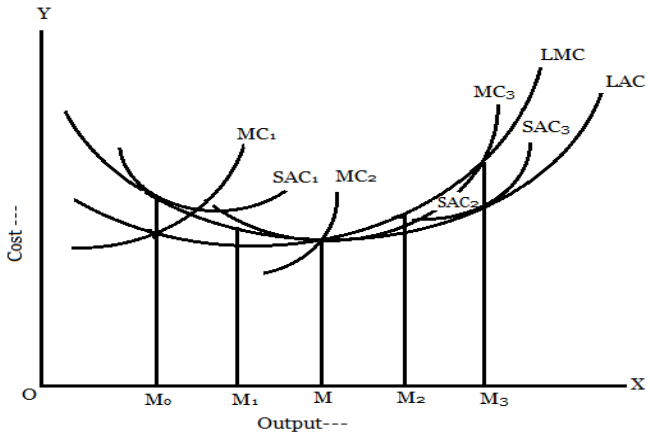

Figure 14: Long Run Marginal Costs

Relationship between LAC and LMC curves

(i) The U-shape of the LAC curve implies that LMC is also U-shaped.

(ii) The LMC curve cuts the LAC curve at the latter's minimum point.

(iii) When LAC is falling, LMC is below it.

(iv) When LAC is rising, LMC is above it.

(v) When LAC is at its minimum point, then LMC = LAC

5.4.3 Relationship Between Production and Cost Curves

This section describes the relationship between

(i) average variable cost (AVC) and average product (AP)

(ii) marginal cost and marginal product

(i) AVC is inversely related to AP, given the price of the variable factor

Suppose the variable factor is Labour (L) and price of the variable factor is the wage rate (W).

$$AVC = \frac{TVC}{Q}$$

Since we know that $TVC = W.L$

Therefore, we can write $AVC = W.L/Q$

We know that $(Q/L) = AP_L$

Therefore $AVC = W/ AP_L$

Therefore, given the price of the variable factor (say wage rate of the labour), the average variable cost (AVC) is inversely related to the Average product of labour ($AP_{L)}$.

(ii) MC is inversely related to MP, given the price of the variable factor

$$MC = \frac{\Delta TC}{\Delta Q}$$

Since the marginal cost is only dependent on the variable cost, we can say

$$MC = \frac{\Delta TVC}{\Delta Q}$$

In case the variable factor is labour (L) and the price of variable factor is wage rate (W), TVC can also be expressed as,

$$TVC = W.\Delta L$$

Therefore,

$$MC = \frac{W.\Delta L}{\Delta Q} = W/(\Delta Q/\Delta L)$$

Thus, $MC = W/MP_L$

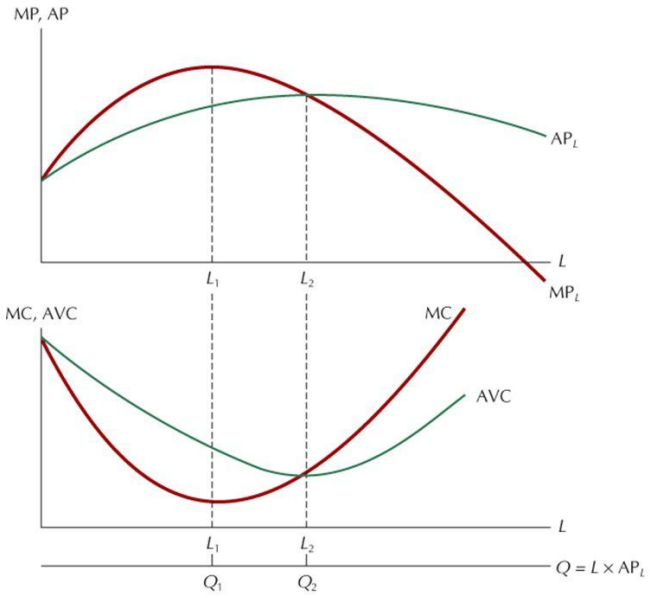

Figure 15: Relationship Between Production and Cost Curves

5.5 MODERN THEORY OF COST

We have learnt about the traditional theory of costs in the previous section. In this section, we will learn about the modern theory of costs. Unlike the traditional theory of cost, the modern theory does not agree on the U-shaped cost curves. According to modern theory, the short-run cost curve is saucer-shaped, while the long-run average cost curve is either L-shaped or inverse J-shaped. This is due to the presence of built-in reserve capacity, which provides flexibility and allows the plant to produce more output without increasing costs.

The Modern theory proposes the existence of "built-in reserve capacity," which provides flexibility and allows the plant to produce more output without increasing costs. The short-run cost curve is shaped like a saucer, whereas the long run cost curve is either L-shaped or inverse J-shaped. The firm, according to the Modern theory of costs, can produce a range of output optimally rather than a single level of output as in the traditional theory of cost. Firms construct industrial plants with some degree of flexibility in their productive capacity, so that instead of a single output level, a wide range of output can be produced optimally and at a low cost. The 'Built-in Reserve capacity' allows for flexibility in the manufacturing process. The 'Saucer - shaped' short run average variable costs are explained by the planned reserve capacity. The modern theory of cost emphasizes the role of economies of scale in allowing a firm to continue production at the lowest point of average cost for an extended period of time. In contrast to the traditional theory, where the average cost rises after the firm reaches the optimal level of output, the firm checks diseconomies of scale by planning ahead of time and enjoys production gains. The L-shaped and inverse J-shaped LAC curves are explained by developments in managerial economies.

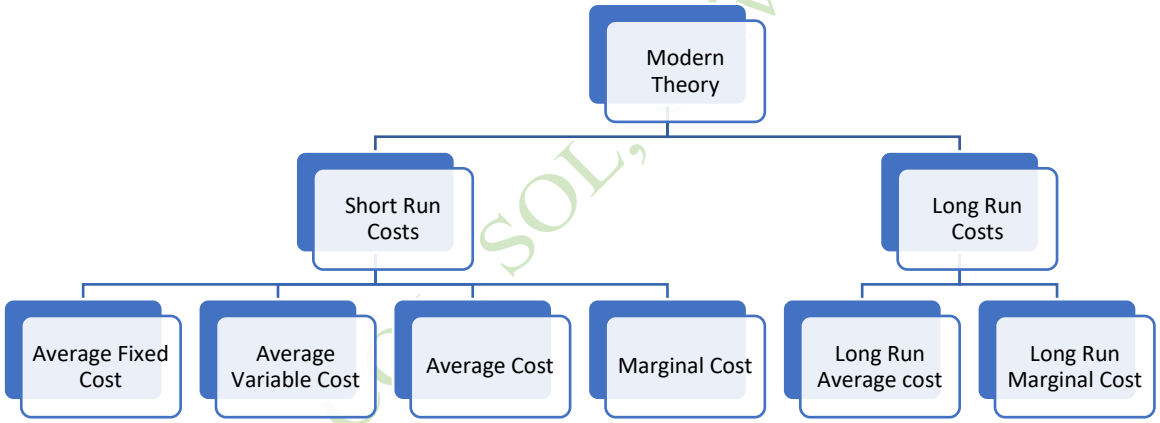

Figure 16: Modern Theory of Costs

5.5.1 Short Run Average Fixed Cost

The average fixed costs in modern microeconomics plot as a rectangular hyperbola, just like in traditional cost theory.

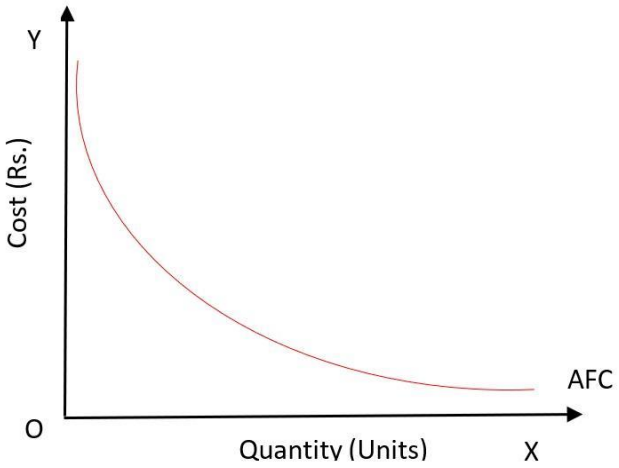

Figure 17: Short Run Average Fixed Costs (Modern Theory)

5.5.2 Short Run Average Variable Cost

According to modern theory, average variable cost is saucer-shaped and has a flat stretch over a range of output. This flat stretch represents the firm's reserve capacity to meet seasonal and cyclical demand changes. The average variable cost curve looks like this:

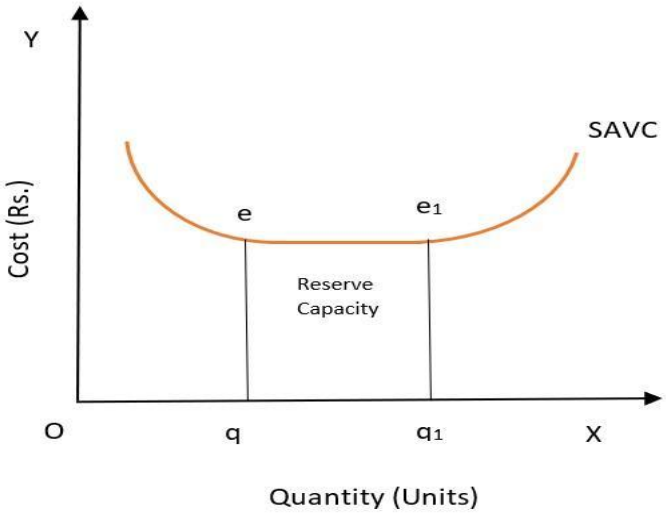

Figure 18: Short Run Average Variable Costs (Modern Theory)

5.5.3 Short Run Average Cost

Average fixed costs and Average variable costs comprise the short-run Average costs. The smooth and continuous fall in the average cost curve is caused by the AFC curve being a rectangular hyperbola and the AVC curve falling and then becoming horizontal within the range of reserve capacity. Beyond that, it begins to climb steeply. The average cost curve looks like this:

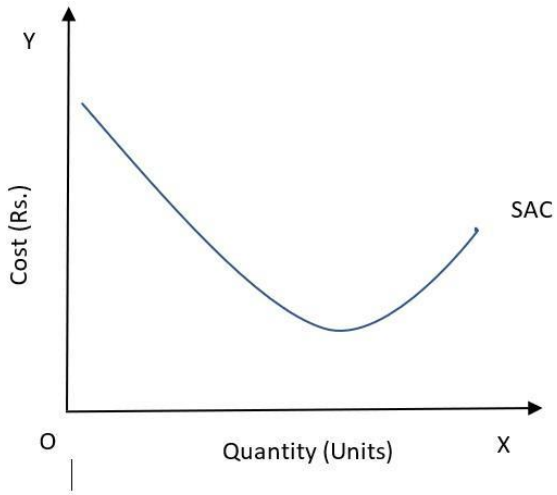

Figure 19: Short Run Average Costs (Modern Theory)

5.5.4 Short Run Marginal Cost

The MC curve intersects the SAVC curve at its minimum point. Because the SAVC curve reaches its minimum point not at a single point but over the entire flat stretch ee_1, the SMC coincides with the SAVC over the entire range of output corresponding to the flat stretch of the SAVC Curve. The SMC curve will be below the Saucer-shaped SAVC curve for any output less than Oq, and it will be above the SAVC curve for any output greater than Oq_1. As a result, the short-run marginal cost curve coincides with the SAVC Curve over the flat stretch corressponding to Reserve Capacity.

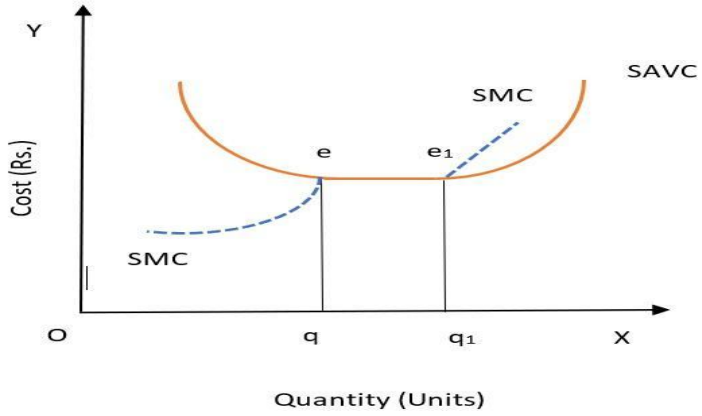

Figure 20: Short Run Marginal Costs (Modern Theory)

5.5.5 Long Run Average Cost

Modern economists divide long run costs into production costs and managerial costs. In the long run, all costs are variable, giving rise to an L-shaped long run average cost curve. This curve initially slopes rapidly downwards but later remains flat or gently slopes downwards at its right-hand. The long run average cost curve looks like this:

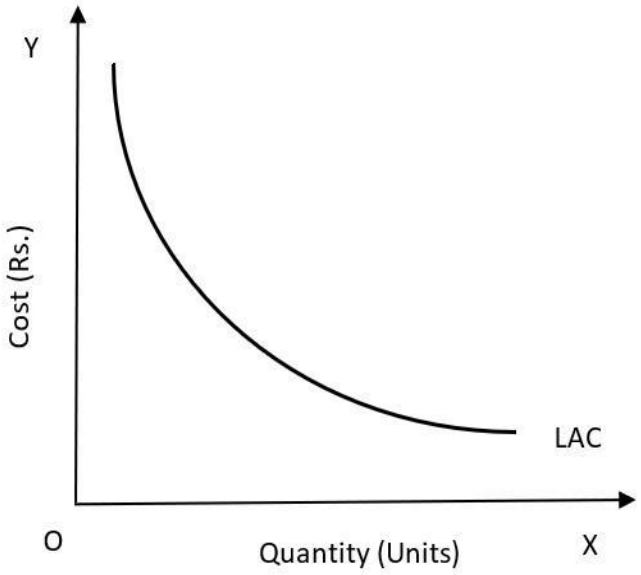

Figure 21: Long Run Average Costs (Modern Theory)

5.5.6 Long Run Marginal Cost

The shape of the long-run marginal cost curve corresponds to the shape of the long-run average cost curve as per the modern theory of costs. The diagram shows that when LAC is

L-shaped and the LAC curve is falling, the LMC curve will also fall and its falling portion will be lower than the LAC curve's falling portion.

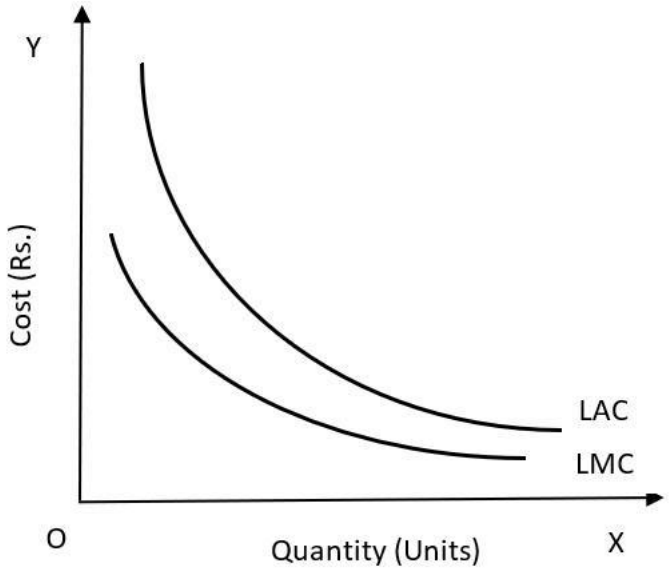

Figure 22: Long Run Marginal Costs (Modern Theory)

IN-TEXT QUESTIONS

According to modern theory, average variable cost is _____shaped.

The flat stretch of short-run AVC in modern theory of costs represents the firm's reserve capacity to meet seasonal and cyclical demand changes. True/False

Long run average costs as per modern theory of costs is U shaped. True / False

The average fixed costs plot as a rectangular hyperbola according to both traditionl and modern theory of costs. True/False

According to modern theory, average variable cost :

a) L shaped
b) Saucer shaped
c) U Shaped
d) M shaped

5.6 SUMMARY

The main points and themes covered in the lesson must be reviewed and highlighted at the end of the lesson in the form of a summary. Please note that 'this is not a conclusion: rather it will help the learners in remembering the main points of the lesson and therefore it is written at the end of the lesson. It should be one paragraph and should not be too long. Further, if the author feels the need, key points can be given as a numbered or bulleted list or a diagram chart.

5.7 GLOSSARY

Short Run- It is a time period in which some factors are fixed, while others are variable.

Long Run- It is a time period in which all factors are variable and none of the variables is fixed.

Fixed Costs- Fixed costs are those that are not affected by changes in output.

Variable Costs- These are the costs associated with the use of variable factors of production, the amount of which can be changed in the short run.

Marginal Costs –These are the costs added to the total cost byproducing one more unit of output.

Accounting Costs- These are the expenses that are recorded in the books of account such as profit and loss statements and the balance sheet.

Economic Costs- It is the sum total of explicit and implicit cost.

Opportunity Costs- These are the returns from the firm's second-best use of resources that it foregoes in order to reap the benefits of the best use of resources

Sunk Costs- These are investments that have no opportunity cost.

Historical Costs- The historical cost of an asset is its original cost.

Replacement Costs- A replacement cost is the amount of money that would have to be paid today to replace the same asset.

Incremental Costs- Incremental costs are defined as the change in overall costs caused by specific decisions.

Books Costs- These are costs that do not involve cash payments, but a provision is made in the books of account and they are taken into account when the profit and loss accounts are finalised.

Out of Pocket Costs- These also known as explicit costs, are those that require immediate cash payment.

Private Costs- Private cost is the cost of production incurred and provided for by an individual firm engaged in the production of a commodity.

Social Costs- The total cost to society of producing a good.

Shutdown Costs- Costs incurred when production operations are suspended.

5.8 ANSWERS TO IN-TEXT QUESTIONS

1. Implicit	9. Average Costs
2. True	10. True
3. b	11. Saucer Shaped
4. Social Costs	12. True
5. False	13. False
6. True	14. True
7. Average Costs	15. b
8. a	

5.9 SELF-ASSESSMENT QUESTIONS

1. Discuss why the average variable cost, average cost and marginal cost are "U"-shaped.
2. When the output of the firm increases, the average total cost and average variable cost curves come closer and closer to reach other but never meet. Why?
3. Explain the derivation of the long run average cost curve from the short run average cost curve?
4. Why is the long run cost curve always an envelope of the short run cost curves?
5. Is there any situation when the marginal cost is constant throughout but the average cost is falling? If yes, then under what circumstances it happens?
6. Distinguish between average and marginal cost. Show byexamples and diagrams that marginal costs are less than average: costs, if average costs are falling, and more that average costs if average costs are rising.

7. Discuss the relationship between production and cost curves.
8. Discuss in detail the cost-output relationship in the short run according to the traditional theory of cost.
9. Differentiate Between:

(i) Opportunity costs and actual cost.

(ii) Explicit and Implicit costs.

(iii) Fixed Costs and Variable Costs.

10. The Modern theory proposes the existence of built-in reserve capacity. Discuss the modern theory of costs in the light of this statement.

5.10 REFERENCES

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5.11 SUGGESTED READINGS

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UNIT: 04

MARKET STRUCTURES

Campus of Open Learning
School of Open Learning
University of Delhi

LESSON 6

MARKET STRUCTURES

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STRUCTURE

6.1 LEARNING OBJECTIVES

After studying this chapter, students will be able to:

- *Describe the nature of various types of markets and recognize the firms operating under different market structure.*
- *Explain the relationships between marginal cost (MC) and marginal revenue (MR), total cost (TC) and total revenue (TR), economic profits and losses.*
- *Determine the short-run and long-run optimal output and price for firms and industry under different market conditions.*

6.2 MARKET STRUCTURES

Market structure is the classification and differentiation of various types of firms based on their level competition, types of goods and services offered, number of buyers and sellers, degree of information available, etc. Market structure basically characterizes the market place "*where buyers and sellers meet and exchange products and services*" (Kotler, 2012). On the one hand, market structure influences seller's behavior and on the other it determines the supply of different goods and services.

We can characterize market structures based on the number of buyers and sellers, ability to set the prices, degree of product homogeneity and the autonomy of entry and exit from the market. Based on above criteria markets are generally classified as:

Perfect competition: there are unlimited number of sellers selling homogenous goods at uniform price. The demand curve of a firm is perfectly elastic parallel to X-axis with freedom of entry and exit from the market.

Under imperfect competition different types of markets exists such as;

Monopolistic competition: with large number of firms, each having a small market share, selling almost identical goods with slight difference. Each firm can influence the price of their products up to a certain extent.

Monopoly: where only a single seller is operating in the market with strong barriers to entry. The firm can set a price which is more than perfectly competitive market price.

Oligopoly: where few large firms capturing a larger share of the market. The product offered by them can be homogenous or not, and they may form a cartel or compete with other firms in the market.

Duopoly: as the name suggests, this type of market is like oligopoly with only two large companies capturing a significant share of market.

Monopsony: is a special type of market with only a single buyer.

Oligopsony: is a market with only few buyers.

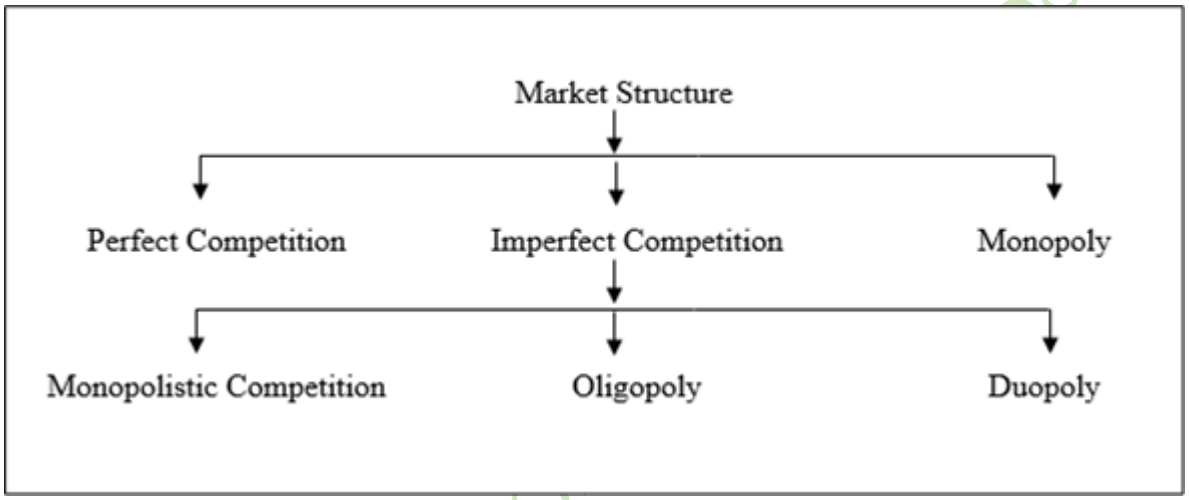

Fig 6.1: Types of Market Structures

6.3 PERFECT COMPETITION

It is a type of market with unlimited number of small companies selling identical goods at a uniform price. Firms under perfectly competitive market cannot fix the prices and they are considered as 'price takers'. They are free to either enter or exit from the market and the consumers have full knowledge about the goods sold in the market.

6.3.1 Characteristics:

- Unlimited producers and buyers
- No barrier in entry and exit from the market.
- Products are homogenous in nature
- Perfectly elastic demand curve horizontal to X-axis where, AR = MR
- Complete information about the product, price, quality and production methods
- Firms are price-takers
- Profit Maximization: firms aim is to maximize its profits
- No transaction costs
- Perfect factor mobility

6.3.2 Equilibrium of Firm and Industry under Perfect Competition:

It is important to differentiate between firm and industry before analyzing the two. Lipsey & Chrystal (2011), have defined, "*Firm is the unit that employs factors of production to produce commodities that it sells to other firms, to households, or to the government*". Industry on the other hand, is a group of firms that sells identical products. For example, Tata Motors, Mahindra and Mahindra, Toyota, etc., are automobile producing firms, whereas a group of such companies is called the automobile industry.

A. Short-Run Equilibrium of a Firm

A firm changes its output in the short-run by changing its variable factors of production. No firm can enter or leave the market in the short-run. There are two techniques of determining the equilibrium position of a firm. These are;

(1) Marginal Cost-Marginal Revenue Approach

A firm under perfect competition is in equilibrium at a point where it produces optimal level of output giving him maximum profit. The two conditions for achieving equilibrium are;

(i) MC = MR (first order and necessary condition)

(ii) MC curve must cut the MR from below (second order condition)

A firm can have five possibilities in the short-run which are given below.

(a) Supernormal Profits

When the prevailing market price is higher than the SAC, a firm earns super normal profits. As shown in Fig 6.2 (A), the equilibrium point is E_1 where SMC = MR and SMC curve intersects the MR curve from below (i.e., slope of MC > slope of MR). The optimal level of output is OQ and price is OP. The area as TSE_1P is the supernormal profits for the firm.

(b) Normal Profits

At the equilibrium point E_2, the price equals the SAC, giving only normal profits to the firm (Fig 6.2 (B)).

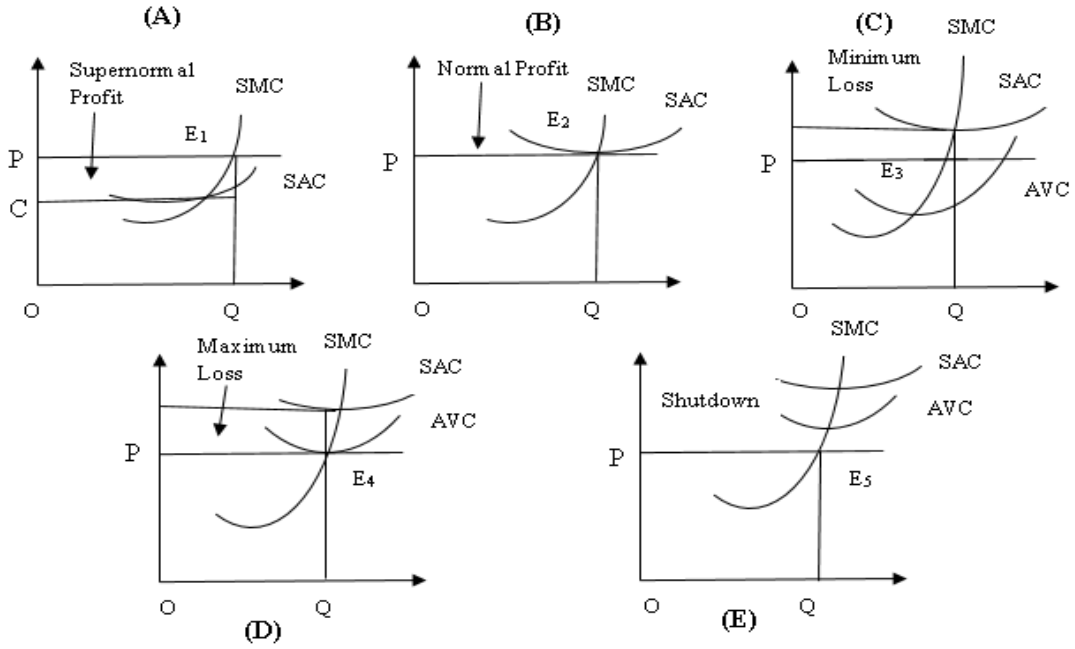

Fig 6.2: Short-Run Equilibrium of the Firm under Perfect Competition (Marginal Cost-Marginal Revenue Approach)

(c) Minimum Loss

When the price is fixed below the SAC, a perfectly competitive firm incur losses equal to the area PE_3BA as shown in Fig 6.2 (C). Note that the firm will stay in the market as long as it is covering its average variable cost plus some of its fixed cost.

(d) Maximum Loss

But when the price falls to the level of AVC, as shown in fig 6.2 (D), the firm becomes indifferent whether to continue production or shutdown. At point E_4, the firm will just cover its average variable cost. Therefore, point E_4 is the shutdown point for the firm.

(e) Shut Down Point

In Fig 6.2 (E), shut down point is depicted where a firm is unable to cover even its AVC. Therefore, in short-run a firm is in equilibrium in all the above explained situations.

(2) Total Cost-Total Revenue Approach

A firm under perfect competition prefers the point of production where the gap between TC and TR is maximum (Fig 6.3). This is the point of equilibrium.

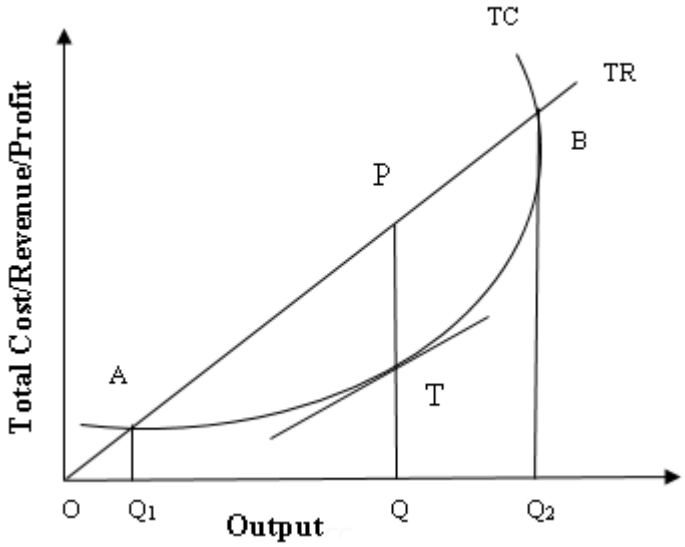

Fig 6.3: Short-Run Equilibrium of the Firm under Perfect Competition (Total Cost-Total Revenue Approach)

B. Short-Run Equilibrium of the Industry

A perfectly competitive industry must fulfil two conditions to reach the equilibrium position in short-run. These are;

(i) SAC = AR and

(ii) SMC = MR for all the firms

(iii) Market demand = Market supply

This implies that all firms of a perfectly competitive industry must be earning only normal profits. This is totally a coincidence, because we have seen that in short-run a firm may earn supernormal profits or incur losses. Even then, there is a possibility of industry to achieve equilibrium when its quantity demanded equals to its quantities supplied at the price which clears the market.

Fig 6.4 depicts the equilibrium of a perfectly competitive industry. At point E, the total demand curve "D" and total supply curve "S" intersects giving equilibrium price OP and output OQ. But one can see that at the prevailing market price OP, some firms are earning supernormal profits PE_1ST, while some other firms are incurring losses.

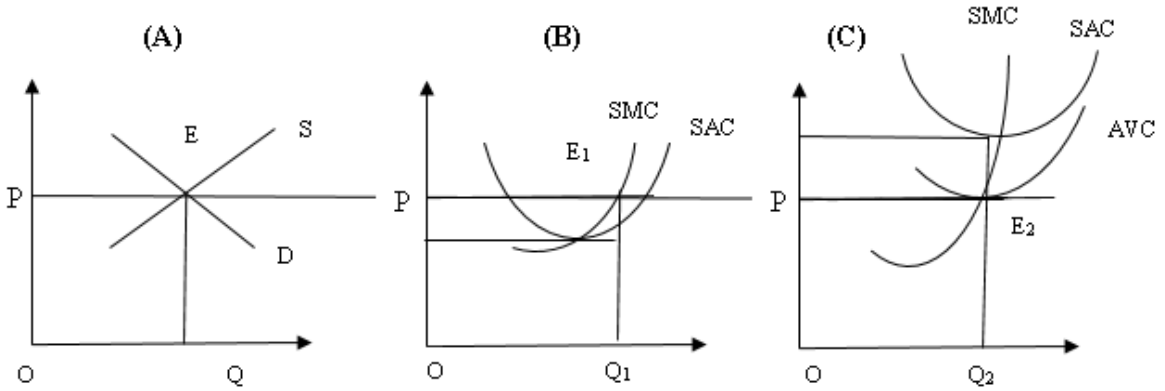

Fig 6.4: Short-Run Equilibrium of the Industry under Perfect Competition

C. Long-Run Equilibrium of the Firm

In the long-run all costs become variable. This means that the firm can change its production-capacity based on the level of demand. There is an absence of fixed costs in the long-run and optimal production point is at the lowest level of long-run AC curve.

Each firm in the long-run is earning only normal profits. Since, free entry and exit are allowed for firms from the market, if some firms are getting more than normal profits, new companies will enter the market. Similarly, if some firms are incurring losses, they will leave the industry.

Thus, each firm of the industry under perfect competition have to fulfil two conditions to achieve the equilibrium point.

(i) LMC = SMC = AR = MR = P = SAC = LAC at its lowest point (first-order condition).

(ii) LMC curve must cut the MR curve from below (second-order condition)

Fig. 6.5 is showing both these conditions being satisfied at point E. Hence, the optimal output is OQ and equilibrium price is OP giving the firm normal profits.

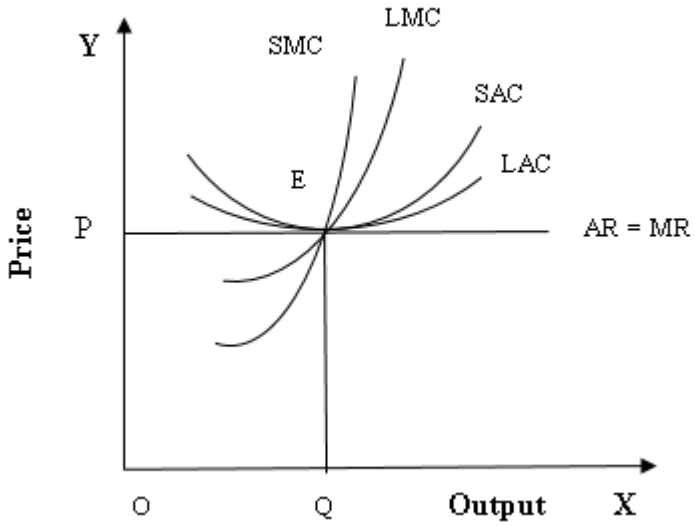

Fig 6.5: Long-Run Equilibrium of the Firm under Perfect Competition

D. Long-Run Equilibrium of the Industry

The long-run equilibrium condition for an industry operating under perfect competition is when 'LMC = MR = AR = LAC at its minimum level'. At this point industry's total demand is equal to its total supply (fig. 6.6). Note that the supply curve of the industry is determined by the horizontal summation of the supply curves of the individual firms. This can be upward sloping (increasing- cost industry), downward sloping (decreasing- cost industry) or horizontal (constant- cost industry). On the other hand, the demand curve of the industry is downward sloping.

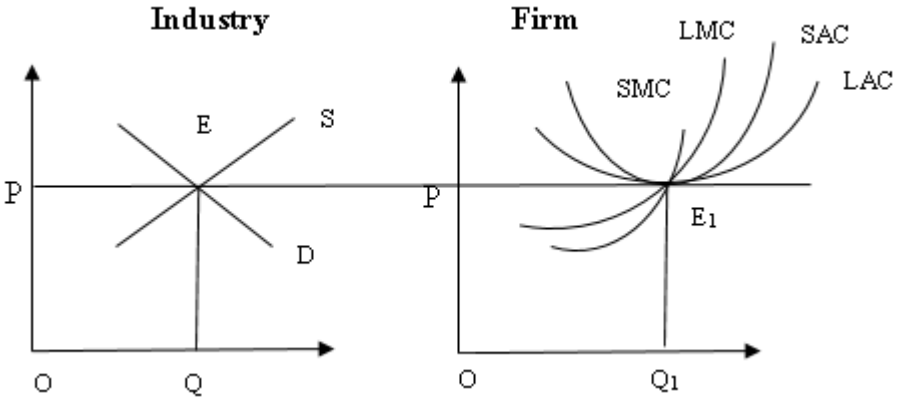

Fig 6.6: Long-Run Equilibrium of the Industry under Perfect Competition

6.3.3 Price Determination under Perfect Competition:

Prices under perfect competition are based on the level of demand and supply. Products sold under perfect competition are homogenous with perfectly elastic demand curve which is horizontal to X-axis. This implies that a firm cannot alter the prices and only accept the prevailing market prices which are fixed by the industry based on interactions of total demand and supply. Hence, the 'law of one price' prevails in this market.

6.4 MONOPOLY

Under monopoly market a single firm represents the whole industry. It captures the entire market and faces no competition. The firm set the prices for its products. This can be due to sole access to resources, government licenses, Intellectual Property Rights (IPR) over the product, or high initial setup costs. Under monopoly, the market forces become irrelevant as the consumer lose all their power to negotiate and become price-takers. Although, a pure monopoly is very rare but few examples that are close to monopoly are; local electricity supplier, supplier of Uranium and Thorium (raw materials for Nuclear power plants), etc.

6.4.1 Characteristics:

- Single firm with not rival or direct competition
- Entry of new firms is completely blocked due to technical, legal or economic reasons
- Firm decides its price, 'price-maker'.
- Demand curve is downward sloping
- Monopolist can either set its prices or the quantity but not both
- The concept of supply curve is meaningless under monopoly
- Monopolist practices price discrimination to extract maximum profit
- Monopolist can earn super normal profits even in long-run

6.4.2 Equilibrium under Monopoly:

Just like perfect competition, there are two approaches through which equilibrium position can be determined in monopoly. These are;

A. Marginal Revenue and Marginal Cost Approach

B. Total Revenue and Total Cost Approach

A. Marginal Revenue and Marginal Cost Approach

There are two conditions that needs to be fulfilled to achieve under monopoly.

(i) MR = MC (first-order condition)

(ii) MC curve must cut MR curve from below (second-order condition)

a. Short Run Equilibrium

A monopolist in short-run cannot change its fixed factors of production like, plant and machineries and can increase its production by increasing variable factors only. In short-run, three situation can occur for a monopolist. These are;

Super Normal Profits

A monopolist can earn super normal profits when the price charged is more than the SAC. The equilibrium point is at E, where the MC curve cuts the MR curve from below giving equilibrium quantity (OQ_1). At this point the price charged is (AO) which is more than SAC giving super normal profit equal to the area ABDC (fig 6.7).

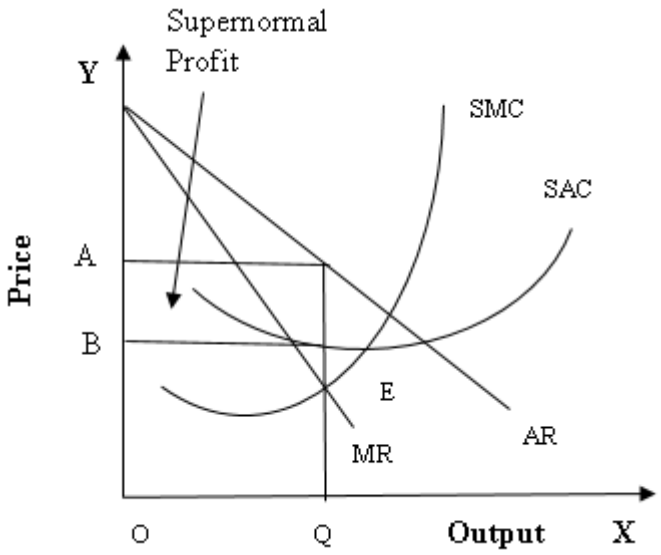

Fig 6.7: Super normal Profits of a Monopolistic Firm

Normal Profits

A monopolist will earn only normal profit when the price charged is just equals to the SAC (i.e., AR = SAC). In fig 6.8, the equilibrium point is at E where, MC = MR and the optimal output is OM and price is OP.

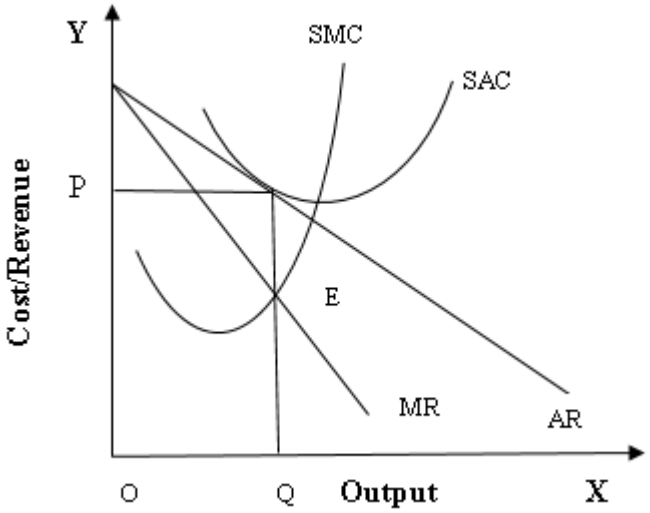

Fig 6.8: Normal Profits of a Monopolistic Firm

Minimum Losses

When the monopolist fixes the price below the variable cost, it incur losses. In fig 6.9, the price is fixed at P_1 which is equal to the SAVC, which means the monopolist is able to cover only the average variable cost. Below this point the monopolist will discontinue production call the shutdown point.

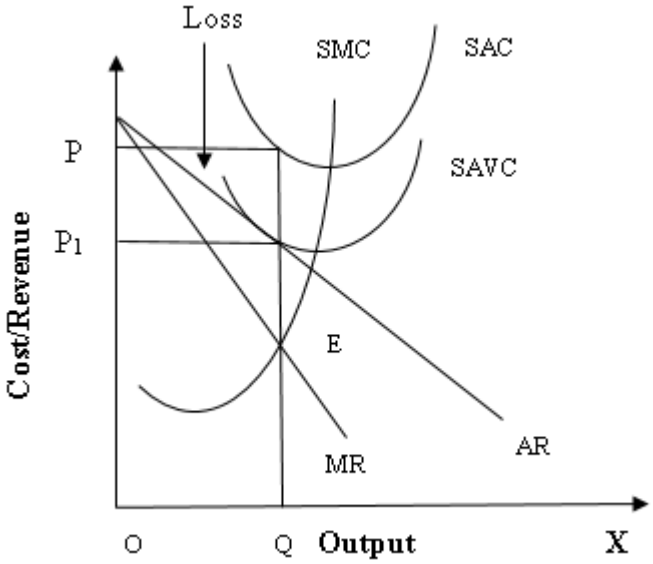

Fig 6.9: Loss of a Monopolistic Firm

b. Long Run Equilibrium

The long-run equilibrium condition for a monopolist is same as the short-run that is at point where the LMC curve cuts the MR curve from below (i.e., slope of LMC > slope of MR). In fig 6.10, the equilibrium point is at E where the optimal output is OM and the

equilibrium price is OP and the monopolist earns maximum profit equivalent to the area $PJHP_1$.

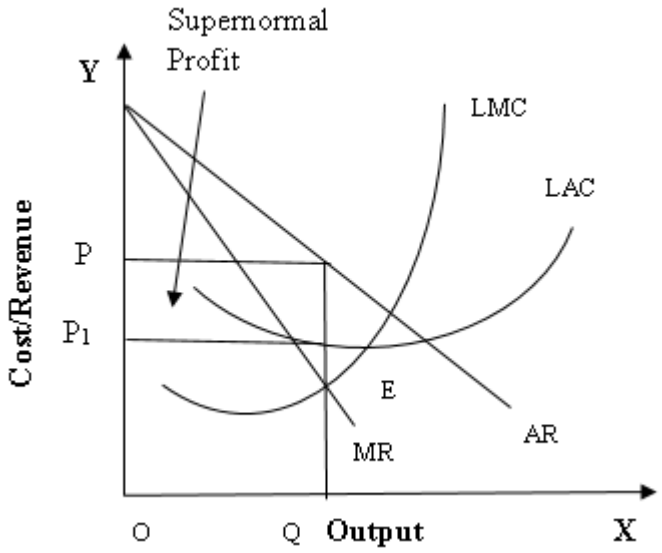

Fig 6.10: Long-run Equilibrium under Monopoly (Marginal Cost-Marginal Revenue Approach)

B. Total Revenue and Total Cost Approach

The equilibrium is reached at a point where the distance between TR and TC is maximum. A monopolist finds out the optimal level of output that gives maximum profits. In fig. 6.11, the equilibrium is achieved at point E, here the gap (AB) between TC and TR is maximum.

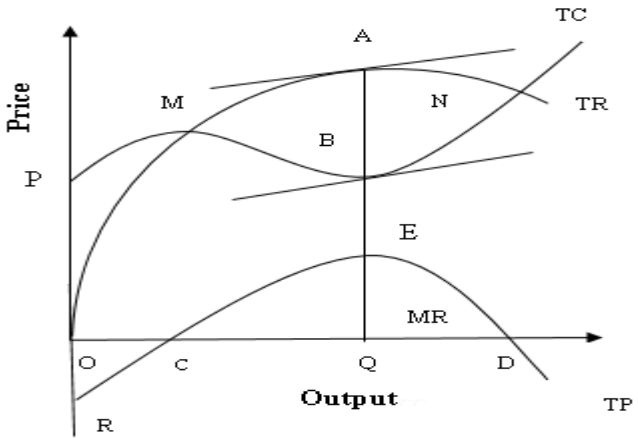

Fig 6.11: Long-run Equilibrium under Monopoly (Total Cost-Total Revenue Approach)

6.4.3 Price Determination under Monopoly

Under monopoly the price is determine by single firm. Monopolist also practices price discrimination in order to extract maximum revenue for their products.

IN-TEXT QUESTIONS

1. The demand curve of a firm under perfect competition is perfectly inelastic. (True/False)

2. A firm under perfect competition is a 'price-taker' because:

A. the firm's management doesn't know what price to set.

B. the output of the firm is too small to influence the market price.

C. the firm is following a price leader

D. the firm produces less output to set a higher price.

3. A monopolist will fix a _____ price and also produce _____ quantity than a perfectly competitive firm.

4. There is no unique supply curve under monopoly. (True/False).

6.5 PRICE DISCRIMINATION

It is a pricing strategy where a company sells the same product or service at different prices to different customers. Robinson, (1961) defines price discrimination as "*the act of selling the same article, product under a single control, at different prices to different buyers*." This is practiced so as to get the maximum possible revenue from the consumers or say to minimize the consumer surplus to the possible extent. This strategy is found to work more effective in a monopolistic market, where sellers are free to determine the prices without obeying any standard pricing mechanisms, rules, or laws.

Note that price discrimination is different from product differentiation where the distinction is made between the products and not their prices. Price discrimination is classified into three degrees:

- first degree (unit-based)
- second degree (quantity-based)
- third degree (consumer group-based)

First degree price discrimination or perfect price discrimination, is the strategy whereby firms fix the maximum rate for each unit of product and service. Entire consumer surplus is absorbed or eliminated in this type of discrimination. This is also called the 'take it or leave it' pricing strategy. Under **Second** degree price discrimination also known as 'menu pricing', the prices are set as per the quantity consumed by the consumers. It may also involve offering a product line similar to a menu card in which more options are given to the consumers for the same product with slight modifications to sell them at a differential price. **Third** degree discrimination, also termed group pricing, occurs when companies divide their customers into different groups and sell the same products at different prices to specific groups.

Price discrimination depends upon the following conditions:

1. Firm's Monopoly: When the firm has a monopoly in the market, it becomes the price maker. An imperfect market gives companies the liberty to opt for such strategies.

2. Market Segmentation: Segmenting markets to make this pricing strategy work is a must. Thus, companies divide the markets based on various factors, including age, gender, physical distance, preferences, time, nature of the product, etc. The market segments should be divided such that no two markets get entangled at any cost. The seepage of one market into the other would mean resale facilitation. As a result, the entities that purchase the goods and resell them at a lower rate would start getting direct customers, making the original sellers incur huge losses. Thus, it is important to prevent resale opportunities.

3. Elasticity of Demand: Furthermore, the elasticity of demand plays a great role in determining if price discrimination would work for a company. For example, a lower income group searches for options that involve less expenditure, and hence, they narrow down their options being elastic. On the other hand, the higher income groups are ready to spend more, and therefore they are open to wider options and have more demands.

Examples:

Let us consider the following price discrimination examples to understand how the strategy works:

1. Charging higher price than its usual charges, taking advantage of the event to earn more (i.e., weddings, festivals, etc.)
2. Offering hefty discounts for bulk purchases.
3. Charging higher rent for a flat located in posh area.

Pros and Cons of Price Discrimination:

Following are some of the pros and cons of price discrimination:

Table 6.1: Pros and Cons of Price Discrimination

Pros	Cons
Businesses sell more, generate better revenues	Prices go too high in some cases
Lenient pricing helps lower-income groups to buy products at a lower cost	Consumer surplus is no option
As the cost is adjusted, sales increase and the output level automatically improves (economies of scale)	Might hamper the company's image as the same products might be available at lower prices in other markets
Helps even the deprived sections have a better standard of living	

6.6 PRICING STRATEGIES

Every economic activity involves pricing decisions. From house rent to consultant fee, insurance premium or salesman commission. There involves some kind of pricing decisions. Similarly, every business firms adopts a certain type of pricing strategies based on the type of products being sold, type of market structure, season in which business is being carried, quantity in which products are being sold, etc.

There are various other factors that affects the pricing strategies of a firm. These are;

- **Pricing objective:** whether the firm is pursuing survival, maximum profit, maximum market penetration, pricing leadership, etc.
- **Demand of the product:** whether the product is highly price sensitive, just like in the case of perfect competition, or the product is price inelastic in case of highly essential commodities.
- **Cost of production:** every firm wants to cover its production cost and some proportion of profit from sale of their products. If the firms is not able to recover its AVC, it shutdowns its business.
- **Competitors pricing strategies:** generally seen in imperfect competition like oligopoly, where there are only few firms are operating in the market. Here, competitors pricing strategies affects the firms pricing decisions.
- **Other factors:** like government regulations, number of substitutes, product life cycle, method of production, brand value, etc.

Based on these the pricing strategies are broadly classified into four major categories. These are;

A. Cost Based Pricing Strategies: As the name suggests the major factor is the cost of production that decides the firms' pricing policy. There are various pricing strategies under cost-based pricing.

(i) Full Cost/ Cost plus Pricing: Here, the prices are set just equal to the average cost, also called 'break-even' pricing (no profit no loss). Or prices includes some share of mark-up/ margin of profit. It is generally used for pricing public utilities.

(ii) Incremental Cost Pricing: Similar to full cost pricing, but here average variable cost is used as a yardstick in place of average cost.

(iii) Marginal Cost Pricing: Here, marginal cost is used to determine the prices of the products.

(iv) Target Pricing: Similar to cost plus pricing but here the firm fixes the mark-up based on certain targets that it wants to achieve.

B. Competition Based Pricing Strategies: The competitors pricing strategies becomes the dominating factor in deciding the prices.

(i) Going rate Pricing: under this pricing method firms fixes the prices that are prevailing in the industry.

(ii) Sealed Bid Pricing: Very common in cases where some kind of bidding is involved. Here, the prospective companies give their bids in a sealed cover. The firms must have to stick to their pricing quotes or they may lose their contracts.

C. Demand Based Pricing Strategies: The pricing decision is based on the demand of the products.

(i) Dual Pricing: As the name suggests, here two prices are set. Certain fixed price is applied to part of the product and remaining product is sold at prevailing market price. Sugar prices in India is fixed based on dual pricing strategy.

(ii) Price Lining: Prices are fixed on the size, quality, quantity, colour, flavour, etc. of a same product. For example, in case of garments size XXL may be priced higher than the size S or M.

(iii) Cyclical Pricing: Every firm goes through some kind of cyclical fluctuation also called trade cycle. The prices are fixed based on the phase in which firms are in. For example, prices are high during prosperity phase and vice-versa.

D. Strategy Based Pricing: Different businesses adopts different strategies for their products based on the nature of the product.

(i) Penetration Pricing: When the firm wants to capture larger market share for their products they go for this type of pricing strategies. Here, the prices are fixed at a lower side to cover larger customer segment and after establishing the product credibility in the minds of the consumers prices are increased to recover the losses.

(ii) Skimming Pricing: Just opposite to the Penetrative pricing, here the prices are fixed on the higher side in the beginning to attract an elite customer segment. Firms spend huge sum on Research and Development of their products and wants to recover the cost as soon as possible. When they believe that the products that they are offering are innovative and have no close substitute they go for such a pricing strategy. This type of pricing is also used in case of a product having high brand value. For example, Apple company fixes the prices of their products very high whenever they launch an updated version of their I-phones.

6.7 MONOPOLISTIC COMPETITION

It is a type of an imperfectly competitive market with the characteristics of both the perfect competition and monopoly. Here, the firms sell identical but slightly differentiated products in terms of quality, looks, taste, flavours, brands, etc. for example, shampoo, soap, washing powder, etc. The products are close but not the perfect substitutes. Each company is therefore the sole owner of a particular brand or commodity.

6.7.1 Characteristics:

- Large number of firms selling closely related goods
- Downward sloping demand curve
- Products are not the perfect substitutes: differentiation is created in terms of quality, colour, packaging, taste, etc.
- Firms are free to enter and exit from the market
- Firms have a degree of control over price
- High advertisement cost: Chamberlin introduced U-shaped selling cost curve.
- Excess capacity in the long-run

6.7.2 Equilibrium of the Firm under Monopolistic Competition

Short-run Equilibrium

In the short-run, each firm under monopolistic competition act as monopolists. As new firms are not allowed to enter the market in the short-run, they can earn supernormal profits or may incur losses. The equilibrium condition for a firm in the short-run is at a point where SMC = MR. Fig 6.12 depicts the equilibrium position E, where the optimal output and price are OQ and OP respectively, and the firm earns profit equivalent to the area BPAR.

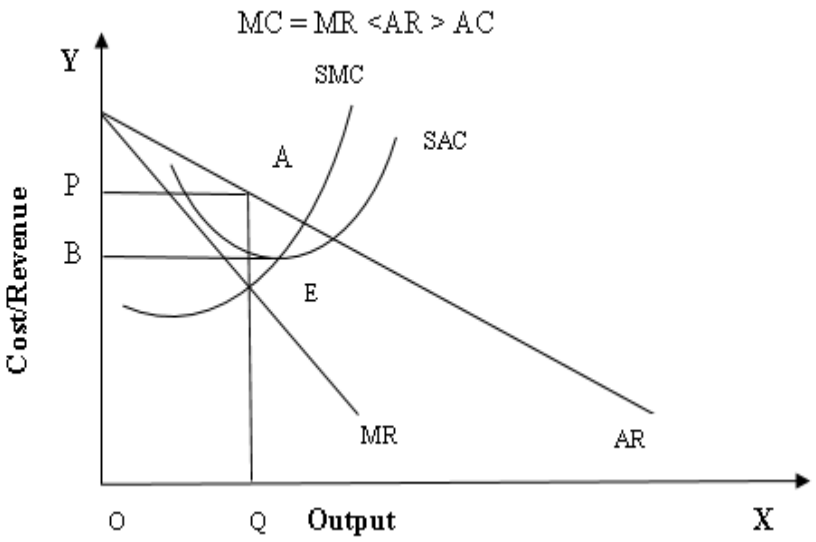

Fig 6.12: Short-run Equilibrium for a Firm under Monopolistic Competition

Note that in the short-run, a firm may earn only normal profit if SMC = MR < AR = SAC occurs and may incur loss if SMC = MR < AR < SAC happens.

Long-run Equilibrium

A firm under monopolistic competition act as perfectly competitive firm and earns only normal profit in the long-run. This is due to the fact that in the long-run they are free to enter and leave the market.

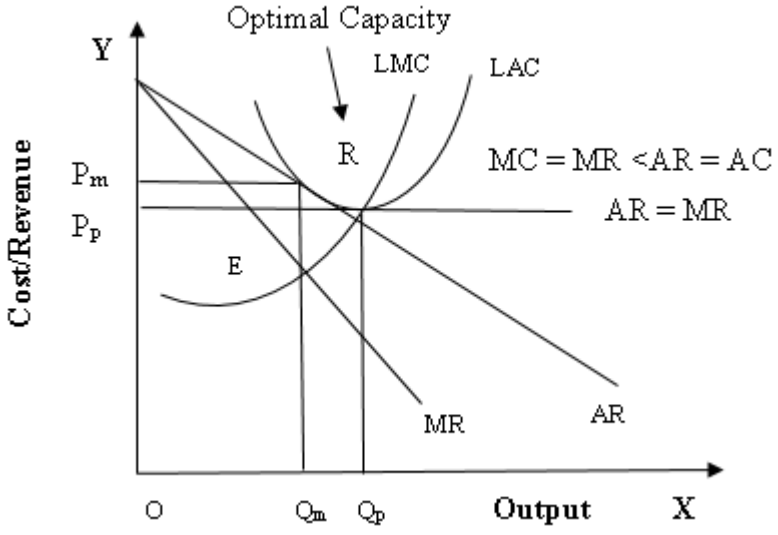

Fig 6.13: Long-run Equilibrium of a Firm under Monopolistic Competition and perfect competition.

The long-run equilibrium condition for a firm is at a point where LMC cuts the MR from below (Fig 6.13). The equilibrium level of output and price are OQ_M and OP_M. Note that the price under monopolistic competition is higher and the output is lower than the perfectly competitive price and output P_P and Q_P respectively.

6.7.3 Price Determination under Monopolistic Competition:

Each firms under monopolistic competition have a slight control over the prices as they ignores the market price and sets its own prices. Since the products offered are not perfect substitutes a firm may increase its prices up to a certain extent without losing its market share. Firms in order to create a differentiation in the minds of customers for their products from the competitors incur heavy advertisement expenditure resulting higher costs. The prices are fixed at the point where the MC curve cuts the MR curve from below both in short-run and long-run.

ACTIVITY

Make a list of different types of products that you consume on daily basis and identify in which market structure they falls in. You will find that it is very difficult to find products that falls under perfect competition or monopoly.

6.8 OLIGOPOLY

Oligopoly comes from the combinations of two Greek words 'oligo' and 'pole' which means 'few' and 'merchants' respectively. Hence, oligopoly is a market structure with few companies selling identical or differentiated goods and services. Given firms are few in number, competitive strategies depend on the move of other firms. Firms in this market either compete with another firm or collaborate together to form a cartel. In either case they have significant control over the prices and can earn supernormal profits in the long-run as well unlike in perfect competition where they are price-takers. Few examples of oligopoly market are: Steel industry, Film, mobile phone, natural gas, etc. Given below are the key characteristics of oligopoly for your reference.

6.8.1 Characteristics:

- Few large sellers

- Goods can be identical or differentiated in nature
- Profit maximization: at point where MC equals MR
- Firms are price setters: They have a strong influence over prices
- Barriers in entry and exit
- Companies can earn super normal profits even in long-run
- Firms having complete knowledge of their own cost and demand functions.
- Kinked-demand curve: because competitors follows price reduction by the firms but not the price rise.
- Non-price competition among firms
- High selling costs: advertisements, promotions, loyalty schemes, etc.

6.8.2 Price Rigidity:

Paul Sweezy is an American economist who argued that, the pricing decisions under oligopoly are guided by competitors' actions rather than by cost or demand objectives. He introduced the 'Kinked Demand curve' for an oligopolist firm, where a price reduction by the firm is followed by its rivals but not the price rise.

In the fig 6. 14, we can see that, the upper portion of the demand curve is more price elastic than the lower part. It is responsible for the price-rigidity among firms. Also, note that the MR curve is discontinuous in shape and the equilibrium condition is at a point where, MC = MR.

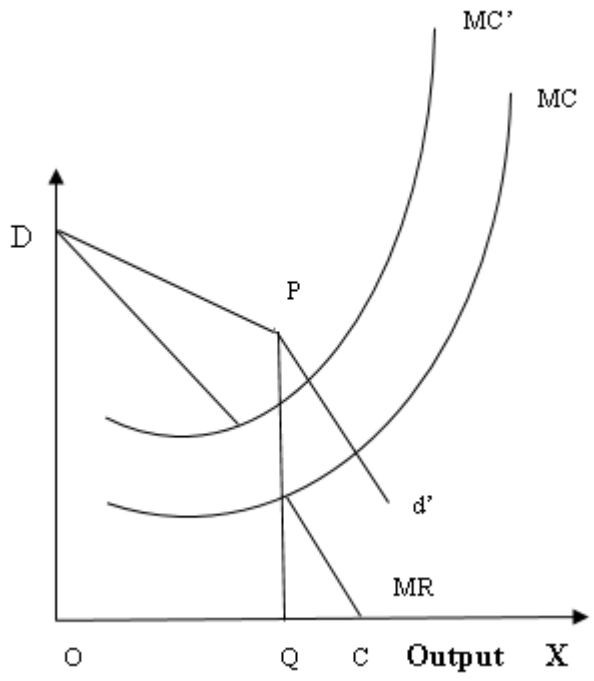

Fig 6.14: Kinked Demand Curve under Oligopoly

Hence, the above situation leads to a never ending 'price war'. In order to overcome this problem, oligopolists generally form a cartel. Let's understand the situation of a cartel.

6.8.3 Price Leadership Model:

Under oligopoly, firms generally form an imperfect collusion, where they follow one leader. Price leadership could be of various forms; a) Low-cost Price Leadership, b) Dominant Price Leadership and c) Barometric Price Leadership.

a) **Low-cost Price Leadership:** Under this, a low-cost firm would charge a lower price and this price is followed by other firms in the market. This may not be a profit-maximizing situation for the followers, but is a necessary step to avoid a price war between the firms where the one with lowest price will easily win.

b) **Dominant Price leadership:** As the name suggests, under this model the dominant firm (one with largest market share) act as a monopolist and fixes the prices at a point where his MC = MR. This situation leads to a profit maximization for the leader but on the other hand, the followers act as price-takers and supply the remaining share in the market at a prevailing price.

The large dominant firm in this model is assumed to be aware of the market demand. It is also assumed that the leader firm also knows the MC curves of the smaller firms, and adding them horizontally gives the total supply by the small firms at each price. Using this information, the dominant firm can obtain his own demand curve by supplying the section of the total market not supplied by the smaller firms.

The dominant firm maximises his profit at a point where his MC = MR, while the smaller firms act as price-takers, and may or may not maximise their profit, depending on their cost structure.

c) **Barometric Price Leadership:** It is a formally/informally agreed market situation where all the firms follow the prices set by a barometric (leader) firm. This leader firm may not have the largest market share or lowest cost but have a good market knowledge and can better forecast the market demands. It is interesting to note that a firm from other industry could be chosen as the barometric leader. For instance, a firm in the semi-conductor industry may be selected as a barometric leader for price changes in the Information and Communication Technology (ICT) hardware industry like laptops, desktops, mobiles, etc.

You will learn about oligopoly in detail in the coming chapters.

Table 6.2: Characteristics of Different Market Structures

Type of Market	Sellers' Entry & Exit	Nature of goods/services	No. of firms	No. of buyers	Price
Perfect Competition	Free	Identical	Unlimited	Unlimited	Price-takers

Monopolistic competition	Free	Closely related but differentiated	Unlimited	Unlimited	Partial control over price
Monopoly	Restricted	Differentiated (No Substitute)	Single	Unlimited	Price- maker
Duopoly	Restricted	Identical or Differentiated	Two	Unlimited	Price rigidity due to price war
Oligopoly	Restricted	Identical or Differentiated	Few	Unlimited	Price rigidity due to price war
Monopsony	Free	Identical or Differentiated	Unlimited	Single	Price-taker
Oligopsony	Free	Identical or Differentiated	Unlimited	Few	Price-taker

IN-TEXT QUESTIONS

5. The basic difference between monopolistic competition and oligopoly is the barrier to entry. (True/False)

6. Forming cartels is very common in _____.

7. Which is the following is NOT a feature of monopolistic competition?

   Product differentiation
   Large number of sellers
   Huge selling costs
   Homogenous products

8. The telecom industry falls in which type of market structure?

   Monopolistic Competition
   Monopoly
   Perfect Competition
   Oligopoly

6.9 SUMMARY

We see different types of market structures in real life. Some are specialized in a particular goods, some offer products at uniform prices, and some have a very limited number of sellers and so on. In economics, we divide these markets into perfect competition, imperfect competition and monopoly. In this chapter we have analyzed each of these market structures and defined them along with that determined their equilibrium conditions and pricing strategies.

While companies in the short-run in any market structure can earn super normal profits. However, the level of competition and freedom of entry decides the long-run profits. We studied that on the one hand, firms under perfect competition are price-takers and earns normal profits, and on the other hand a monopolist using its monopoly power sets its prices to earn super normal profits even in the long-run. We also saw how a monopolist firm segregate its customers and practices price discrimination to extract entire consumer surplus.

Similarly, under monopolistic competition and oligopoly firms which are closer to real world market uses different promotional tools to differentiate their products from the competitors.

6.10 GLOSSARY

Consumer Surplus: It is "*the difference between the maximum amount of money that the consumers are willing to pay and the amount they actually pays"*.

Firms: *Individual unit selling products or services.*

Industry: *Group of firms selling identical products.*

Marginal Revenue: *is the addition to the total revenue by selling one additional unit of output*.

Price Discrimination: *Charging different prices to different customers for identical products*.

Total Revenue: *Total amount of money/income received by the company from the sale of a certain quantity of goods and services*.

6.11 ANSWERS TO IN-TEXT QUESTIONS

1. False
2. B.
3. Higher, Less
4. True
5. True
6. Oligopoly
7. D Homogenous Products
8. D. Oligopoly. In the telecom industry there are 3-5 dominant players (Airtel, Vodafone, Jio, etc). Each setting price based on the competitor's pricing strategies

6.12 SELF-ASSESSMENT QUESTIONS

1. What is market structure? Explain with the help of examples the characteristics of different types of markets.

2. Differentiate between perfect competition and monopolistic competition.

3. Explain why a firm under perfect competition can only earn normal profits in the long-run.

4. What is price discrimination? List the various instances where you have to face such kind of discriminations.

5. Explain why there is no unique supply curve under monopoly.

6. "Under monopolistic competition too many firms each producing too little." Comment.

7. Differentiate between penetration pricing and skimming pricing.

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Department of Distance and Continuing Education
University of Delhi

BBA(Financial Investment Analysis)
Discipline Specific Core (DSC-3)

Bachelor of Management Studies (BMS)
Discipline Specific Core (DSC-2)

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Semester-I

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LESSON 1

INTRODUCTION TO STATISTICS

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STRUCTURE

1.1 LEARNING OBJECTIVES

After reading this lesson, you should be able to :
(a) Learn the meaning of central tendency and other averages
(b) Learn the process of computing arithmetic mean, weighted Mean, Geometric mean, Median, Deciles, Quartiles, Percentiles and Mode under different situations
(c) Comprehend mathematical properties of Arithmetic average
(d) Learn specific uses of different averages.

1.2 INTRODUCTION

The word statistics is used to mean pieces of numerical information. In this sense, the Inflation Rate for the year 2022 is a statistic as is the crime rate in each state across the country or the number of deaths due to COVID19 in a city in the last year. In fact, the notion of statistics was derived from the word state. Traditionally, it has been the function of governments to keep records of population, GDP, Inflation agricultural production, industrial production, exports and imports, employment and unemployment, tax collections, commodity prices, and so on. The counting and measurement of these events results in enormous amounts of quantitative information. Not only governments but all organizations and businesses, big and small, also collect and use huge amounts of numerical information. Today, an annual report without tables and graphs is inconceivable. A company marketing a product without first collecting and using information on customer preferences is just as unlikely. Similarly, a government report on the economy or on any other subject for that matter can most certainly be expected to include numerical data. The newspaper columns and business magazines are full of numerical facts and zigzag graphs presenting such information. Thus, it is no wonder that statistics has been often equated with quantitative information

Statistics can be defined as the body of knowledge which is used for collecting, organizing, presenting, analysing and interpreting qualitative and quantitative data.

Data is defined as "Factual information (as measurements or statistics) used as a basis for reasoning, discussion, or calculation."

A statistical investigation deals with large mass of inter-related facts in the form of numerical figures. These information in the form of numerical figures is generally termed as data. Whereas sometimes data can be in the form of general description or elaboration too.

Or

Data are special type of information, generally obtained through observation, surveys, enquiries, or are generated as a result of human activity for the purpose of research.

1.3 QUALITATIVE AND QUANTITATIVE DATA

The statistical data may be classified on the basis of their characteristics such as qualitative, quantitative, chronological, geographical in nature.

1.3.1 Qualitative Data: When the elements of a sample are recorded as falling into different categories, such type of generated data are termed as qualitative data. The qualitative data are classified on the basis of same attributes or qualities such as sex, religion, employment, status, address, education qualification, income level etc. These attributes cannot not be measured along with a scale. Qualitative data can be only ordinal or nominal. Thus, qualitative data provide only labels or names for categories of the elements under study. The categories for such Data may be identified by either non-numeric descriptions or numeric codes. The qualitative data can be further classified as nominal qualitative data or ordinal qualitative data.

1.3.1.1 Nominal Qualitative Data: The nominal qualitative data are obtained when the elements of the sample are placed in different categories not involving any meaningful ordering. The data on variables Name of Student, Roll Number, Program & section are example of nominal qualitative data.

Some other examples are:

- District-wise classification of businesses according to the address of their respective corporate offices:
- Classification of tax payers for taxation purposes as being resident, not-ordinarily resident, and non-resident is a case in point.
- Classification of students on the basis of streams (Arts, Commerce, Science).
- Cross-classification of corporate employees on the basis of their sex (males or females or transgender) and their attitude towards a new voluntary retirement scheme (VRS) (as favourable, unfavourable or indifferent).
- Classification of employee according to their department. To illustrate, the employees may be asked to specify their department (HR, Sales, Marketing, IT, Others)

1.3.1.2 Ordinal Qualitative Data: An ordinal data set is one where there is a meaningful ordering of the elements so that they can be ranked as being the first, the second, the third, and so on. The data variable ET500 ranking are ordinal qualitative. Some other examples of ordinal qualitative

data include:

i) Ranking of participants in a quiz competition on the basis of their quizzing ability;

(i) Ranking of stocks and bonds by a credit rating agency (Credit Rating Information Services of India Limited, Investment Information and Credit Rating Agency of India Limited, Credit Analysis & Research) as. for example, AAA, AA+, AA, AB, etc.:

ii) Ranking of a set of proposed colour and size schemes for packaging of a product

(iv) Ranking of participants in a beauty contest; and

v) Ranking of students on the basis of elhi University Entrance Exam.

vi) Ranking of athletes in 100-meter sprint.

1.3.2 Quantitative Data:

The **quantitative data** are those which are expressed in meaningful numbers that represent the amount or quantity of some characteristic possessed by an element. Thus, such data indicate either how much" or "how many'" of something. Quantitative data are always numeric and are obtained from either an interval scale or a ratio scale of measurement. The data related to Portfolio investment of an individual such as No. of shares, purchase price, closing price, PE ratio, and Dividend (%) are all quantitative in nature. Quantitative data can be further categorized as being discrete or continuous depending upon the values that the characteristic in question can take.

1.3.2.1 Discrete Quantitative Data: When the variable involved is discrete, then the resulting data are called discrete quantitative data. A discrete variable is one which can assume only selected values and not all. It takes values in jumps. For example, the number of cricket matches held between two nations can be integer and not fractions. It makes no sense to say that the two countries played 20.5 matches. Similarly, the number of accidents in a city can be 0, 1, 2, 3, 4, etc. and cannot be 1.2, 3.7, etc. Other examples include the following:

i) Number of customers visited a bank on a given day;

(ii) Number of computer shutdowns in a corporate in a week;

(ii) Number of shareholders in each company of nifty 50 at a given point of time; and

(iv) Number of insurance claims received by different branches of an insurance company during a week; etc.

1.3.2.2 Continuous Quantitative Data: Continuous quantitative data result when the underlying variable is continuous in nature. A continuous variable is one which can assume any value in a certain range. To illustrate, given a precise measuring instrument and method of measuring. we could find the length of a machine turned steel bar correct to nearest tenth of an inch, hundredth of an inch or to any greater degree of accuracy. A bar given as 12 inches might be found to De 12.2 inches or measured more accurately as 12.18 inches and

vet more accurately as 12.1/9 inches, and so on Similarly. the heights of the students, for example. can be measured up to any degree of accuracy and. unlike discrete variables, they need not be only 66", 67", 68", etc. Accordingly, theoretically, a continuous variable can take any value. The variables P/E ratio, closing price and dividend in Table 1.1 data are also continuous in nature because the values each of these can take may be fractions as well as integers. Some more examples of continuous variables are:

(i) Weights of boxers;

(ii) Weight of tea powder filled in tea pouches;

(iii) Diameter of steel rods produced by a manufacturing process

(iv) Volume of juice filled in 1,000 ml bottles;

(v) Length of cricket bat produced by a machine; and

(vi) Rates of return on each of the investments made by a consortium.

(vii) Marks scored by students out of 100

(viii) Time taken by athlete to complete 100-meter sprint.

Broadly speaking, discrete variables result when counting is involved while continuous variables arise when measurements are done.

In terms of the statistical methods used for summarizing data, qualitative data provided by the nominal and ordinal scales employ similar methods. Also, quantitative data provided by the interval and ratio scales employ similar methods.

Finally. one point may be noted. We have already pointed out that the data obtained on nominal and ordering variables cannot be subjected to arithmetic operations. Even numbers may be when data obtained are qualitative in nature. However, care must be taken while handling such numbers. This is because not all numbers can be subjected to arithmetical manipulation. To illustrate, it is logical to add up the heights expressed in inches of some students and find the average height, but it makes no sense to add up the numbers assigned to various categories as 1 (married), 2 (never married), 3 (divorced/separated), etc. and then obtain their average value. Similarly, suppose respondents in a survey are asked to give their opinion on a certain brand of a product by assigning their preference by marking on a scale from 1 to 7, where the numbers indicate the following: O1. Excellent 2. Very Good 3. Good 5. Not So Good 6. Poor In this case although the answers will be obtained in numbers, the data obtained are just ordinal qualitative data. Such data are analysed using appropriate statistical tools. It is not proper in this situation to treat the numbers obtained like they are treated ordinarily because it is not really clear whether the difference, for example, between answers of 6 and 5 is of the same magnitude as the difference between 2 and 1, or, say, between 4 and 3.

However, not all numbers related to qualitative data are not amenable to analysis. If there are only two categories and each item in the sample is assigned 0 or 1 accordingly as one falls in the first or the second category, then in many situations it is possible to treat them as quantitative data and process accordingly.

IN-TEXT QUESTIONS

1. The building is tall: a)Qualitative data b) Quantitative data
2. The building is 50 feet tall: a)Qualitative data b) Quantitative data
3. My friend is 18-years-old: a)Qualitative data b) Quantitative data
4. The paragliding ride is 15 minutes long : a)Qualitative data, b)Quantitative data
5. There are 20 chairs in a class. a)Qualitative data, b)Quantitative data
6. Salt water freeze at 28.4 degrees Fahrenheit a)Qualitative data, b)Quantitative data
7. Pin code of Delhi University is 110007

1.4 SCALE OF MEASUREMENT

Whenever data are collected and analysed, we need to understand about the scale (or scales) of measurement used in the collection of such data. This is because the nature of statistical analysis appropriate for a given set of data on a particular variable depends upon the scale of measurement used for the variable. There are four scales of measurement. They are: nominal, ordinal, interval and ratio scales. The scale of measurement determines the amount of information contained in the data and the data summarization and the statistical analysis that is appropriate. The different scales of measurement are:.

1.4.1 Nominal Scale

When the data obtained for a variable are simply labels used to identify an attribute of the element, the scale of measurement for the variable is termed nominal. For the data given in Table 1.1, the first variable, scrip ID, is measured on a nominal scale. This is because SBI, CASTROL. TCS, etc. are labels which are means of identifying various stocks.

In cases where the measurement is on a nominal scale, we may use numeric as well as nonnumeric symbols. For the data set under consideration, the variable BSE code provides an example where the numeric symbols are used. The only significance that the numbers given here have is that they are used to identify the scrips for trading on BSE, Bombay Stock Exchange Limited. Such a coding is done to facilitate recording and processing of the data on the exchange.

Some other examples of variables where the data have nominal scale include:

(a) Sex (male, female)

(b) Education (educated, uneducated)

(c) Marital status (married, unmarried, widowed, divorced)

(d) Employment status (employed, unemployed)

(e) Component identification code used in inventory control (4307B5, 444C, 2778K etc)

(f) Occupation (service, business, professional, others)

Thus, the key feature of the nominal scale is that the data obtained, both numeric and nonnumeric, are labels used to identify some attribute of elements. What is significant, however, to note is that arithmetical operations like addition, subtraction, multiplication and division make no sense for nominal data, even when they are numeric.

1.4.2 Ordinal Scale

The scale of measurement for a variable is said to be ordinal when the data have the properties of the nominal data and the rank, or the order, of the data is meaningful. An example of this is the variable ET500 Ranking. The given ranking of a company not only provides a means of identification to it but also conveys the relative positioning of the company. Another example of the ordinal scale of measurement is found when organizations place questionnaires to solicit customer/visitor opinions on the quality of service provided by them.

Thus. a restaurant may seek its customers to evaluate its performance in terms of food, service and ambience. and so on, by providing ratings on these variables. The ratings may be (i) excellent, (ii) very good, (iii) good, and (iv) poor. The observations for each variable possess the characteristics of the nominal data in the sense that each response rating is a label for excellent, very good, good or poor quality. But, in addition, the data can be ranked, or ordered, with respect to quality. For example, after collecting the data on food quality variable, from a group of customers, we can rank the data by beginning with excellent, followed by very good, good and, finally, poor.

The data obtained from an ordinal scale can also be just like data obtained from a nominal scale. either non-numeric or numeric. Thus, for recording observations, we may use letters E for excellent, VG for very good, G for good and P for poor. We may as well use the numerals 1, 2. 3 and 4, respectively, for these categories. What is important, however, is that here the numerals do not merely identify the category; they also indicate relative importance so that 1 is better than 2. which in turn is better than 3 and 4. However, like in the case of nominal data, no arithmetic operations can be performed on the ordinal data even when they are numeric.

1.4.3 Interval Scale

The scale of measurement for a variable is said to be interval when the data enjoy the properties of ordinal data and the difference, or the interval between the data values, represents how much more or less of a variable does one element possess in comparison to another element. Thus, when interval data are obtained, it is possible to (i) rank the elements on the basis of the variable values, like for ordinal data, and (ii) calculate difference between any two elements in terms of the variable under consideration by subtracting the data value for one element from that of the other.

The marks scored by candidates in Common Admission Test (CAT) for admission in graduate management program is an example of interval scale data. Thus, three students with scores of, say, 832, 806 and 772 can be ranked or ordered in terms of best to poorest (or poorest to best) on the basis of these scores. In addition, the differences are meaningful so that student 1 scored 832 - 806 = 26 marks more than student 2, while student 2 scored 806-772 = 34 marks more than student 3. Another example of interval-scale data is provided by the temperature. Thus, on a typical day, the maximum temperature of some cities was recorded as follows:

Mumbai 29° C31° C Delhi 38° C Chennai 35° C Kolkata

The interval Celsius-scale temperatures are numeric with the property of ordinal data so that the cities can be ranked in terms of temperature as Delhi, Chennai, Kolkata and Mumbai, with Delhi as the warmest. In addition, it may be seen that Delhi is 9°C warmer than Mumbai and 3°C warmer than Chennai, for example. The given data on maximum temperatures could also be measured on Fahrenheit scale. The values in that case would be Delhi 100.4° F Mumbai 84.2° F Chennai 95°F and Kolkata 87.8° F. The cities may be ranked on the basis of these as well. Also, the temperature differences can be meaningfully calculated. Thus, Delhi is 100.4 84.2 = 16.2° F warmer than Mumbai and 100.4-95 = 5,4°F warmer than Chennai.

It may be noted that interval data are always numeric. With such data, the arithmetic operations of addition, subtraction and averaging are meaningful., As a consequence, data obtained using this scale lend themselves to more alternatives than data obtained from nominal or ordinal scales.

1.4.4 Ratio Scale

The scale of measurement of a variable is termed ratio scale when the data possess all the properties of interval data and the ratio of two data values is meaningful. Examples of variables which use the ratio scale of measurement include height, weight, wages, production, costs, etc. The ratio scale has a key requirement that a zero value is inherently defined on this Scale. The zero value must indicate that nothing exists for the variable at this point. Consider the variable production. The zero value is inherently defined here since a

zero production indicates no production. Further, if the production in year 1 is 12,000 units while in year 2, it is 18,000 units, then the ratio property of the data shows that the production in year 2 1S 1.5 times the production in year 1. Now compare this with the variable temperature considered in the context of interval Scale. Neither a temperature of zero-degree centigrade means that the temperature ceases to be there, and nor do temperatures of 40° C in City A and 20° C in City B imply that City A is twice as warm as City B.

Since the ratio scale data has all the properties of interval data, it is clear that they can only be numeric. Further, arithmetic operations like addition, subtraction, multiplication, division and averaging are all feasible with ratio data. Thus, such data lend themselves to greater manipulation and statistical analysis than do other data considered earlier. To conclude, it is evident that the amount of information in the data varies with the scale of measurement. The nominal data contain the least amount of information, followed by ordinal, interval and ratio data. Most of the statistical methods deal with interval and ratio-scaled data.

IN-TEXT QUESTIONS

8. Which of the following is not a level of measurement?
   a. Nominal b. External c. Ordinal d. Interval
9. Nominal scale is also known as _____ variable.
   a. Categorical b. Continuous c. Predictor d. Rational
10. _____ scales are used for labelling variables into distinct classifications.
    a. Nominal b. Ordinal c. Ratio d. Interval
11. _____ scale has a key requirement that a zero value is inherently defined.

1.5 MEASURE OF CENTRAL TENDENCY

Measure of central tendency describe the location of the centre of a set of data or its average. In our daily life we use average to summarized information such as, we often talk about the average income of the family, average marks in all the subjects, average number of defective products manufacture in a factory, average number of customers visiting a bank, average number of kilometres covered by car per day, average time taken for conveyance from home to office. The average is a specific value of the data around which other values are clustered. Let's us take an example of average weight of students in a class , it can be clearly visualized that most of the students will be clustered around the particular value say 70 kg (average) weight although there will be some students with extreme values (heavy and light weight). The average value is used to represent the entire set of data in consideration (like a class prefect represents the whole class) and is used as benchmark for making comparisons.

The different measures of central tendency or averages are available with some unique differences with respects to their characteristics. These measures are:

1. *Arithmetic mean*
2. *Median*
3. *Mode*
4. *Geometric mean*
5. *Harmonic mean*

The arithmetic, geometric and harmonic mean are called mathematical averages while median and the mode are termed as *positional averages*.

1.5.1 Arithmetic Mean

This is the most commonly used and easy to understand measure of central tendency. The arithmetic mean is obtained by dividing the sum of the observation by the number of observations. This is simply referred to as mean and is represented by $\bar{x}$.

For Ungrouped data: for ungrouped data the formula for arithmetic mean is:

1. **Direct Method**

$$\bar{X} = \frac{1}{n}(X_1 + X_2 + X_3 + X_4 \ldots\ldots + X_n)$$

or

$$\bar{X} = \frac{\Sigma X}{n}$$

where, $\bar{X}$ = mean

ΣX= sum of the observation

n = number of observations

Illustration: The following are the weekly salaries (Rs.) of twelve employees in a company. Calculate the average salary of the employees: 150, 200, 200, 300, 400, 500, 700, 800, 900, 1000.

Solution: $\bar{X} = \frac{1}{n}(X_1 + X_2 + X_3 + X_4 \ldots\ldots + X_n)$

$$= \frac{1}{12}(150 + 200 + 200 + 300 + 400 + 500 + 700 + 800 + 900 + 1000 + 100 + 400)$$

$$= \frac{1}{12}(5650) = 470.8333$$

2. **Deviation method:** In deviation method first, we take any value (A) as assumed mean. Then deviation (d) is measured by deducting assumed mean (A) from the value (x).
   Next, sum of the deviation is calculated and then we put these values in the formulas given below to obtain the average.

$$\bar{x} = A + \frac{\Sigma d}{n}$$

where A is assumed mean and deviations or *d = (X-A)*

Solving the same above problem with short-cut method.

Computation of Arithmetic Mean

Serial Number	Salary (Rupees) X	Deviations from assumed mean where d = (X-A), A(assumed mean = 500)
1	150	-350
2	200	-300
3	200	-300
4	300	-200
5	400	-100
6	500	0
7	700	200
8	800	300
9	900	400
10	1000	500
11	100	-400
12	400	-100
	N = 12	$\sum D$ = -350

$$\bar{x} = A + \frac{\Sigma dx}{n}$$

$$\bar{x} = 500 + \frac{-350}{12} = 500 - 29.17 = 470.83 \text{ Rupees}$$

For Frequency distribution: For both discrete and continuous frequency distributions mean can be calculated by either of the following method.

There are three methods used to calculate mean.

1. **Direct method**

$\bar{x} = \frac{\Sigma fX}{\Sigma f}$

where f = Frequency

$\bar{x}$ = Mean

Illustration: The following distribution shows the number of computers sold by Apple company in the month of March across its 30 Stores. Find the mean number of computers sold at the stores.

Number of computers sold	5	10	15	20	30	40
Number of Store	12	15	8	19	13	3

Solution:

Number of computers sold (x)	Number of stores (f)	fx
5	12	60
10	15	150
15	8	120
20	19	380
30	13	390
40	3	120
Total	**70**	**1220**

$\bar{x} = \frac{\Sigma fX}{\Sigma f}$

$\bar{x} = \frac{1220}{70}$ = 17.4286 computers

Illustration: the following is the marks distribution of students from MBA 1st semester. You are required to find the average performance of the class.

Class Interval (Marks Scored)			Number of Students (f)
0	-	10	13
10	-	20	16
20	-	30	23
30	-	40	24
40	-	50	24
50	-	60	19
60	-	70	11
70	-	80	23
80	-	90	22
90	-	100	25

Solution:

Calculation of average marks of the class

Class Interval (Marks Scored)			Number of Students (f)	X(Mid-point) = [Upper CI +Lower CI)/2]	FX
0	-	10	13	5	65
10	-	20	16	15	240
20	-	30	23	25	575
30	-	40	24	35	840
40	-	50	24	45	1080
50	-	60	19	55	1045
60	-	70	11	65	715
70	-	80	23	75	1725
80	-	90	22	85	1870
90	-	100	25	95	2375
TOTAL			**200**		**10530**

$$\bar{x} = \frac{\Sigma fX}{\Sigma f}$$

$$\bar{x} = \frac{10530}{200} = 52.65 \text{ marks.}$$

2. Deviation method:

Formula $\bar{X} = A + \frac{\Sigma fd}{\Sigma f}$

where A is assumed mean and deviations or *d = (X-A)*

Illustration The weight of national level basketball players is given below in continuous distribution. Find the average weight by using deviation method.

Class Interval (Weight in kg)			Number of basketball players (f)
65	-	70	99
70	-	75	65
75	-	80	91
80	-	85	88
85	-	90	75
90	-	95	88
95	-	100	73
100	-	105	99

Solution

Class Interval (Weight in kg)			Number of basketball players (f)	X	d = X - A	fd
65	-	70	99	67.5	-15	-1485
70	-	75	65	72.5	-10	-650
75	-	80	93	77.5	-5	-465
80	-	85	88	**82.5**	0	0
85	-	90	75	87.5	5	375
90	-	95	88	92.5	10	880
95	-	100	73	97.5	15	1095
100	-	105	99	102.5	20	1980
TOTAL			**680**			**1730**

$$\bar{x} = A + \frac{\Sigma fd}{\Sigma f}$$

$$\bar{x} = 82.5 + \frac{1730}{680} = 82.5 + 2.54 \quad = 85.044 \text{ kg}$$

3. Step- deviation method

This method is the modified version of deviation method.

Formula : $\bar{x} = A + \frac{\Sigma fd`}{\Sigma f} \times C$

Where, A = assumed mean,
f = frequency
d`= d/C = (X-A)/C
c = difference in class interval

Illustration Salary distribution of employee in an organisation is given below. You are required to calculate the mean monthly salary of employees.

Salary (in Rs)			No of employee (f)
0	-	20000	26
20000	-	40000	20
40000	-	60000	29
60000	-	80000	24
80000	-	100000	30
100000	-	120000	20
120000	-	140000	11
140000	-	160000	16
160000	-	180000	14
180000	-	200000	10
Total			**200**

Solution

Calculation of average salary by step deviation method

Salary (in Rs)			No of employee (f)	X	d= X-A	d` = d/C	fd`
0	-	20000	26	10000	-80000	-4	-104
20000	-	40000	20	30000	-60000	-3	-60
40000	-	60000	29	50000	-40000	-2	-58
60000	-	80000	24	70000	-20000	-1	-24
80000	-	100000	30	90000	0	0	0
100000	-	120000	20	110000	20000	1	20
120000	-	140000	11	130000	40000	2	22
140000	-	160000	16	150000	60000	3	48
160000	-	180000	14	170000	80000	4	56
180000	-	200000	10	190000	100000	5	50
Total				**200**			**-50**

$$\bar{x} = A + \frac{\Sigma fd`}{\Sigma f} \times C$$

$$\bar{x} = 90{,}000 + \frac{-50}{200} \times 20000 \quad = 90{,}000 - 5000 = \mathbf{85{,}000}$$

1.5.2 Weighted Arithmetic Mean

The weighted mean is calculated when there is a need for weights to be attached to the different values of the variable. For example, suppose if Mr A buys different numbers of shares of X company at different price.

	No of Shares purchased	Share price (Rs.)
1.	100	35
2.	150	40
3.	200	45
4.	50	50

If we want to know the average price at which the investor purchased the shares of X company than it would be unfair if we calculate the average by direct method (35+40+45+50)/4 = 42.50 Rs.. Here we have not considered the number of shares purchased at each price. Therefore, the ideal mean in such cases is weighted arithmetic mean. The correct average price of the share is given by total amount paid divided by total number of shares brought.

Share price (X)	Number of Shares (weights = W)	Total amount (WX)
35	100	3500
40	150	6000
45	200	9000
50	300	15000

TOTAL	**750**	**33500**

$$\bar{x}_w = \frac{\Sigma WX}{\Sigma W}$$

Where , $\bar{x}_w$ = weighted arithmetic mean, W = weightage

$$\bar{X}_W = \frac{\Sigma WX}{\Sigma W} = \frac{33500}{750} = 44.67 \text{ Rs.}$$

Illustration

Comment on the performance of the students of ABC College and XYZ college. The program name, pass percentage and number of students are given below:

	ABC College		XYZ College	
Program	**Pass %**	**Number of Students**	**Pass %**	**Number of Students**
B.Com	72	695	84	371
B.A Economics	67	571	74	447
BMS	75	941	79	340
BBA(FIA)	80	863	83	432
B.Sc Physics	69	780	71	483
B.Sc Mathematics	68	714	80	431

Calculate the simple a weighted arithmetic mean.

Solution

	ABC College			XYZ College		
Program	**Pass %**	**Number of Students**	**WX**	**Pass %**	**Number of Students**	**WX**
B.Com	72	695	50040	65	371	24115
B.A Economics	67	571	38257	74	447	33078
BMS	75	941	70575	58	340	19720
BBA(FIA)	80	863	69040	83	432	35856
B.Sc Physics	69	780	53820	71	483	34293
B.Sc	68	714	48552	80	431	34480

Mathematics						
Total	**431**	**4564**	**330284**	**431**	**2504**	**181542**

Simple Average		Weighted Average	
ABC College	=431/6 = 71.83	ABC College	330284/4564 = 72.37
XYZ College	=431/6 = 71.83	XYZ College	181542/ 2504 = 72.50

Properties of Mean

1. The sum of deviations of all the observations from the arithmetic mean is always zero. $\sum(X - \bar{X}) = 0$
2. The sum of squares of deviations from mean is minimum. Therefore, it is also known as least squares measure of central tendency. Symbolically $\sum (X - \bar{X})^2$ = smaller than $\sum (X - \text{any other value})^2$
3. The combined mean of two or more series can be calculated if their individual means and their sizes are given.

$$\bar{X}_{12} = \frac{N_1\bar{X}_1 + N_2\bar{X}_2}{N_1 + N_2}$$

where $\bar{X}_{12}$ = combined average of two groups,
$\bar{X}_1$ =arithmetic mean of first group,
$\bar{X}_2$ = arithmetic mean of second group,
N1 = number of items of first group, and
N2 = number of items of second group

4. The mean of the sum (or difference) of two or more series of equal sizes is given by the sum (or difference) of their individual means.
5. The arithmetic mean is dependent of the change in origin and scale. If each value of a variable X is increased or decreased or multiplied by a constant k, the arithmetic mean also increases or decreases or multiplies by the same constant.

Illustration : The mean wages paid to 50 employee of ABC ltd. in Delhi's Branch is Rs. 500. And the mean wages paid to 60 employees in Mumbai branch is 800. Calculate the daily average salary paid to all the employee from both Delhi and Mumbai.

Solution

Given: = $N_1 = 50$ $N_2 = 60$ $\bar{X}_1 = 500$ $\bar{X}_1 = 800$

Combined Mean = $\frac{N1\bar{X}1 + N2\bar{X}2}{N1 + N2}$

$= \frac{50 \times 500 + 60 \times 800}{50 + 60} =$ **664**

Thus, the average wages of all the employee taken together is Rs 664 per day

1.5.3 Geometric Mean(GM): The geometric mean is an average which is used for certain specific cases where the quantities required to be averaged are drawn from situations in which they follow exponential law of growth or decline. Example, population growth, compound interest on deposits in bank.
GM is defined as the nth root of the product of n values.

$$GM = \sqrt{(X1 \times X2 \times X3 \dots \dots \dots \dots \times Xn)}^{1/n}$$

Alternatively ,

$$GM = \text{Antilog } \frac{\sum \log X}{n}$$

Illustration: Calculate the GM of the data given below

5 3 4 6 11 5 8 11

Solution: $GM = \text{Antilog } \frac{\sum \log X}{n}$

X	LogX
5	0.699
3	0.4771
4	0.6021
6	0.7782
11	1.0414
5	0.699
12	1.0792
10	1
8	0.9031
11	1.0414
Total	8.3205

$GM = \text{Antilog } \frac{8.3205}{10}$
$= \text{Antilog } 0.83205$
$= 6.79$

1.5.4 MEDIAN

The median is the middle value when all the observation are arranged in either ascending or descending order. The median divides the group in two equal parts where one part comprises the values greater than median and other part comprises the value smaller than median.

Median = size of $\{\frac{N+1}{2}\}$th item.

Median = [size of $\frac{N}{2}$ th item + size of $\{\frac{N+1}{2}\}$th item]/2

Illustration: Find the median of the following series;

(i) 8 6 14 10 12 12 13 9

(ii) 15 6 7 12 11 12 13 6 16

Solution:

Computation of median

(i)		(ii)	
Serial No.	**X**	**Serial No.**	**X**
1	6	1	6
2	8	2	6
3	9	3	7
4	10	4	11
5	12	5	12
6	12	6	12
7	13	7	13
8	14	8	15
		9	16
N =8		N=9	

For the series (i): Median = [size of $[\frac{N+1}{2}]$ th item = $\frac{8+1}{2}$th item

$$\frac{\text{size of 4th item} + \text{size of 5th item}}{2}$$

$$\frac{10 + 12}{2}$$

= 11 Ans.

(ii): Median = size of $[\frac{N+1}{2}]$ th item

= $[\frac{9+1}{2}]$ th item size of the 5th item = ***12 Ans***

Calculation of Median in Discrete Series

Steps:

1. Arrange the data set in either ascending or descending order
2. Find the cumulative frequency
3. Median = size of (N+1)/2 th item.
4. Locate median according the size i.e., variable corresponding to the size for next cumulative frequency

Illustration: Following are the number of rooms available in the hotels in Delhi. Find the median number of rooms.

Number of Hotels	65	47	90	31	22	93	84
Number of Rooms	10	12	8	6	12	12	11

Solution

Number of Rooms (X)	Number of Hotels (*f*)	Cumulative Frequency (C*f*)
6	31	31
8	90	121
10	65	186
11	84	270
12	47	317
12	22	339
12	94	433

Median = size of $[\frac{N+1}{2}]$th item = (433+1)/2 = 217th item.

The median lies in the cumulative frequency of 270 and the value corresponding to this is 11. Thus, the median number of rooms in hotel in Delhi is 11 rooms.

Calculation of Median in Continuous Series

Steps:

1. Arrange the data set in either descending or ascending order.
2. The confidence interval must be exclusive (if not then convert into exclusive)
3. Calculate the cumulative frequencies
4. Use Median = size of (N)/2 th item to ascertain median class
5. Apply formula of interpolation to ascertain the value of median.

$$\text{Median} = l_1 + \frac{\frac{N}{2} - cfo}{f} \times (l_2 - l_1)$$

Where, $l1$ = lower limit of median class
$l2$ = higher limit of median class
cf_0 = cumulative frequency of previous class
f = frequency of median class.

Illustration: The following is the result of a survey of age distribution of CEO of 300 Companies during the last year. Calculate the median age of the CEOs in corporate.

Age (in years)			No of CEO's
20	-	30	38
30	-	40	42
40	-	50	65
50	-	60	70
60	-	70	50
70	-	80	35

Solution:

Age (in years)			No of CEO's	*Cf*
20	-	30	38	38
30	-	40	42	80
40	-	50	65	145
50	-	60	70	215
60	-	70	50	265
70	-	80	35	300

$$\text{Median} = l_1 + \frac{\frac{N}{2} - cfo}{f} \times (l_2 - l_1)$$

Median = size of N/2 th item = 300/2 =150 = 150 item.
Accordingly, the mean class interval = 50-60, Thus $l_1 = 50$ and $l_2 = 60$, $cf_0 = 145$

$$\text{Median} = 50 + \frac{\frac{300}{2} - 145}{70} \times (60 - 50)$$

= 50+0.71 =***50.71 Ans***

The median age of CEOs in Corporate is 50.51 years

1.5.5 Others Positional Averages

The median divides the series of data into two equal parts. Similar there are some other measures which divide the data set into certain equal parts. There are percentiles, deciles and quartiles.

Symbolically this are given below:

1. **Quartile**
   a. First quartile (Q_1) = Size of (N+1)/4 th item
   b. Second quartile = median = Size of 2(N+1)/4 th item
   c. Third quartile (Q_3) = Size of 3(N+1)/4 th item

2. **Decile**
   a. First decile (D_1) = Size of (N+1)/10 th item
   b. Seventh decile (D_7) = Size of 7(N+1)/10 th item
3. **Percentile**
   a. Three percentiles(P_3) = Size of 3(N+1)/100 th item
   b. Thirty-three percentiles(P_{33}) = Size of 33(N+1)/100 th item

Illustration: From the following data calculate Q1, Q3, D3, P5.

Marks:	Below 20	20-40	40-60	60-80	80-100
Number of students	16	20	44	50	10

Solution:

Age (in years)			No of CEO's	*Cf*
0	-	20	16	16
20	-	40	20	36
40	-	60	44	80
60	-	80	50	130
80	-	100	30	160
			N = 160	

1. Q_1= size of N/4 th item = 160/4 =40th item
Hence Q_1 lies in the class interval 40-60.

$$Q_1 = l_1 + \frac{\frac{N}{4} - cfo}{f} \times (l_2 - l_1)$$

$l1 = 40$, $l2 = 60$, $cf_0 = 36$, $f = 44$

$$Q_1 = 40 + \frac{\frac{160}{4} - 36}{44} \times (60 - 40)$$
$$= 40 + 1.82$$
$$= 41.82 \text{ Ans}$$

2. Q_3 = size of 3N/4 th item = 160/4 =120th item
Hence Q_3 lies in the class interval 60-80.

$$Q_1 = l_1 + \frac{\frac{3N}{4} - cfo}{f} \times (l_2 - l_1)$$

$l1 = 60$, $l2 = 80$, $cf_0 = 80$, $f = 50$

$$Q_1 = 60 + \frac{\frac{3*160}{4} - 36}{44} \times (60 - 40)$$
$$= 60 + 3.82 = \textbf{\textit{63.82 Ans}}$$

3. D_3= size of 3N/10 th item = 3*160/10 =48th item
Hence D_3 lies in the class interval 40-60.

$$D_3 = l_1 + \frac{\frac{3N}{10} - cfo}{f} \times (l_2 - l_1)$$

$l1 = 40, \quad l2 = 60, \quad cf_0 = 36, \quad f = 44$

$$Q_1 = 40 + \frac{\frac{3*160}{10} - 36}{44} \times (60 - 40)$$

$$= 40 + 5.45 = \textbf{\textit{45.45 Ans}}$$

4. P_5= size of 5N/100 th item = 5*160/100 =8th item
Hence P_5 lies in the class interval 20-40.

$$Q_1 = l_1 + \frac{\frac{5N}{100} - cfo}{f} \times (l_2 - l_1)$$

$l1 = 20, \quad l2 = 40, \quad cf_0 = 0, \quad f = 16$

$$P_5 = 20 + \frac{\frac{5*160}{100} - 0}{16} \times (60 - 40)$$
$$= 20 + 10$$
$$= \textbf{\textit{30 Ans}}$$

1.5.6 Missing Frequency

Illustration: The frequency distribution of profit earned by 150 companies is given below.

Profit (in lakhs)	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Number of companies(in ,000)	8	15	?	12	?	33	19	17

However, the median is known to be **57**

Solution: Lets, assume missing frequency for class interval 30-40 = x , and 50-60 = y

Calculation of Missing Frequency

Age (in years)	No of CEO's	Cf
10 - 20	8	8
20 - 30	15	23
30 - 40	**X**	23+x
40 - 50	12	35+x
50 - 60	**y**	35+x+y
60 - 70	33	68+x+y
70 - 80	19	87+x+y
80 - 90	17	104+x+y
	N= 104+x+y	

From the above table N = Σf = 104+x+y = 150
Therefore, x + y = 150-104
x + y = 46……..equation 1

The Median 57 given lies between the class interval of 50-60.

$l1 = 50$, $l2 = 60$, $cf_0 = 35 + x$, $f = y$

By using the median formula:

$$\text{Median} = l_1 + \frac{\frac{N}{2} - cfo}{f} \times (l_2 - l_1)$$

$$57 = 50 + \frac{\frac{150}{2} - (35+x)}{y} \times (60 - 50)$$

$$57 = 50 + \frac{75 - (35+x)}{y} \times 10$$

$$5.7 = 5 + \frac{75 - (35+x)}{y} \text{ (Divide by 10)}$$

$$5.7 - 5 = \frac{75 - (35+x)}{y}$$

$$0.7y = 40 - x$$

$$y = \frac{40 - x}{0.7} \quad \ldots\ldots\ldots\ldots\ldots \text{ Equation 2}$$

put the value of y in equation 1

$$x + y = 46$$

$$x + \frac{40 - x}{0.7} = 46$$

$$\frac{0.7x + 40 - x}{0.7} = 46$$

$$-0.3x = 32.2 - 40$$

$$x = 7.8 / .3 \qquad \boldsymbol{x = 26}$$

for the value of y, put value x in the equation 1

$$x + y = 46$$
$$y = 46 - x$$
$$y = 46 - 26$$

y = 20 Ans

1.5.7 MODE

The mode is that value of the variable which occurs maximum number of times. The common examples are common size shoes sold at store individual visiting museum, number of weights of a male and female etc. In the continuous frequency distribution, mode is defined as that value of the variable where there is densest concentration of observation. The value of mode is denoted by the alphabet z.

Illustration: Calculate mode from the following data:

Roll Number	1	2	3	4	5	6	7	8	9	10
Marks scored	74	80	55	80	90	74	90	78	30	74

Solution

Calculation of Mode

Marks (X)	Number of Students (f)
30	1
55	1
74	3
78	1
80	2
90	2

The mode (z) here is 74 which occurs most frequently (3 times which is maximum)

Mode in continuous frequency distribution

Formula: Mode (z) $= l_1 + \frac{f1-fo}{2f1-f0-f2} \times (l_2 - l_1)$

l_1 = lower limit of the class, where mode lies.
l_2 = upper limit of the class, where mode lies.
f_0 = frequency of the class proceeding the modal class.
f_1 = frequency of the class, where mode lies.
f_2 = frequency of the class succeeding the modal class.

Example 29 : Calculate modal age of employee in ZYZ Limited. the following frequency distribution is given below.

Calculation of Mode

Age			Number of Employee
0	-	20	30
20	-	40	50
40	-	60	30
60	-	80	25
80	-	100	20

Here the maximum frequency is 50 and its corresponding class interval is 20 - 40
$l_1 = 20$ $l_2 = 40$ $f_0 = 30$ $f_1 = 50$ $f_2 = 30$

Mode (z) $= l_1 + \frac{f1-fo}{2f1-f0-f2} \times (l_2 - l_1)$

Mode (z) $= 20 + \frac{50-30}{2*50-30-30} \times (40 - 20)$

$= 20 + \frac{20}{100-60} \times 20$

$= 20 + 0.5 \times 20$ = 20+10

The model age of entrepreneur = 30 years

1.6 SUMMARY

- Qualitative variables are used to identify, categorize or rank the elements
- Quantitative variables can be expressed in number and objectively measured. They may be discrete or continuous.
- The scales used for collecting data may be nominal, ordinal, interval and ratio.
- The nominal scale is the lowest-level and the ratio scale is the highest-level scale of measurement.
- The central tendency indicates the location of the centre of a set of data. It is the average value.
- Mathematical averages can be *simple* or *weighted* and used accordingly as all values enjoy an equal or unequal weightage.
- Geometric mean, which is *n*th root of the product of *n* values, is basically used to obtain population growth, compounded interest rates, price changes etc.

- Median divides the series into two equal parts, similarly quartile divides the series in four equal parts, decile into 10 and percentile into 100 equal parts.
- Mode is defined as the value occurring most frequently in series of items and around which the other items are distributed most densely.

1.7 ANSWERS TO IN-TEXT QUESTIONS

1. Qualitative data 2. Quantitative data 3. Quantitative data 4. Quantitative data 5. Quantitative data 6. Quantitative data 7. Qualitative data	8. External 9. Categorical 10. Nominal 11. Ratio

1.8 SELF-ASSESSMENT QUESTIONS

1. Define data? Explain the difference between qualitative and quantitative data.
2. Explain the various scale of measurement of data.
3. State whether the following random variable are qualitative or quantitative data:
    a. Number of calls made by a call centre daily
    b. Litre of water consumed.
    c. T-shirt size (Large Medium & Small)
    d. Quality of food (Good, Average and Poor)
    e. Annual turnover of companies (in Rs)
    f. City of customer.
    g. Family size
    h. Name of 4 programs offered in college
    i. Number of students in a college
    j. Temperature in Degree Celsius
    k. Rank of employee in a company (Manager, Clerk, Office Assistance etc)

    Ans a) Ratio, b) Ratio, c)Ordinal, d)Ordinal, e) Ratio, f) Nominal, g)Ratio, h) Nominal, i) Ratio, j)Interval, k) Ordinal,

4. Define Average? Discuss the desirable properties of a good measure of central tendency.
5. "An average is a number indicating the central value of a group of observations." How far is it true for mean, median and mode? Give illustrations.

A cab ride in Mumbai costs Rs. 20 for the first one kilometre and thereafter it cost Rs. 11 per kilometre. Let's assume that the cost of each kilometre is incurred at the beginning of the kilometre. The waiting charges are Rs. 30 per hour or a part thereof, subject to a minimum of 15 minutes stay. Calculate the effective average cost per kilometre to a customer who rides a taxi from the Airport to hotel which is 21.7 kilometres away and chooses to stay for a coffee for 25 minutes on the way. ***(Ans12.14 kms)***

6. Define median, quartiles, deciles and percentiles with a suitable example.
7. Find The arithmetic mean of a distribution given below:

CI	10-20	20-30	30-40	40-50	50-60	60-70	70-80
F	12	20	8	15	30	35	25

(Ans 51.28)

8. 500 bulbs were installed government on the streets of Delhi. The failure over the period was also observed and recorded as below

End of week :	1	2	3	4	5	6	7
No. of failures :	12	40	108	242	346	428	500

You are required to calculate the mean life of bulb. (***Ans 4.15***)

9. A factory in Delhi employs 100 workers. The mean daily wages of 99 of these workers is Rs. 85 while the wages of the 100th worker are Rs. 99 more than the mean wages of all the workers. Obtain mean wages of the workers of the factory. ***(Ans. 86)***
10. The following data gives the distribution of rainfall in Delhi over the weekdays of the last month:

Days:	Sun	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
Average rainfall in mm	26	16	12	10	8	10	8

Over the particular month there were 5 Monday & 5 Tuesday. Calculate the mean rainfall per day. ***(Ans 14.27)***

11. A survey of 350 banks in a Mumbai provides the following information :

No. of branches:	0	1	2	3	4or more
No. of banks :	13	94	146	67	30

Find the median number of branches in the families. ***(Ans 2)***

12. Find the missing frequency in the distribution given below. N = 50 and median = 30

Marks	0-10	10-20	20-30	30-40	40-50	50-60
Number of Students	10	?	25	30	?	10

(Ans 15 and 10)

13. ABC limited runs a hotel, the number of customers over the past 20 days is given below:

7	6	13	16	8	5	9	9	10	19
16	8	11	13	7	24	22	15	21	21

Find the Q_1, Q_3, 2nd Decile, 50th, 75th and 88th percentiles.

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STATISTICS FOR BUSINESS DECISIONS

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STRUCTURE

2.1 LEARNING OBJECTIVES

The purpose of this lesson is to

1. Impart knowledge about dispersion measurements. On the basis of which reliability of measure can be assessed by facilitating variability measurement.
2. Serves as the foundation for many other statistical measurements, including skewness, to enable the students to distinguish between average, dispersion, skewness and kurtosis.
3. Facilitate knowledge about Box and Whisker plot and Big data.

2.2 INTRODUCTION

This chapter facilitate an overview of the notion of variability. Variability (also called diversity, uncertainty, dispersion, and spread) is the extent to which data values differ from one another. A measure of variability shows how closely the data values typically are to this central size measure, even though measures of center (like the average, median, or mode) indicate the typical size of the data values. The variability is zero if all the data values are the same. The variability increases with how dispersed things are. In statistics, measures of dispersion aid in analyzing data variability, i.e. trying to ascertain how homogeneous or heterogeneous the inferences are. Basic sense, it indicates how closely or broadly the variable is squeezed or distributed. The traditional choice for measuring variability is the standard deviation, which summarizes the usual separation between the average and a data value. The standard deviation reveals the degree to which individuals deviate from the mean. The deviations measure how far each data value is from the average. Individuals who are positive deviations are above average, and those who are negative deviations are below average. This

chapter describes the concepts of positional measures of dispersion, averaging deviation and Lorenz curve. We go into great detail about rescaling the data and how to interpret the range, mean deviation and standard deviation for a normal distribution.

2.3 Meaning and Definition of Dispersion

The numerous measures of central value result in a single statistic that represents all of the data. However, unless all of the observations are the same, the average cannot adequately describe a set of observations. Similarly, the central value of two or more distributions may be the same, but there may be significant differences in the distribution's formation. Since we can not provide the full information about frequency distribution and/or magnitude of the series on the basis of average, the concept of dispersion uses for the solving these problems.

Dispersion measures aid in the inquiry of this important feature of a distribution.

Some important definitions of dispersion are:

1. "Dispersion is the measure of the variation of the items."

-A.L. Bowley

2. "The degree to which numerical data tend to spread about an average value is called the variation of dispersion of the data."

-Spiegel

3. Dispersion or spread is the degree of the scatter or variation of the variable about a central value."

-Brooks & Dick

4. "The measurement of the scatterness of the mass of figures in a series about an average is called measure of variation or dispersion."

-Simpson & Kajka

It is clear from the aforementioned that dispersion (also defined as scatter, spread, or variation) measures how far items deviate from certain central value. Measures of dispersion are also known as average values of the second order because they provide an average of the variations of different items from an average. When dispersion is considered, an average becomes more meaningful. For instance, if the average wage of factory A workers is Rs. 4200 and that of factory B workers is Rs. 4000, we cannot necessarily conclude that factory A workers are better off because wage distribution in factory A may be much more dispersed.

The study of dispersion is remarkably important and effective, as demonstrated by the following example:

STATISTICAL SERIES

	A	B	C
	30	20	50
	30	10	40
	30	10	25
	30	30	05
	30	80	30
TOTAL	150	150	150
AVERAGE	30	30	30

Since the arithmetic mean is the same in all the three series, it is reasonable to conclude that these series are similar in nature. However, a close examination reveals that their distributions differ. They vary significantly from one another. In series A, the arithmetic mean perfectly represents each and every item, or in other words, none of the items in series A deviate from the arithmetic mean, and thus there is no dispersion.

Though the mean in series 'B' is 30, the series' formation is different. The lowest value in this case is 10 and the maximum value is 80. The lowest value is 140 less than the mean, while the maximum value is 70 greater than the mean. Further, dispersion is much significantly larger in series C than in series B, where the lowest value is less than 145 from the mean and the highest value is greater than 100 from the mean.

2.3.1 Absolute and Relative Dispersion

Dispersion can be expressed in two ways: absolute measurement and relative measurement. Absolute measurement occurs when the dispersion is calculated in terms of the original units of a series. Absolute measures, for example, are dispersion in income expressed in Rs., dispersion in weight expressed in Kg., and dispersion in age expressed in years. The major drawback of this measurement is that it cannot be used to compare two or more series. As a result, relative measurement in the form of ratios or percentages is used for comparison purposes. This is known as the "Coefficient of Dispersion."

2.3.2 Significance of Dispersion

The following objectives are functioned by the measurement of dispersion or variation measures:

1.Assess the reliability of average The reliability of average can be evaluated or it can be decided whether or not an average is representative of the series based on the measure of dispersion. If there is little dispersion, the average is appropriately ant the series. On the other hand, the average may not be considered a true representative of the data if dispersion is high, and it may even be quite unreliable.

2.Facilitate the comparison of the variability of two series The degree of variations between two or more series can be diminished using dispersion. The consistency or uniformity values of the variable are inversely proportional to the degree of variability. On the other hand, uniformity or consistency would be implied by a low level of variability.

3.To regulate variability Dispersion is also measured in order to control the variation itself. For example, a country needs to measure the degree of variation of inequality in its wealth and income distributions in order to control it.

4.Act as foundation for further statistical measurement Dispersion measurements are also used as the foundation for a number of other statistical measurements, including skewness, correlation, regression, quality control, etc.

Thus, it is evident that measures of dispersion are crucial for determining the nature of a set of data and that these measurements significantly influence a number of other statistical techniques and measurements.

2.3.3 Prerequisite of Measure of Dispersion

The following characteristics should be prevalent in an ideal measure of dispersion

(1) It should be clearly defined.

(2) It should be simple to calculate and understand.

(3) It should be founded on every component of the series.

(4) It should be amenable to additional mathematical analysis.

(5) It should be least impacted by variations in sampling, according to

(6) The extreme observations shouldn't have a big impact on it.

1.4 MEASURES OF DISPERSION

The various measures of dispersion are as follows

(A) Methods of Limits or Positional Measures of Dispersion

(1) Range

(2) Inter-Quartile Range

(3) Percentile Range

(B) Methods of Averaging Deviations or Calculation of Measures of Dispersion

(4) Quartile Deviation

(6) Standard Deviation

2.4.1 Methods of Limits or Positional Measures of Dispersion

2.4.1.1 Range

The range is the easiest measure of dispersion since it is the difference between the maximum and minimum value of data.

RANGE= $X_{MAXIMUM}$ - $X_{MINIMUM}$

Coefficient of Range= $\frac{MAX-MIN}{MAX+MIN}$

Range in Individual Series

Illustration 1

Let's consider two varieties of tea – Y & Z with different yields.

Tea Y and Z have the following yields for a period of six months:

Months	Y	Z
July	36	58
August	31	42
September	32	33
October	34	29
November	30	50
December	33	20

To know the spread of each variety of tea, Find out its range and coefficient of range.

Solution:

Since in category Y tea the maximum value is 36 and minimum value is 30 then,

Range= $X_{MAXIMUM}$ - $X_{MINIMUM}$

Range= 36-30=6

Coefficient of Range= $\frac{36-30}{36+30}$ = 0.09

Further, in category Z tea the maximum value is 58 and minimum value is 20 then,

Range= 58-20=38

Coefficient of Range= $\frac{58-20}{58+20}$ = 0.487

As previously stated, the greater the range, the greater the data spread. Thus, Y has a lower range. It means it has less scattered data or a more homogeneous data set has a higher range. It represents a highly scattered data set or a more heterogeneous data set.

Therefore, X has a lower spread than Y. Lower spread means better yield, and a higher spread represents lower yield. Hence, higher dispersion in data means lesser returns, and lower dispersion in the data set means higher returns.

Range in Discrete Series

Under this series range is calculate on the basis of smallest and largest values irrespective of frequencies.

Illustration 2

Find out the Range and Coefficient of Range in the given distribution:

X	6	8	12	14	4
F	10	9	13	12	10

Solution:

In this series the smallest value is 4 and largest value is 14. So,

Range= $X_{MAXIMUM}$ - $X_{MINIMUM}$

Range= 14-4 =10

$$\textbf{Coefficient of Range=} \frac{14-4}{14+4} = 0.556$$

Range in Continuous Series

Illustration 3

Find the range for the following frequency distribution:

Size of Item	**Frequency**
10- 20	7
20- 40	11
40- 60	30
60-80	17
80-100	5
Total	70

Solution

Here, the upper limit of the highest class is 100 and the lower limit of the lowest class is 10.

Hence, the range is 100-10 = 90. Note that the range is not influenced by the frequencies. Symbolically, the range is calculated by the formula L - S, where L is the largest value and S is the smallest value in a distribution.

$$\textbf{Coefficient of Range=} \frac{100-10}{100+10} = 0.82$$

Merit of Range

1.Range is the easiest to understand and compute.

2.It is rigidly defined.

3.Range provides a broad picture of the data in which all of the items occur within the limits.

LIMITATIONS OF RANGE

There are some range limitations, which are as follows

1. It is based on only two items and doesn't encompass the entire distribution.

2. It varies greatly from to sample to sample centered on the same population.

3. It provides no information about the distribution pattern.

4. At last, in the particular instance of open-ended distributions, the range cannot be computed.

Despite these limitations, the range is largely used in scenarios where a quick understanding of the variability or a set of data is required. Whenever the sample size is small, the range is regarded as an adequate measure of variability. As a result, is extensively used in quality control in which a continuous inspection on the variability of raw materials is required. Materials or finished goods are required. The range is also an appropriate measure in forecast of the weather The meteorological department makes use of the range by providing the maximum and minimum temperatures This information is extremely beneficial to the common man, because he is aware of the extent to which temperature can vary on a daily basis on a particular day.

2.4.1.2 INTERQUARTILE RANGE

The interquartile range or the quartile deviation is a better measure of variation in a distribution than the range. Here, avoiding the 25 percent of the distribution at both the ends uses the middle 50 percent of the distribution. In other words, the interquartile range denotes the difference between the third quartile and the first quartile. Symbolically, interquartile range = Q_3- Q_1

Many times, the interquartile range is reduced in the form of semi-interquartile range or quartile deviation as shown below:

Semi interquartile range or Quartile deviation = (Q_3- Q_1)/2

When quartile deviation is small, it means that there is a small deviation in the central 50 percent items. In contrast, if the quartile deviation is high, it shows that the central 50 percent items have a large variation. It may be noted that in a symmetrical distribution, the two quartiles, that is, Q_3 and Q_1 are equidistant from the median.

Symbolically, M- Q_1 = Q_3-M

However, this is seldom the case as most of the business and economic data are asymmetrical. But, one can assume that approximately 50 percent of the observations are contained in the interquartile range. It may be noted that interquartile range is an absolute measure of dispersion. It can be changed into a relative measure of dispersion as follows:

Coefficient of QD $\frac{Q3 - Q1}{Q3 + Q1}$

C.I.	f	c.f.
0-10	5	5
10-20	3	8
20-30	7	15
30-40	5	20
40-50	5	25
50-60	5	30
60-70	3	33

As, the value of Q1 and Q3 denotes middle 50% portion it is not affected by extreme values and proved superior than range. But in the contrast, it is not based on all the observation. Moreover, it is not capable for further algebraic treatment as influenced by sampling fluctuation.

2.4.1.3 Percentile Range

It represents the difference between 90th percentile (P_{90}) and 10th Percentile (P_{10}).It is considered better than range and inter quartile range because it is not influenced by extreme values and covers the middle 80% values.

Illustration 4

From the following data find out inter-quartile range and percentile range

Wages (less than)	**10**	**20**	**30**	**40**	**50**	**60**	**70**
No. of workers	5	8	15	20	25	30	33

Solution:

$Q_1 \frac{N}{4} = \frac{33}{4} = 8.25th\ item$

$Q1 = L_1 + \frac{i}{f}(q_1 - C)$

$Q1 = 20 + \frac{10}{7}(8.25 - 8)$

$= 20 + \frac{10}{7} X .25$

$= \mathbf{20.35}$

$Q_3 = \frac{N X 3}{4} = \frac{33 X 3}{4} = 24.75th$ item

$Q_3 = L_1 + \frac{i}{f}(q_3 - C)$

$=40 + \frac{5}{5}(24.75 - 20) = 44.75$

Inter-Quartile Range = Q_3- Q_1 = 44.75 – 20.35 = **24.4**

$P_{10} = \frac{N\ X\ 10}{100} = \frac{33\ X\ 10}{100} = 3.3th$ item

$P_{10} = L_1 + \frac{i}{f}(P_{10} - C) = 0 + \frac{10}{5}(3.3 - 0) = 6.6$

$P_{90} = \frac{N\ X\ 90}{100} = \frac{33\ X\ 90}{100} = 29.7th$ item

$P_{90} = L_1 + \frac{i}{f}(P_{90} - C) = 50 + \frac{10}{5}(29.7 - 25) = 59.4$

Percentile Range = $\mathbf{P_{90}} - \boldsymbol{P_{10}}$ = 59.4-6.6 =**52.8**

2.4.2 Methods of Averaging Deviations or Calculation of Measures of Dispersion

2.4.2 .1 Quartile Deviation

The importance of dispersion measurement by range method is only given to extreme values. To overcome this limitation, the Quartile Deviation measure has been developed.

This metric is based on the first and third quartiles (Q1). Mills defines quartile deviation as "the semi-interquartile range, half the distance along the scale between the first and third quartiles." In layman's terms, quartile Deviation (Q. D.) is half the difference between Q_3 and Q_1 in a series, and it is also known as Semi-interquartile range.

Calculation

The method for calculating Q. D. is very simple. We simply compute the values of the third or upper quartile (Q_3) and the first or lower quartile (Q_1), and then use the following formula for absolute and relative measurements.

$$\boldsymbol{Quartile\ Deviation} = \frac{\boldsymbol{Q_3 - Q_1}}{\mathbf{2}}$$

$$\boldsymbol{Coefficient\ of\ Q.D.} = \frac{\boldsymbol{Q_3 - Q_1}}{\boldsymbol{Q_3 + Q_1}}$$

MERITS OF QUARTILE DEVIATION

The following merits are entertained by quartile deviation:

1. As compared to range, it is considered a superior measure of dispersion.

2. In the case of open-ended distribution, it is quite suitable.

3. Since it is not influenced by the extreme values in a distribution, it is particularly suitable in highly skewed or erratic distributions.

LIMITATIONS OF QUARTILE DEVIATION

1. Like the range, it fails to cover all the items in a distribution.

2. It is not amenable to mathematical manipulation.

3. It varies widely from sample to sample based on the same population.

4. Since it is a positional average, it is not considered as a measure of dispersion. It merely shows a distance on scale and not a scatter around an average.

In view of the above-mentioned limitations, the interquartile range or the quartile deviation has a limited practical utility.

Q.D. in individual series

Illustration 5

Calculate Quartile Deviation and its coefficient from the following data:

10 20 21 22 23 24 25

Solution

$Q_1 = \frac{N+1}{4}$th item $= \frac{7+1}{4} = 2nd$ item = 20

$Q_3 = \frac{3(N+1)}{4}$th item $= \frac{3(7+1)}{4} = 6th$ item = 24

$$\boldsymbol{Quartile\ Deviation} = \frac{\mathbf{24-20}}{\mathbf{2}} = \mathbf{2}$$

$$\boldsymbol{Coefficient\ of\ Q.D.} = \frac{\mathbf{24-20}}{\mathbf{24+20}} = \mathbf{0.0909}$$

Illustration 6

Compare the following two series of data in regard of their dispersion by Quartile Method

Height (Cm.)	150	155	145	140	163	130	120	100	135
No. of Students	**58**	**56**	**63**	**61**	**62**	**65**	**55**	**66**	**54**

Solution

Firstly, items need to arrange in ascending order

Sr. No.	**Height (Cm.)**	**No. of Students**
1	100	54
2	120	55
3	130	56

4	135	58
5	140	61
6	145	62
7	150	63
8	155	65
9	163	66

Height

$Q_1 = \frac{N+1}{4}$th item $= \frac{9+1}{4} = 2.5th$ item

$2.5th$ item= 2nd term +.5 (3rd term-2nd term) term)

=120+.5(130-120)

=120+.5 X10 =**125**

$Q_3 = \frac{3(N+1)}{4}$th item $= \frac{3(9+1)}{4} = 7.5th$ item

$7.5th$ item= 7th term+.5(8th term – 7th term) term)

150+.5(155-150)

150+2.5= **152.5**

$$\textbf{Coefficient of Q.D.} = \frac{152.5 - 125}{152.5 + 125}$$

$$= \frac{27.5}{277.5} = \mathbf{0.099}$$

0.071

Weight

$Q_1 = \frac{N+1}{4}$th item $= \frac{9+1}{4} = 2.5th$ item

$2.5th$ item= 2nd term +.5 (3rd term-2nd

=55+ .5(56-55)

= 55+.5(1) = **55.5**

$Q_3 = \frac{3(N+1)}{4}$th item $= \frac{3(9+1)}{4} =$

$7.5th$ item= 7th term+.5(8th term – 7th

= 63+.5(65-63)

=64

$$\textbf{Coefficient of Q.D.} = \frac{64 - 55.5}{64 + 55.5}$$

$$= \frac{8.5}{119.5} =$$

Remark: There is more variability in height as compared to weight.

Q.D. in Discrete series

Illustration 7

Calculate Q.D. and its coefficient from the following observation:

Height (Cm.)	145	146	147	148	149	150	151	152	153	154
No. of Students	15	20	32	35	33	22	20	10	8	4

Solution

Height (Cm.)	f	$c.f.$
145	15	15
146	20	35
147	32	67
148	35	102
149	33	135
150	22	157
151	20	177
152	10	187
153	8	195
154	4	199

$Q_1 = \frac{N+1}{4}$th item $= \frac{199+1}{4} = 50th$ item

$50th$ item exists in $c.f.$ 67, So, Q_1=147

$Q_3 = \frac{3(N+1)}{4}$th item $= \frac{3(199+1)}{4} = 150th$ item

$150th$ item lies in $c.f.$ 157, So, Q_3=150

$Quartile\ Deviation = \frac{150-147}{2} =$ **1.5**

$Coefficient\ of\ Q.D. = \frac{150-147}{150+147} = \frac{3}{297} =$ **0.1**

Q.D. in Continuous series

Illustration 8

Calculate Q.D. and its coefficient from the following observation:

Weight (Kgs)	**0-10**	**10-20**	**20-30**	**30-40**	**40-50**
No. of Students	4	15	28	16	7

Solution

Weight (Kgs)	f	$c.f.$
0-10	4	4
10-20	15	19
20-30	28	47
30-40	16	63
40-50	7	70

$Q_1 = \frac{N}{4}$th item $= \frac{70}{4} = 17.5th$ item

Q_1 17.5 lies in ***c.f*. 19, So by applying the** applying the

formula in class 10-20

$$Q1 = L_1 + \frac{i}{f}(q_1 - C)$$

$$= 10 + \frac{10}{15}(17.5 - 5)$$

$$= 10 + \frac{10}{15}(13.5) = 19$$

$Q_3 = \frac{3(N)}{4}$th item $= \frac{3(70)}{4} = 52.5th$ item

Q_3 52.5 lies in $c.f.$ 63, So by

formula in class 30-40

$$Q_3 = L_1 + \frac{i}{f}(q_3 - C)$$

$$= 30 + \frac{10}{16}(52.5 - 47)$$

$$= 30 + \frac{10}{16} \times 5.5 = 30 + 3.44 = \mathbf{33.44}$$

$$\boldsymbol{Quartile\ Deviation} = \frac{Q_3 - Q_1}{2} = \frac{33.44 - 19}{2} = \mathbf{7.22}$$

$$\textbf{Coefficient of Q.D.} = \frac{3.44 - 19}{3.44 + 19} = \frac{14.44}{52.44} = \mathbf{0.2754}$$

2.4.2.2 MEAN DEVIATION

Mean Deviation is also known as 'Average Deviation' or 'First Moment of Dispersion'. It is the arithmetic average of the deviation of various items from a measure of central tendency (either Mean, Median or Mode). As the name implies, it is the average of absolute amounts by which the individual items deviate from the mean. Since the positive deviations from the mean are equal to the negative deviations, while computing the mean deviation, we ignore positive and negative signs. Symbolically,

$$\boldsymbol{M.D.} = \frac{\sum|\boldsymbol{d\bar{x}}|}{\boldsymbol{N}}$$

OR

$$\boldsymbol{M.D.} = \frac{\sum|\boldsymbol{d\bar{m}}|}{\boldsymbol{N}}$$

Where, MD = mean deviation, $|d\bar{x}|$ = deviation of an item from the mean ignoring positive and negative signs, N = the total number of observations

"The Mean Deviation of a series of magnitudes is the arithmetic mean of their deviations from an average value, either Mean or Median." -
Mills

"Average deviation is the average amount of scatter of the items in a distribution from either the mean or the median, ignoring signs of the deviations. The average that is taken of the scatter is an arithmetic which accounts for the fact that this measure is often called the Mean Deviation."

-Clark and Schakade

Precautions in the Calculation of Mean Deviation (M.D.)

The following factors should be taken into account while calculating M.D.

1. In theory, M.D. can be calculated using deviations from any one of the three averages, namely Mean, Median, or Mode. However, mode is rarely used in practice because its value is frequently uncertain and indeterminate. The median is supposed to be better than the mean because M.D. is the smallest while calculated from the median. However, because mean is widely used in statistics as a measurement of central tendency, mean deviation is commonly computed from mean. In this case, the question may contain instructions. If the question contains no instructions, the median should be used.
2. The algebraic signs (plus or minus) are neglected while taking deviations for M.D., and all deviations are taken as positive. In this case, the sign of deviation 'd' is positioned between two vertical bars known as modulus, i.e., |d|.
3. To compute the coefficient of M.D., divide the absolute measure (M.D.) by the average through which deviations were acquired.

MERITS OF MEAN DEVIATION

1. A major advantage of mean deviation is that it is simple to understand and easy to calculate.
2. It takes into consideration each and every item in the distribution. As a result, a change in the value of any item will have its effect on the magnitude of mean deviation.
3. The values of extreme items have less effect on the value of the mean deviation.
4. As deviations are taken from a central value, it is possible to have meaningful comparisons of the formation of different distributions.

LIMITATIONS OF MEAN DEVIATION

1. It is not capable of further algebraic treatment.
2. At times it may fail to give accurate results. The mean deviation gives best results when deviations are taken from the median instead of from the mean. But in a series, which has wide variations in the items, median is not a satisfactory measure.

3. Strictly on mathematical considerations, the method is wrong as it ignores the algebraic signs when the deviations are taken from the mean. In view of these limitations, it is seldom used in business studies. A better measure known as the standard deviation is more frequently used.

Mean Deviation in individual Series

Illustration 9

Calculate Mean Deviation and its coefficient from mean and median for the given data:

200	**210**	**220**	**225**	**225**	**235**	**240**	**260**	**270**	**295**

Price(X)	**Deviation from Mean (from 238) $d\bar{x}$**	**Deviation from Median (from 230) $\lvert d\bar{m}\rvert$**
200	28	20
210	18	10
220	13	5
225	13	5
225	13	5
235	3	5
240	2	10
260	12	20
270	32	40
295	42	50

$$Mean\ (\bar{X}) = \frac{\sum X}{N} = \frac{2380}{10} = \mathbf{238}$$

Median (M) = Value of $(\frac{N+1}{2})$th Item = $((\frac{10+1}{2})$th item

=Value of 5.5th item = $\frac{225+235}{2}$ = **230**

$$M.D. = \frac{\sum|d\bar{x}|}{N}$$

$$= \frac{176}{10} = \mathbf{17.6}$$

Coefficient of M.D. = $\frac{M.D.}{\bar{X}}$

$$= \frac{17.6}{238} = \mathbf{.074}$$

$$M.D. = \frac{\sum|d\bar{m}|}{N}$$

$$= \frac{170}{10} = \mathbf{17}$$

Coefficient of M.D. = $\frac{M.D.}{\bar{m}}$

$$= \frac{\mathbf{17}}{\mathbf{230}} = \mathbf{.074}$$

Short Cut Method

The process of calculation of M.D. as follows:

On the basis of Mean

Firstly, mean $\bar{X}$of the series is calculated. Further, the sum of values greater than mean ($\sum X_A$) and the sum of values less than mean ($\sum X_B$) are obtained. Furthermore, number of items greater than mean N_A and number of items less than mean N_B are obtained. Then, M.D. is calculated by applying the given formula:

$$M.D.(Mean) = \frac{\sum X_A - \sum X_B - (N_A - N_B)\bar{X}}{N}$$

On the basis of Median

Firstly, the items are arranged in ascending order and the value of median is find out. Further, the sum of values greater than median ($\sum X_A$) and the sum of values less than median ($\sum X_B$) are obtained. Then, M.D. is calculated by applying the given formula:

$$M.D.(Median) = \frac{\sum X_A - \sum X_B}{N}$$

Mean Deviation in Discrete Series

Illustration 10

Calculate Mean Deviation and its coefficient of mean deviation from the given data:

X	10	15	20	30	40	50
f	8	12	15	10	3	2

Solution:

X	***f***	***fX***	$\|d\bar{x}\|$ **from 21.6**	$f\|d\bar{x}\|$
10	8	80	11.6	92.8
15	12	180	6.6	79.2
20	15	300	1.6	24.0
30	10	300	8.4	84.0
40	3	120	18.4	55.2
50	2	100	28.4	56.8
N=50		**=1080**		**392.0**

$\bar{X} = \frac{\sum fX}{N} = \frac{1080}{50} =$ **21.6**

$$M.D. = \frac{\sum f|d\bar{x}|}{N} = \frac{392}{50} = \mathbf{7.84}$$

Coefficient of M.D.= $\frac{M.D.}{Mean} = \frac{7.84}{21.6} = \mathbf{0.363}$

Mean Deviation in Continuous Series

Illustration 11

Calculate the Mean Deviation from the Mean and Median from the following observation along with coefficient:

Class Interval	0-20	20-40	40-60	60-80	80-100
f	30	5	6	4	2

Solution:

C.I.	**M.V.**	f	dx **from A= 50**	fdx	$\|d\bar{x}\|$ **from**	$f\|d\bar{x}\|$
0-20	10	3	-40	-120	20	60
20-40	30	5	-20	-100	0	0
40-60	50	6	0	0	20	120
60-80	70	4	40	160	40	160
80-100	90	2	20	40	60	120
	N=20			**-20**		**460**

$$\bar{X} = A + \frac{\sum fdx}{N} \times i = 50 + \frac{-20}{20} \times 20 = 50 - 20 = 30$$

$$M.D. = \frac{\sum f|d\bar{x}|}{N} = \frac{460}{20} = \mathbf{23}$$

Coefficient of M.D.= $\frac{M.D.}{Mean} = \frac{23}{30} = \mathbf{0.767}$

2.4.2.3 STANDARD DEVIATION

Standard deviation (S.D.) is an ideal, scientific and most popular measure of the dispersion. It was first used by Karl Pearson in the year 1893. As a definition "Standard Deviation is the square root of the arithmetic mean of the squares of deviations of items from their arithmetic mean." Standard deviation can also be defined as positive square root of variance.

Standard Deviation: An Ideal and Scientific Measure

S. D. is considered as an ideal and scientific measure of dispersion and there are following reasons for it

1. S.D. is based on all items of the series.
2. Deviations are always taken from arithmetic mean, which is rigidly defined measure of central tendency.
3. Algebraic sign of '+' and '-' are considered, while taking deviations.
4. S.D. is fully capable of further algebraic treatment.

Rational of Standard Deviation

S. D. is most popular among various measures of dispersion. Range is based on two extreme values of the series and ignores all other values. Quartile Deviation considers only middle (50%) of the items and other items are left out. Mean Deviation is based on all values but at the time of calculating deviations algebraic signs of '+' and '-' ignored. Moreover, its value is also not certain because it can be computed on the basis of any average i.e., Mean, Median or Mode. Standard deviation is free from all these limitations. That is why this measure is more popular.

Merits of Standard Deviation

(1) Based on all values-The calculation of standard deviation is based on values of a series, Thus, it is a reliable measure of dispersion.

(2) Use in higher algebraic analysis-Standard deviation is amenable to algebraic treatment and possesses many mathematical properties. On account of these properties combined standard deviation can be computed and therefore, S.D. is used in advanced studies like skewness, correlation, regression, test of significance, etc.

(3) Rigidly Defined-Standard deviation is rigidly defined and its value is always definite. Moreover, this measure can be obtained in every condition.

(4) Less influence of sampling-S.D. is affected least by fluctuations of sampling than other measures of dispersion.

(5) Determination of the area of normal distribution-Standard deviation is specifically related to the area of normal distribution curve. Hence, the area of this curve is clearly determined on the basis of S.D.

Limitations of S. D.

(1) Difficulty in calculation-Squares and square-roots are calculated in standard deviation, which are comparatively difficult. However, this does not reduce the importance of S. D. because of its high degree of accuracy.

(2) More weightage to extreme values-The extreme values are given more weights on account of squares of deviations.

Calculation of S.D.

Direct Method: Firstly, Arithmetic $\left(\bar{X} = \frac{\sum X}{N}\right)$ is calculated. After it, deviation of each observation from mean is extracted. Then each deviation is squared up and their sum is calculated. At last, the sum of squared deviation is divided by number of items and square root of their value is obtained by using given formula:

$$S.D.(\sigma) = \sqrt{\frac{\sum d^2}{N}}$$

Coefficient of S.D.$= \frac{S.D.}{Mean}$ *or* $\frac{\sigma.}{\bar{X}}$

Short Cut Method

This method is applicable when actual mean is given in fraction or when S.D. is to be calculated from assumed mean rather than actual mean.

$$S.D.(\sigma) = \sqrt{\frac{\sum d^2x}{N} - \left(\frac{\sum dx}{N}\right)^2}$$

Or

$$S.D.(\sigma) = \frac{1}{N}\sum d^2x \times N - (\sum dx)^2$$

Illustration 12

Calculate the standard deviation from the following observation

68	49	32	21	54	38	59	66	40

X	dx from 50	d^2x
68	+18	324
49	-1	1
32	-18	324
21	-29	841
54	+4	16
38	-12	144
59	+9	81
66	+16	256
40	-10	100

$$S.D.(\sigma) = \sqrt{\frac{\sum d^2x}{N} - \left(\frac{\sum dx}{N}\right)^2}$$

$$= \sqrt{\frac{2087}{9} - \left(\frac{-23}{9}\right)^2}$$

$$= \sqrt{231.89 - 6.53}$$

$$= \sqrt{225.36}$$

=15.01

Or

$$S.D.(\sigma) = \sqrt{\frac{1}{9}\ 2087 \times 9 - (-23)^2}$$

$$= \sqrt{\frac{1}{9}\ 18783 - 529} = \textbf{15.01}$$

Illustration 13

Calculate the Arithmetic Mean, Standard deviation and Coefficient of S.D. from the following observation:

x	2	4	6	8	10
f	**1**	**4**	**6**	**4**	**1**

Solution

x	f	fx	d from 6	d^2	fd^2
2	1	2	-4	16	16
4	4	16	-2	4	16
6	6	36	0	0	0
8	4	32	2	4	16
10	1	10	4	16	16

$$\bar{X} = \frac{\sum fx}{N} = \frac{96}{16} = \mathbf{6}$$

$$S.D. = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{64}{16}} = \mathbf{2}$$

Coefficient of S.D.= $\frac{\sigma.}{\bar{X}} = \frac{2}{6} = .\mathbf{33}$

Illustration 14

Find out Standard Deviation and its coefficient from the following data:

Marks	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	6	8	15	7	3	0	1

Marks	M.V.	f	$d'x$ **from 35**	$fd'x$	fd^2x
10-20	15	6	-2	-12	24
20-30	25	8	-1	-8	8
30-40	35	15	0	0	0
40-50	45	7	+1	7	7
50-60	55	3	+2	6	12
60-70	65	0	+3	0	0
70-80	75	1	+4	4	16

$\bar{X} = A + \frac{\sum fd'x}{N} \times i$ = $35 + \frac{-3}{40} \times 10 = 35\text{-}.75 = \mathbf{34.25}$

$$S.D.(\sigma) = \frac{1}{N}\sqrt{\sum fd^2x \times N - (\sum fd'x)^2}$$

$$= \frac{10}{40}\sqrt{67 \times 40 - (-3)^2}$$

$$= \frac{1}{4}\sqrt{2680 - (9)^2}$$

$$= \frac{1}{4}\sqrt{2671}$$

$= \frac{1}{4} \times 51.68 = \mathbf{12.92}\times$

Coefficient of S.D.$= \frac{\sigma.}{\bar{X}} = \frac{12.92}{34.25} = .\mathbf{377}$

Coefficient of Variation (C.V.) = $\frac{S.D.}{Mean}\times 100$ or $\frac{\sigma.}{\bar{X}}\times 100$

(C.V.) = $\frac{S.D.}{Mean}\times 100$ or $\frac{\sigma.}{\bar{X}}\times 100$

Illustration 15

From the prices of shares of X Co. and Y Co. given below, state which is more stable in value:

X Co.	**55**	**54**	**52**	**53**	**56**	**58**	**52**	**50**	**51**	**49**
Y Co.	108	107	105	105	106	107	`104	103	104	101

Solution:

Calculation of coefficient of variation

X Co.			**Y Co.**		
X	d from 53	d^2	X	d from 105	d^2
55	+2	4	108	+3	9
54	+1	1	107	+2	4
52	-1	1	105	0	0
53	0	0	105	0	0
56	+3	9	106	+1	1
58	+5	25	107	+2	4
52	-1	1	104	-1	1
50	-3	9	103	-2	4
51	-2	4	104	-1	1
49	-4	16	101	-4	16
$\sum \boldsymbol{X}$**= 530**		$\sum \boldsymbol{d^2}$**= 70**	$\sum \boldsymbol{X}$**= 1050**		$\sum \boldsymbol{d^2}$**= 40**

X Co.

$\bar{X} = \frac{\sum X}{N} = \frac{530}{10} = 53$

$S.D.(\sigma) = \frac{\sum d^2}{N}$

$= \sqrt{\frac{70}{10}} = \sqrt{7} = \mathbf{2.646}$

Y Co.

$\bar{X} = \frac{\sum X}{N} = \frac{1050}{10} = 105$

$S.D.(\sigma) = \frac{\sum d^2}{N}$

$\sqrt{\frac{40}{10}} = \sqrt{4} = \mathbf{2}$

$$\text{C.V.} = \frac{S.D. \times 100}{Mean} \qquad \text{C.V.} = \frac{S.D. \times 100}{Mean}$$

$$= \frac{2.646 \times 100}{53} = 4.992\% \qquad = \frac{2 \times 100}{105} = 1.905\%$$

It is clearly evident that the shares of Y co. are more stable as C.V. is low in comparison of X Co.

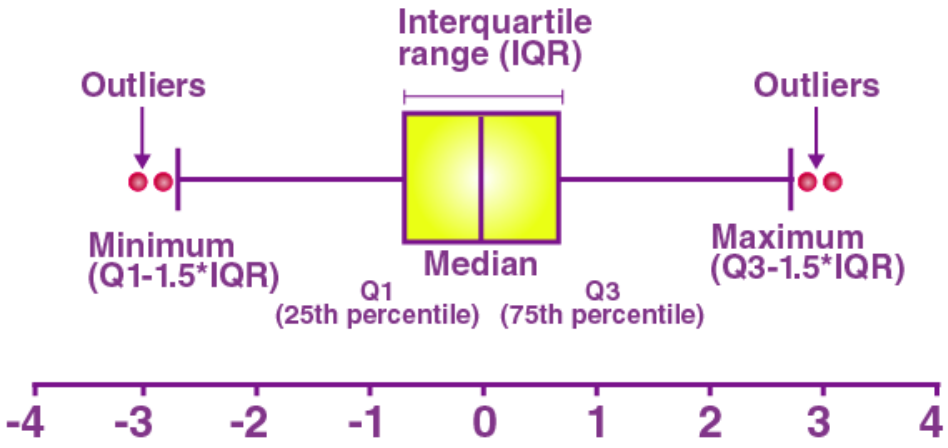
2.5 Box and Whisker Plot

A box and whisker plot is a method of abstracting a set of data that is estimated using an interval scale. It is also known as a box plot. These are mostly used to interpret data. It is a type of graphical method that displays the variation of data in a dataset. The data can also be displayed using the histogram. However, the histogram is a sufficient display. A box and whisker diagram will provide more information than a histogram because it allows multiple sets of data to be displayed in the same graph.

We use box plots or graphical representations to determine:

1. Central Value
2. Variability
3. Distribution Shape

When we plot a box plot graph, we outline a box from the first to third quartiles. The median is a vertical line that runs through the box. As shown in the figure below, the whiskers (small lines) lead from each quartile to the minimum or maximum value.



Source: 1https://byjus.com/maths/box-and-whisker-plot/

A box and whisker plot is a graph that displays data from a five-number summary, including one of the central tendency measures. It does not accurately depict the distribution as a stem and leaf plot or histogram does. However, it is primarily used to determine whether a distribution is skewed and whether there are any potentially outlier observations in the data set. Boxplots are also useful when comparing or involving large numbers of data collections.

Because the centre, spread, and overall range are immediately visible, the arrangements can be easily matched using these boxplots.

A box and whisker plot is a method of presenting a set of data on an interval scale. It is also used to interpret descriptive data. It shows how the data is distributed. There are five pieces of information in the box and whisker diagram (also called a five-number summary).

2.5.2 Elements of a Box and Whisker Plot

The elements required to construct a box and whisker plot outliers are given below.

Minimum value (Q_0 or 0 percentile) The dataset's minimum value, which is shown at the far-left end of the diagram.

The first quartile (Q1) is located on the left side, between the minimum and median values.

The median value is represented by the line in the box's centre**.**

The third quartile (Q3) is located on the right side, between the median and the maximum value.

The dataset's **maximum value,** which is shown at the far-right end of the diagram.

The difference between the upper and lower quartiles, i.e. Q3 and Q1, is referred to as the **interquartile range (IQR).**

Box and whisker diagrams allow us to read data quickly and easily. It compiles data from various sources and displays it in a single graph. It assists us in making an informed decision by comparing data from various categories. When we have multiple datasets from different sources that are related to each other, we use the box and whisker plot. For instance, compare test scores between classrooms.

2.5.3 Process to draw Box Plot

The box and whiskers plot can be drawn using five simple steps. To draw a box and whisker diagram, we need to find:

Step 1: The smallest value in the data is called the minimum value.

Step 2: The value below the lower 25% of data contained, called the first quartile.

Step 3: Median value from the given set of data.

Step 4: The value above the lower 25% of data contained, called the third quartile.

Step 5: The largest value in the dataset is called maximum value.

Illustration 16

Draw the box plot for the given set of data: {3, 7, 8, 5, 12, 14, 21, 13, 18}.

Solution:

Firstly, write the given data in increasing order.

3, 5, 7, 8, 12, 13, 14, 18, 21

Range = Maximum value – Minimum value

Range = 21 – 3 = 18

Now, Median = center value of the given data

Median = 12

Now, we need to find the quartiles.

First quartile = Q_1 = Median of data values present at the left side of Median

Q_1 = Median of (3, 5, 7, 8)

Q_1 = (5+7)/2 = 12/2 = 6

Third quartile = Q_3 = Median of data values present at the right side of Median

Q_3 = Median of (13, 14, 18, 21)

Q_3 = (14+18)/2 = 32/2 = 16

Therefore, the interquartile range = $Q_3 – Q_1$ = 16 – 6 = 10

The five-number summary is given by:

Minimum, Q_1, Median, Q_3, Maximum

Hence, 3, 6, 12, 16, 21 is the five-number summary for the given data.

Now, we can draw the box and whisker plot, based on the five-number summary.

Source: 2 https://byjus.com/maths/box-and-whisker-plot/

2.6 Skewness and Kurtosis

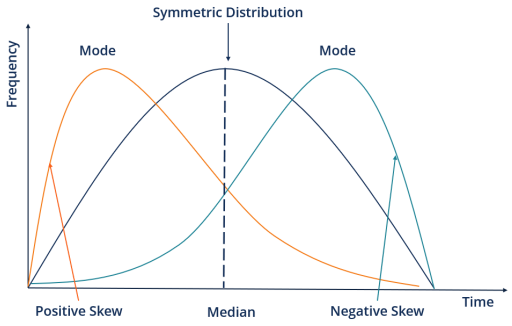
2.6.1 Meaning of Skewness

Skewness is a measure of asymmetry or symmetric distribution distortion. It calculates the deviation of a random variable's given distribution from a symmetric distribution, such as the normal distribution. A normal distribution has no skewness because it is symmetrical on both sides. As a result, a curve is considered skewed if it is shifted to the right or left.

The literal definition of skewness is "lack of symmetry." In other words, skewness occurs when the distribution on either side of the central value is not symmetrical. Some definitions of skewness are as follows:

Measures of skewness tell us the direction and the extent of skewness. In symmetrical distribution the mean, median and mode are identical. The more the mean moves away from the mode, the larger the asymmetry or skewness."

-Simpson and Kafka



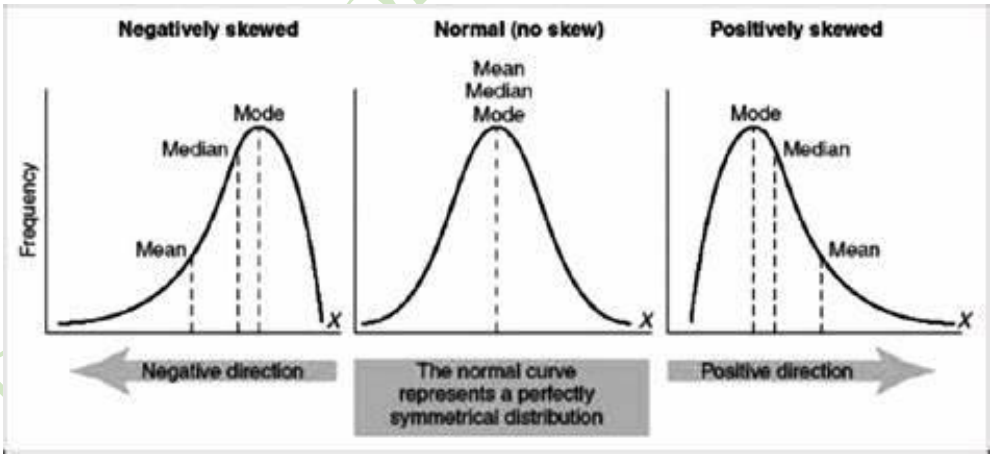
A distribution is said to be skewed when the mean and median fall at different points in the distribution, and balance is shifted to one side or the other."

-Garret

After reviewing the definitions above, it is possible to conclude that skewness is a statistical measure that explains the asymmetrical nature and degree of a frequency distribution.

2.6.1.1 Types of Skewness

1. **Positive Skewness**
   It is a positively skewed distribution if the given distribution is shifted to the left and has its tail on the right side. It's also known as the right-skewed distribution. A tail is the tapering of the curve that differs from the data points on the other side. A positively skewed distribution, as the name implies, has a skewness value greater than zero. Because the skewness of the given distribution is to the right, the mean value is greater than the median and moves to the right, and the mode occurs at the distribution's highest frequency.



2. **Negative Skewness**
   It is a negatively skewed distribution if the given distribution is shifted to the right and has its tail on the left side. It's also known as a left-skewed distribution. Any distribution with a negative skew has a skewness value less than zero. Because the skewness of the given distribution is on the left, the mean value is less than the median and moves to the left, and the mode occurs at the distribution's highest frequency.

2.6.1.2 Tests of Skewness

The following tests can be used to determine whether a distribution is skewed or not. Skewness exists when:

1. The mean, median, and mode values do not coincide.
2. When the data is plotted on a graph, it does not take the typical bellshaped form, i.e. the two halves are not equal when cut along a vertical line through the centre.
3. The total of positive deviations from the median does not equal the total of negative deviations.
4. The quartiles are not equally spaced from the median.
5. Frequencies are not distributed equally at equal deviations from the mode.

When skewness is absent, i.e., in the case of a symmetrical distribution, the following conditions are met:

1. The mean, median, and mode values all coincide.

2. When data is plotted on a graph, it takes the typical bell-shaped shape.

3. The total of positive deviations from the median equals the total of negative deviations.

4.The median is equidistant from the quartiles.

5. Frequencies are distributed equally at equal deviations from the mode.

2.6.1.3 Measures of Skewness

Skewness is measured in three ways, each with absolute and relative values. The relative measure, known as the coefficient of skewness, is more commonly used than the absolute measure. Furthermore, when comparing two or more distributions, it is the relative measure of skewness that is used. The following skewness measures are available:

1. Karl Pearson's measure,
2. Bowley's measure,
3. Kelly's measure, and

These measures are briefly discussed below:

- **Karl Pearson's measure**

The mean, median, and mode of a symmetrical distribution all coincide. These values are pulled apart in skewed distributions; the mean tends to be on the same side of the mode as the longer tail. As a result, the difference provides a measure of the asymmetry (). By dividing by a measure of dispersion, this can be made dimensionless (such as SD). Karl Pearson's relative skewness measure is

$$J = \frac{Mean - Mode}{S.D.} \text{ OR } J = \frac{\bar{X} - Z}{\sigma}$$

Skewness can have a positive or negative value.

The empirical skewness formula (also known as second coefficients of skewness) is

$$J = \frac{3(Mean - Mode)}{S.D.} \text{ OR } J = \frac{3(\bar{X} - Z)}{\sigma}$$

- **Bowley's measure**

The quartiles in a symmetrical distribution are equidistant from the median ($Q_2 - Q_1 = Q_3 - Q_2$). The quartiles will not be equidistant from the median if the distribution is not symmetrical (unless the entire asymmetry is located in the extreme quarters of the data). The skewness measure proposed by Bowley is

$$J = \frac{Q_3 + Q_1 - 2M}{Q_3 - Q_1}$$

When the quartiles are equidistant from the median, this measure is always zero, and it is positive when the upper quartile is farther from the median than the lower quartile. This skewness metric varies between +1and -1.

- **Kelly's measure**

Kelly's coefficient of skewness is calculated using data deciles or percentiles. Kelly proposed a skewness measure based on the middle 80% of the data set's observations.

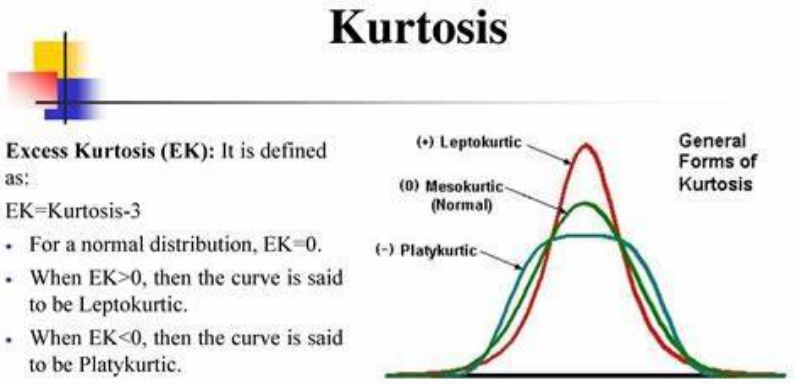
$$J = \frac{P_{90} + P_{10} - 2P_{50}}{P_{90} - P_{10}}$$

- If Sk<0Sk<0, the data is negatively skewed.
- If Sk=0Sk=0, the data is symmetric (i.e., not skewed).
- If Sk>0Sk>0, the data is positively skewed.

2.6.2 Kurtosis

Kurtosis is a statistical measure that describes how much a distribution's tails differ from the tails of a normal distribution. Kurtosis, in other words, determines whether the tails of a given distribution encompass extreme values. Kurtosis, like skewness, is an important descriptive statistic of data distribution. However, the two ideas should not be confused with one another. Skewness essentially measures the distribution's symmetry, whereas kurtosis defines the heaviness of the distribution tails.

Tail data from distributions with high kurtosis outnumber the tails of the normal distribution (e.g., five or more standard deviations from the mean). Tail data in low kurtosis distributions are generally less extreme than tail data in the normal distribution.



Kurtosis is sometimes confused with a measure of a distribution's peakedness. Kurtosis, on the other hand, is a metric that describes the shape of a distribution's tails in relation to its overall shape. A distribution can be infinitely peaked with low kurtosis or infinitely flat-topped with infinite kurtosis. Thus, kurtosis measures "tailness" rather than "peakness."

2.6.2.1 Type of Kurtosis

- **A mesokurtic distribution** is medium-tailed as outliers are neither extremely common nor extremely rare in a mesokurtic distribution. Kurtosis is calculated by comparing the distribution to a normal distribution. Because normal distributions have a kurtosis of three, any distribution with a kurtosis of three or less is mesokurtic.

  Kurtosis is frequently described in terms of excess kurtosis, which is kurtosis 3. Because normal distributions have a kurtosis of 3, excess kurtosis makes comparing the kurtosis of a distribution to a normal distribution even easier. Because normal distributions have zero excess kurtosis, any distribution with an excess kurtosis of about 0 is mesokurtic.

- **A platykurtic distribution** is thin-tailed as outliers are uncommon in a platykurtic distribution because it is thin-tailed. Kurtosis is lower in platykurtic distributions than in normal distributions. To put it another way, platykurtic distributions have a kurtosis less than three and a kurtosis excess of less than 0. Platy kurtosis is also known as negative kurtosis because the less kurtosis is negative.

- **A leptokurtic distribution** is fat-tailed, which means there are many outliers. Leptokurtic distributions are kurtotic in comparison to normal distributions. They have the following; A kurtosis greater than 0 or 3. It is sometimes referred to as positive kurtosis.

	Category		
	Mesokurtic	Platykurtic	Leptokurtic
Tailedness	Medium-tailed	Thin-tailed	Fat-tailed
Outlier frequency	Medium	Low	High
Kurtosis	Moderate (3)	Low (< 3)	High (> 3)
Excess kurtosis	0	Negative	Positive
Example distribution	Normal	Uniform	Laplace

2.7 BIG DATA

Big Data is a contemporary analytics trend that enables businesses to make more data-driven decisions than ever before. When these massive amounts of data are analyzed, the insights they provide lead to real commercial opportunities in marketing, product development, and pricing.

Big data is defined as "high-volume, high-velocity, and diverse information assets that necessitate cost-effective, novel forms of processing for improved insight and decision making." It relates to the large collections of data that are so complicated and vast that neither humans nor traditional data management systems can interpret them. It can now be used and tracked thanks to recent software developments.

When properly analysed with modern tools, these massive amounts of data provide businesses with the information they require to make informed decisions. To the human eye, much of this user data appears meaningless and unconnected. Big data analytic tools, on the other hand, can track the relationships between hundreds of different types and sources of data to produce useful business intelligence.

Data scientists and Big Data solution architects are joining the movement in businesses of all sizes and sectors. With the Big Data market expected to nearly double by 2025 and user data generation on the rise, this is an excellent time to become a Big Data specialist.

The five "vs" of big data—volume, veracity, value, variety, and velocity—combine to form this term.

Today, big data are produced in a variety of ways. As you are aware, there are various types of data and consequently various types of big data.

Structured Data

Structured data is defined as data that can be stored, accessed, and processed in a fixed format. In general, structured data is coded using page markup on the page to which the information applies to. One example of structured data is data stored in a relational database management system. Another example SQL, Excel, ORACLE etc.

Semi- Structured Data

The **Semi-Structured** data can contain both forms of data but has some structure. it lacks a fixed or rigid schema. This type of data is generally found in XML Files. Example POS,POL, IR etc.

Unstructured Data

Unstructured data can get into an unknown form, that is, it is not organised in a definite manner. A heterogeneous data source containing a mix of simple text, videos, and images is an example of unstructured data.

Example

Big Data in social media

Perhaps the most well-known application of big data is this. Millions (in some cases, billions) of user-generated contents are produced daily on social media sites like Facebook, YouTube, Twitter, Instagram, and Pinterest.

These user-generated contents may be audio, visual, graphical, or text-based. Given that there are 86,400 minutes in a day, and that YouTube receives 300 hours of video uploads every minute, you can see that there is a lot of data being generated on a daily basis.86,400 times 300 equals nearly 26 million hours each day. In comparison, 26 million hours are equivalent to nearly 30 centuries. Every day, 30 centuries of videos are posted to YouTube. And while this number is based on 2019 statistics, it is anticipated that in 2020 there will be more YouTube uploads per hour.

In a blog post published in May 2019, Google AI researchers claimed that they used 2,000 "mannequin challenge" YouTube videos as a training dataset to build an AI model that could predict depth from moving videos. This example only scratches the surface of the importance of those 300 hours per minute uploads.

Test Data for Autonomous Vehicles

The majority of us who work in artificial intelligence are familiar with the trends in autonomous vehicle development. And we are aware that the development of autonomous vehicles heavily relies on big data, primarily sensor data from test vehicles. Autonomous and ADA test vehicles, according to Texura, generate more than 11 Terabytes (TB) of data each day. Leading self-driving car firms like Waymo produce a tonne of data yearly just from their test cars. Waymo's test vehicles have logged hundreds of billions of miles in computer simulations and over 20 thousand miles on public roads since their inception (in 2009). What's more shocking is that this only happened in 2019.

A Texura report claims that an autonomous vehicle's sensors can record up to 19 TB of data per hour.A year's worth of 10 million miles equates to 1,142 miles per hour and 27,400 miles per day.Although Waymo hasn't disclosed the size of its fleet, 200 cars travelling for 8 hours a day at 17 mph would correspond to its 10 million annual miles rate.

With the help of the aforementioned estimates, we can determine that Waymo's test cars generate anywhere between 2.2 Petabytes (PB) and 30.4 PB of sensor data each day.

Stock Exchange Data

One excellent example of big data is stock exchange data. Imagine the scene at the stock exchange's main office in your nation. What is the first thought that pops into your head? Numbers. fluctuating stock prices.You know those numbers are important information and a lot of data because you are smart, right? They are, indeed.The New York Stock Exchange can be used as an example, producing 4-5 terabytes of data each day. Of course, you are aware that businesses and individuals use these data for a variety of uses, including stock investing and forecasting.

1.7.1 Characteristic of Big Data

Big Data are characterized by the 5Vs: Volume, Variety, Velocity, Veracity and Value.

Volume

The volume of data is a fundamental component of big data. The term "Big Data" refers to a massive amount of information. The size of the data is very important in determining the value of the data.

This volume addresses the most immediate threat to traditional IT structures. This is the first thought that comes to mind when people think of big data. Many businesses have already huge quantities of archived data in the form of log data but lack the capacity to process it. The main attraction of big data analytics is the benefit gained from the capacity to process a large amount of data.

Variety

refers to a wide range of data sources and data types, alike structured and unstructured. Previously, spreadsheets and databases were the only data sources considered by most applications. Data in the forms of emails, photos, videos, monitoring devices, PDFs, audio, and so on are now considered in analysis applications. This wide range of unstructured data raises concerns about data storage, mining, and analysis.Massive amounts of data are being generated at an alarming rate today, and numerous of these data are unique.

Given the amount of data (structured and unstructured) in big data, big data analysts must collect, analyse, and make sense.

Veracity

In general, big data veracity refers to the accuracy (quality and precision) of a dataset, as well as the degree of trustworthiness of the data source and processing.

When dealing with a high volume, velocity, and variety of data, it is impossible for all of the data to be 100% correct; dirty data will exist. The accuracy of the data captured can vary greatly. The variety of the source data influences the analysis's data accuracy.

Velocity: The rate at which data is generated and processed in order to meet the needs and challenges of growth and development. Real-time access to big data is common. Big data is produced more frequently than small data. The frequency of generation and the frequency of handling, recording, and publishing are two types of velocity in relation to big data. Massive amounts of data must arrive quickly enough to qualify as big data. In fact, for some businesses, data that does not arrive on time is rendered useless (invaluable).

Big data velocity is more than just data arriving frequently; it is also about data arriving as soon as possible. Real-time data provides strategic and competitive advantages to organisations, particularly businesses.

Value

The data must be valuable, but value comes in various forms and sizes.Consider a scenario in which a self-driving car company collects massive amounts of data relating to plant diseases and pests in real time.That data is, of course, valuable, but is it valuable to the self-driving car company working on developing fully autonomous vehicles? The primary reason that organisations undertake big data projects is to create value for themselves. If the big data project is not providing any value to the organisation, it is a waste of the organization's resources.

2.7.2 Stages of Big Data Processing

1st Stage: Data Extraction

The first step in Big Data Processing is to collect information from various sources such as enterprise applications, web pages, sensors, marketing tools, transactional records, and so on. Professionals in data processing extract information from a variety of Unstructured and Structured Data Streams. For example, in the construction of a Data Warehouse, extracting entails combining information from multiple sources and then verifying the information by

removing incorrect data. To make future decisions based on the outcomes, the data collected during the Big Data Processing data collection phase must be labelled and accurate. This stage establishes both a quantitative standard and a target for improvement.

2nd Stage: Data Transformation

The Big Data Processing transformation phase defines changing or modifying data into required formats, which aids in the creation of various insights and visualisations. Aggregation, Normalization, Feature Selection, Binning and Clustering, and concept hierarchy generation are just a few of the transformation techniques available. Developers use these Big Data Processing techniques to convert Unstructured Data into Structured Data and Structured Data into a user-friendly format. As a result of the transformation, business and analytical operations become more efficient, and firms can make better data-driven decisions.

3rd Stage: Data Loading

During the load stage of Big Data Processing, the converted data is transported to the centralised database system. Index the database and remove constraints before loading the data to make the process more efficient. Loading became automated, well-defined, consistent, and batch-driven or real-time using Big Data ETL.

4th Stage: Data Visualisation

Data Analytics tools and Big Data Processing methods enable businesses to visualise massive datasets and create dashboards to gain a comprehensive view of their entire business operations. Analytics in Business Intelligence (BI) provide answers to fundamental business growth and strategy questions. On the transformed data, BI tools make predictions and what-if analyses that assist stakeholders in understanding the depth patterns in data and the correlations between the attributes.

5th Stage: Machine Learning Application

The Machine Learning phase of Big Data Processing focuses on the development of models that can learn to evolve in response to new input. The learning algorithms allow for faster analysis of large amounts of data.

Supervised Learning is the first type of Machine Learning, and it uses labelled data to train models and predict outcomes. Supervised learning employs data patterns to identify new information output for labels. This method is frequently employed in applications that use historical data to forecast future outcomes.

The second type is **Unsupervised Learning**, in which the data is unlabeled and trained by the algorithm. Unsupervised Machine Learning is applied to data that does not have any historical labels.

Reinforcement, the final type is learning, in which no primary data can be used as input to models. The algorithms must make decisions on their own based on observations or

situations that occur around them. The models attempt to make correct decisions by manipulating the decisions with a reward function.

The Machine Learning phase of Big Data Processing enables automatic pattern recognition and feature extraction in complex unstructured data without human intervention, making it a valuable resource for Big Data research.

2.8 Glossary

Dispersion	Formulas
Range	$X_{MAXIMUM} - X_{MINIMUM}$
Coefficient of Range	$\frac{MAX - MIN}{MAX + MIN}$
Quartile Deviation	$\frac{Q_3 - Q_1}{2}$
Coefficient of Q.D.	$\frac{Q_3 - Q_1}{Q_3 + Q_1}$
Mean Deviation (Individual Series)	$\frac{\sum\lvert d\bar{x}\rvert}{N}$ or $\frac{\sum\lvert d\bar{m}\rvert}{N}$

Mean Deviation (Discrete Series)	$\frac{\sum f\|d\bar{x}\|}{N}$
Mean Deviation (Continuous Series)	$\frac{\sum f\|d\bar{x}\|}{N}$
Coefficient of Mean Deviation	$\frac{M.D.}{\bar{X}}$ Or $\frac{M.D.}{\bar{m}}$
Standard Deviation (Individual Series)	$\sqrt{\frac{\sum d^2}{N}}$
Coefficient of Standard Deviation	$\frac{S.D.}{Mean}$ or $\frac{\sigma.}{\bar{X}}$
Coefficient of Variance	$\frac{S.D.}{Mean}\times 100$ or $\frac{\sigma.}{\bar{X}}\times 100$
Karl Pearson's Measure	$J = \frac{Mean-Mode}{S.D.}$ OR $J = \frac{\bar{X}-Z}{\sigma}$
Bowley's Measure	$J = \frac{Q_3 + Q_1 - 2M}{Q_3 - Q_1}$
Kelly's Measure	$J = \frac{P_{90} + P_{10} - 2P_{50}}{P_{90} - P_{10}}$

2.9 SELF ASSESSMENT QUESTIONS

(I) Long Answer Questions:

1. Define dispersion and discuss its various measures.
2. What is Standard Deviation? Explain its superiority over other measures of dispersion.
3. Explain Quartile Deviation, Mean Deviation and Standard Deviation. Discuss the circumstances in which they may be used.

(II) Short Answer Questions:

1. Differentiate absolute and relative measures of dispersion.
2. Differentiate between mean deviation and standard deviation.

(III) If in a series the lowest value is 240 and the largest value is 350.Find out coefficient of range.

[0.184]

(IV) Find the coefficient of standard deviation for the data set: 32, 35, 37, 30, 33, 36, 35 and 37

(V) The mean and variance of seven observations are 8 and 16, respectively. If five of these are 2, 4, 10, 12 and 14, find the remaining two observations.

(VI) In a town, 25% of the persons earned more than Rs 45,000 whereas 75% earned more than 18,000. Compute the absolute and relative values of dispersion.

(VII) If $Q_1 = 41, Q_3 = 49$, find out the value of coefficient of Q.D.

[.089]

(VIII) Find the Variance and Standard Deviation of the Following Numbers: 1, 3, 5, 5, 6, 7, 9, 10.

[5.75]

(IX) Calculate the range and coefficient of range for the following data values.

45, 55, 63, 76, 67, 84, 75, 48, 62, 65

[0.302]

(X) Find Range and Coefficient of Range of the following

x	5	10	15	20	25	30
f	8	12	15	10	5	2

[R=25 Coefficient of Range= 0.714]

(XI) Find Range and Coefficient of Range of the following

class	1-10	11-20	21-30	31-40	41-50
f	3	7	20	15	6

[R=50, Coefficient of R= 0.98]

(XII) Find out Q.D. and its coefficient from the following observation

size	20	25	30	35	40	45	50
f	7	12	14	19	10	8	3

[$Q_1 = 25, Q_3 = 40, Q.D. = 7.5, Coefficient = 0.231$]

(XIII) Find out Q.D. and its coefficient from the following observation

class	f
4-8	6

8-12	10
12-16	18
16-20	30
20-24	15
24-28	12
28-32	10
32-36	6
36-40	2

$[\ Q_1 = 14.5\ , Q_3 = 24.92, Q.D. = 5.21, Coefficient = 0.264]$

(XIV) Calculate M.D. from mean and median from the following data

size	0-10	10-20	20-30	30-40	40-50	50-60
f	10	12	25	35	40	50

[M.D.(Mean)=41, M.D.(Median)=12.45]

(XV) Calculate M.D. from mean and median from the following data

Marks	No. of Students	Marks	No. of Students
10-20	2	10-60	63
10-30	8	10-70	83
10-40	20	10-80	93
10-50	38	80-90	7

[M= 54.8, M.D.=12.95, Coefficient=0.236]

(XVI) Calculate Mean and S.D. of the following

size	13	12	11	10	9	8	7
f	5	7	10	18	12	5	3

$[\bar{X} = 10.13,\ S.D. 1.53]$

(XVII) Calculate Mean, S.D. and coefficient of S.D. of the following

size	10-20	20-30	30-40	40-50	50-60	60-70	70-80
f	6	8	15	7	3	0	1

$[\bar{X} = 34.25,$ $S.D. 12.92, Coeff. 0.377]$

(XVIII) Draw a box plot for the given set of data {3, 7, 8, 5, 12, 14, 21, 15, 18, 14}.

(XVIV) Find the five-number summary for the given set of data {25, 28, 29, 29, 30, 34, 35, 35, 37, 38}.

2.10 Suggested Readings

1. Business Statistics by Amir D. Aczel and J. Sounder pandian. Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Business Statistics by S.P. Gupta and M.P. Gupta. Sultan Chand and Sons., New Delhi.
3. Statistical Method by S.P. Gupta. Sultan Chand and Sons., New Delhi.
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7. Statistics for Management by G.C. Beri. Tata McGraw Hills Publishing Company Ltd., New Delhi.
8. Statistics for Management by Richard I. Levin and David S. Rubin. Prentice Hall of India Pvt. Ltd., New Delhi.
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10. Stuart, A.; and Ord, J. K. Kendall's Advanced Theory of Statistics, Vol. 1: Distribution Theory, 6th ed. New York: Oxford University Press, 1998.

LESSON 3

CORRELATION ANALYSIS

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STRUCTURE

3.1 LEARNING OBJECTIVES

The objectives of this lesson is to study the relationship between two variables. The aim is to present different measures of relationship between two variables and understand the difference between them. The lesson also explains suitability of different measures under different conditions. The concepts have been explained through suitable numerical examples. The concepts will enable the students to understand and interpret the relationship between two variables through scatter diagram as well as through different coefficients.

3.2 INTRODUCTION

In the previous lessons you have learnt about different types of data. It was also explained how to summarize the data. These summarizations are of immense importance in data analysis. In this lesson we will concentrate on a bivariate data. Bivariate data is a data where there are two variables. For example, you collect a monthly income and expenditure data of different households in a city. The collected data will be of form (x_i, y_i), $i = 1,2,\ldots,n$, where x_i and y_i represents income and expenditure respectively of i-th household. Here, the data (x_i, y_i), $i = 1,2,\ldots,n$ may be referred to as a bivariate data. Sometimes we are interested in knowing how the two variables are related. In our case we might be interested in exploring if a higher value of income suggests a higher value of expenditure in general or vice versa. Or there does not exist any relationship between the variables! The present discussion will help us to understand the relation between two variables.

In this section we will present different techniques to measure the relationship between two variables. We will begin with presenting different types of correlation. Next, we will graphically examine the relationship between two variables using 'Scatter diagram'. The section will proceed further with giving numerical measurement of relationship between two variables. Three numerical measures: covariance, coefficient of correlation, and coefficient of determination will be discussed. At the end, statistical test concerning coefficient of correlation will be explained. The techniques presented in the section will be illustrated through suitable numerical example.

3.3 Correlation: Meaning and Types

Correlation means relation between two or more variables. Correlation analysis deals with studying the relationship between two or more variables. The foundation of correlation analysis was laid by Sir Francis Galton (Millar, 1996) in 1880s. It was further developed by Karl pearson (Stigler, 1986). He expressed coefficient of correlation in product moment form. During the initial years of introduction of the idea, correlation was used mainly in the areas related to biology. Now, there is hardly any field where correlation is not used and it finds application in social sciences, finance, marketing etc to name a few.

Correlation can be studied from many perspective. Some of the important types of correlation is as below:

- Positive and Negative correlation
- Linear and non-linear correlation
- Simple, multiple and partial correlation

Positive and negative correlation. In case of positive correlation, two variables change in the same direction in general. If one variable increases, then other variable also increases.

Similarly, if one variable decreases then other also decreases. In general, there is a positive correlation between work experience and salary, height and weight, salary and work satisfaction. When the two variables are negatively related, they change in opposite direction. Examples of negative correlation are: winter temperature and energy consumption, price of a product and demand etc.

Linear and non-linear correlation. Correlation is linear if variation in the values of the two variables is either proportional or constant. The points of scatter diagram in a linearly related data fall around a straight line. Variation in the values of two variables in a non-linear relationship is neither proportional nor constant. Some of the important types of non-linear relationship is curvilinear, logarithmic, and exponential.

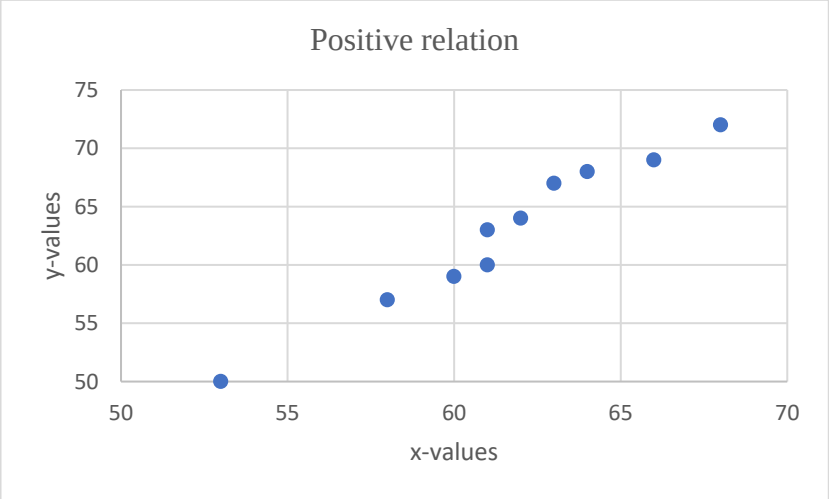
Simple, multiple and partial correlation. The correlation between two variables is referred to as simple correlation. In case of more than two variables, we can think of multiple and partial correlation. The correlation between one variable and combined influence of all other variables is called multiple correlation. Partial correlation is defined as The correlation between two variables eliminating the influence of all other variable is called partial correlation. Let us illustrate the case of multiple and partial correlation through example. Consider three variables as family expenditure (x_1), family income (x_2), and number of members in family (x_3). Then correlation between expenditure (x_1) and joint influence of income (x_2) and number of members (x_3) will be termed as multiple correlation. On the other hand, correlation between expenditure (x_1) and income (x_2) treating number of members (x_3) as constant is an example of partial correlation.

In the following sections, we will concentrate on simple linear correlation.

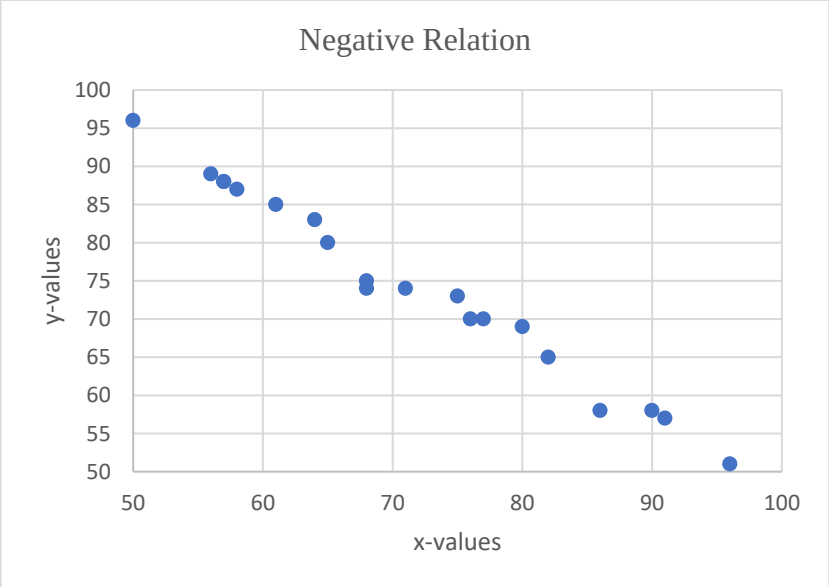
3.4 Graphical measure of relationship

Scatter diagram represents a bivariate data in xy-plane. It is a useful way of graphically representing the data through which pattern in the data, if any, can be visualized. In the present context, a scatter diagram can be used to understand the linear relationship between two variables. Generally, we label the dependent variable as y and independent variable as x. If there is no dependency of one variable on the other, the variables are labelled as x and y arbitrarily. Each of the data point (x_i, y_i), $i = 1,2,\ldots,n$ is plotted as a point in the xy-plane to give the scatter diagram of the bivariate data. The pattern of the points reveals about degree as well as direction of the relationship. If the points of the scatter diagram appear to fall around a straight line, a linear relationship can be understood. The variation of two variables in the same direction suggests a positive linear relationship, whereas the variation of the two variables in opposite direction suggests a negative linear relationship. A strong relation can be inferred if the points are lying very close to a line. Wide scattering of the points about a line indicates moderate to low degree of relationship.

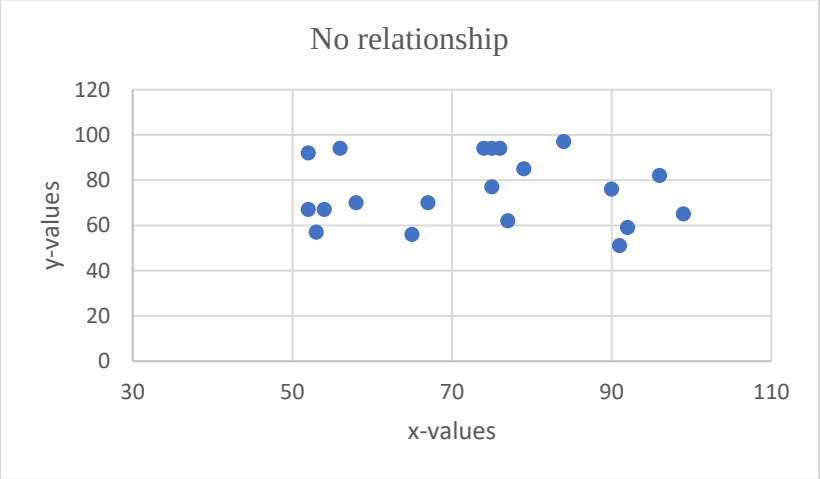
Positive relationship: In the following scatter plot, both the variables change in the same direction, in general. It should be noted here that we talk about the average relationship. Therefore, you can always find fewer points not following the general pattern of the data.



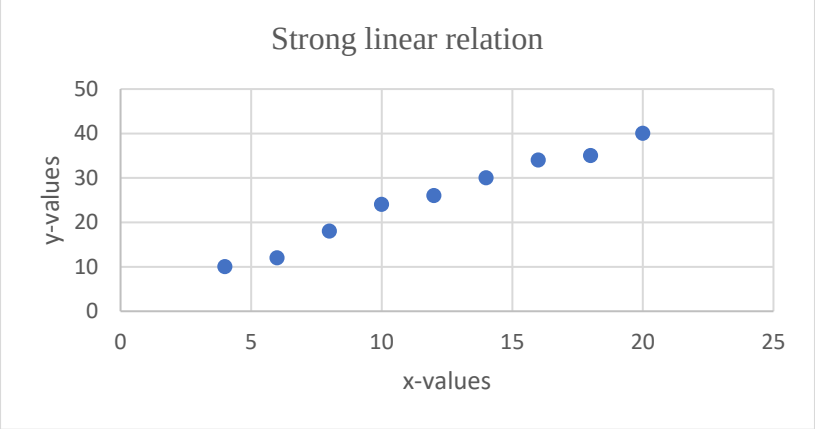
Negative relationship: In the following scatter plot, a negative linear relationship may be concluded as the variables change in the opposite direction.

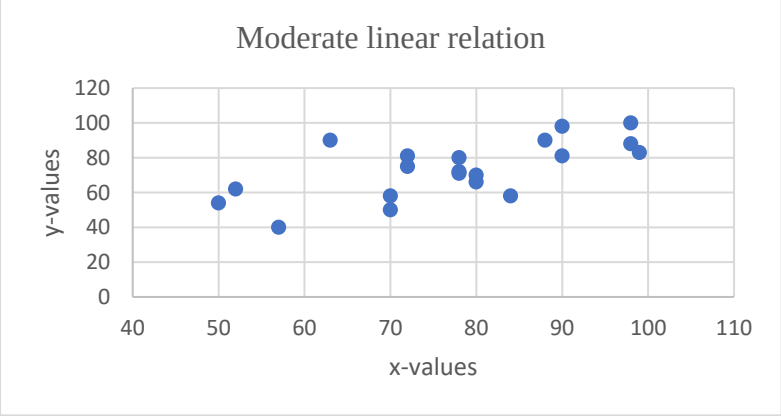


No linear relation: It may also happen that there exists neither positive nor negative linear relationship between the variables. The variables may be related to each other through a non-linear relationship or they may be unrelated also. Following scatter diagram depicts a case of no relationship. The dispersion of the points can be observed to follow a horizontal pattern in this case.



Strong and weak linear relationship: When there exists strong linear relationship between the variables, the scatter plot is closely dispersed. In case of moderate and low degree of relationship, the scatter plot is widely dispersed.





ACTIVITY

Collect on your own or download from website the following datasets:

(i) a data comprising of selling price and area of 20 homes in an area.
(ii) A data comprising of SGPA and Attendance (%) of 25 students of a class

Draw the scatter diagram and interpret the linear relationship between the variables

IN-TEXT QUESTIONS

1. Scatter diagram is used to plot a _____data.
2. Scatter diagram is useful for understanding degree as well as direction of linear relationship between two variables. True / False
3. If in general, by increasing value of one variable, the other variable is also increased, there exists

   a) Positive relationship b) Negative relationship

   c) No relationship d) Undefined relationship

4. If there exists a a perfect linear relationship between two variables, all the points in the scatter diagram will lie:

   a) in the xy-plane b) in a straight line

   c) very close to a straight line d) in a curve

5. If the slope of the line representing the scatter diagram is negative, then there is

   a) negative relation b) positive relation

   c) no relation d) non-linear relation

3.5 Numerical measures of linear relationship

Scatter diagram describes relationship between two variables graphically. Sometimes only visual understanding of linear relationship may not be enough and a numerical measure of relationship may be required. A numerical measurement brings objectivity in the statistical analysis. The three important numerical measures of linear relationship are: Covariance, Coefficient of correlation, and Coefficient of determination.

3.5.1 Covariance

Covariance is a measurement of strength of linear relationship between two variables. It gives information about how two variables change together. A positive value of covariance indicates that both the variables change in the same direction on an average. Similarly, if the variables change in opposite direction then the covariance is negative. Zero covariance means that the variables are linearly unrelated.

Populations covariance cov(x, y) is given by the following formula:

$$cov(x,y) = \frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})(y_i - \bar{y}),$$

where (x_i, y_i) denotes *i*-th observation, $i = 1,2,\ldots,N$ and N is the population size. The formula can also be written alternativey as below:

$$cov(x,y) = \frac{1}{N}\sum_{i=1}^{n} x_i y_i \; - \bar{x}\bar{y}$$

Sample covariance is given by:

$$cov(x,y) = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}),$$

where (x_i, y_i) denotes *i*-th observation, $i = 1,2,\ldots,n$ and *n* is the sample size.

Covariance is an important statistical measure. It finds application in many areas which includes Portfolio Theory and Principal Component Analysis among others. A higher value of covariance is related with strong linear relationship. However, covariance does not have any prescribed range of values. It depends on the data points. Therefore sometimes it is difficult to understand the degree of relationship by looking at the value of covariance. Unit of covariance is product of x and y unit. For example if the unit of x is kilogram (kg) and that of y is meter, then unit of covariance would be (kg)x(meter).

Example 3.1 Consider the following example to illustrate the computation of covariance:

x-value	5	7	12	8	13
y-value	4	6	10	12	8

$$\bar{x} = \frac{5+7+12+8+13}{5} = 9, \;\; \bar{y} = \frac{4+6+10+12+8}{5} = 8$$

$$cov(x,y) = \frac{(5-9)*(4-8)+(7-9)*(6-8)+(12-9)*(10-8)+(8-9)*(12-8)+(13-9)*(8-8)}{5}$$

$= \frac{16+4+6-4+0}{5} = 4.4$

Since cov(x,y) > 0, therefore there exists a positive linear relationship between the variables.

3.5.2 Coefficient of correlation

Coefficient of correlation is a very popular measure of linear relationship between two variables. It not only tells the direction, but also the degree or strength of the relationship. Moreover,

it is free from any unit. Here, we are going to talk about two types of coefficients; Karl Pearson's and Spearman's.

Karl Pearson's coefficient of correlation: It is also called product moment coefficient of correlation. Pearson's coefficient of correlation is used for continuous data. Greek symbol ρ (rho) or sometimes r is used to denote the Pearson's coefficient of corrlelation.

$$r = \frac{cov(x,y)}{\sigma_x.\sigma_y} = \frac{\sum_{i=1}^{N}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{N}(x_i-\bar{x})^2}\sqrt{\sum_{i=1}^{N}(y_i-\bar{y})^2}} = \frac{N\sum_{i=1}^{N}x_iy_i - \sum_{i=1}^{N}x_i \sum_{i=1}^{N}y_i}{\sqrt{N\sum_{i=1}^{N}x_i^2-(\sum_{i=1}^{N}x_i)^2}\sqrt{N\sum_{i=1}^{N}y_i^2-(\sum_{i=1}^{N}y_i)^2}}$$

The formula can be viewed as a normalized value of covariance as it is obtained by dividing covariance by product of two standard deviations. As a resut of this the value of coefficient of correlation always lies between -1 and +1. A value of +1 corresponds to perfect positive linear relationship. In this case all the data points of the scatter diagram falls on a straight line with slope of the line positive. Similarly, in case of perfect negative relationship, the value of coefficient of correlation is -1. In this case, all the points of the scatter diagram will lie on a line having a negative slope. If the value of coefficient is closer to -1 or +1, the relationship or association is strong. If the variables are linearly unrelated, the value of coefficient of correlation is zero. It should be noted here that, zero cefficient of correlation only tells no linear relationship. Therefore, some other relationship may be possible.

Example 3.2 Let us compute Karl pearson's coefficient of correlation for the bivariate data given in Example 3.1

$$\rho = \frac{cov(x,y)}{\sigma_x.\sigma_y}$$

The value of covariance between x and y is already computed as 4.4.

$$\sigma_x^2 = \frac{1}{5}\sum_{i=1}^{5}(x_i-\bar{x})^2 = \frac{1}{5}[(5-9)^2+(7-9)^2+(12-9)^2+(8-9)^2+(13-9)^2]$$

=9.2

$$\sigma_y^2 = \frac{1}{5}\sum_{i=1}^{5}(y_i-\bar{y})^2 = \frac{1}{5}[(4-8)^2+(6-8)^2+(10-8)^2+(12-8)^2+(8-8)^2]$$

= 8

Therefore, $\rho = \frac{4.4}{\sqrt{9.2*8}} = 0.512$

The value 0.512 indicates that there exists a moderate positive linear relationship between the variables x and y.

Example 3.3 In an experiment, following values related to a bivariate data were obtained:

$N = 20,\ \sum x = 125, \sum x^2 = 919, \sum y = 113, \sum y^2 = 773, \sum xy = 745$.

$$r = \frac{N\sum_{i=1}^{N} x_i y_i - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{\sqrt{N\sum_{i=1}^{N} x_i^2 - (\sum_{i=1}^{N} x_i)^2}\sqrt{N\sum_{i=1}^{N} y_i^2 - (\sum_{i=1}^{N} y_i)^2}} = \frac{20*745-125*113}{\sqrt{20*919-(125)\text{^}2}\sqrt{20*773-(113)\text{^}2}}$$

Simplifying the above, we obtain the value of 'r' as 0.284.

Assumptions of Karl Pearson's coefficient of correlations. The calculation of pearsonian coefficient of correlation is based on following assumptions:

i. The variables under consideration are interval or ratio type
ii. There exists a linear relationship between the variables
iii. The variables are normally distributed

Properties of Karl Pearson's coefficient of correlations. The main properties of Pearsonian coefficient of correlation is as below:

i. The value of coefficient of correlation lies between -1 and +1
ii. Coefficient of correlation is free from any unit
iii. Calculation of correlation coefficient is unaffected by change of origin and scale
iv. Coefficient of correlation is symmetric in nature

Correlation does not mean causality

Even if the value of coefficient of correlation is high, it may not be concluded that there is a cause and effect relationship between the variables. A high correlation only suggests pattern present in the data. The strong linear relationship may be due to another variable or reason. Therefore, further investigations should be done to understand if one variable is causing other to change.

Correlation is not causation! Often people make causal claims based on spurious or misleading correlation. In an article Michael Luca (HBR, 2021) has pointed out that business leaders and managers often confuse correlation with causation. For instance, in a study, a positive correlation was established between taking baths and cardiovascular disease. Based on the study, people may arrive at a conclusion that taking bath regularly reduces the risk of cardiovascular disease. But this is hard to conclude. It is likely that people who take bath regularly are less stressed and they have free time to relax. This could be the real reason why such people are at a lower risk of heart disease. Similarly, in 2013, marketing team of ebay believed that areas where more advertisements were shown, sales was high. An analysis was carried out by economists Tom Blake and others. Through experiment they found that ebay was targeting customers who were already likely to shop on ebay. Thus actually it was targeted customers' pre-existing purchase intentions responsible for both advertisement being shown and the purchase decisions.

Human capital is an important concept. It consists of health, education, knowledge, skills etc. of the people. Researchers have found a positive correlation between human capital and economic growth. S. Self and R. Grabowski (2004) found a significant positive correlation between various levels of education (Primary, Secondary and Tertiary) and growth in India. Education and growth are not only related but education has a causal impact on growth. Researchers perform causality tests to understand the causality.

Spearman's rank correlation. Karl Pearson's coefficient of correlation is useful for interval and ratio data. It is not appropriate for ordinal or ranked data. Charles Spearman (1863-1945) introduced the idea of correlation coefficient for ranked or ordinal data. However, the formula can be used for continuous data as well. Similar to Karl Pearson's coefficient, Spearman's rank correlation coefficient is also a measure of the degree and direction of association between two ranked data. But unlike Karl Pearson's correlation, Spearman's rank correlation does not require the assumption that there exists a linear relationship between

variables (J. Hauke et al. 2011). It is a pure number and it always lies between -1 and +1. When the rankings of two seies of the data is same, rank correlation coefficient will be 1. On the other extreme, when the ranking of two series is diametrically opposite the rank correlation coefficient will be -1. We will use the notation r_R to represent rank correlation coefficient. The formula for computing r_R is given by:

$$r_R = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

n is the number of observations and d_i , i=1,2,…,n represents difference in ranks of i-th observation.

Example 3.4 Two financial experts were asked to rank ten stocks for the benefit of investors. The rankings given by the experts are as below:

Stock	A	B	C	D	E	F	G	H	I	J
Expert I ranking	4	1	2	10	9	3	5	6	8	7
Expert II ranking	3	2	1	9	5	4	6	7	10	8

Here rankings of the stocks by experts are already given. Spearman's rank correlation coefficient can be computed as below:

Stock	Expert I ranking	Expert II ranking	d	d^2
A	4	3	1	1
B	1	2	-1	1
C	2	1	1	1
D	10	9	1	1
E	9	5	4	16
F	3	4	-1	1
G	5	6	-1	1
H	6	7	-1	1
I	8	10	-2	4
J	7	8	-1	1

n =10, and $\sum d_i^2 = 28$.

Therefore $r_R = 1 - \frac{6\sum d_i^2}{n(n^2-1)} = 1 - \frac{6*28}{10*(100-1)} = 0.8303$

The value of rank correlation coefficient suggests that the similarilty in ranking of the stocks by two experts is high.

It may happen that while assigning ranks to the data, the values in the series are equal. This may lead to the case of tied ranks. In such cases the modiefied rank correlation coefficient formula is used. The modified formula:

$$r_R = 1 - \frac{6[\sum d_i^2 + \frac{1}{12}(m_1^3 - m_1) + \frac{1}{12}(m_2^3 - m_2) + \cdots]}{n(n^2-1)}$$

Example 3.5 Calculate the rank correlation coefficient for the following data:

X	14	10	12	17	10	15	10	12	19	11
Y	21	16	32	25	30	16	20	22	35	23

In the given data set ranks are not given. First we require to rank the data. Smallest element in a series is given rank 1. One can alternatively choose to give rank 1 to greatest element in the series also. Next smallest element is given rank 2. The process should be repeated till all the element of a series are ranked. In case of tie, a tied rank is given to all such elemnts. For instance, in series 1, a value 10 is repeated thrice. If we put the data in increasing order these three 10s will occupy position first, second and third. Arithmetic mean of position 1,2, and 3 turns out to be 2. Therefore a common rank 2 is assigned to all the three 10s. Next smallest value 1 is assigned rank 4. Continuing this process all the values in both the series is assigned ranks as given in the following table:.

X	Y	r_1	r_2	$d=r_1-r_2$	d^2
14	21	7	4	3	9
10	16	2	1.5	0.5	0.25
12	32	5.5	9	-3.5	12.25
17	25	9	7	2	4
10	30	2	8	-6	36
15	16	8	1.5	6.5	42.25
10	20	2	3	-1	1
12	22	5.5	5	0.5	0.25
19	35	10	10	0	0
11	23	4	6	-2	4

Number of observation n = 10, $\sum d_i^2 = 109$. Three values in series 1 have got equal rank 2 and two values have got equal rank of 5.5. In series 2, two values have got equal rank 1.5. Therefore, $m_1 = 3$, $m_2 = 3$, and $m_3 = 3$.

$$r_R = 1 - \frac{6[\sum d_i^2 + \frac{1}{12}(m_1^3 - m_1) + \frac{1}{12}(m_2^3 - m_2) + \frac{1}{12}(m_3^3 - m_3)]}{n(n^2-1)} = 1 - \frac{6[109+2+0.5+0.5}{990} = 0.321.$$

Thus, there is positive correlation between two variables. The strength of correlation is low.

3.5.2 Coefficient of Determination

Coefficient of determination is obtained by squaring the value of coefficient of correlation. It's a pure number lying between 0 and 1. It tells about the strength of the relation only. Yet this concept is useful because quite often we are interested in knowing the strength of the relation rather than direction. Moreover, the value of coefficient of determination interprets the amount of variation in dependent variable explained by independent variable. Coefficient of determination is generally denoted by R^2 or r^2. Coefficient of determination is also useful for comparing the strength of relationship between different datasets. For instance, consider coefficient of correlation for one dataset is 0.4 and for another dataset is 0.8. Then it can be said that extent of correlation in second dataset is four times stronger than that in first dataset as the values of coefficient of determination for the two datasets is respectively 0.16 and 0.64.

Example 3.6 Let us consider the value of coefficient of correlation between income and level of education as 0.8. Here income can be regarded as a dependent variable and level of education as independent variable.

For this example coefficient of determination turns out to be 0.64. Therefore, 64 percent of the variation in income is due to level of education. It also means that remaining variation in income is explained by other factors.

Coefficient of determination can also be computed directly using the following formula:

$$R^2 = 1 - \frac{Explained\ variability\ in\ y}{Total\ variablility\ in\ y} = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}.$$

Here $\bar{y}$ is the mean of the dependent variable y, and $\hat{y}$ denotes estimated value of y for a given value of the independent variable.

ACTIVITY

(iii) Investigate the relation between consumer spending and GDP. Collect a relevant data of consumer spending and GDP in Indian context and compute the coefficient of correlation

(iv) In order to study the correlation between stock prices of two software companies, collect their weekly stock price data (30 weeks). Determine coefficient of correlation and coefficient of determination.

(v) Collect a data of 40 students of your class. The data should comprise of two variables, 'time spent on social media' and 'marks scored in statistics class test'. Compute the coefficient of correlation. Do you think there exists a cause and effect relationship.

IN-TEXT QUESTIONS

6. Covariance is an absolute measure. True / False
7. Covariance is free from any unit. True / False
8. Covariance measures degree as well as direction of the relationship. True / False
9. Karl Pearson's coefficient of correlation is a relative measure. True / False
10. Karl Pearson's coefficient of correlation is a pure number. True / False
11. The value of Karl Pearson's coefficient of correlation lies between_____.
12. Karl Pearson's coefficient of correlation:
    a) has same unit as that of covariance b) is dependent on origin
    c) is dependent on scale d) is independent of origin and scale
13. Which of the following does not measure linear relationship between two variables:
    a) variance b) scatter diagram
    c) covariance d) coefficient of correlation
14. Which of the following is not true about Spearman's rank correlation coefficient:
    a) it's a pure number b) it is suitable for ordinal data
    c) it lies between -1 and +1 d) it's an absolute measure

3.6 Hypothesis test for Correlation Coefficient

The computation of correlation coefficient is based on a sample data. Occurrence of sampling error may not be ruled out during analysis. Thus, presence of correlation between variables may be due to chance also. For example, in above paragraph we talked about correlation between income and level of education as 0.8. This indicates a strong correlation between the variables. However, we are not sure if this value is valid for the entire population.

To deal with this situation, test of hypothesis concerning population correlation coefficient (ρ) is done. It is tested if the population correlation coefficient (ρ) is zero. Null and alternate hypothesis is constructed as below:

Null Hypotheis (H_0) : $\rho = 0$

Alternate Hypothesis (H_1) : $\rho \neq 0$

Test statistic consists of t-test and is given by:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$ with n-2 degrees of freedom.

Here n is number of observation and r is the correlation coefficient computed from sample.

Example 3.7 Consider in above example of income and level of education, n=20, r = 0.8 and level of significance α = 0.05.

$$t = \frac{0.8*\sqrt{20-2}}{\sqrt{1-0.8^2}} = 5.66$$

Critical value: $t_{18,\ 0.05}$ = 2.1. Since computed value of t-statistic is greater than 2.1, therefore reject the null hypothesis that population correlation coefficient is zero. It may be concluded that there is statistical evidence the variables income and level of education are correlated.

Probable error of correlation coefficient. Probable error (PE) of correlation coefficient can also be used to validate the value of correlation coefficient. Probable error of the correlation coefficient is given by expression 0.6745*SE(r). Here SE(r) is the standard error of r, and is given by:

$$SE(r) = \frac{(1-r^2)}{\sqrt{n}}. \qquad \text{Thus } PE = \frac{0.6745(1-r^2)}{\sqrt{n}}.$$

It can be observed here that greater the value of 'n' (sample size), smaller is the value of probable error. The observed correlation coefficient is considered significant if it is six times greater than the value of probable error. If the value of r is less than probable error then r is not considered significant.

In Example 3.7, $PE = \frac{0.6745(1-0.8^2)}{\sqrt{20}}$ = 0.054

6*PE = 6*0.054 = 0.324

Since the value of of r is greater than 0.324, therefore correlation coefficient can be regarded as significant.

IN-TEXT QUESTIONS

15. F-test is used for testing the significance of correlation coefficient. True / False.
16. In an analysis of correlation, sample size n is 16. While testing the significance of correlation coefficient, degrres of freedom in t-test will be ____.
17. Correlation coefficient is considered significant if it is six times greater than __.

3.7 SUMMARY

In this chapter an attempt was made to understand the association between two variables. We learned how to measure the correlation between two variables. Correlation was measured graphically as well as numerically. First scatter diagram was used to present the idea. Then three numerical measures; covariance, coefficient of correlation, and coefficient of determination were utilized to study the correlation between two variables. Testsing of hypothesis concerning population correlation coefficient was also discussed. At the end another useful idea of probable errors for checking the significance of correlation coefficient was explained. Numerical examples were presented to illustrate the idea.

3.9 GLOSSARY

Correlation analysis: It deals with relation between two or more variables

Scatter diagram: A diagram obtained after plotting all the data points in an xy-plane.

Simple correlation: Correlation between two variables.

Standard error: Standard error is nothing but standard deviation of a statistic. It gives an idea about how much a statistic would vary if different samples are taken.

3.10 ANSWERS TO IN-TEXT QUESTIONS

1. bi-variate	9. True
2. True	10. True
3. a) positive relationship	11. -1 and +1
4. b) in a straight line	12. d) is independent of origin and scale
5. a) negative relation	13. a) variance
6. True	14. d) it's an absolute measure
7. False	15. False
8. False	16. 14

	17. probable error (PE)

3.11 SELF-ASSESSMENT QUESTIONS

14. On a certain performance test, ten employees in an organization were given following scores by two HR managers:

Manager 1	10	14	13	15	20	16	10	17	19	16
Manager 2	16	14	15	16	18	22	15	20	23	21

Calculate Spearman's rank correlation coefficient for the data.

15. A data of an organization reveals that the ratio between 'dividends paid' and 'net income' has always been 1:3. Calculate the correlation coefficient between 'dividends paid' and 'net income' of the company.
16. In an experiment, following values related to a bivariate data were obtained:
$N = 10,\ \sum x = 150, \sum x^2 = 2352, \sum y = 180, \sum y^2 = 3336, \sum xy = 2766$.
Based on the given information, compute the following:
(i) Variances of x and y series
(ii) Covariance(x,y)
(iii) Karl Pearson's coefficient of correlation
17. A data of ten alumni of a B-school was collected to understand how much income they are earning after working for certain number of years

Number of years	12	6	5	10	8	9	15	6	10	9
Income (in lacs)	30	20	18	25	20	18	30	10	15	14

Calculate the Karl Pearson's coefficient of correlation. What percentage of variation in income is explained by number of years (working). Test the significance of correlation coefficient.

3.12 REFERENCES

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3.13 SUGGESTED READINGS

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LESSON 5

PROBABILITY THEORY

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STRUCTURE

5.1 LEARNING OBJECTIVES

After going through this unit, you should be able to:

- Understand the difference between deterministic and random experiments.
- Define sample space, events and use of different algebraic operations for events.
- Define probability using classical, empirical and axiomatic approach.

- Understand the concept of conditional probability and able to solve problem based on it.
- Prove and apply Baye's theorem
- Define random variable, discrete random variable and continuous random variable and understand the difference between them.

5.2 INTRODUCTION

The use of statistical methodology is indispensable in modern era. It has a wide application in every discipline, be it physical sciences, engineering and technology, economics or social sciences. For their advance research they are applying statistical tools. It is essential for the students to get acquainted with the subject of probability and statistics at an early stage. The first attempt to give quantitative measure of probability was made by, an Italian mathematician Galileo (1564-1642). This course is design to provide you with a basic, intuitive and practical introduction into Probability Theory. In this unit topic covered are Probability: meaning and need, different definition of probability, theorem of addition and multiplication, conditional probability, Baye's theorem, random variable, discrete and continuous random variable.

5.3 PROBABILITY: MEANING AND NEED

The probability can be defined as the "Mathematics of Chance". The word probability or chance we often experienced in our daily life. We usually say that it is very probable that it will rain today or it is expected that today is a sunny day. It is obvious that these expectations are comes from our personal view. For the clearer view of probability we explore the few definitions.

***Deterministic and Random Experiments*:**

Every experiment consists of three major steps:

- Input: It relates to the equipments, material, input data etc which involves in any experiment.
- Action: Any experiment is performed using the input.
- Output: The results or outcome of the action, called the output of the experiment.

Definition: A **deterministic experiments** are those experiments in which fixed input and action yields fixed output. We can predict the output of the experiment. For example; distance covered by a car travelling at a constant speed, ohm's law, determining gravitational constant at a place, *etc*.

In all the above mentioned examples for a fixed input and action, we get a fixed output.

Definition: A **random or non-deterministic experiments** are those experiments in which fixed input and action does not yields the fixed output. For example; tossing a coin or throwing a dice, *etc*. In these examples we does not predict the exact outcome beforehand.

In probability theory we are mainly concerned with the random experiments.

***Sample Space*:**

It is the set of all possible outcomes of a random experiment. Usually it is denoted by the Ω and a point belonging to Ω by $\omega \in \Omega$. Some examples of sample space are:

- In tossing a coin the sample space is $\Omega = \{H, T\}$
- In throwing a dice the sample space is $\Omega = \{1, 2, 3, 4, 5, 6\}$
- In a coin tossing experiment if we toss a coin three tiems then the sample space is $\Omega = \{HHH, HHT, HTH, THH, HTT, THT, TTH, TTT\}$.
- In observing the queue size at a college fee counter, the sample space is given by $\Omega = \{0,1,2,3, \dots, \dots\}$.
- The sample space for the time taken (in minutes) to download a website is observed as $\Omega = \{t: 0 < t < \infty\}$.

***Events*:** It is the set of possible outcomes of a random experiment or An event A is a set of specific outcomes we are interested in. It is obvious that an event is a subset of sample space Ω. If we denote an event associated with a random experiment by A and Ω is the corresponding sample space then $A \subseteq \Omega$. For example:

- Toss a coin and we define event A that outcome is "H" then
  $A = \{H\}$
- Throw a dice. Let A be the event that outcome is an odd number
  A={1,3,5}
- Toss a coin until we obtain an "H". A be the event that number of tosses is more than 3
  A={TTTH, TTTTH…}
- No customer in the queue at the college fee counter
  A={0}

Firstly, we have to define about random experiment and sample space then only we can talk about event. Otherwise it make no sense. In throwing a dice (random experiment), $\Omega = \{1, 2, 3, 4, 5, 6\}$ (sample space), and define A be the event that outcome is an odd number then, A={1,3,5}, and if outcome is 3, then A occurs whereas if outcome is 4 then A does not occur.

An event is said to be a **sure event** if it is occur in a single trial. In other word sample space Ω is sure to occur. Further, the **null or impossible event** is denoted by ϕ.

***Algebra of Events*:**

Since an event is a subset of the sample space, it is also a set and we can perform different algebraic operations like union, intersection, complement *etc.* on events.

Let A and B be two events on the sample space Ω. Then we have different algebraic operations are as follows:

- **Union:** $A \cup B$ is an event which occurs when either A or B (or both) occur.
- **Intersection:** $A \cap B$ is an event which occurs when both A and B occur.
- **Complement:** An event which occurs whenever A does not occur is called the complement of event A and is denoted by A^c *or* $\bar{A}$.
- **Difference**: $A \sim B = A \cap B^c$ be an event which occurs when A occurs and B does not occur. It is obvious that $A^c = \Omega \sim A$.

***Exhaustive events*:** The total number of possible outcomes in an random experiment is called exhaustive events. In tossing a coin experiment, there are two exhaustive cases, *viz.*, head and tail and In throwing a dice experiment, there are six exhaustive cases, *viz.*, 1, 2, 3, 4, 5, 6.

***Mutually exclusive events*:** Two events A and B are said to be mutually exclusive if $A \cap B = \phi$ *i.e.*if the occurrence of one does not precludes the occurrence of other. In throwing a dice experiment "2 occurs" and "5 occurs" are mutually exclusive events.

***Equally likely events*:** Two events A and B are said to be equally likely if P(A)=P(B). In a pack of well-shuffled 52 cards, all the cards are equally likely to appear at the time of experiment of dwaing a card at random.

5.3.1 The Classical Definition of probability

Let us assume that, N is the total number of elementary events in the sample space and is finite. We also assume that all the elementary events are equally likely to occur. Under these assumption the classical (or mathematical or a priori) definition of probability is:

***Definition*:** If a random experiment can result in N mutually exclusive, exhaustive and equally likely outcomes, out of which n are favourable to occurrence of an event A, then the probability 'p' of occurrence of A is given by:

$$p = P(A) = \frac{n}{N} = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases}.$$

Example 1: An unbiased (all faces of the dice are equally likely) dice is thrown. Let A be the event that we obtain an odd number. Then

$$\Omega = \{1, 2, 3, 4, 5, 6\}; A = \{1,3,5\}$$

so that, $P(A) = \frac{3}{6} = \frac{1}{2}$.

Example 2: Two unbiased coins are tossed. Let us define an event A that getting at least one head. Then

$$\Omega = \{HH, HT, TH, TT\}; A = \{HH, HT, TH\}$$

so that, $P(A) = \frac{3}{4}$.

Remark: The classical definition of probability, however suffers from some serious darwbacks.

i. When outcomes of the random experiments are not equally likely then this definition fails.
ii. It is a circular definition means the term equally likely is defined in terms of probability and the term equally likely is used in defining probability.
iii. When the total number of elementary events in the sample space is infinite.

ACTIVITY

Take a coin and spin it 5000 times. Note down the value, *n*, the number of times spins made and *m*, the number of heads in the spins. Now find out the proportion between these two values and see their fluctuations and draw it on a graph.

5.3.2 Empirical or Statistical Definition of Probability

Relative Frequency Ratio: Let an event A occurs n times in m repititions of a random experiment. Relative frequency ratio of event A is defined as

$$f_A = \frac{n}{m}.$$

Obviously,

i. $0 \leq f_A \leq 1$
ii. $f_A = 1$, iff, A occurs every time in m repetitions of the experiments;
iii. $f_A = 0$, iff, A never occurs in m repetitions;
iv. For two mutually exclusive events A and B

$$f_{A \cup B} = f_A + f_B.$$

As $m \to \infty$, f_A converges to P(A) in certain probabilistic sense. This property gives the empirical or statistical definition of probability.

The only assumption for this definition is that the experiments must be conducted under identical conditions and the number of trials must be large.

Remark: The disadvantage of this definition is that if an experiment is repeated a large number of times, the experimental conditions may not remain identical and homogeneous.

5.3.3 Axiomatic Definition of Probability

Axiomatic definition of probability was formulated by Russian Mathematician A.N. Kolmogorov. There are three simple axioms on which the whole field of probability theory for finite sample space is based, is given below:

***Definition*:** Probability Function, P(A) is the probability function defined on a $\sigma - field$ B of events if the following axioms hold.

1. *Axiom of non-negativity*: $0 \leq P(A) \leq 1$.
2. *Axiom of certainty*: $P(\Omega) = 1$.
3. *Axiom of additivity*: For pair wise mutually exclusive events $A_1, A_2, \ldots, \ldots$ $(A_i \cap A_j = \emptyset) \forall i \neq j, P(\cup_i A_i = \sum_i P(A_i))$.

Remark:

i. $\sigma - field$: A $\sigma - field$ B is a non-empty class of sets that is closed under the formation of 'countable unions' and complementations, *i.e.*,
(i) $A_i \in B, i = 1,2, \ldots \Rightarrow \cup_{i=1}^{\infty} A_i \in B$. (ii) $A \in B \Rightarrow \bar{A} \in B$

ii. The above axiomatic definition of probability has an obvious advantage, that is, it does not concerned with assigning numerical values to the probabilities of events.

5.3.4 Some Important Results on Probability

Some important results as below:

(i) $P(A^c) = 1 - P(A)$

Proof: We have

$$A \cap A^c = \emptyset$$

Thus A and A^c are mutually exclusive. Further

$$A \cup A^c = \Omega$$

Hence,

$$P(A \cup A^c) = P(\Omega)$$

$$P(A) + P(A^c) = 1, \quad \text{(by axiom 2 and 3)}$$

or, $P(A) = 1 - P(A^c)$

(ii) $P(A \cap B^c) + P(A \cap B) = P(A)$

Proof: We observe that

$$(A \cap B) \cap (A \cap B^c) = A \cap (B \cap B^c)$$

$$= A \cap \emptyset = \emptyset$$

So that $(A \cap B)$ *and* $(A \cap B^c)$ are mutually exclusive. Further

$$(A \cap B) \cup (A \cap B^c) = A \cap (B \cap B^c)$$

$$= A \cap \Omega = A$$

Hence

$$P[(A \cap B) \cup (A \cap B^c)] = P(A)$$

or, $P(A \cap B) + P(A \cap B^c) = P(A)$ (using axiom 3)

(iii) **Theorem of Addition**

***Statement*:** If A and B are any two events (subsets of sample space Ω) and are not disjoint, then

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

***Proof*:** We can write

$$A \cup B = A \cup (A^c \cap B)$$

Again $A \cap (A^c \cap B) = \emptyset$, so that A and $A^c \cap B$ are mutually exclusive.

Hence

$$P(A \cup B) = P(A \cup (A^c \cap B))$$

$$= P(A) + P(A^c \cap B) \qquad \text{[By Axiom 3]}$$

Further, using result (ii), we have

$$P(A^c \cap B) = P(B) - P(A \cap B)$$

Hence we obtain

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

Example 1. A fair coin is flipped successively at random until heads is observed on two successive flips. Write down the sample space Ω.

Solution. Let x denote the number of flips of the coin that are required, then

$\Omega = \{x: x = 2, 3, 4, \ldots\}$.

Example 2. If a pair of dice is thrown, what is the event of

(i) getting a sum less than 6
(ii) getting a sum greater than 6
(iii) getting a number multiple of 2 on the first die

(iv) getting a number multiple of 3 on the first die and a multiple of 2 on the second die
(v) getting a doublet
(vi) getting sum as 10

Solution. If a die is thrown twice or a pair of dice is thrown simultaneously, then sample space is

Ω = {(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}.

Hence, $n(\Omega) = 36$.

(i) Let A_1 be the event of getting a sum less than 6.
$\therefore A_1$= {(1, 1), (1, 2), (1, 3), (1, 4), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (4, 1)}.
(ii) Let A_2 be the event of getting a sum greater than 6.
$\therefore A_2$= {(1, 6), (2, 5), (2, 6), (3, 4), (3, 5), (3, 6), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}.
(iii) Let A_3 be the event of getting a number multiple of 2 on the first die.
$\therefore A_3$= {(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}.
(iv) Let A_4 be the event of getting a number multiple of 3 on the first die and a multiple of 2 on the second die.
$\therefore A_4$= {(3, 2), (3, 4), (3, 6), (6, 2), (6, 4), (6, 6)}.
(v) Let A_5 be the event of getting a doublet
$\therefore A_5$= {(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)}.
(vi) Let A_6 be the event of getting a sum as 10
$\therefore A_6$= {(4, 6), (5, 5), (6, 4)}.

Example 3. A letter of the English alphabet is chosen at random, write the event that the letter so chosen

(i) is a vowel
(ii) precedes S (in alphabetical order)
(iii) follows K and precedes T and is a vowel

Solution. A letter of the English alphabet is chosen then the sample space is Ω is

Ω = {A, B, C, …, X, Y, Z}, $n(\Omega) = 26$

(i) Let A_1 be the event that letter chosen at random be a vowel
$\therefore A_1$= {A, E, I, O, U}
(ii) Let A_2 be the event that letter chosen at random be precedes ‘s’
$\therefore A_2$= {A, B, C, D, …, P, Q, R}

(iii) Let A_3 be the event that letter chosen follows K and precedes T and is a vowel
$\therefore A_3 = \{O\}$

Example 4. A card is selected at random from a pack of 52 cards. Let A = 'the card is a club' and B = 'the card is a queen'. Find $P(A)$, $P(B)$.

Solution. $p=\frac{n}{N} = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases}$.

For event A, n = 13 (there are 13 club in a pack of card), and for event B, n = 4 (there are 4 queen in a pack of card). Therefore

$P(A) = \frac{13}{52}\ and\ P(B) = \frac{4}{52} = \frac{1}{13}$.

Example 5. An urn contains 6 white, 4 red and 9 green balls. If 1 ball is drawn at random, find the probability that:

(i) it is white
(ii) it is not green
(iii) it green or red

Solution. Total number of balls in the urn is 6 + 4 + 9 = 19 (total number of exhaustive cases). Since one ball is drawn at random then

(i) Let E_1 be the event that it is a white ball

$$P(E_1) = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases} = \frac{6}{19}$$

(ii) Let E_2 be the event that it is not a green ball

$$P(E_2) = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases} = \frac{10}{19}$$

(iii) Let E_3 be the event that it is a green or a red ball

$$P(E_3) = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases} = \frac{13}{19}$$

Example 6. What is the probability of getting 53 Sundays in a randomly selected leap year?

Solution. We know that there are 366 days (52 complete weeks and 2 days over) in a leap year. The following are the possible outcomes for these 2 over days:

(i) Sunday and Monday
(ii) Monday and Tuesday
(iii) Tuesday and Wednesday
(iv) Wednesday and Thursday
(v) Thursday and Friday
(vi) Friday and Saturday
(vii) Saturday and Sunday

Let A be the event of getting 53 Sundays. There will be 53 Sundays in a leap year, when one of the two over days must be Sunday. Since out of 7 possibilities, only 2, *viz.*, (i) and (vii) are favorable to the event.

Therefore, $P(A) = \frac{2}{7}$.

Example 7. Two coins are tossed. Let *A* be the event 'two heads are obtained', and, *B* be the event 'one head and one tail is obtained'. Find *P*(*A*), *P*(*B*).

Solution. The sample space Ω in this case is

$$\Omega = \{\text{HH}, \text{HT}, \text{TH}, \text{TT}\}$$

For event *A*, number of favorable case is 1 *i.e.*, {HH}.

$$P(A) = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases} = \frac{1}{4}$$

For event *B*, number of favorable case is 2 *i.e.*, {HT, TH}.

$$P(B) = \frac{total\ number\ of\ favourable\ cases}{total\ number\ of\ exhaustive\ cases} = \frac{2}{4} = \frac{1}{2}.$$

Example 8. If the letters of the word MANAGEMENT are arranged randomly then find the probability that all vowels come together.

Solution. Let A be the event that selected word contains all vowels together. There are 10 letters in 'MANAGEMENT' and in this word vowels are 4 *i.e.*, 2 A, 2 E. If we consider these vowels as a single letter then we have 7 letters i.e. AAEE, 2 M, 2 N, 1 G, 1 T.

Number of possible arrangements with 4 vowels coming together is = $\frac{7!}{2!.2!}$

Number of favorable cases for event A is = $\frac{7!}{2!.2!}$

Number of exhaustive cases = Total number of permutations of 10 letters in the word MANAGEMENT is = $\frac{10!}{4!.2!.2!}$ [out of 10 letters, 4 vowel, 2 M and 2 N]

$$P(A) = \frac{\frac{7!}{2!.2!}}{\frac{10!}{4!.2!.2!}} = \frac{1}{30}.$$

5.4 CONDITIONAL PROBABILITY

The probability of occurrence of any event may be influenced by the information about the occurrence of an event which already occured. Here we are going to introduce the concept of conditional probability. Let start with an example:

Example 1: Consider a bag containing 100 balls out of which 60 are red balls. Two balls are selected randomly (i) with replacement; (ii) without replacement. Let

A={first ball is red}

B={second ball is red}

In with replacement case P(A)=P(B)=60/100=3/5.

In without replacement case P(A)=3/5. If A has already occurred, probability of occurrence of B is 59/99. If A has not occurred, probability of occurrence of event B is 60/99. Hence the information about the occurrence of event A influence the probability of occurrence of event B.

***Definition*:** Let A and B are two events defined on the sample space Ω. Then conditional probability of B, given A (means A already occur) and is denoted by $P(A|B)$, is defined as

$$P(A|B) = \frac{P(A \cap B)}{P(A)}, provided\ P(A) \neq 0.$$

Further, let us suppose that in the sample space of a random experiment there are N exhaustive, mutually exclusive and equally likely outcomes. Out of which N_A outcomes are favourable to event A and N_B outcomes are favourable to event B and $N_{A \cap B}$ outcomes are favourable to $A \cap B$. Then

$$P(A|B) = \frac{N_{A \cap B}}{N_A} = \frac{N_{A \cap B}/N}{N_A/N} = \frac{P(A \cap B)}{P(A)}.$$

Remark:

i. For the conditional probability $P(A|B)$, A behaves like a new sample space.
ii. The unconditional probability of an event A, P(A) may be viewed as a conditional probability of event A given Ω.

5.4.1 Theorem of Multiplication

***Statement*:** From the definition of conditional probability, for two event A and B,

$$P(A \cap B) = P(A).P(B|A), P(A) > 0$$
$$= P(B).P(A|B), P(B) > 0$$

where, $P(B|A)$ represents conditional probability of happening of B when the event A has already occurred and $P(B|A)$ represents conditional probability of occurrence of B when the event A has already happened.

***Proof*:** In the usual notation we have

$$P(A) = \frac{N_A}{N};\ P(B) = \frac{N_B}{N}\ and\ P(A \cap B) = \frac{N_{A \cap B}}{N} \qquad (*)$$

For the event A|B, the sample space is B and out of N_B sample points, $N_{A \cap B}$ pertain to be happen of the event A. Hence

$$P(A|B) = \frac{N_{A \cap B}}{N_B}$$

Rewriting (*), we get: $P(A \cap B) = \frac{N_B}{N} \times \frac{N_{A \cap B}}{N_B} = P(B).P(A|B)$ (**)

Similarly, we get from (*) $P(A \cap B) = \frac{N_A}{N} \times \frac{N_{A \cap B}}{N_A} = P(A).P(B|A)$ (***)

From (**) and (***), we get the result.

5.4.2 Independent Events and Baye's Theorem

***Independent Events*:**

Let us consider the concept of conditional probability with an example. Suppose from a well shuffled pack of 52 card, a card is draw at random, then the probability of drawing a club is $13/52$. If the draw was done without replacement, then for the next draw, the probability of drawing the second card 'a card of club' is $12/51$ and it is the conditional probability. Now, if the first draw was done with replacement, then the conditional probability would have been $13/52$. This implies that if it is done with replacement, then the probability of second draw and subsequent draws was remains unaltered. So, the happening or non-happening of any draw does not affected by the preceding draws. This example helps you in better understanding of the concept of independent event.

Let us now define independent event:

***Definition*:** Two events are said to be independent whenever

$$P(A \cap B) = P(A).P(B).$$

If two events are independent then

$$P(B|A) = P(B) \text{ and } P(A|B) = P(A), \text{provided } P(A) > 0, P(B) > 0.$$

Law of Total Probability

***Statement*:** Let Ω be the sample space and $E_1, E_2, \dots, E_n$ are n exhaustive and mutually exclusive events with $P(E_i) \neq 0; i = 1,2, \dots, n$. Let A be any event which is a subset of $\bigcup E_i$ (means at least one of the events $E_1, E_2, \dots, E_n$) with $P(A) > 0$, then

$$P(A) = P(E_1)P(A|E_1) + P(E_2)P(A|E_2) + \cdots + P(E_n)P(A|E_n)$$
$$= \sum_{i=1}^{n} P(E_i)P(A|E_i)$$

***Proof*:** As a is a subset of $E_1 \cup E_2 \cup \dots \cup E_n$. Therefore,

$$A = A \cap (E_1 \cup E_2 \cup \dots \cup E_n) \qquad [\because \text{if } A \text{ is subset of } B, \text{then } A = A \cap B]$$

$$\Rightarrow A = (A \cap E_1) \cup (A \cap E_2) \cup \dots \cup (A \cap E_n) \quad \text{[Distributive property of set theory]}$$

$$= (E_1 \cap A) \cup (E_2 \cap A) \cup \dots \cup (E_n \cap A)$$

$$\Rightarrow P(A) = P[(E_1 \cap A) \cup (E_2 \cap A) \cup \dots \cup (E_n \cap A)]$$

$$= P(E_1 \cap A) + P(E_2 \cap A) + \cdots + P(E_n \cap A)$$

[$\because E_1, E_2, \dots, E_n$ *and hence* $(E_1 \cap A), (E_2 \cap A), \dots, (E_n \cap A)$ *are mutually exclusive*]

$$= P(E_1)P(A|E_1) + P(E_2)P(A|E_2) + \cdots + P(E_n)P(A|E_n)$$

[Using multiplicative theorem for dependent events]

$$= \sum_{i=1}^{n} P(E_i)P(A|E_i).$$

***Baye's Theorem*:**

- Bayes theorem was given by Thomas Bayes (1701-1761).
- Knowing the outcome of a particular situation, Bayes theorem enables us to find the probability that the outcome occurred as a result of a particular previous event.

For example, In a certain assembly plant, three machines, B1, B2, and B3, make 30%, 45%, and 25%, respectively, of the products. It is known from past experience that 2%, 3%, and 2% of the products made by each machine, respectively, are defective. Now, suppose that a finished product is randomly selected and found to be defective, what is the probability that it was made by machine B3?

- This theorem is also known as 'Inverse probability theorem', because here moving from first stage to second stage, we again find the probabilities (revised) of the events of first stage i.e. we move inversely.

***Statement*:**

Let Ω be the sample space and $E_1, E_2, \dots, E_n$ are n exhaustive and mutually exclusive events with $P(E_i) \neq 0; i = 1,2, \dots, n$. Let A be any event which is a subset of $\bigcup E_i$ (means at least one of the events $E_1, E_2, \dots, E_n$) with $P(A) > 0$, then

$$P(E_i|A) = \frac{P(E_i)\,P(A|E_i)}{P(A)}; i = 1,2, \dots, n$$

***Proof*:** From the theorem of total probability, we have

$$P(A) = P(E_1)P(A|E_1) + P(E_2)P(A|E_2) + \cdots + P(E_n)P(A|E_n)$$ [you have to prove it]

Also we have

$$P(A \cap E_i) = P(A)P(E_i|A)$$

$$\Rightarrow P(E_i|A) = \frac{P(A \cap E_i)}{P(A)} = \frac{P(E_i)\,P(A|E_i)}{\sum_{i=1}^{n} P(E_i)P(A|E_i)}.$$

Remarks:

$P(E_i)$'s are known as "a priori (or prior) probabilities". They exist before we gain any information about A (the result of a experiment).
$P(A|E_i)$'s are known as "likelihoods". They indicate how likely event A to occur under the information that $E_i$occurs.
$P(E_i|A)$'s are known as 'a posteriori (or posterior) probabilities". They are determined after the results of the experiment are known.

Example 9. A fair die is thrown, what is the probability of getting either a number multiple of 3 or a prime number.

Solution. A fair die is thrown then sample space is

$\Omega = \{1, 2, 3, 4, 5, 6\}$.

Let A be the event of getting a number multiple of 3 and B be the event of getting a prime number.

∴ A = {3, 6} and B = {2, 3, 5}, A∩B = {3} [a non empty set]

Hence required probability is

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$
$$= \frac{2}{6} + \frac{3}{6} - \frac{1}{6} = \frac{4}{6} = \frac{2}{3}.$$

Example 10. A box contains three red cards and three green cards numbered as follows:

Red			***Green***		
1	1	2	1	2	2

One card is picked out of the box at random. If *A* is the event 'the card is green' and *B* is the event 'the card is marked 2', are *A* and *B* independent?

Solution. $P(A) = \frac{3}{6} = \frac{1}{2}$ since 3 cards are green.

$P(B) = \frac{3}{6} = \frac{1}{2}$ since 3 cards are marked 2.

$P(A \cap B) = P(card\ is\ green\ and\ marked\ 2) = \frac{2}{6} = \frac{1}{3}$ since 2 cards satisfies this condition.

Now $\frac{1}{3} \neq \frac{1}{2}.\frac{1}{2}$, so A and B are not independent.

Example 11. Three cards are drawn at random one by one without replacement from a well shuffled pack of 52 playing cards. What is the probability that first card is ace, second is queen and the third is again a jack.

Solution. Let A_1 be the event of drawing ace in the first draw, A_2 be the event of drawing queen in the second draw and A_3 be the event of drawing jack in the third draw.

Therefore, required probability is

$$P(A_1 \cap A_2 \cap A_3) = P(A_1)P(A_2|A_1)P(A_3|A_1 \cap A_2)$$
$$= \frac{4}{52}\frac{4}{51}\frac{4}{50} = \frac{1}{13}\frac{4}{51}\frac{2}{25} = \frac{8}{33150}.$$

Example 12. Let A and B are independent events,

(i) If P(A) = 0.4 and P(A∪B) = 0.16 then find P(B).

(ii) If P(A) = 0.5 and P(B) = 0.4, then find P(A|B) and P(B|A).

(iii) If P(A) = 0.4 and P(B) = 0.2, then find $P(\bar{A} \cap B), P(A \cap \bar{B}), P(\bar{A} \cap \bar{B})$.

Solution. (i) Given that, P(A) = 0.4 and P(A∪B) = 0.16,

We know that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$= P(A) + P(B) - P(A).P(B)$$
$$0.16 = 0.4 + P(B) - 0.4.P(B)$$
$$0.16 = 0.4 + (1 - 0.4.)P(B)$$
$$0.12 = 0.6.P(B)$$
$$\Rightarrow P(B) = \frac{1}{2} = 0.5$$

(ii) Given that, P(A) = 0.5 and P(B) = 0.4

Since A and B are independent, then $P(A \cap B) = P(A).P(B) = 0.5 \times 0.4 = 0.20$

$$P(A|B) = \frac{P(A \cap B)}{P(A)} = \frac{0.20}{0.5} = \frac{2}{5} = 0.4$$

$$P(B|A) = \frac{P(A \cap B)}{P(B)} = \frac{0.20}{0.4} = \frac{2}{4} = 0.5$$

(iii) Given that, P(A) = 0.4 and P(B) = 0.2

We know that if two events A and B are independent then $\bar{A}$ *and* B, A *and* $\bar{B}$ and $\bar{A}$ *and* $\bar{B}$ are also independent.

$$P(\bar{A} \cap B) = P(\bar{A})P(B) = (1 - P(A))P(B) = 0.6 \times 0.2 = 0.12$$

$$P(A \cap \bar{B}) = P(A)P(\bar{B}) = P(A)\big(1 - P(B)\big) = 0.4 \times 0.8 = 0.32$$

$$P(\bar{A} \cap \bar{B}) = P(\bar{A})P(\bar{B}) = \big(1 - P(A)\big).\big(1 - P(B)\big) = 0.6 \times 0.8 = 0.48.$$

Example 13. A bag contains 4 white r and 5 black w balls. Another bag contains 2 white and 3 black balls. A ball is drawn from the first bag and is transferred to the second bag. A ball is then drawn from the second bag and is found to be white, what is the probability that white ball was transferred from first to second bag?

Solution. Let E_1 be the event that a white ball is drawn from the first bag and E_2 be the event that the drawn ball from the first bag is black. Let A be the event of drawing a white ball from the second bag after transferring the ball drawn from first bag into it.

Therefore, $P(E_1) = \frac{4}{9}, P(E_2) = \frac{5}{9}$

$P(A|E_1) = \frac{3}{6}, P(A|E_2) = \frac{2}{6}$

∴ by law of total probability,

$$P(A) = P(E_1).P(A|E_1) + P(E_2).P(A|E_2)$$

$$= \frac{4}{9} \times \frac{3}{6} + \frac{5}{9} \times \frac{2}{6} = \frac{11}{27}$$

Thus, By Bayes' theorem

$$P(E_1|A) = \frac{P(E_1).P(A|E_1)}{P(A)} = \frac{\frac{4}{9} \times \frac{3}{6}}{\frac{11}{27}} = \frac{6}{11}.$$

Example 14. In a bolt manufacturing company, three machines manufacture 20%, 30% and 50% of its total output and of these 6% and 3% and 2% are found defective respectively. A bolt is drawn at random and is found defective. Find the probability that the defective bolt is manufactured by machine 1.

Solution. Let A_1, A_2 *and* A_3 be the event that the defective bolts is manufactured by machine 1, 2 and 3 respectively. Therefore,

$$P(A_1) = \frac{20}{100} = \frac{1}{5}, P(A_2) = \frac{30}{100} = \frac{3}{10} \text{ and } P(A_3) = \frac{50}{100} = \frac{1}{2}.$$

Let A denotes the event that the bolt drawn at random is defective. Then, using conditional probability

$$P(A|A_1) = \frac{6}{100} = 0.06, P(A|A_2) = \frac{3}{100} = 0.03 \text{ and } P(A|A_3) = \frac{2}{100} = 0.02$$

∴ by law of total probability,

$$P(A) = P(A_1).P(A|A_1) + P(A_2).P(A|A_2) + P(A_3).P(A|A_3)$$

$$= \frac{1}{5} \times 0.06 + \frac{3}{10} \times 0.03 + \frac{1}{2} \times 0.02 = 0.031$$

By Bayes' theorem,

The probability that the defective bolt is from machine 1is,

$$P(A_1|A) = \frac{P(A_1)P(A|A_1)}{P(A)} = \frac{\frac{1}{5}\times 0.06}{0.031} = \frac{0.012}{0.031} = \frac{12}{31}$$

Example 15. The prior probabilities for events E_1 and E_2 are $P(E_1) = 0.60$ and $P(E_2) = 0.40$. It is also given that $P(E_1 \cap E_2) = 0, P(E|E_1) = 0.20\ and\ P(E|E_2) = 0.05$. Find the following:

(i) Are E_1 and E_2 are mutually exclusive?

(ii) Compute $P(E), P(E_1 \cap E)\ and\ P(E_2 \cap E)$.

(iii) Use Bayes' theorem to compute $P(E_1|E) and\ P(E_2|E)$.

Solution. (i) it is given that $P(E_1 \cap E_2) = 0$, the events E_1 and E_2 are mutually exclusive.

(ii) $P(E_1 \cap E) = P(E_1).P(E|E_1) = 0.60 \times 0.20 = 0.12$

$P(E_2 \cap E) = P(E_2).P(E|E_2) = 0.40 \times 0.05 = 0.02$

The event E can be define in the following mutually disjoint ways:

i.e., $E = (E \cap E_1) \cup (E \cap E_2)$

$\Rightarrow\ P(E) = P(E \cap E_1) + P\ (E \cap E_2) = 0.12 + 0.02 = 0.14$

(iii) using Bayes' theorem

$$P(E_1|E) = \frac{P(E\cap E_1)}{P(E)} = \frac{0.12}{0.14} = \frac{6}{7}$$

$$P(E_2|E) = \frac{P(E\cap E_2)}{P(E)} = \frac{0.02}{0.14} = \frac{1}{7}.$$

5.5 Random Variable: Discrete and Continuous

Often, the outcomes of random experiments are not real numbers. In such situations, we want to assign a real number to each point ω of the sample space Ω.

Example: Tossing a coin; Sample Space is Ω ={H, T}

We may assign number 1 to 'H' and number 0 to 'T'. In other words, we define a function X(.) such that X(H)=1 and X(T)=0.

Definition: Let X(ω), ω∈Ω be a real valued function defined up on the sample space Ω. Such that for each real number x, $\{\omega: X(\omega) \leq x\} \in \mathcal{B}$. Then X is called a random variable defined upon $\{\Omega,\mathcal{B}\}$. Domain of X is Ω and range is a subset of real line, say, Rx.

Example: Let Ω={a,b,c,d}. Define X(a)=1, X(b)=X(c)=X(d)=2. Then X is a r.v.

Induced Probability Measure:

For any interval I= (-∞,x], we define

$P_X(I)=P[\omega:X(\omega)\leq x]=P[X^{-1}(I)]$.

P_X is called the probability measure induced by the r.v. X.

Cumulative Distribution Function:

The function $F_X(x)=P_X[X\leq x]$ is called the cumulative distribution function (cdf) of the r.v. X.

Note: We will drop the subscript X in P_X and F_X.

Some Properties of Cumulative Distribution Function

- $0\leq F(x)\leq 1$.
- For a<b, $P(a<X\leq b)=F(b)-F(a)$.
- If a<b, then $F(a)\leq F(b)$, i.e. cdf F(x) is monotonic non-decreasing function of x.
- F(x) is right continuous.
- We have

$$\lim_{x\to\infty} F(x) = F(\infty) = 1;\ \lim_{x\to-\infty} F(x) = F(-\infty) = 0$$

Proof:

- Obvious as probability lies between 0 and 1.
- Write $(-\infty,b]=(-\infty,a]\cup(a,b]$. Since$(-\infty,a]$ and (a,b] are mutually exclusive

  $P\{X\in(-\infty,b]\}=P\{X\in(-\infty,a]\}+P\{X\in(a,b]\}$

  or $F(b)=F(a)+P[a<X\leq b]$.
- Follows from the proof of previous result.

Right Continuous

- For h>0,

  $F(x+h)-F(x)=P(x<X\leq x+h)$

So that

$$\lim_{h\to 0}[F(x+h)-F(x)]=0$$

Result: *F(x) is left continuous at point x iff P(X=x)=0.*

Discrete Random Variable: A r.v. X is called discrete if it takes finite or countably infinite number of values. Thus R_X has countable number of points.

Discrete Distribution Function and Probability Mass Function:

Let X be a discrete r.v. with $R_X=\{x_1,\ldots,x_i,\ldots\}$. With each possible outcome x_i we associate a number $p(x_i)=P(X=x_i)$; i=1, 2,…, satisfying the following conditions:

- $p(x_i)\geq 0$ for all i=1, 2,…
- $\Sigma p(x_i)=1$.
- The function p satisfying the above conditions is called the probability mass function (pmf) of the r.v. X.

The collection of pairs $(x_i,p(x_i))$; i=1,2,…, is called the probability distribution of X.

The cdf of X is given by

$$F(x)=\sum_{i:x_i\leq x} p(x_i)$$

$x_1,x_2,\ldots$ are called mass points and $p(x_i)$ is the probability mass associated with mass point x_i.

If $x_1<x_2<\ldots$, then

$$F(x)=\begin{cases} 0 \; if \; x<x_1 \\ p(x_1), if \; x_1\leq x<x_2 \\ p(x_1)+p(x_2), if \; x_2\leq x<x_3 \\ \vdots \end{cases}$$

Obviously F(x) is a step function with jumps at mass points $x_1,x_2,\ldots$ The magnitude of jump at mass point x_i is $p(x_i)$.

Domain of pmf p(x) is R_X and range is interval [0,1].

Continuous Random Variable and Probability Density Function:

X is said to be a continuous random variable if there exists a function f(x), called the *probability density function (pdf)* of X, such that

(a) $f(x)\geq 0$ for all x,

(b) $\int_{-\infty}^{\infty} f(x)dx=1$

(c) For $-\infty<a<b<\infty$, $P(a\leq X<b)=\int_a^b f(x)dx$

The cdf of X is given by $F(x)=\int_{-\infty}^{x} f(x)dx$

Conversely, $f(x)=\frac{d}{dx}F(x)$

For continuous random variable X, P(X=x)=0.

Example 16. Three fair coins are tossed simultaneously then find the probability distribution of the number of heads.

Solution. Suppose X be the number of heads in the toss of three fair coins. As the random variable, "the number of heads" in a toss of three coins may be 0 or 1 or 2 or 3 associated with the sample space

Ω ={HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}

Therefore, X can take the values 0, 1, 2, 3, with

$P[X = 0] = \frac{1}{8}$ (no heads)

$P[X = 1] = \frac{3}{8}$ (one head)

$P[X = 2] = \frac{3}{8}$ (two heads)

$P[X = 3] = \frac{1}{8}$ (three heads)

Probability distribution of X, i.e. the number of heads when three coins are tossed simultaneously is

X	0	1	2	3
p(x)	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$

Example 17. Check, which of the following are not probability distribution?

(i)

X	0	1	2
p(x)	¾	¾	¼

(ii)

X	0	1	2	3
p(x)	1/8	3/8	3/8	1/8

Solution.

(i) Here, $p(x_i)>1$, (i=1, 2, 3)

But $\sum_{i=1}^{3} p(x_i) = p(x_1) + p(x_2) + p(x_3) = p(0) + p(1) + p(2) = \frac{3}{4} + \frac{3}{4} + \frac{1}{4} = \frac{7}{4} > 1.$

So, the given distribution is not a probability distribution.

(ii) Here, $p(x_i)>1$, (i=1, 2, 3, 4)

And $\sum_{i=1}^{4} p(x_i) = p(x_1) + p(x_2) + p(x_3) + p(x_4) = p(0) + p(1) + p(2) + p(3)$

$= \frac{1}{8} + \frac{3}{8} + \frac{3}{8} + \frac{1}{8} = 1.$

So, the given distribution is probability distribution.

5.6 SUMMARY

- Those experiments in which we cannot predict the outcome, even we have the knowledge of all possible outcomes is called Random experiment.
- The set of all possible outcome of a random experiment is known as sample space and its subset is event.
- Different definitions of probability of occurrence of event are given.
- In classical definition of probability, the outcomes in the sample space must be exhaustive, equally likely and mutually exclusive and it's defined as the ratio of total number of favourable outcomes to the total number of outcomes.
- In axiomatic definition, it is defined as areal number lying between 0 and 1 provided all the three axioms are satisfied *i.e.*, (i) axiom of non-negativity, (ii) axiom of certainty, (iii) axiom of additivity.
- The conditional probability is defined as when occurrence of one event gets affected by certain condition and the numeric value of probability of occurrence of an event varies as per this condition.
- Baye's theorem revises the initial probabilities of occurrence of events.
- A real valued function defined over the sample space is called random variable.

5.7 SELF-ASSESSMENT QUESTIONS

1. If a die and a coin are tossed simultaneously, write the event of getting

(i) tail and an odd number
(ii) head and a multiple of 2
(iii) tail and prime number
(iv) head and a multiple of 3

2. What is the probability of drawing a club or diamond from a pack of 52 cards when one card is drawn at random?

3. Out of 52 well shuffled playing cards, two cards are drawn atrandom. Find the probability of getting.

(i) One red and one black

(ii) Both cards of the same suit
(iii) One jack and other king
(iv) One red and the other of club

4. A single letter selected at random from the word 'STATISTICS'. What is the probability that it is a vowel?

5. A Card is drawn from a well shuffled pack of 52 playing cards, find the probability that the drawn card is a jack or a black colour card.

6. If the probabilities are, respectively, 0.23,0.24 and 0.38 that a car stopped at a roadblock will have faulty brakes, badly worn tires, faulty brakes and/or badly worn tires, what is the probability that such a car will have both faulty brakes and badly worn tires.

7. A biology professor has two graduate assistants helping him with his research. The probability that the older of the two assistants will be absent on any given day is 0.08, the probability that the younger of the two will be absent on a given day is 0.05 and the probability that both of them will be absent on a given day is 0.02. Find the probabilities that

i) Either or both of the assistants will be absent on a given day;
ii) At least one of the assistants will not be absent on a given day;
iii) Only one of the assistants will be absent on a given day.

8. A box of fuses contains 20 fuses, of which 5 are defective. If three fuses are selected randomly and removed from the box randomly (without replacement), what are the probabilities that

i) All the three are defective?
ii) At most two are defective?
iii) At least two are defective?

5.8 REFERENCES

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LESSON 6

PENDING

LESSON 7

ESTIMATION

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STRUCTURE

7.1 LEARNING OBJECTIVES

1. To **understand** the concept of estimator and estimate.
2. To **state** the various properties of a good estimator.
3. To **explore** the types of estimates: point and interval estimates.
4. To **comprehend** the concept of confidence interval and confidence level.
5. To **understand** the concept of margin of error.

7.2 INTRODUCTION

Now, you have understood that the populations are generally too large to analyze in their entirety, so we require samples to draw inferences about them. By deriving samples from a population, you can estimate the population mean with the mean of a representative sample. Hence, estimation is done based on the observations taken from the samples and used to measure the true value of a specified set of populations.

This lesson provides an overview of estimation. It discusses the concept of estimator and estimate. The next part of the lesson briefly explains the four main properties of a good estimator i.e. unbiasedness, consistency, efficiency and sufficiency. The lesson also explores the two types of estimates i.e. point and interval estimates. A point estimate employs a statistic to estimate the parameter at a single point or value whereas an interval estimate depicts the range within which the population parameter might fall. Later on, this lesson also discusses the confidence interval and confidence level for both large and small samples. There are three confidence levels commonly used with confidence intervals i.e. 90%, 95% and 99%.

This lesson will help the learners to understand various properties related to a good estimator and will assist them in estimating the population from a sample whether the population is small or large.

7.3 ESTIMATOR

7.3.1 Concept of Estimator and Estimate

A sample statistic that is utilized for estimating a population parameter is referred to as an **estimator**. In other words, an estimator can be defined as a technique of estimation namely a statistical measure that has been employed. For estimating a population mean μ, the sample mean "$\bar{x}$" can be used whereas for estimating the population proportion, the sample proportion can be used.

Whenever we perceived any specific numerical value of our estimator, we called that value an **estimate**. In simple words, we can say that an estimate is a specific observable statistical value. For example (see table 1.1):

Table 1.1: Example of Population, Population Parameter, Sample Statistic and Estimate

Population (interested)	Employees in a cosmetic factory
Population Parameter (wish to estimate)	Mean turnover per year
Sample Statistic (estimator)	Mean turnover for 1 month
Estimate	6% turnover per year

In this example, an estimator is "*the mean turnover for 1 month*" whereas the estimated value is the specific numeric value i.e. "*6%*".

7.3.2 Properties of a Good Estimator

An estimator is said to be a good estimator which is close to the parameter that is being estimated. Therefore, to determine the quality of a good estimator, there are four properties namely unbiasedness, consistency, efficiency and sufficiency. Let us understand them one by one.

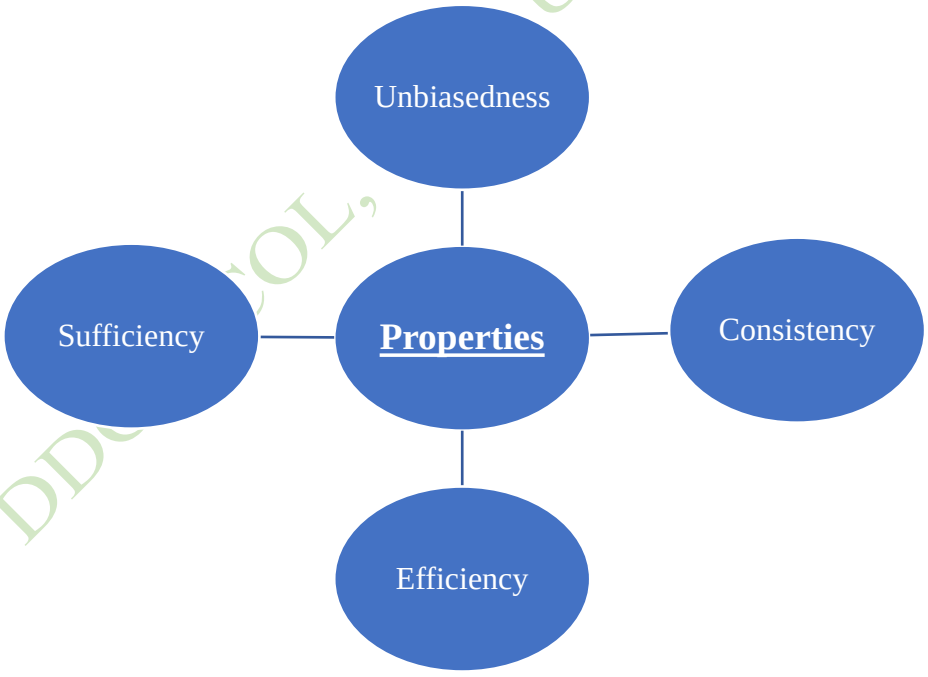


Fig 1.1: Properties of a Good Estimator

Unbiasedness: An estimator is called an unbiased estimator "*when the expected value of the estimator is the same as that of the population parameter that is being estimated"*. In other words, if "θ" is an unbiased estimate of θ, then the expected value of θ must be equal to θ i.e.

$E(\theta) = (\theta)$. For example, we can say that the sample mean is considered to be an unbiased estimator of a population mean. This is because the mean of the sampling distribution of a sample means taken from the same population is equal to the population mean itself. Many estimators are called "*asymptotically unbiased*," which means that when *n* becomes sufficiently large, their biases reduce to a nearly insignificant value (i.e. zero).

Consistency: The estimator is termed as a consistent estimator of a population parameter as "*when the sample size tends to increase, an estimator approaches the population parameter closer and closer*". In other words, when an estimator is found to be consistent, it becomes more reliable with a large sample size. For example, the sample mean is considered to be an unbiased estimator of a population mean regardless of the shape of the population distribution, whereas the sample median is considered to be an unbiased estimate of a population mean only when the population distribution is symmetrical. Hence, for estimating the population mean, the sample mean, in terms of both unbiasedness and consistency, outperforms the sample median.

Efficiency: The term "efficiency" relates to a "*sampling variability of an estimator*". It is known as the size of the standard error of the statistic. Whenever there is a comparison between two unbiased estimators, the one who is having the lower standard error or standard deviation of the sampling distribution (for the given sample size) is considered to be relatively more efficient than the one who is having the higher standard error or standard deviation of the sampling distribution (for the given sample size). Hence, we can conclude that the lower the estimator's standard error, the more concentrated the distribution of an estimator around the parameter that is being estimated, and therefore, the better this estimator is.

Sufficiency: An estimator is considered to be sufficient if the estimator is able to convey as much information as possible about the parameter in the sample. The significance of sufficiency twigs from the fact that if a sufficient estimator exists, it is completely irrelevant to analyze any other estimate. More precisely, a sufficient estimator gives a guarantee that all information a sample may offer in relation to the estimation of a parameter has been gathered.

For estimating parameters, various methods might result in estimators meeting the aforesaid properties namely unbiasedness, consistency, efficiency and sufficiency. The two most significant methods that are used to estimate population are the least square method and the maximum likelihood method.

- **Least Square Method:** The least square method is used to determine the several unknown parameters that exist in the linear regression model.
- **Maximum Likelihood Estimation**: The maximum likelihood method is employed for the estimation of a parameter and is also used for fitting a statistical model using statistical data.

IN-TEXT QUESTIONS

1. Which of the following is not the property of a good estimator?
   a) Sufficiency b) Biasedness
   c) Consistency d) Efficiency
2. A sample statistic that is employed to estimate a population parameter is called:
   a) Estimator b) Estimate
   c) Parameter d) Statistics
3. When the expected value of the estimator is the same as that of the population parameter that is being estimated, the estimator has which of the following property?
   a) Sufficiency b) Unbiasedness
   c) Consistency d) Efficiency
4. The _____ the estimator's standard error, the _____ concentrated the distribution of an estimator around the parameter being estimated.
   a) smaller, more b) smaller, less
   c) larger, less d) none of the above
5. Which of the following properties does sample mean has?
   a) Efficiency b) Unbiasedness

7.4 POINT ESTIMATES

7.4.1 Concept of Point Estimate

Now, we have understood that the sample mean **"** $\bar{x}$ **"** is considered to be the best estimator of the population mean *"*μ*"* as it entails all four properties of a good estimator namely unbiasedness, consistency, efficiency and sufficiency.

"*A method of determining an estimated value of a population parameter such as the mean of a population from random samples of the population*" is known as **point estimation**.

Any statistic can be termed as a point estimate. A statistic is considered to be an estimator of some parameter in a population. More precisely, you can say that a point estimator is a type of estimation in which a single value or a sample statistic is utilized to derive information about the population parameter as a single value or point.

Examples of point estimates are depicted in Table 1.2.

Table 1.2: Examples of Point Estimates

Particulars	Point Estimate

Population mean (μ)	Sample mean ($\bar{x}$)
Population standard deviation (σ)	Sample standard deviation (s)
Population variance (σ^2)	Sample variance (s^2)

7.4.2 Point Estimate for the Population Mean

To estimate the population mean associated with a population, the point estimate for the population mean is simply the sample mean.

To illustrate how the sample mean is calculated, consider a medical-supplies firm that manufactures disposable needles. Each syringe is individually wrapped in sterile packaging before being haphazardly packed into a huge corrugated carton. Because of the jumbled packaging, each carton has a different quantity of syringes. The company needs to bill the syringes on a per-unit basis to know how many syringes are packed in each carton.

We have taken a sample of 35 cartons at random and recorded the number of syringes in each carton.

Results of the Sample of 35 cartons of Syringes

101	103	112	102	98	97	93
105	100	97	107	93	94	97
97	100	110	106	110	103	99
93	98	106	100	112	105	100
114	97	110	102	98	112	99

For calculating the sample mean, first we have to sum all the individual values and then we have to divide this sum by the number of samples measured.

The formula for calculating the sample mean:

$$\textbf{\textit{Sample Mean:}}\ \bar{X} = \frac{\sum x}{n}$$

Using this formula, we get 3570/35= 102 syringes. Hence, by employing the sample mean as our estimator, the point estimate of the population mean is found to be **102** syringes per carton.

7.4.3 Point Estimate for the Population Variance and Standard Deviation

Now, after estimating the population mean, we are required to estimate the variance or standard deviation associated with a population. The point estimate of the population variance and standard deviation is nothing but the sample variance and sample standard deviation respectively.

The formula for estimating the sample variance is:

$$\text{Sample Variance: } s^2 = \frac{\sum(x_i - \bar{x})^2}{n-1}$$

The formula for estimating the sample standard deviation is:

$$\text{Sample Standard Deviation: } s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Now, taking the previous example, let us calculate the sample variance and sample standard deviation using the above formulas (Table 1.3)

Table 1.3: Calculation of Sample Variance and Sample Standard Deviation for Syringes per Carton

Values of x (Needles per Carton) (1)	x^2 (2)	Sample Mean $\bar{x}$ (3)	$(x - \bar{x})$ (4) = (1) – (3)	$(x - \bar{x})^2$ (5) = (4)^2
101	10,201	102	–1	1
105	11,025	102	3	9
97	9,409	102	–5	25
93	8,649	102	–9	81
114	12,996	102	12	144
103	10,609	102	1	1
100	10,000	102	–2	4
100	10,000	102	–2	4
98	9,604	102	–4	16
97	9,409	102	–5	25
112	12,544	102	10	100
97	9,409	102	–5	25

Table 1.3: Calculation of Sample Variance and Sample Standard Deviation for Syringes Per Carton (Cont.)

110	12,100	102	8	64
106	11,236	102	4	16
110	12,100	102	8	64
102	10,404	102	0	0
107	11,449	102	5	25
106	11,236	102	4	16
100	10,000	102	–2	4
102	10,404	102	0	0
98	9,604	102	–4	16
93	8,649	102	–9	81
110	12,100	102	8	64
112	12,544	102	10	100
98	9,604	102	–4	16
97	9,409	102	–5	25
94	8,836	102	–8	64
103	10,609	102	1	1
105	11,025	102	3	9
112	12,544	102	10	100
93	8,649	102	–9	81
97	9,409	102	–5	25
99	9,801	102	–3	9
100	10,000	102	–2	4
99	9,801	102	–3	9
3,570	**365,368**	Sum of all the squared differences	$\Sigma(x-\bar{x})^2$ →	**1,228**

$$s^2 = \frac{\Sigma x^2}{n-1} - \frac{n\bar{x}^2}{n-1}$$
$$= \frac{365,368}{34} - \frac{35(102)^2}{34}$$
$$= \frac{1,228}{34}$$
$$= 36.12$$

← or → Sum of the squared differences divided by 34, the number of items in the sample – 1 (sample variance)

$$\frac{\Sigma(x-\bar{x})^2}{n-1} \rightarrow 36.12$$

$$s = \sqrt{s^2}$$
$$= \sqrt{36.12}$$
$$= 6.01 \text{ syringes}$$

Sample standard deviation s

$$\sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}} \rightarrow 6.01 \text{ syringes}$$

Hence, the sample standard deviation is **6.01** syringes and the sample variance is **36.12**.

IN-TEXT QUESTIONS

6. $Z_{\alpha/2}$ is known as _____.
   a) Interval Estimate b) Point Estimate
   c) Confidence Level d) Confidence Coefficient
7. Population mean is denoted by which symbol?
   a) $\bar{x}$ b) $\sigma_{\bar{x}}$
   c) s^2 d) μ
8. If there are five samples say 110, 105, 125, 140, 120, what will be the sample mean?
   a) 110 b) 120
   c) 130 d) 140
9. Point estimate for a population variance is:
   a) Sample standard deviation b) Sample mean
   c) Sample variance d) Sample median
10. A type of estimation in which a single value or a sample statistic is used to infer information about the population parameter as a single value or point.
    a) Interval Estimate b) Point Estimate
    c) Confidence Level d) Margin of Error

7.5 INTERVAL ESTIMATES AND CONFIDENCE INTERVAL

7.5.1 Concept of Interval Estimate

A set of values between which a population parameter falls is referred to as an interval estimate.

For instance, the interval estimate for the population mean is $a < \bar{x} < b$. It means that the population mean will fall between "*a*" and "*b*" i.e. population mean will be greater than "*a*" and will be less than "*a*". In simple words, you can say the lower value is "*a*" and the upper value is "*b*".

For calculating the interval estimate, the confidence level is important. With the help of confidence interval, you can find out the lower as well as the upper value of the estimate.

The formula for the interval estimate is:

$$\mu = \bar{x} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

Where,

$\bar{x}$ is the sample mean

α is the confidence level

$Z_{\alpha/2}$ is the confidence coefficient

σ is the standard deviation

n is the sample size

The above formula will be used for deriving the interval within which a population parameter will fall. We will now be discussing the confidence interval and confidence level so as to derive the interval ranges.

7.5.2 Concept of Confidence Interval

A confidence interval is defined as a range in which the true population mean lies. There are three important parts of confidence interval namely confidence level, a margin of error and statistics. The confidence level is referred to as the uncertainty level in the process of sampling. Both the margin of error and statistics depicts the accuracy of the method and forms the interval estimate of a confidence interval.

For example, we might say that we have a 95% confidence level that the true population mean lies within a given range of values. This is termed a **confidence interval**. More precisely, we can say that for choosing different samples, if we are employing the same sampling procedure and determining numerous interval estimates, then, in such a case, we can say that 95% of the time the true population mean would fall within the range value as indicated by the sample statistic and margin of error.

The confidence interval, for say, a 95% confidence level can be shown as:

$\bar{x}$ - $1.96\sigma_{\bar{x}}$ = lower limit of the confidence interval

$\bar{x}$ + $1.96\sigma_{\bar{x}}$ = upper limit of the confidence interval

Therefore, the confidence limits are basically denoted as the lower and upper limits of the confidence interval.

Now, we have understood both the point estimates as well as confidence intervals. In comparison to point estimates, confidence intervals are considered to be preferable as they lay emphasis on both the precision and uncertainty of the estimate.

7.5.3 Concept of Confidence Level

A confidence level is referred to as "*the probability element of a confidence interval*". Confidence level echoes how confident we are that a specific sampling process will offer a confidence interval that will contain the true population parameter.

For instance, assume that we have gathered numerous samples and produced confidence intervals for each. While certain confidence intervals may represent the population parameter accurately and precisely whereas others may not. Let us take an example to understand this point. For example, when there is a 95% confidence level, it reflects that 95% of the intervals will have the true population parameter whereas when a confidence level is 99%, it means that 99% of the intervals will have the true population parameter.

7.5.4 Association between Confidence Interval and Confidence Level

There is a need to understand the association between the two important concepts i.e. confidence interval and confidence level. One may think that using a high confidence level say 99% in all the estimator problems will be better as a high confidence level might seem to reflect a high degree of precision in the estimate.

But in reality, a high confidence level will produce large confidence intervals. These large confidence intervals are not precise and accurate as they might provide you with fuzzy estimates which are not good.

Therefore, one should take judicious decisions while choosing the confidence level.

7.5.5 Confidence Intervals for the Population Mean for Large Samples

Large sample means when the sample size is more than and equal to 30. The level of confidence can be any number between 0 and 100% but the most common values employed in statistics are probably: 90% (α=0.10), 95% (α=0.05), and 99% (α=0.01).

For 95% confidence, see fig 1.2.

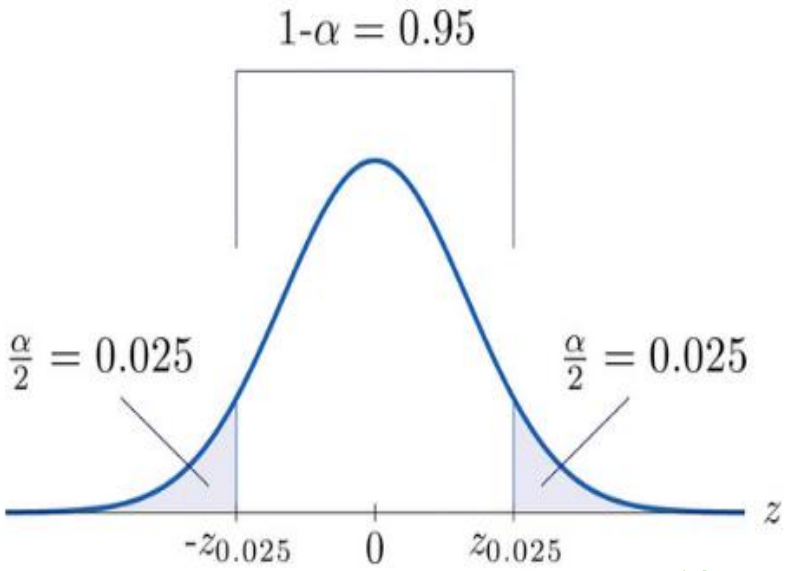


Fig 1.2: For 95% confidence, the area in each tail is α/2 = 0.025.

The formula for the confidence intervals for the population mean for large samples:

Large Sample $100(1-\alpha)\%$ Confidence Interval for a Population Mean

- If σ is known:

$$\bar{x} \pm z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

- If σ is unknown:

$$\bar{x} \pm z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

A sample is considered large when $n \geq 30$.

When the population standard deviation (σ) is unknown, in that case, we will make use of the sample standard deviation to estimate the population standard deviation. So, in this case, σ will be replaced by s. We can also symbolize this estimated value by $\hat{\sigma}$, which is known as a sigma hat.

Estimate of the Population Standard Deviation (When the population is Infinite)

Estimate of the population standard deviation $\longrightarrow \hat{\sigma} = s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$

Example 1.1: (Population standard deviation is known)

Calculate the confidence interval for the population mean when the sample size is 100, the sample mean is 35,500 and the population standard deviation is 7,200 (The confidence level given is 95%).

Solution: n = 100, $\bar{x}$ = 35,500, σ = 7,200, $Z_{\alpha/2}$ = 1.96

Using the below formula,

$$\mu = \bar{x} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

$$\mu = 35{,}500 \pm (1.96) \frac{7{,}200}{\sqrt{100}}$$

$$= \mathbf{34{,}088.80 \leq \mu \leq 36{,}911.20}$$

Example 1.2: **(Population standard deviation is known)**
Calculate the confidence interval for the population mean when the sample size is 50, the sample mean is 146.75 and the population standard deviation is 35.2 (The confidence level given is 95%).

Solution: n = 50, $\bar{x}$ = 146.75, σ = 35.2, $Z_{\alpha/2}$ = 1.96

Using the below formula,

$$\mu = \bar{x} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

$$\mu = 46.75 \pm (1.96) \frac{35.2}{\sqrt{50}}$$

$$= \mathbf{136.99 \leq \mu \leq 156.51}$$

Example 1.3: (Population standard deviation is not known)
Calculate the confidence interval for the population mean when the sample size is 50, the sample mean is 652.68 and the sample standard deviation is 217.43 (The confidence level given is 99%).

Solution: n = 50, $\bar{x}$ = 652.68, s = 217.43, $Z_{\alpha/2}$ = 2.58

Using the below formula,

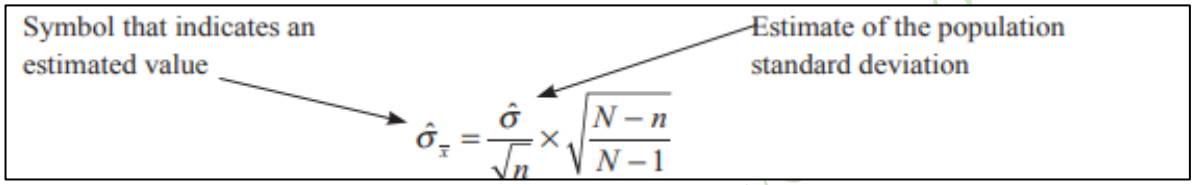
$$\mu = \bar{x} \pm Z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$$

$$\mu = 652.68 \pm (2.58) \frac{217.43}{\sqrt{50}}$$

$$= 573.35 \leq \mu \leq 732.01$$

Estimate of the Population Standard Deviation (When the population is Finite)

When the population is finite and a sample is more than 5% of the population, we will use the formula:



Example 1.4: Calculate the confidence interval for the population mean when the sample size is 60 from a population of 540, the sample mean is 6.2 and the sample standard deviation is 1.368 (The confidence level given is 99%).

Solution: n = 60, N= 540, n/N= 0.50, $\bar{x}$ = 652.68, s = 1.368, $Z_{\alpha/2}$ = 2.58

Using the below formula,

$$\hat{\sigma}_{\bar{x}} = \frac{\hat{\sigma}}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$$

We get the sample standard deviation as 0.167.

Now, we have to calculate the confidence interval,

$$\mu = 6.2 \pm (2.05)\ (0.167)$$

$$= 5.86 \leq \mu \leq 6.54$$

7.5.6 Concept of Margin of Error

The margin of error is defined as *"the range of values above and below the sample statistic"*.

For example, let us assume that the local newspaper wants to conduct an election poll. For this, he finds that the independent candidate will receive 35% of the vote. As per the

newspaper, the survey had a 5% margin of error and a 90% confidence level. On the basis of these observations, we can say that the confidence interval is:

"We are 95% confident that the independent candidate will receive between 25% and 45% of the vote".

The formula for the margin of error

a) **When the population standard deviation is known**

$$E = z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

b) **When the population standard deviation is unknown**

$$E = z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

Example 1.5: (Population standard deviation is known)
You are required to find out the margin of error (E) when the sample size is 62 and the population standard deviation is σ = 4000 and you are needed to establish a 95% confidence interval for μ.

Solution: 95% Confidence level means that α = 1− 0.95 = 0.05,

So, α/2=0.025, we obtain $Z_{0.025} = 1.960$.

Using the below formula,

$$E = z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

$$= (1.960)\ \frac{(4000)}{\sqrt{62}}$$

$$= \mathbf{996.19}$$

Hence, the margin of error in this question is 996 (approx.).

Example 1.6: (Population standard deviation is known)
You are required to find out the margin of error (E) when the sample size is 150 and the population standard deviation is σ = 6500 and you are needed to establish a 95% confidence interval for μ.

Solution: 95% Confidence level means that α = 1− 0.95 = 0.05,

So, α/2=0.025, we obtain $Z_{0.025} = 1.960$.

Using the below formula,

$$E = z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

$$= (1.960)\ \frac{(6500)}{\sqrt{150}}$$

$$= \mathbf{1040}$$

Hence, the margin of error in this question is 1040.

Example 1.7: (Population standard deviation is unknown)
You are required to find out the margin of error (E) when the sample size is 90 and the sample standard deviation is σ = 2000 and you are needed to establish a 95% confidence interval for μ.

Solution: 95% Confidence level means that α = 1− 0.95 = 0.05,

So, α/2=0.025, we obtain $Z_{0.025} = 1.960$.

Using the below formula,

$$E = z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

$$= (1.960)\ \frac{(2000)}{\sqrt{90}}$$

$$= \mathbf{130.666}$$

Hence, the margin of error in this question is 131 (approx.).

7.5.7 Confidence Intervals for the Population Mean from Small Samples

When the population standard deviation is unknown and the sample size n is small, then when we replace the sample standard deviation s for σ, the normal approximation is no longer applicable. In this scenario, we select a different distribution known as the **Student's t -distribution with *n-1* degrees of freedom**.

The Student's t-distribution is similar to the standard normal distribution. Student's t-distribution is also centered at 0 and has the same qualitative bell shape, but it does not have

the heavier tails as that of the standard normal distribution. You can see from Fig. 1.2 that the first curve (in brown color) is the t-distribution with two degrees of freedom which meets the dashed vertical line at the lowest point. The second curve (in blue color) is the t-distribution with five degrees of freedom, and the third curve (in red color) is the standard normal distribution.

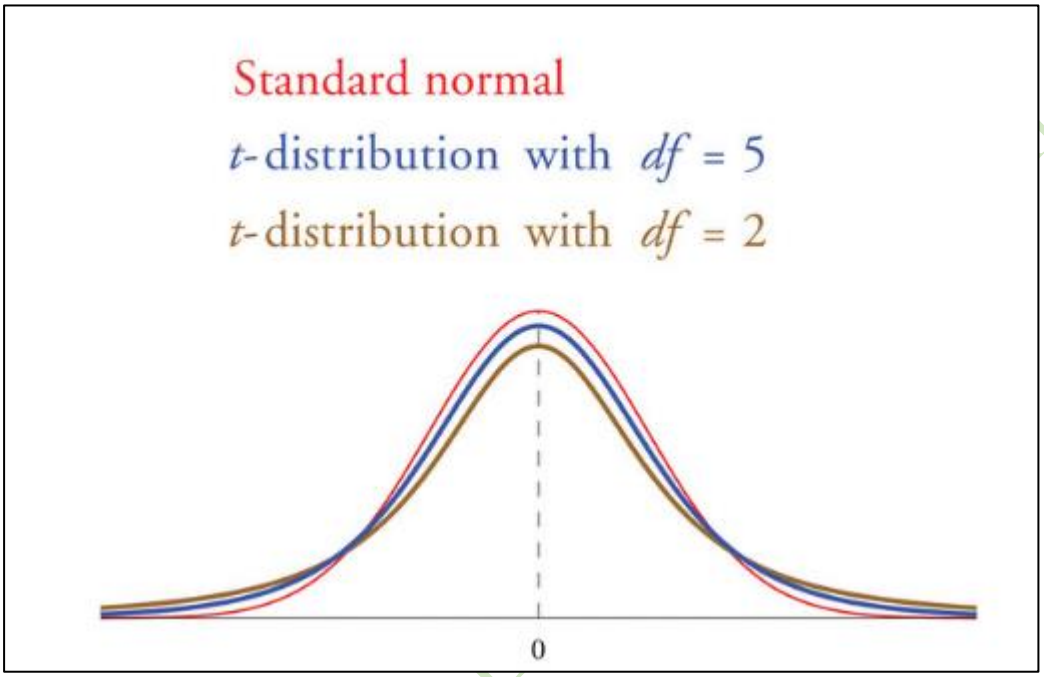


Fig 1.2: Student's t- distribution

From Fig 1.2, you can see that as the sample size *n* increases, the student's t-distribution tends to approach the standard normal distribution. Though there is a separate t-distribution for each value of *n*, if the sample size is 30 or more, it is usually appropriate to use the standard normal distribution.

The formula for the confidence intervals for the population mean for small samples:

Small Sample $100(1-\alpha)\%$ Confidence Interval for a Population Mean

If σ is known:

$$\bar{x} = \pm z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

If σ is unknown:

$$\bar{x} = \pm t_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

with the degrees of freedom $df = n - 1$.

The population must be normally distributed and a sample is considered small when $n < 30$.

Example 1.8: (Population standard deviation is not known)
On the basis of a random sample of 100 people working in a company, the average travel time to reach the office is 20 minutes with a standard deviation of 5 minutes. You are required to design the working hours by establishing a 95% confidence interval for the average travel time of everyone in the company.

Solution: $\bar{x}$ = 20, s = 5, n = 100, $t_{\alpha/2}$ = 2.262

Using the below formula,

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

$$\mu = 20 \pm (2.262) \frac{5}{\sqrt{100}}$$

$$= 18.87 \leq \mu \leq 21.13$$

Example 1.9: (Population standard deviation is not known)
On the basis of a random sample of 20 people working in a company, the average travel time to reach the office is 102 minutes with a standard deviation of 8.5 minutes. You are required to design the working hours by establishing a 95% confidence interval for the average travel time of everyone in the company.

Solution: $\bar{x}$ = 102, s = 8.5, n = 10, $t_{\alpha/2}$ = 1.729

Using the below formula,

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

$$\mu = 102 \pm (1.729) \frac{8.5}{\sqrt{20}}$$

$$= 98.71 \leq \mu \leq 105.29$$

7.5.8 Determining the Sample Size in Estimation:

To estimate a population mean μ within a margin of error (E) units at 100 (1−α) % confidence, the formula for the estimated minimum sample size *n* needed is:

$$n = \frac{(z_{\alpha/2})^2 \sigma^2}{E^2} \text{ (rounded up)}$$

Example 1.10: You are required to find out the minimum sample size needed to establish a 95% confidence interval for μ with a margin of error (E) = 1000. Assume that the population standard deviation is σ = 4000.

Solution: 95% Confidence level means that α = 1− 0.95 = 0.05,

So, α/2=0.025, we obtain $Z_{0.025}$ = 1.960.

$$n = \frac{(z_{\alpha/2})^2\sigma^2}{E^2} = \frac{(1.960)^2(4000)^2}{(1000)^2} = 61.4656$$

The final answer is rounded up to **61** as it is not possible to take a fractional observation.

7.7.9 Summary of Confidence Limits:

Now, we have understood the concept of the confidence interval and confidence level and also understood what will be the upper and lower limit when the population is finite or infinite. Table 1.4 depicts the summary of the confidence limits:

Table 1.4: Summary of the confidence limits

	When the Population Is Finite (and $n/N > 0.05$)	When the Population Is Infinite (or $n/N < 0.05$)
Estimating μ (the population mean): When σ (the population standard deviation) is known	Upper limit $\bar{x} + z\frac{\sigma}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$	$\bar{x} + z\frac{\sigma}{\sqrt{n}}$
	Lower limit $\bar{x} - z\frac{\sigma}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$	$\bar{x} - z\frac{\sigma}{\sqrt{n}}$
When σ (the population standard deviation) is not known ($\hat{\sigma} = s$) When n (the sample size) is larger than 30	Upper limit $\bar{x} + z\frac{\hat{\sigma}}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$	$\bar{x} + z\frac{\hat{\sigma}}{\sqrt{n}}$
	Lower limit $\bar{x} - z\frac{\hat{\sigma}}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$	$\bar{x} - z\frac{\hat{\sigma}}{\sqrt{n}}$
When σ (the population standard deviation) is not known ($\hat{\sigma} = s$) When n (the sample size) is 30 or less and the population is normal or approximately normal*	This case is beyond the scope of the text; consult a professional statistician.	$\bar{x} + t\frac{\hat{\sigma}}{\sqrt{n}}$
		$\bar{x} - t\frac{\hat{\sigma}}{\sqrt{n}}$

IN-TEXT QUESTIONS

11. If the population standard deviation is unknown and the sample size n is small, then we use _____ distribution?
    a) Normal Distribution b) Student t–distribution
    c) Non-normal Distribution d) Polynomial Distribution
12. A sample of 45 individuals is taken from a population of 650. From this sample, the mean and the standard deviation is found to be 3.6 and 2.52 respectively. What is the estimated standard error of the mean?
    a) 0.176 b) 0.276
    c) 0.376 d) 0.476
13. You are required to find out the minimum sample size needed to establish a 99% confidence interval for μ with a margin of error (E) = 0.2 Assume that the population standard deviation is σ = 1.3.
    a) 251 b) 271
    c) 261 d) 281
14. When n/N > 0.05, the population is:
    a) Finite b) Infinite
    c) Balanced d) Unbalanced
15. A sample is considered small when n is
    a) Less than 30 b) Less than 50
    c) Less than 100 d) Less than 150

7.6 SUMMARY

- A sample statistic that is utilized for estimating a population parameter is referred to as an estimator.
- Whenever we perceived any specific numerical value of our estimator, we called that value an estimate.
- The four properties of a good estimator are unbiasedness, efficiency, consistency and sufficiency.
- An estimator is called an unbiased estimator when the expected value of the estimator is the same as that of the population parameter that is being estimated.
- The term "efficiency" relates to a sampling variability of an estimator. Whenever there is a comparison between two unbiased estimators, the one who is having the lower standard error or standard deviation of the sampling distribution (for the given sample size) is considered to be relatively more efficient than the one who is having

the higher standard error or standard deviation of the sampling distribution (for the given sample size).

- An estimator is termed a consistent estimator of a population parameter as "*when the sample size tends to increase, an estimator approaches the population parameter closer and closer*". In other words, if an estimator is considered to be consistent, it becomes more reliable with large samples.
- An estimator is considered to be sufficient if the estimator is able to convey as much information as possible about the parameter in the sample.
- The two most essential methods are the least square method and the maximum likelihood method.
- The sample mean **"** $\bar{x}$ **"** is considered to be the best estimator of the population mean *"*μ*"* as it entails all four properties of a good estimator namely unbiasedness, consistency, efficiency and sufficiency.
- Point estimation is described as the method of determining an estimated value of a population parameter such as the mean of a population from random samples of the population.
- A set of values between which a population parameter falls is referred to as an interval estimate.
- There are three important parts of confidence interval namely confidence level, a margin of error and statistics. A confidence level is the probability element of a confidence interval.
- In reality, a high confidence level will produce large confidence intervals. These large confidence intervals are not precise and accurate as they might provide you with fuzzy estimates which are not good.
- A margin of error is defined as *"the range of values above and below the sample statistic"*.
- When the population standard deviation is unknown and the sample size n is small, then when we replace the sample standard deviation s for σ, the normal approximation is no longer applicable. In this scenario, we select a different distribution known as the Student's t -distribution with *n-1* degrees of freedom.

7.7 GLOSSARY

Confidence Interval: A range of values that has some designated probability of including the true population parameter value.

Confidence Level: Echoes the degree of uncertainty in a process of sampling.

Confidence Limits: The lower and upper values of a confidence interval.

Consistent Estimator: A statistic is termed as a consistent estimator of a population parameter as when the sample size increases, an estimator approaches the population parameter closer and closer.

Degrees of Freedom: The number of values in a sample we can specify freely once we know something about that sample.

Efficient Estimator: Sampling variability of an estimator.

Estimate: A specific observable statistical value.

Estimator: A sample statistic that is utilized to estimate a population parameter.

Finite Population: A population having a stated or limited size.

Infinite Population: A population in which it is theoretically impossible to observe all the elements.

Interval Estimate: A set of values between which a population parameter falls.

Point Estimation: A method of determining an estimated value of a population parameter such as the mean of a population from random samples of the population.

Sufficient Estimator: An estimator is considered to be sufficient if the estimator is able to convey as much information as possible about the parameter in the sample.

Unbiased Estimator: An estimator is called an unbiased estimator when the expected value of the estimator is the same as that of the population parameter that is being estimated.

7.8 ANSWERS TO IN-TEXT QUESTIONS

1. Biasedness	9. Sample variance
2. Estimator	10. Point estimate
3. Unbiasedness	11. Student t–distribution
4. smaller, more	12. 0.376
5. All of the above	13. 281
6. Confidence Coefficient	14. Finite
7. μ	15. Less than 30
8. 120	

7.9 SELF-ASSESSMENT QUESTIONS

18. What are the four properties of a good estimator? Briefly explain each one of them.
19. On the basis of the random sample of 200 people working in a company, the average travel time to reach the office is 60 minutes with a standard deviation of 20 minutes.

You are required to design the working hours by establishing a 95% confidence interval for the average travel time of everyone in the company.

20. You are required to find out the minimum sample size needed to establish a 95% confidence interval for μ with a margin of error (E) = 2. Assume that the population standard deviation is σ = 6.
21. Distinguish between a point estimate and an interval estimate.
22. Calculate the confidence interval for the population mean when the sample size is 100, the sample mean is 24,000 and the population standard deviation is 6,500 (The confidence level given is 95%).
23. Calculate the confidence interval for the population mean when the sample size is 36, the sample mean is 25.6 and the sample standard deviation is 3.5 (The confidence level given is 99%).

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7.11 SUGGESTED READINGS

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LESSON 8

Hypothesis testing and Sampling error I & II

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STRUCTURE

8.1 LEARNING OBJECTIVES

- To explore the Hypothesis idea
- To construct the hypothesis
- To get knowledge of hypothesis testing
- To examine the notion of Error – I and II
- To describe hypothesis testing using mean and percentage
- To do hypothesis testing using confidence interval
- To explain the Variance Analysis (ANOVA)

8.2 INTRODUCTION

Students need to know about average mean, standard deviation, standard error, sampling methods, sample size, etc., in order to understand hypothesis in research. In this lesson, students and researchers will learn what a hypothesis is, how to write one, and how to test it with the help of the t-test and the Anova. Students will also learn about error I and error II, which are the basics of sampling error.

Researchers and students are always interested in what the expected results of research are. The testing of hypotheses tells us how to make a research hypothesis and how to know with a certain level of confidence that something is true in the whole population based on just one sample. This lesson will help students understand the risk of testing a hypothesis in terms of sampling errors I and II. This will help us minimise the risk of making a decision to reject or fail to reject the hypothesis. This lesson will also explain how to design a hypothesis and the different types of hypothesis methods. The confidence interval will give us more confidence that research hasn't made any mistakes when testing hypotheses. T-test and the extension of t-test in terms of analysis of variance will be used to test the hypothesis (ANOVA).

Research is all about making predictions, forecasts, and figuring out how one thing affects another. For example, students can test the idea that a student's intelligence is related to how well they do in school. In the same way, students can gather and analyze data to test any business problem or situation using a sample of data. This lesson is interesting because it helps students figure out what might happen. Fig. 1.1 shows the different topics we've talked about in the lesson.

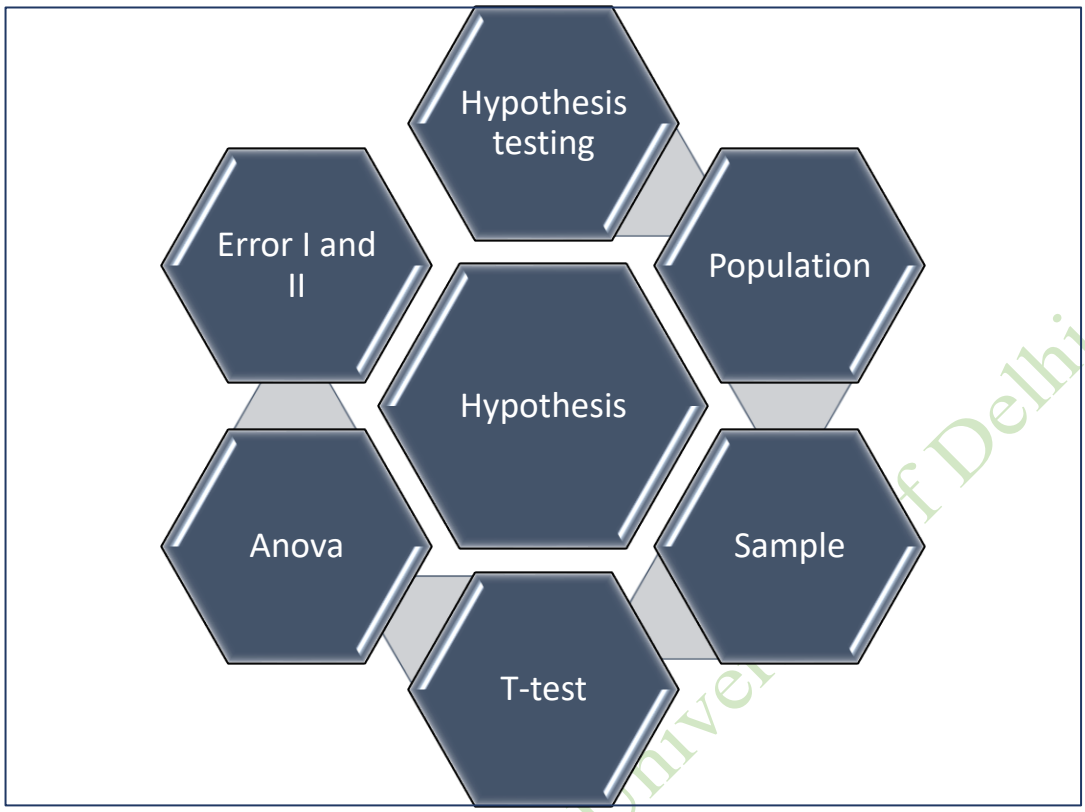


Fig 1.1: Hypothesis testing types and steps

8.3 Population and Sample

We frequently work with specific datasets, and we usually use the appropriate statistical and mathematical methods to uncover hidden knowledge in the data. Scientists, mathematicians, and statisticians have devised numerous methods for dealing with data from various sources. The true origins of inferential statistics can be found in the testing of hypotheses, which is central to sampling theory. However, real-life situations are not always predictable. They usually have random details that are difficult to deal with. A related method that can be used in these situations is hypothesis testing. Hypothesis testing, also known as statistical hypothesis testing, is a technique for comparing two datasets or a sample from a dataset. It's a statistical method for drawing conclusions, so you can draw some conclusions about the things you matched at the end of the test.

In this lesson, we will cover the fundamentals of sampling, population, sample, standard error, and sampling error, as well as why this area of analytics is important. Then we'll go over the fundamentals of hypothesis testing.

8.3.1 Population:

The goal of a statistical investigation is usually to figure out how big something is in general and to study how people in a group differ in one or more ways. The people being

studied are referred to as the population or the universe. As such, in statistics, the population is a group of things that are being studied, whether they are living or not. This population could be small or large depending on the circumstances. Most of the time, obtaining an entire population total is either impossible or impractical. It is possible that the population is so large that it cannot be counted. Furthermore, during a full examination, the population units could be destroyed or disturbed, making it impossible. All of these issues lead us to the concept of sampling, which means we must first define the term sample. The population's characteristics are described with the population, e.g.the population mean (μ), variance (σ^2) etc., referred to as *parameters.*

8.3.2 Sample:

- A sample is a small group of people from a population that can be counted. The number of participants in a sample is called the sample size. Instead of counting all of the people in the population, only the participants in the trial are observed to find out what their characteristics are. Then, the characteristics of the sample are used to make an approximation or estimate of the population. However, sampling has a lot of benefits, especially when it comes to saving time and money. Sampling is used quite often in our everyday lives. For example, A housewife usually tastes small quantity of food she has cooked to see if it is done right and has the right amount of salt. The characteristics of sample is described in terms of the sample of the respective population, e.g., the sample mean ($\bar{x}$), sample variance (s^2), etc., were termed as *statistics.*

ACTIVITY

A student working on their doctoral degree is interested in conducting research on students at the University of Delhi to understand about their experiences with online classroom learning while during Covid – 19. In this scenario, the population that he is supposed to research is going to consist of all of the students at the University of Delhi, but it is not possible to gain an accurate count of the total number of students at any given moment in time. The question now is how to make this research or study a reality.

Do you require a sample to be taken? Determine the criteria you will use and the procedure you will follow to pick a sample for this investigation. Make an informed prediction regarding the research.

8.3.3 Standard Error (S.E) :

The basic idea behind standard error is to justify how you can make decisions and interpret results based on just one sample drawn from the population. Standard deviation calculates deviation within the observation of one set of data, allowing you to determine whether or not the output will remain the same if you take another sample. To address this issue, the standard error is calculated, which allows us to demonstrate that if the sample is taken again and again, the same outcome or result will be obtained. As a result, standard error is the average of the standard deviation of the sampling distribution.

S.E. stands for "standard error" which is the sampling distribution of the standard deviation of a statistic. The standard errors of some well-known statistics are given below for large samples, where n is the sample size, 2 is the population variance, P is the population proportion, and Q = 1 – P, n 1 and n 2 are the sizes of two independent random samples drawn from the given population (s).

Statistics	Standard Error
Sample mean ($\bar{x}$)	$\frac{\sigma}{\sqrt{n}}$

S.D. is calculated from a single distribution, but S.E. is calculated across all distributions. The standard deviation of a sampling distribution is referred to as the standard error. Standard error refers to the average variation from sample to sample. It provides consistency, also known as the reliability coefficient.

IN-TEXT QUESTIONS

1. The standard deviation of a sampling distribution is referred to as------- .
2. Standard deviation and standard error are the same thing. True or false?
3. The sample's characteristics are as follows:

   a) sample mean b) Variance

   c) population mean d) all of the above
4. Error – I is representing alpha or byta _____.
5. I-you-me-mode is a _____ style of writing.

8.4 Hypothesis

8.4.1 Why hypothesis: In research, it is exceedingly difficult to access the entire population because it is time-consuming and expensive, hence a sample is used to infer the population. In other words, we cannot access the population, or it is unknown, so we pick a sample and extrapolate to the population (hypothesis). For instance, Tata automobiles make EV - Tiago and a new, better version of the old one, claiming that the new mileage is greater than 26 kilometers. It's a population assumption. Therefore, the population parameter is 26. Can you test every vehicle to determine whether the mileage exceeds 26 or not? No, because it is impossible to test every car, hence we test the hypothesis using a sample (subset of the population).

8.4.2 What hypothesis: The hypothesis is a claimable assumption. Managers, supervisors, and experts base their claims in enterprises and sectors on their experience, practises, and hunches. For instance:

- Apple claims that the performance of the i-phone 14 is superior than that of the i-phone 13. It is an assertion based on assumptions made by an Apple representative.
- Mahindra and Mahindra introduced the Thar vehicle model and asserted that the new Thar version will provide improved fuel economy. This is also a claim based on their intuition, experience, etc.
- Micro-lab, a pharmaceutical business that manufactures Dolo – 650, asserts that it is distinct from other salts in the market.

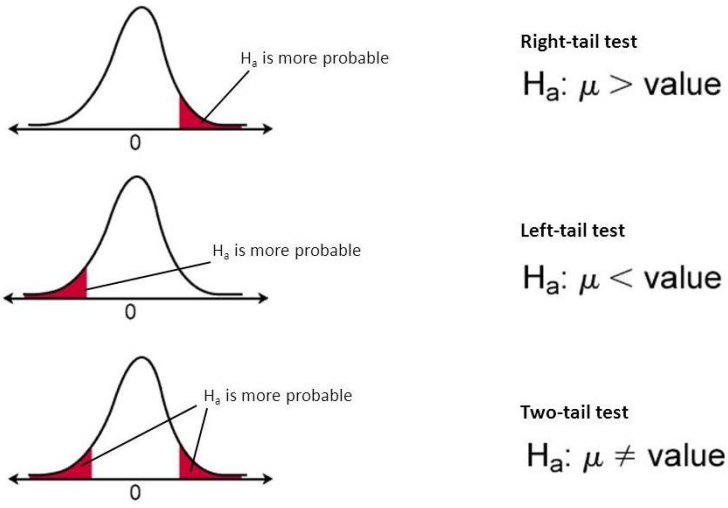
In academic research, hypothesis is designed on the basis of review of literature. For example:

- According to new research published in the American Economic Review, there is a clear correlation between Facebook use and rising anxiety and despair.
- Advertising that is humorous is more effective than advertising that is emotive or rational.
- There is a difference between the General Fertility Rate (GRF) of illiterate and literate women, with literate women having a lower GFR on a national scale. (GFR referes to the number of children born per 100 women in a year in the reproductive age group of 15 - 49 years) (GFR referes to the number of children born per 100 women in a year in the reproductive age group of 15 - 49 years.)
- Frequent daytime breaks reduce stress and avoid weariness.
- Exercise enhances immunity by increasing the circulation of immune cells in the blood, which aids in the fight against harmful germs and viruses.

8.4.3 Types of hypothesis:

- Alternative hypothesis: Your population claim is an alternative hypothesis based on your experience, practise, intuition, and assessment of available literature or reports or research. typically represented by H_1 or H_a For instance:

- It is a claim and alternate hypothesis that Mahindra asserts that the improved version of the Thar will achieve greater than 25 miles per gallon. In this instance, something is greater than something else, hence $H_1: \mu > \mu_0$, is a right-tailed alternative hypothesis. This is also known as the directional hypothesis because it provides direction for more than one object.
- The manufacturers of Dolo paracetamol assert that the likelihood of Dolo being ineffective is less than 2%. In this instance, one thing is lesser to another. $H_1: \mu < \mu_0$, is therefore a left-tailed alternative hypothesis. This is also known as the directional hypothesis because the direction of something less than is specified.
- During Covid – 19, Bharat Biotech asserts that co-vaccine and covi-shield are not equally effective. In this scenario, neither more nor less applies. This is referred to be a non-directional hypothesis because you have no idea which is greater or lesser. $H_1: \mu \neq \mu_0$ $(\mu > \mu 0 \; or \; \mu < \mu 0)$ also known as a two-tailed alternative hypothesis.
-



Null Hypothesis: the complimentary of alternative is called null hypothesis. The null hypothesis is an assumption made when figuring out a test statistic that says there can't be any difference from how things are in the whole population. It is written as H_0. Under the assumption that it is true, the null hypothesis is the hypothesis that is tested to see if it can be rejected. For example:

- The null hypothesis for the preceding alternative (Mahindra cliam about Thar that now improved version will give mileage greater than 25 is a claim and alternative hypothesis. In this case, something is more important than another) will be:

Thar's newly enhanced version will provide mileage of less than or equivalent to 25.

So null hypothesis is : $H_0 \leq 25.(\mu \leq \mu_1)$

- The null hypothesis for the aforementioned alternative is (that there is a less than 2% chance that Dolo will not work as intended. In this instance, something that is inferior to another) will be:
  That now Dolo ineffectiveness will be more than or equal to 2%.
  So null hypothesis is $H_0 \geq 2\%$. ($\mu \geq \mu_1$).
- The null hypothesis for above alternative hypothesis (During Covid – 19, Bharat Biotech claim that efficacy of co-vacine and covi-shild is not same.) will be:
  That efficacy of Co-vacine and Covi-shield vaccine is same.
  So null hypothesis is: $\mu = \mu_1$.

8.4.3.1How to decide right talied or left tailed:

On the basis of alternative hypothesis.

(i) > right tailed
(ii) < Left tailed.
(iii) $\mu 1 \neq \mu 2$ two tailed.

Caveat: never use equal sign in alternative. always use in null hypothesis.(≥, or ≤, =)

ACTIVITY

A directed hypothesis and a non-directional hypothesis are two types of alternative hypotheses that can be represented by making a variety of statements. You can also develop hypotheses based on a review of the relevant literature as well as on the basis of hunches and experiences, and then define those hypotheses in terms of right-tailed, left-tailed, and two-tailed test hypotheses..

8.4.4 Hypothesis testing:

- If you can figure out something about the whole population based on a sample, this is called hypothesis testing. For example, if Mahindra and Mahindra says (Hypothesis) that the new Thar will get better gas mileage than the old Thar, then 10 sample from the Thar population (10000) will be tested. You can test and make a claim about whether or not claim is true. Hypothesis testing is the process of seeing if a sample is representative of the whole population. Here, we'll talk about the steps of testing a hypothesis.

- **Setting up the hypotheses**: In this step, we set up alternative hypotheses based on claims and information in the literature, etc., and then we set up the complementary null hypothesis H_0 by assuming that the sample statistical value is the same as the population value. Also, the alternative is said to be in line with the null hypothesis. The most important thing is to choose the type of alternative (two-tailed or single-tailed) based on the test conditions and requirements.
- **Choosing the level of significance:** In this step, we choose the right level of Significance (α) based on how accurate the estimates are and how much risk we are willing to take. This will be decided before the sample is chosen, which means that α will be set earlier in the process. Common significance levels are 0.10 (1 chance in 10), 0.05 (1 chance in 20), and 0.01 (1 chance in 100).
- **Test criterion or test statistic:** In this step, we choose the best test statistic and figure out its value(s) based on the null hypothesis.
- **Conclusion:** Lastly, we compare the statistic value to the standard value at the given level of significance and decide whether or not to accept the null ypothesis..

8.4.5 Hypothesis testing with mean - Student's t-Test (t-Test):

In some cases, researchers want to test hypotheses about population means with sample sizes that aren't large enough for the normal distribution to provide a rough estimate. When the sample size is small and the population's standard deviation is unknown, the t-distribution is used. The t-distribution, like the standardised normal curve, has a bell-shaped distribution with a mean of zero and a standard deviation of one. When there are more than 30 samples, the distribution and the Z-distribution may be nearly identical.

- A t-test is an inferential statistic that is used to determine whether the sample mean (x) differs significantly from the hypothetical population mean ((μ)) value.
- only the significance of the difference between two sample means
- There are significant differences between the two data sets.
- The t-statistic, t-distribution values, and degrees of freedom all contribute to statistical significance.
- To run a test with three or more means, an analysis of variance is required..

T-test assumptions:

- **Normal Distribution:** A plot of the data should show a bell-shaped distribution curve, often known as a normal distribution. This is the first assumption that needs to be made.
- **Continuous dependent variable**The size of the measurement scale is the subject of the t-test's underlying assumption. A t-test makes the assumption that the scale that was used to measure the data that was collected was a continuous scale. An example of this would be the scores that one receives on an intelligence construct.

- **Equality of variance:** The final assumption is that the variance is constant throughout. When the standard deviations of samples are nearly the same, this is referred to as homogeneous or equal variance..
- **Random sample**: The final assumption is that the data comes from a simple random sample, which means that it comes from a random selection of people who are representative of the entire population.
- **Sample size is less then 30**: A hypothesis test that uses the t-distribution rather than the z- distribution. It is used when testing a hypothesis with a small sample size and unknown σ.

8.4.6 Univariate hypothesis test using the t – test:

$$t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}},$$

where

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad \text{and} \quad S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

follows student's $t-$ distribution with $(n-1)$ d.f. In symbolic form

$$t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}} \sim t_{n-1}.$$

We now compare the calculated value of t with the tabulated value of a certain level of significance. If the calculated value $|t| >$ tabulated value of t, null hypothesis is rejected and if the value of $|t| <$ tabulated of t, null hypothesis may be accepted at that level of significance. The tabulated values of t as given below:

d_f	Level of Significance for Directional Test (t_{crit})					
	∝=0.10	∝=0.05	∝=0.025	∝=0.01	∝=0.005	∝=0.0005
	Level of Significance for Non-directional Test (t_{crit})					
	∝=0.20	∝=0.10	∝=0.05	∝=0.02	∝=0.01	∝=0.001
1	3.0780	6.3140	12.7100	31.8200	63.6600	636.6000
2	1.8860	2.9200	4.3030	6.9650	9.9250	31.6000
3	1.6380	2.3530	3.1820	4.5410	5.8410	12.9200
4	1.5330	2.1320	2.7760	3.7470	4.6040	8.6100
5	1.4760	2.0150	2.5710	3.3650	4.0320	6.8690
6	1.4400	1.9430	2.4470	3.1430	3.7070	5.9590
7	1.4150	1.8950	2.3650	2.9980	3.4990	5.4080
8	1.3970	1.8600	2.3060	2.8960	3.3550	5.0410
9	1.3830	1.8330	2.2620	2.8210	3.2500	4.7810
10	1.3720	1.8120	2.2280	2.7640	3.1690	4.5870
11	1.3630	1.7960	2.2010	2.7180	3.1060	4.4370
12	1.3560	1.7820	2.1790	2.6810	3.0550	4.3180
13	1.3500	1.7710	2.1600	2.6500	3.0120	4.2210
14	1.3450	1.7610	2.1450	2.6240	2.9770	4.1400
15	1.3410	1.7530	2.1310	2.6020	2.9470	4.0730

Example: Let's say a teacher believe that the average grade a student gets in each class is 50. The grades of 11 students are collected, and they are as follows::

Marks	56	54	44	57	55	57	58	51	61	51	54

Do the grades support the teacher's belief??

The first step is to design the null the alternative and null hypothesis:

$H_0: \mu = 50$

$H_1: \mu \neq 50.$

Next, calculate a sample mean, $\bar{x}$ = 54.36 and a sample standard deviation, S = 4.5, and estmates the standard error of the mean (SEM).

$$\bar{x} = \frac{598}{11} = 54.36$$

Standard error of mean; **SEM = SD/√N**.

4.5/√11 =1.35

Next, finds the t value associated with the desired level of statistical significance. If a 95 percent confidence level is required, the significance level is .05.

So

$$t = 3.20 \sim t_{10}.$$

The value of t at $\alpha = 0.05$ and 10 d.f. is 2.228. As $t = 3.20 > 2.228$, therefore H_0 is rejected. It means that averge marks is more then 50 marks at a 5% level of significance.For confidence interval

$$CI = \bar{X} \pm Z \times \frac{\sigma}{\sqrt{n}}$$

$$= 54.36 \pm 1.9600 \times \frac{1.35}{\sqrt{11}}$$

$$= 54.36 \pm 0.798$$

= a 95% confidence interval of the mean [53.56 55.15] suggests that we are 95% confident that the population mean is between 53.56 and and 11.

8.4.7 Hypothesis test of a proportion:

The proportional hypothesis test is conceptually similar to the univariate hypothesis test, but there is a difference in the mathematical formulation of the proportional standard error..

Researchers frequently test univariate statistical hypotheses about the size and distribution of a population. You can guess the population proportion based on the sample proportion. Testing a hypothesis about a proportion is conceptually the same as testing a hypothesis about the mean. The proportion's standard error is calculated in a different way mathematically..

> Example: The MIT Sloan School of Management published a report on the relationship between Facebook presence and a decline in mental health among college students. The negative mental health effects were significant: "Facebook access resulted in a 20% increase in severe anxiety disorder."
> In other words, the null hypothesis to be tested is that the proportion of severe enxiety disorder among college students is .2. The researcher formulates the statistical null hypothesis that the population proportion (π) equls 20 percent (.2).

$$H_0: \pi = .2$$
$$H_1: \pi \neq .2$$

If a researcher conduct a survey with a sample of 200 studetns and calculates p = .7. though the population proportion is not known. Here we willuse Z test rather than t -test as sample size is large. If the decision will be taken at the ,01 level of significance, the critical Z value of 2.57 is used for the hypothesis test. Using the following formula

$$z = \frac{p - \pi}{Sp},$$

The formula for Sp = **√p(1-p)/n**
Sp = estimate of the standard error of the proportion
P = proportion of successes

So

Sp = **√(.2)(.2)/200 = .028**

Z = p – π/Sp = .2 - .8/.028 = 21.42

Here Z value of 21.42 is more than the critical value of 2.57 so the null hypothesis is rejected.

8.4.8 hypothesis testing for two population mean:

In this case, two independent samples $(x_1, x_2, \cdots, x_{n_1})$ and $(y_1, y_2, \cdots, y_{n_2})$ of sizes n_1 and n_2 have been drawn from the normal populations with mean μ_X and μ_Y respectively under the assumption that the population variance is equal and equal to σ^2.

$$= \frac{(\bar{x} - \bar{y})}{S\sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \sim t_{n_1+n_2-2}$$

The null hypothesis about difference between group is stastes as:

$\mu_1 = \mu_2$ or $\mu_1 - \mu_2$

The comparisions are between two sample means $(\bar{x} - \bar{y})$

Example: Null hypothesis: There is no difference between perception of students towards online learning between male and female students.

Male students	Female students
$\bar{x}_1 = 11.2$	$\bar{x}_2 = 14.5$
$S_1 = 2.6$	$S_2 = 2.1$
$n_1 = 14$	$n_2 = 21$

$$S^2 = \frac{1}{n_1 + n_2 - 2}\left(\sum_{i=1}^{n_1}(x_i - \bar{x})^2 + \sum_{i=1}^{n_2}(y_i - \bar{y})^2\right)$$

S = .797

The t – value is = (11.2 – 14.5)/ .797 = 4.14

Here calculated value of t, 4.14 exceed the critical t value of 2.75. at the .01 level. In other words, research shows that female students have more positive perception towards online learning.

8.4.9 Test of Significance:

The application of significance tests is an essential component of the sampling process. These tests provide assistance in drawing inferences from the results of a sample when the following conditions are met:

- The difference in value between the sample statistic that was observed and the parameter that was hypothetical value, or
- The difference between two statistics based on separate samples, which may or may not be significant as a result of random events or variations in the sampling process.

8.4.10 Level of Significance and critical region:

- A region (corresponding to a statistic) in the sample space which amounts to a rejection of is termed as the critical region or region of rejection. If is the critical region and if is the value of the statistic based on a random sample of size , then where is the complementary set of in sample space and is called the acceptance region.
- The degree of significance is defined as the probability that a random value of the statistic falls within the crucial region. This probability is expressed as a percentage. To put it another way, the degree of significance is equal to the size of the type I mistake, which is also known as the maximal producer's risk. In the process of putting hypotheses to the test, the levels of significance that are typically used are 5% and 1%.

8.5 Analysis of Variance

The t test compares two means or populations for each group. For example, compare male and female perceptions or attitudes of online learning. We only have two groups or levels of the independent variable, gender, in this case (male and female). The dependent variable, on the other hand, is one (attitude). If we want to compare more than two groups, the t-test will

fail. For example, we want to examine the attitudes of primary, middle, as well as high school students. We have three student groups (independent variable) but only one dependent variable (attitude). ANOVA (one-way analysis of variance) is the appropriate statistical tool in this case. The t - test cannot be used to test hypotheses in this case. So null hypothesis and alternative hypothesis is:

H_o: $\mu_1 = \mu_2 = \mu_3$

Ha: $\mu_1 \neq \mu_2 \neq \mu_3$

The null hypothesis states that all means are equal, while the alternative hypothesis states that at least two groups differ.Assumptions:

(i) Data is normally distributed

(ii) Groups are independent.

(iii) Equality of Variance

Difference between groups: The difference between μ_1 and μ_2 and μ_3 is called difference between group.

Differnce within groups: The difference within μ_1 or μ_2 or μ_3 is called difference within groups.

ANOVA is the statistical term for making simultaneous comparisons of means when there are more than two levels..

$$f = \frac{Variance\ between\ groups}{Variance\ within\ groups},$$

Example:

Using the following data, perform analysis of variance (ANOVA) using $\alpha = .05$

Groups I	Group II	Group III
67	45	74
45	43	76
33	23	87
53	23	56
43	43	56

Sol:

$$f = \frac{Variance\ between\ groups}{Variance\ within\ groups},$$

Source of Variance	Degree of Freedom (df)	Sum Square (SS)	Mean Square (MS)	F-ratio
Between Groups (Treatment)	k-1	$SSB = \sum_{j=1}^{k}\left(\frac{T_j^2}{n_j}\right) - \frac{T^2}{n}$ $SSB = \sum_{j=1}^{k} n_j(\bar{X}_j - \bar{X}_t)^2$	$MSB = \frac{SSB}{k-1}$	$F = \frac{MSB}{MSW}$
Within Groups (Error)	n-k	$SSW = \sum_{j=1}^{k}\sum_{i=1}^{n} X_{ij}^2 - \sum_{j=1}^{k}\left(\frac{T_j^2}{n_j}\right)$ $SSW = \sum_{j=1}^{k}\sum_{i=1}^{n}(X_{ij} - \bar{X}_j)^2$	$MSW = \frac{SSW}{n-k}$	
Total	n-1	$SST = \sum_{j=1}^{k}\sum_{i=1}^{n} X_{ij}^2 - \frac{T^2}{n}$ $SST = \sum_{j=1}^{k}\sum_{i=1}^{n}(X_{ij} - \bar{X}_t)^2$		

- SST = SSB + SSW

k: number of groups n: number of samples
df: degree of freedom

SS_{within}: is computed by taking the square root of the difference between each score and the mean of the group, then adding up all of these scores.

Where X_{ij} = individual score.

$\bar{x}_j$ = group mean for the j_{th} group

k = number of observations in a group

n = number of j_{th} groups.

$SS_{between}$ is the variance of the group means relative to the grand mean can be computed by squarring the amount by which each group mean deviates from the grand mean, multiplying that result by the total number of items in the group, and then adding up all of these individual scores.

Where $\bar{x}_j$ = group mean for the j_{th} group

$\bar{x}_t$ = grand mean

n_j = number of items in the jth group.

$SS_{within} = (67 - 48.2)^2 + (45-48.2)^2 + (33-48.2)^2 + (53-48,2)^2 + (43-48.2)^2 + (45-35.4)^2 + (43-35.4)^2 + (23-35.4)^2 + (23-35.4)^2 + (74-69.8)^2 + (76-69.8)^2 + (87-69.8)^2 + (56-69.8)^2 + (56-69.8)^2$

$= 1892.8$

$SS_{between} = 5(48.2-51.13)^2 + 5(35.4 - 51.13)^2 + 5(69.5 - 51.13)^2$

$= 3185.23$

$MS_{between} = 3185.23/(3-1) = 1592.5$

$MS_{within} = 1892/(15-3) = 157.6$

$F = 1592.5/157.6 = 10.10$

$F_{critical}(2,12)=3.89$

Decision = Reject H_0

The critical value of f at the .05 level for 2 and 12 degrees of freedom indicated that an F of 3,89 would be required to reject the null hypothesis.

The conclusion that we reach from this particular illustration is that the null hypothesis should not be accepted. It would appear that every group has its own characteristics..

8.6 Error – I and II

Sampling error or risk in testing hypothesis: (Error – I and II)

In the event that the test is performed again, how confident are you that you would obtain the same result? because the validity of the hypothesis is determined by the sample. During the process of picking the sample, there is a possibility of making a mistake. Therefore, there is an element of risk involved in the testing of the hypothesis. When testing a hypothesis, there are essentially two different kinds of risk involved. In this section, we will determine which danger poses the greater threat. The risk is caused by a variety of different circumstances.

Situation 01: According to Mahindra & Mahindra, the new Thar will have a mileage that is greater than 25 miles per gallon thanks to the updated engine.

In this particular scenario, if the null hypothesis is disproved despite the fact that it was correct. If the corporation sends the wrong message regarding Thar's mileage, the image of the company will suffer in the long run.

Situation 02: The micro-lab pharmaceutical company claims that the percentage of ineffectiveness of the dolo paracetamol drug is less than 2%.

In this particular scenario, the cost of risk would be borne by people if the null hypothesis is rejected despite the fact that it was correct. Consequently, we will go over the two categories of errors that can occur while testing the hypothesis in Error I and Error II. The primary objective of sampling theory is to develop the capability of drawing reliable inferences about the characteristics of the entire population on the basis of the findings obtained from a sample. In actual operations, we examine an observation of a huge amount before deciding whether to accept or reject it. As a result of this, we run the risk of making the two types of errors listed below.:

- **Type I Error:** Rejecting the Null Hypothesis H_0, when it is true.
- **Type II Error:** Accepting H_0 when it is wrong, i.e., when H_1, is true.

In terms of probability, we can write,

$$P[Reject\ H_0\ when\ it\ is\ true\ ] = P[\ Reject\ H_0\ |\ H_0\ ] = \boldsymbol{\alpha}$$

$$P[Accept\ H_0\ when\ it\ is\ wrong\ ] = P[Accept\ H_0|H_1] = \boldsymbol{\beta}$$

The α and β are called the sizes of type I error and type II error, respectively. **α** is called the *producer's Risk,* and **β** is called the *consumer's Risk.*

	H_0 is true	H_0 is false
Accept H_0	No error	β
Reject H_0	α	No error

CASE STUDY

US Study: Research conducted in the United States found that social media addiction is associated with increased levels of anxiety and depression.

According to new research published in the American Economic Review, Facebook use is strongly associated with increased anxiety and depression. However, social networks disagree and assert that the evidence is unclear. The MIT Sloan School of Management published a paper on how the mental health of college students appears to deteriorate when they use Facebook.A new study is significant because it compares two distinct sets of data from the early days of Facebook, between February 2004 and September 2006. Facebook was introduced gradually to college campuses in the United States. It started at Harvard. The researchers compared the responses of students when Facebook arrived on campus. When the researchers examined the 4,300,000 survey responses from that time, they discovered "a substantial correlation between college students' Facebook use and their deteriorating mental health."

The negative consequences on mental health were significant: "Access to Facebook linked to a 7% increase in severe depression and a 20% increase in anxiety disorders." According to researchers, using Facebook is around 20% as detrimental to mental health as losing a job. And this was before Facebook included the "like" button. It was also observed that Facebook's effects on mental health worsened over time.

IN-TEXT QUESTIONS

15. The t-test requires normally distributed data. True / False
16. Rejecting the Null Hypothesis H_0, when it is true is called _____.
17. Your claim is:
    a) Alternative hypothesis b) Null hypothesis
    c) Both of the above d) none of the above
18. Full form of ANOVA _____
19. Standard error is _____.
20. Complementary to your claim is
    a) Alternative hypothesis b) Null hypothesis
    c) Both of the above d) none of the above
21. Is there any error in accepting a hypothesis when it is true?.(T/F)
22. Accepting H_0 when it is wrong, i.e., when H_1, is true is:
    (a) Error – I (c) Both a and b
    (b) Error - II (d) none of the above
23. Risk in Hypothesis testing is known as
    (a)Error – I (c) Both a and b
    (b)Error - II (d) none of the above
24. Hypothesis testing is the process of matching the mean of a sample to the mean of a population.. true/false
25. Which among the followings representing assumptions of hypothesis testing.
    (i) Data is normally distributed (iii) Equality of variance
    (ii) Groups are independent. (iv) All of the above.
26. μ represent sample parameter (True/False)
27. You can use .($\geq$, or $\leq$, =) in alternative hypothesis.True/False.
28. We use Sample size less then 30 in ---------- test.
29. In case of sample size is more then 30 we use ---------- test.

8.7 SUMMARY

When doing a statistical investigation, the primary focus is typically on determining the overall scale of a phenomenon and conducting research into the variance of one or more traits that are associated with individuals who are members of a group. The persons who are the subject of this research are referred to as the population or the universe.

The number of persons that make up a given sample is referred to as the sample size. A sample is defined as a discrete subset of the statistical individuals that make up a population.

It's possible that the two groups of people—the population and the sample, with the latter being a subset of the former—could have different statistical constants depending on the circumstances. To clear up any misunderstandings that may have arisen, these constants connected with the population, e.g., the population mean (μ), variance (σ^2) etc., referred to as parameters. Similarly, the constants associated with the sample of the respective population, e.g., the sample mean ($\bar{x}$), sample variance (s^2),

The application of significance tests is an essential component of the sampling process. These tests provide assistance in drawing inferences from the results of a sample when the following conditions are met:

the difference between the value of the hypothetical parameter and the observed value of the sample statistic, or

a statistically significant difference exists between two independent sample statistics; yet, this difference may also be explained by random variation or the effects of sampling.

An assumption that is made during the process of estimating any test statistic is known as the null hypothesis. This assumption states that there is no possibility of any variation from the situation that is currently occurring in the actual population as a whole. The null hypothesis is represented by the symbol H_0. The hypothesis that is assumed to be correct and then subjected to scrutiny to see whether or not it can be rejected is known as the null hypothesis.

The term "alternative hypothesis" refers to a hypothesis that is distinct from the "null hypothesis" and is typically represented by the letters "H_1" or "Ha." As a consequence of this, we are likely to make the two types of errors listed below.:

Type I Error: Rejecting the Null Hypothesis H_0, when it is true.

Type II Error: Accepting H_0 when it is wrong, i.e., when H_1, is true.

A region (corresponding to a statistic t) in the sample space S which amounts to a rejection of H0 is termed as the critical region or region of rejection.

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A t-test is a form of inferential statistic that is used to evaluate whether or not the mean of the sample ($\bar{x}$) substantially deviates from the value of the population mean μ that is assumed to exist. the importance of the difference in mean between two samples. a noteworthy variance can be seen between the two sets of data.

8.8 GLOSSARY

- **Hypothesis** A hypothesis is an assumption that can be proven or disproved.
- **Standard Error**. Standard Error. stands for "standard error," which refers to the sample distribution of the standard deviation of a statistic.
- **Normal Distribution:** The first assumption is that a plot of the data would show a bell-shaped distribution curve, sometimes known as a normal distribution.
- **Continuous dependent variable**: t-tests are based on the assumption of a continuous dependent variable, and the second assumption concerns the size of the measurement scale. A t-test makes the assumption that the scale that was used to measure the data that was collected was a continuous scale. An example of this would be the scores that one receives on an intelligence test.

- **Equality of variance:** The third assumption is that the variance is the same in all locations, which is known as the equality of the variance. When the standard deviations of different samples are very close to being the same, we have what's known as homogeneous variance.
- **Random sample**: The last supposition is that the information was obtained from a sample that was chosen at random and was intended to be representative of the entire population. This type of sample is known as a simple random sample.

8.9 ANSWERS TO IN-TEXT QUESTIONS

1. standard error 2. False 3. a 4. a 5. Conversational style 6. True 7. Error - I 8. a 9. Analysis of Variatnce 10. which is the sampling distribution of a statistic's standard deviation	11. b 12. True 13. b 14. c 15 true 16. (iv) 17. False 18. False 19. t-test 20. z test

8.10 SELF-ASSESSMENT QUESTIONS

1. Explain why it is necessary to test the hypothesis. Examine the procedures involved in evaluating a hypothesis.
2. What is hypothesis? What different kinds of hypotheses are you familiar with? Talk about each of them individually.
3. Discuss two different sorts of errors that can occur while testing hypotheses. Discuss the part they play in the testing.?
4. Define the following terms:

i) Type II error.

ii) Type I error

iii) Anova

5. Write the assumptions of the following tests:

i) t −test

ii) F −test

6. The average lifetime of a sample of 200 batteries manufactured by a business was determined to be 1540 hours, with a standard deviation of 42 hours. Is it conceivable that a sample was taken from a population whose life time mean age was 1500 hours? You are free to use a significance threshold of 5%. (Given Tabular value is 13.47) (D.U 2021)

7. According to the findings of a survey administered to students, a group of seventy students scored an average of eighty points on their business research paper, with a standard variation of twelve points. Consider the null hypothesis that the marks of the

population mean are 100 with the alternative result that is fewer than 100 marks. Use 5% level of significance. (Critical value of statistic is 1.64).

8. Using the following data, perform analysis of variance (ANOVA) using $\alpha = .05$

Groups I	Group II	Group III
84	131	99
87	120	96
118	143	129
130	145	153

8.11 SUGGESTED READINGS

Surya, P.K., Sharma, S.K. (2020) Business research methods and analytics, Taxmann publication, New Delhi

William G. Zikmund (2003), Exploring marketing research. Thomson press.

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