



# KENDRIYA VIDYALAYA SANGATHAN JABALPUR REGION



## STUDY MATERIAL CLASS – XI SUBJECT – ECONOMICS SESSION -2023-24

## **OUR PATRONS**

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## Class- XI , Subject-Economics (2023-24)

S.No	UNIT	Marks
<b>Part A: Statistics for Economics</b>		
<b>1</b>	Introduction	<b>15</b>
<b>2</b>	Collection, Organisation and Presentation of data	
<b>3</b>	Statistical Tools and Interpretation	<b>25</b>
<b>Part B: Introductory Microeconomics</b>		
<b>4</b>	Introduction	<b>4</b>
<b>5</b>	Consumer's Equilibrium and Demand	<b>14</b>
<b>6</b>	Producer Behaviour and Supply	<b>14</b>
<b>7</b>	Forms of Market and Price Determination	<b>8</b>
<b>Part C : Project work (for 20 Marks)</b>		
<b>TOTAL</b>		<b>100</b>
<b>COMPILATION</b> Shri A.N. Shukla,PGT - Economics., PM SHRI K.V. No.1 G.C.F.Jabalpur		

S.N.	CHAPTER/UNIT	NAME OF THE TEACHER	NAME OF THE KV
1	Introduction ( Introductory Microeconomics & Statistics for Economics )	SHRI S.S. BELWANSHI	NO2 GCF JBP..
2	Collection, Organisation and Presentation of data	SHRI R.P.SHAH	JAYANT COLLIERY
3	Measures of Central Tendency- Arithmetic mean, Median and Mode	SHRI ROOP CHAND	BARKUHI (WCL)
4	Cor-relation	SHRI K.P. PATEL	NO.1,SAGAR
5	Index Numbers	SHRI CHATTAN SINGH YADAV	NO. 1 O.F.KATNI
6	Consumer Behaviour and Demand	SHRI S.S.GAUTAM	1 STC JBP
7	Producer Behaviour and Supply	SMT.GEETIKA AHUJA	DHANA
8	Perfect Competition - Price Determination and simple applications	SHRI RATNESH KUMAR	OFK JBP.

# SYLLABUS OF ECONOMICS

## CLASS – XI (2023-24)

### Part A: Statistics for Economics

#### Unit 1: Introduction

What is Economics?

Meaning, scope, functions and importance of statistics in Economics

#### Unit 2: Collection, Organisation and Presentation of data

**Collection of data** - sources of data - primary and secondary; how basic data is collected with concepts of Sampling; methods of collecting data; some important sources of secondary data: Census of India and National Sample Survey Organisation.

**Organisation of Data:** Meaning and types of variables; Frequency Distribution.

**Presentation of Data:** Tabular Presentation and Diagrammatic Presentation of Data:

(i) Geometric forms (bar diagrams and pie diagrams), (ii) Frequency diagrams (histogram, polygon and Ogive) and (iii) Arithmetic line graphs (time series graph).

#### Unit 3: Statistical Tools and Interpretation

For all the numerical problems and solutions, the appropriate economic interpretation may be attempted. This means, the students need to solve the problems and provide interpretation for the results derived.

**Measures of Central Tendency-** Arithmetic mean, Median and Mode

**Correlation** – meaning and properties, scatter diagram; measures of correlation - Karl Pearson's method (two variables ungrouped data) Spearman's rank correlation (Non-Repeated Ranks and Repeated Ranks).

**Introduction to Index Numbers** - meaning, types - Wholesale Price Index, Consumer Price Index and index of industrial production, uses of index numbers; Inflation and Index Numbers, Simple Aggregative Method.

## **Part B: Introductory Microeconomics**

### **Unit 4: Introduction**

Meaning of microeconomics and macroeconomics; positive and normative economics  
What is an economy? Central problems of an economy: what, how and for whom to produce;  
concepts of Production Possibility Frontier and Opportunity Cost.

### **Unit 5: Consumer's Equilibrium and Demand**

Consumer's equilibrium - meaning of Utility, Marginal Utility, Law of Diminishing Marginal Utility, conditions of consumer's equilibrium using marginal utility analysis.  
Indifference curve analysis of consumer's equilibrium-the consumer's budget (budget set and budget line), preferences of the consumer (indifference curve, indifference map) and conditions of consumer's equilibrium.

Demand, market demand, determinants of demand, demand schedule, demand curve and its slope, movement along and shifts in the demand curve; price elasticity of demand - factors affecting price elasticity of demand; measurement of price elasticity of demand – percentage-change method and total expenditure method.

### **Unit 6: Producer Behaviour and Supply**

Meaning of Production Function – Short-Run and Long-Run Total

Product, Average Product and Marginal Product.

Returns to a Factor

Cost – Short run costs - Total Cost, Total Fixed Cost, Total Variable Cost; Average Cost; Average Fixed Cost, Average Variable Cost and Marginal Cost - meaning and their relationships.

Revenue – Total Revenue, Average Revenue and Marginal Revenue - meaning and their relationship.

Producer's Equilibrium - meaning and its conditions in terms of Marginal Revenue- Marginal Cost.

Supply, market supply, determinants of supply, supply schedule, supply curve and its slope, movements along and shifts in supply curve, price elasticity of supply; measurement of price elasticity of supply - percentage-change method.

### **Unit 7: Perfect Competition - Price Determination and simple applications.**

Perfect competition - Features; Determination of market equilibrium and effects of shifts in demand and supply. (Short Run Only)

Simple Applications of Demand and Supply: Price ceiling, Price floor.

## **Part C: Project in Economics**

Guidelines as given in Class XII curriculum

# **(PART -A) STATISTICS FOR ECONOMICS**

## **UNIT 1- INTRODUCTION**

**Economics** is a science that studies human behavior which aims at allocation of scarce resources in such a way that consumer can maximise their satisfaction, producers can maximise their profits and society can maximise its social welfare. It is about making choice in the presence of scarcity.

**Scarcity** means shortage of goods and resources in relation to their demand. Scarcity is the root of all Economic problem.

**Father of Economics Adam Smith provided wealth definition of economics( Book- The Wealth of Nations, 1776):-** Economics is an enquiry into the factors that determine the wealth of a country.

**Resources are :**

- (a) Scarce / limited and
- (b) Have alternatives uses

**Types of Activities:**

### **1. Economic Activities**

- a. Production
- b. Consumption
- c. Investment
- d. Exchange
- e. Distribution

### **2. Non-Economics Activities**

- a. Social
- b. Religious
- c. Political
- d. Charitable
- e. Parental

**Economic activities** are those activities which are related to earn money and wealth for life. These activities generate new income and increase the flow of goods and services. For example production, consumption, investment, distribution.

**Non economic activities** are those activities which are not related to earn money and wealth. These activities neither generate income nor increase the flow of goods & services. For example a teacher teaching his own son.

**Consumer :** Consumer is an economic agent who buys the goods and services to satisfy his wants.

**Producer** is one who produces goods and services for the generation of income.

**Service holder :** A person who is in job and gives his services as a factor of production and is getting paid for it. E.g. Govt. Teacher.

**Service Provider :** A person who provides services to other for a payment. e.g. transporter, auto driver.

**Statistics :** Statistics is a method of taking decisions on the basis of numerical data.

**Statistics can be defined in two ways:-**

**1. Singular sense:** Statistic Means Statistical methods and techniques related to collection, organisation, classification, Presentation, analysis and Interpretation of data.

**2. Plural Sense:** Statistics means Numerical facts and figures Which have been systematically collected for a definite purpose in any field of study.

**Characteristics of statistics in plural sense**

- 1. Aggregate of facts
- 2. Numerically expressed
- 3. Affected by multiplicity of causes
- 4. Reasonable accuracy
- 5. Collected in a systematic manner
- 6. Pre-determined Purpose
- 7. Placed in relation to each other

**Statistical data**

**(1) Qualitative data** – Not measured in numerical terms like beauty and intelligence.

**(2) Quantitative data** – Measured in numerical terms like price and Income.

**Scope of Statistics**

In the old days the use of statistics was restricted to deal with the affairs of the state. But now-a-days the scope of statistics has spread to all those areas where numerical facts are used such as economics, business industry, medicine, physics, chemistry and numerous other fields of knowledge.

### **Importance of Statistics in Economics**

1. It enables an economist to present economic facts in precise and definite form.
2. Helps in condensing mass data into a few numerical measures.
3. Statistics is used in finding relationship between different economic factors.
4. Economics forecasting through statistical studies.
5. Helpful to formulate appropriate economic policies that solve economic problems.
6. Help to analyse the performance of policies applied before.
7. Economist try to find out cause and effect relationship between different sets of data.
8. Formulation of policies.
9. Used for inter-sectoral and inter-temporal comparisons.
10. It is a quantitative expression for economic problem.

### **Function of Statistics**

1. Statistics simplifies complexities.
2. It expresses facts in numbers.
3. It presents data in condensed form.
4. Statistics compares different phenomena and reassures relationship between them.
5. Statistics is helpful in formation of policies.
6. Statistics is helpful in economic forecasting.
7. It facilitates comparisons.
8. It is useful in testing the laws of other sciences.
9. It helps in establishment of correlation between two facts.

### **Limitations of Statistics**

1. Statistics does not study individuals.
2. Statistics results might lead to fallacious conclusions.
3. Statistics deals with quantitative facts only.
4. Statistics laws are true only on averages.
5. Only experts can make the best possible use of statistics.
6. Uniformity and homogeneity of data is essential.
7. Misuse of statistics is indeed its greatest limitation because misuse of statistics is possible.
8. Study of aggregates only

### **Competency Based Questions**

1. \_\_\_\_\_ is one who consumes goods and services for the satisfaction of their wants.

- (a) Producer
- (b) Consumer
- (c) Investor
- (d) All of the above

Answer: (b) Consumer

2. \_\_\_\_\_ is the one who produces or sells goods and services for the generation of income.

- (a) Producer
- (b) Consumer
- (c) Investor
- (d) All of the above

Answer: (a) Producer

3. Saving and Investment are \_\_\_\_\_ activity

- (a) Production
- (b) Consumption
- (c) Economic
- (d) Non-economic

Answer: (c) Economic

4. Act of abstinence from consumption is known as \_\_\_\_\_.

- (a) Production
- (b) Savings
- (c) Investment
- (d) Consumption

Answer: (b) Savings

5. \_\_\_\_\_ implies scarcity of limited resources with regards to unlimited wants.

- (a) Production
- (b) Consumption
- (c) Economic activity
- (d) Non-economic activity

Answer: (c) Economic activity

6. "Economic activity is the study of mankind in the ordinary life of business", this definition was given by;

- (a) Alfred Marshall
- (b) Robbins
- (c) Peterson
- (d) None of the above

Answer: (a) Alfred Marshall

7. Which of the following are Components of economics?

- (a) Consumption
- (b) Production
- (c) Distribution
- (d) All of the above

Answer: (d) All of the above

8. Which of the following are the features of statistics in the plural sense?

- (a) It is a aggregate of facts
- (b) Statistics is numerically expressed
- (c) Both (a)&(b)
- (d) None of the above

Answer: (c) Both (a)&(b)

9. Which of the following is not one of the limitations of statistics?

- (a) Statistics study numerical facts only
- (b) Statistical results are true only on averages
- (c) Heterogeneous data is required
- (d) Statistics study aggregates only

Answer: (c) Heterogeneous data is required

10. Which of the following are regarded as the importance of economics?

- (a) Statistics is a quantitative expression of economic problems
- (b) Statistics works out cause and effect relationship
- (c) Statistics facilitates economic forecasting
- (d) All of the above

Answer: (d) All of the above



**Unit- 2**  
**(i)Collection of Data**

- ❖ **Data:** Information which can be expressed in numbers
- ❖ "The purpose of collecting data is to provide evidence for reaching a sound and clear solution to an economic problem."

**Differences between Primary and Secondary Data**

Basis	Primary Data	Secondary Data
Originality	These are original data.	These are not original but already collected by some other person for institution.
Cost	These are costlier in terms of time, money and efforts involved.	These are less costly in terms of time, money and efforts involved.
Availability	These are not available in the form of published/unpublished reports as they are collected for the first time.	These are available in the form of published/unpublished reports.
Precaution	More precautions are required while collecting these data.	Less precaution is required while collecting these data.
Editing	No need of editing for these data.	Editing is required.

**Methods/Sources of Collection of Primary Data:**

1. **Direct Personal Interviews:** Data is personally collected by the interviewer/investigator.

Merits	Demerits
i. High response rate.	i. Expensive.
ii. Allows all types of questions.	ii. Takes more time.
iii. More Accurate.	iii. Informants can be influenced.
iv. Originality.	iv. Difficult cover wide areas.
v. Allows clearing doubts regarding questions.	

2. **Indirect Oral Investigation:** Data is collected from third parties who have information about the subject of enquiry.
3. **Information from correspondents:** Data is collected from agents appointed in the area of investigation.
4. **Mailing questionnaire:** Data is collected through questionnaire [list of questions] mailed to the informant.

Merits	Demerits
i. Least Expensive.	i. Longer response time.
ii. Wide coverage.	ii. Cannot be used by illiterates.
iii. Original and Reliable	iii. Lack of accuracy.

5. **Questionnaire filled by enumerators:** Data is collected by trained enumerators who fill questionnaires.
6. **Telephonic interviews:** Data is collected through an interview over the telephone with the interviewer.

**Questionnaire:** A list of questions with space for answers.

**Qualities of a good Questionnaire:**

- i. Number of questions.
- ii. Simple and clear.
- iii. Proper arrangements of questions.
- iv. No personal questions.

- v. No mathematical calculations.
- vi. Cross examinations.
- vii. Pre-testing of the questionnaire.
- viii. Multiple choice questions.
- ix. Necessary instructions should be given.

**Methods/Sources of Collection of Secondary Data:**

**1. Published Source** - International publications, Government publications, Reports of commissions and committees, Semi-government publications, Journals, Newspapers, etc.

**2. Unpublished Source**

Two important sources of secondary data:

- Census of India
- National Sample Survey Organisation (NSSO)

**Precaution in use of secondary data**

- i. Suitability of objects
- ii. Method of collection
- iii. Conditions of collections
- iv. Accuracy- If the available data does not possessed required level of accuracy then such data should not be used.

**Census and Sample Method of Collection of Data**

**1. Census Method**

- A statistical investigation in which the data are collected from each and every element/unit of the population/universe.
- Universe or population in statistics is total items under study.
- It is also known as 'complete enumeration' or '100% enumeration' or 'complete survey'.

Merits	Demerits
Accurate & Reliable.	Expensive.
Indirect Investigations.	Large manpower required.
Complex Investigation is possible.	Not suitable for large case study.
Study of diverse items	

**2. Sample Method:** Data is collected from few units of the population and result is applied to the whole group.

**❖ Difference between Census & Sample Method**

Census Method	Sample Method
i. Every unit of population studied	i. Few units of population are studied
ii. Reliable and accurate results	ii. Less Reliable and accurate results
iii. Expensive method	iii. Less expensive method
iv. More time consuming	iv. Less time consuming
v. Suitable when area of enquiry is small	v. Suitable when area of enquiry is large
vi. Suitable when population is of homogenous nature	vi. Suitable when population is of heterogeneous nature

**❖ Methods of Sampling**

- a. **Random Sampling:** It is a sampling method in which all the items have equal chance of being selected and the individuals who are selected are just like the ones who are not selected.
- b. **Non-random sampling:** It is a sampling method in which all the items do not have an equal chance of being selected and judgment of the investigator plays an important role.

### **Multiple Choice Questions/Statement Based questions:**

1. \_\_\_\_\_ data are collected by the investigator himself.
  - a. Secondary
  - b. Primary
  - c. both (a) & (b)
  - d. none of the above
2. A good questionnaire should be:
  - a. brief
  - b. complete
  - c. in order
  - d. all of the these
3. Data collected from census report of India is
  - a. Primary data
  - b. Secondary data
  - c. Sample data
  - d. none of these
4. \_\_\_\_\_ data is based on the first hand information.
  - a. Secondary
  - b. Primary
  - c. both (a) & (b)
  - d. None of the above
5. Data collected from the newspaper 'The Times of India' is:
  - a. Primary data
  - b. Secondary data
  - c. Sample data
  - d. none of these
6. Which method is suitable to collect data on population of a country?
  - a. Census
  - b. Sample
  - c. Random Sampling
  - d. none of these
7. Which method involves study of each and every item of the universe?
  - a. Sample
  - b. Census
  - c. Random sampling
  - d. None of these
8. Secondary data are original in nature. True/False
9. Collection of Primary data involves lot of time and cost. True/False
10. Read the following Assertion and Reason. Choose the correct alternatives given below:  
Assertion (A): Primary data are original in character; hence these are not available in the for published /unpublished reports.  
Reason (R): Data collected by the investigator for the first time, from beginning to end are called primary data.
  - a. Both Assertion (A) & Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
  - b. Both Assertion (A) & Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
  - c. Assertion (A) is true but Reason (R) is false.
  - d. Assertion (A) is false but Reason (R) is true.

### **Short & Long answer questions**

1. What is Data?
  2. What are the two sources of data?
  3. Distinguish between the Primary Data and Secondary Data.
  4. What do you mean by a Questionnaire? Write the qualities of a good questionnaire.
  5. What are the methods to collect the primary data?
  6. What are the sources of Secondary data?
  7. What do you understand by the Census and Sample methods of collecting data?
  8. Differentiate between the Sample method and Census method.
  9. Define Random Sampling & Non-random sampling with example.
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## (ii) Organization of Data

❖ **Classification of Data:** It is the process of arranging data into sequences and groups according to their common characteristics.

❖ **Objectives of Classification:**

- a. To present the complex data into simple form.
- b. To facilitate comparison.
- c. Scientific arrangement.
- d. To provide base for presentation of data.
- e. To make analysis and interpretation easy.

❖ **Methods/Basis of classification:**

1. **Chronological classification:** In such a classification data are classified either in ascending or in descending order with reference to time such as years, quarters, months, weeks etc.  
Example:

Year	2019	2020	2021	2022
Sales (in units)	100	200	300	400

2. **Geographical/Spatial classification:** The data are classified with reference to geographical location/place such as countries, states, cities, districts, block etc. Example:

States	Madhya Pradesh	Punjab	Orissa	Gujrat
Sales (in units)	100	200	300	400

3. **Qualitative classification:** Data are classified with reference to descriptive characteristics like sex, caste, religion, literacy etc. Example:

Gender	Male	Female	Transgender
No. of Workers (in thousands)	100	200	300

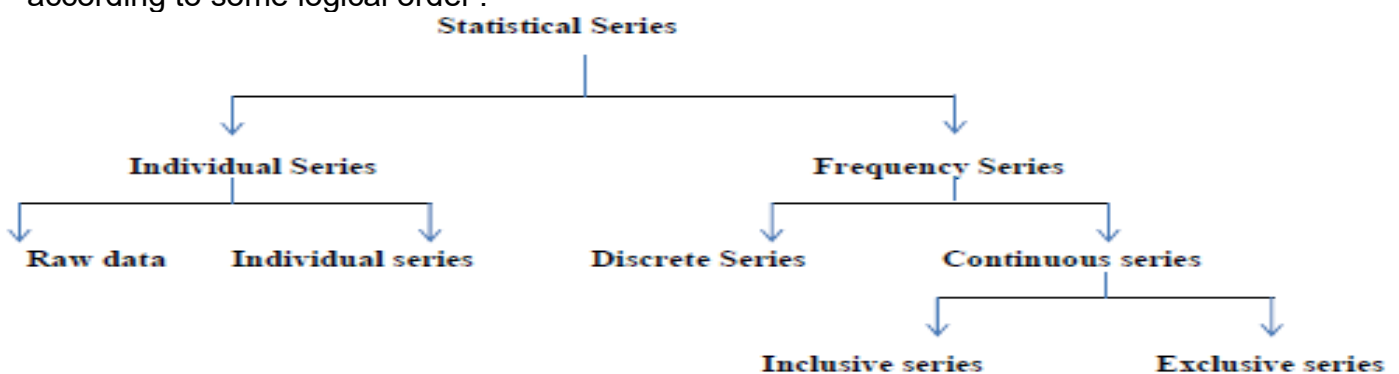
4. **Quantitative classification:** Data are classified on the basis of some measurable characteristics such as height, age, weight, income, marks of students.

Example:

Age (in years)	20-30	30-40	40-50
No. of Workers (in thousands)	100	200	300

❖ **Statistical Series**

• **Series:** 'A series as used statistically may be defined as things or attributes of things arranged according to some logical order'.



• **Variables:** It represents quantitative character of an item which changes its value from time to time.

- i. **Discrete variable:** These are finite and exact value in the series, e.g., 10, 20, 30, etc.
- ii. **Continuous variable:** These variables are expressed in fractions or as range, e.g., 10-20, 20-30, 30-40, etc.

## Statistical series can be arranged on the basis of

### 1. Individual units :

The data can be individually presented in two forms:

a) **Raw data:** Data collected in original form.

b) **Individual Series:** The arrangement of raw data individually. It can be expressed in two ways.

➤ **Alphabetical arrangement:** Alphabetical order

➤ **Array:** Ascending or descending order.

### 2. Frequency Distribution:

Frequency distribution refers to a table in which observed values of a variable are classified according to their numerical magnitude.

i. **Discrete Series:** A variable is called discrete if the variable can take only some particular values.

ii. **Continuous Series:** A variable is called continuous if it can take any value in a given range. In this series the values are shown in a continuous manner.

### Terms used in continuous series:

a) **Class:** Each given interval is called a class e.g., 10-20, 20-30, etc.

b) **Class limit:** There are two limits upper limit and lower limit.

c) **Class interval:** Difference between upper limit and lower limit.

d) **Range:** Difference between upper limit and lower limit.

e) **Mid-point or Mid Value** =  $(\text{Upper Limit} - \text{Lower Limit})/2$

f) **Frequency:** Number of items (observations) falling within a particular class.

### Types of Continuous Series

a. **Exclusive Series:** Excluding the upper limit of these classes, all the items of the class are included in the class itself. E.g.,

Marks	0-10	10-20	20-30	30-40
Number of students	10	6	5	4

b. **Inclusive Series:** Upper class limits of classes are included in the respective classes. E.g.,

Marks	0-4	5-9	10-14	15-19
Number of students	2	5	2	4

c. **Open End Classes:** The lower limit of the first class and upper limit of the last class are not given. 'Below' or 'above' words are used instead of lower limit (first class) and upper limit (last class) respectively.

Marks	below 20	20-30	30-40	40-50	50 and above
Number of students	7	6	12	5	3

d. **Cumulative Frequency Series:** It is obtained by successively adding the frequencies of values of the classes according to a certain law.

i. **Less than Cumulative Frequency Distribution:** The frequencies of each class – interval are added successively.

ii. **More than Cumulative Frequency Distribution:** The more than cumulative frequency is obtained by finding the cumulative totals of frequencies starting from the highest value of variable to the lowest value.

Income (Rs. )	Number of Persons
0-100	07
100-200	17
200-300	20
300-400	14
Total	58

Income ( Rs )	Number of Persons
Less than 100	07
Less than 200	24 (07+17)
Less than 300	44 (24+20)
Less than 400	58 (44+14)

Income ( Rs )	Number of Persons
More than 0	58 (07+17+20+14)
More than 100	51 (17+20+14)
More than 200	34 (20+14)
More than 300	14 (14+0)
More than 400	0

**Multiple Choice Questions/Statement Based questions:**

- When data is classified on the basis of area, it is known as \_\_\_\_\_.  
 a. Qualitative classification                      b. Quantitative classification  
 c. Geographical classification                  d. Chronological Classification
- In chronological classification, data are classified on the basis of  
 a. Time    b. Area  
 c. Attributes    d. None of these
- Types of continuous series:  
 a. Inclusive    b. Exclusive  
 c. Open end series    d. All of the these
- Frequency is the number of, an observation repeats in the series  
 a. years     b. times  
 c. weeks    d. months
- Frequency of variables in an individual series is:  
 a. one    b. same  
 c. zero    d. all of these
- Class interval is group made by \_\_\_\_\_ limits.  
 a. one    b. two  
 c. three    d. four
- Classified data are better than the raw data. True/False
- Discrete variables are finite and are not expressed as range. True/False
- Read the following Assertion and Reason. Choose the correct alternatives given below:  
 Assertion (A): The basis selected for the classification should be in accordance with the objective of the statistical study.  
 Reason (R): If basis selected for classification do not match the requirement, the entire exercise of the investigation is meaningless.  
  
 a. Both Assertion (A) & Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).  
 b. Both Assertion (A) & Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).  
 c. Assertion (A) is true but Reason (R) is false.  
 d. Assertion (A) is false but Reason (R) is true.

10. Read the following Assertion and Reason. Choose the correct alternatives given below:

Assertion (A): Discrete variables are finite and represent an exact value in series.

Reason (R): Continuous variable are expressed a range. These can be of any value within the limits.

- a. Both Assertion (A) & Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- b. Both Assertion (A) & Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
- c. Assertion (A) is true but Reason (R) is false.
- d. Assertion (A) is false but Reason (R) is true.

### **Short & Long answer questions**

- 1. What is classification of data?
- 2. Define statistical series.
- 3. What is raw data?
- 4. Define exclusive and inclusive series with example.
- 5. State the objectives of classifying the data.
- 6. Explain the method of classification.
- 7. Marks obtained by 10 students are given below. Arrange these in an individual series.  
25, 21, 17, 9, 12, 54, 23, 15, 11, 10
- 8. Construct a discrete series with the help of data given on 20 students of Class XI have secured following the marks:  
16, 16, 21, 20, 18, 15, 19, 18, 19, 17, 19, 15, 21, 15, 16, 20, 21, 19, 17, 21
- 9. Covert the following series into less than and more than cumulative frequency series:

X	f
0-10	5
10-20	10
20-30	15
30-40	1
40-50	8

### (iii) Presentations of Data

With proper presentation of data the voluminous data collected can be made readily usable and are easily comprehended.

#### Types of presentation of data-

1. **Textual/Descriptive Presentation of Data:** Data are presented in simple language with facts and figures.
2. **Tabular Presentation of Data:**
  - Tabulation means orderly arrangement of data in rows and columns.
  - It is also called tabulation.

#### Objectives of Tabulation

- It simplifies the complex data.
- Helps in understanding and interpreting the data easily.
- It helps in comparing data.
- It saves space and time.
- Tabulated data can be easily presented in the form of diagrams and graphs.

#### ❖ Essentials of table:

- i. Title
- ii. Size
- iii. Simplicity
- iv. Clarity
- v. Units
- vi. Avoid Abbreviation

#### ❖ Components of a table:

- i. **Table number:** It is given to be used for reference.
- ii. **Title of the table:** It is a brief explanation of contents of the table.
- iii. **Body of the table:** Most important part of table as it contains data.
- iv. **Head note:** Head note is inserted to convey complete information of title.
- v. **Stubs:** It explain heading/content of row of a table.
- vi. **Captions:** It explains the heading/content of a column of a table.
- vii. **Foot note:** It is used for pointing exceptions to the data.
- viii. **Source:** It refers to the source from which information has been taken.

#### ❖ Classification used in tabulation is of four kinds:

- I. **Qualitative:** This classification is done according to characteristics which are qualitative in nature. E.g. Social status, economic status, nationality etc.
- II. **Quantitative:** This classification is done according to characteristics which are quantitative in nature. E.g. Height, weight, production, income, etc.
- III. **Temporal:** This classification is done on the basis of time. E.g., hours, weeks, months, days, years, etc.
- IV. **Spatial:** This classification is done on the basis of place. E.g., Village, town, block, district, state, country, etc.



### Format of a table:

Table Number \_\_\_\_\_

Title \_\_\_\_\_

Head Notes ( \_\_\_\_\_ )

Stubs (Row Heading)	Caption (Column Heading)		
	(Sub Heads)		
Row entries/Stub entries	←	↑ Body/Field/Cell of the Table ↓	→

Footnote: \_\_\_\_\_

Source: \_\_\_\_\_

### (iv) Diagrammatic presentation of data

**Meaning of Diagrammatic presentation** –Diagrammatic presentation is a technique of presenting data in the form of Diagrams .

#### Types of Diagrams:

- I. **Line Diagrams:** Lines are drawn vertically to show large number of items.
- II. **Bar Diagram:**
  - a. **Simple Bar diagrams:** These diagrams represent only one particular type of data.
  - b. **Multiple Bar diagrams:** These diagrams represent more than one type of data at a time.
  - c. **Subdivided Bar diagram or Component Bar diagram:** These diagrams present total values and parts in a set of a data.
  - d. **Pie diagrams:** Circle may be divided into various sectors representing various components of the data.

#### ❖ **Merits**

- i. Attractive
- ii. Makes complex data simple.
- iii. It makes comparison easy.
- iv. Diagrams create long lasting impact on the viewer.

#### ❖ **Limitations/demerits**

- i. Limited use.
- ii. They do not provide detailed information.
- iii. Not of much use for expert.
- iv. Not capable of further analysis.

**Graphical presentation of data:**–Statistical data's are presented on a graph paper in the form of lines or curves.

❖ **Advantages of Graphic Presentation:**

- i. Graphs represent complex data in a simple form.
- ii. Values of median, mode can be found through graphs.
- iii. Graphs create long lasting effect on people's mind.
- iv. Does not require mathematical knowledge.

❖ **Disadvantages of graphic Presentation:**

- i. Graphs do not show precise values.
- ii. Only experts can interpret graphs.
- iii. Graphs may suggest wrong conclusions.

❖ **Rules of Constructing graph:**

- i. The heading of the graph should be simple, clear and self explanatory.
- ii. Graphs should always be drawn with reference to some scale.
- iii. False baselines should be drawn if the difference between zero and the smallest value is high.
- iv. Index should be made if different lines are drawn as in time series graphs.

❖ **Types of Graphs:**

- I. **Line frequency graphs:** Such graphs are used to represent discrete series.
- II. **Histogram:** A two dimensional diagram whose length shows frequency and breadth shows size of class interval.
- III. **Frequency Polygon:** A histogram becomes frequency polygon when a line is drawn joining midpoints of tops of all rectangles in a histogram.
- IV. **Frequency Curve:** Smooth curve joining the points corresponding to the frequency and provides frequency curve of the data.
- V. **Ogives/Cumulative frequency curve:** A curve obtained by plotting frequency data on the graph paper.

**Multiple Choice Questions/Statement Based questions:**

1. Tabulation is, arranging data in \_\_\_\_\_.
  - a. Rows & graphs
  - b. Rows and columns
  - c. Rows & diagrams
  - d. Diagrams & graphs
2. Components of a table:
  - a. Source
  - b. Caption
  - c. Foot notes
  - d. All of the above
3. Bar diagram is a
  - a. Two dimensional diagram
  - b. Three dimensional diagram
  - c. One dimensional diagram
  - d. None of the above
4. The diagram which represent information in a circle is:
  - a. Bar diagram
  - b. Pie diagram
  - c. Polygon
  - d. Histogram
5. Histogram represents \_\_\_\_\_ series.
  - a. Individual series
  - b. Discrete series
  - c. Continuous series
  - d. None of the above

6. Ogives represent \_\_\_\_\_ on a graph.
- Individual frequency
  - Cumulative frequencies
  - Frequency polygon
  - Frequency curve
7. Captions: It explains the heading/contents of rows in a table. True/ False.
8. Degree measure of all components in a pie diagram is  $360^\circ$ . True /False
9. Read the following Assertion and Reason. Choose the correct alternatives given below:  
 Assertion (A): Simple bar diagrams represent only one variable or one characteristic of the data.  
 Reason (R): Simple bar diagram bears uniform thickness and placed at unequal distance.
- Both Assertion (A) & Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
  - Both Assertion (A) & Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
  - Assertion (A) is true but Reason (R) is false.
  - Assertion (A) is false but Reason (R) is true
10. Read the following Assertion and Reason. Choose the correct alternatives given below:  
 Assertion (A): A table must have suitable title. Title briefly explains the contents of a table.  
 Reason (R): A good title contains the topic of study, the time period of study, the place of study.
- Both Assertion (A) & Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
  - Both Assertion (A) & Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
  - Assertion (A) is true but Reason (R) is false.
  - Assertion (A) is false but Reason (R) is true

### Short & Long answer questions

- Give the meaning of Tabulation? What are the main objectives of tabulation?
- What are components of a good table?
- Draw a table showing all its parts.
- Define diagrammatic presentation of data?
- What is one dimensional diagram? Name types of these diagrams.
- What Pie chart.
- Define Histogram.
- What is Ogives? Explain its types.
- Construct a Histogram for the following data:

Weekly Wages (₹)	Number of Workers (f)
10-15	4
15-20	16
20-25	24
25-30	32
30-40	40
40-60	48

10. Construct a frequency polygon for the following data:

Marks	0-10	10-20	20-30	30-40	40-50
Number of students	10	15	20	40	25

## Unit 3- (i)Measures of Central Tendency

A measure of central tendency is a single value that is used to represent an entire set of data. Measure of central tendency is also known as an 'Average'.

The three most commonly used measures of central tendency or 'averages' are:

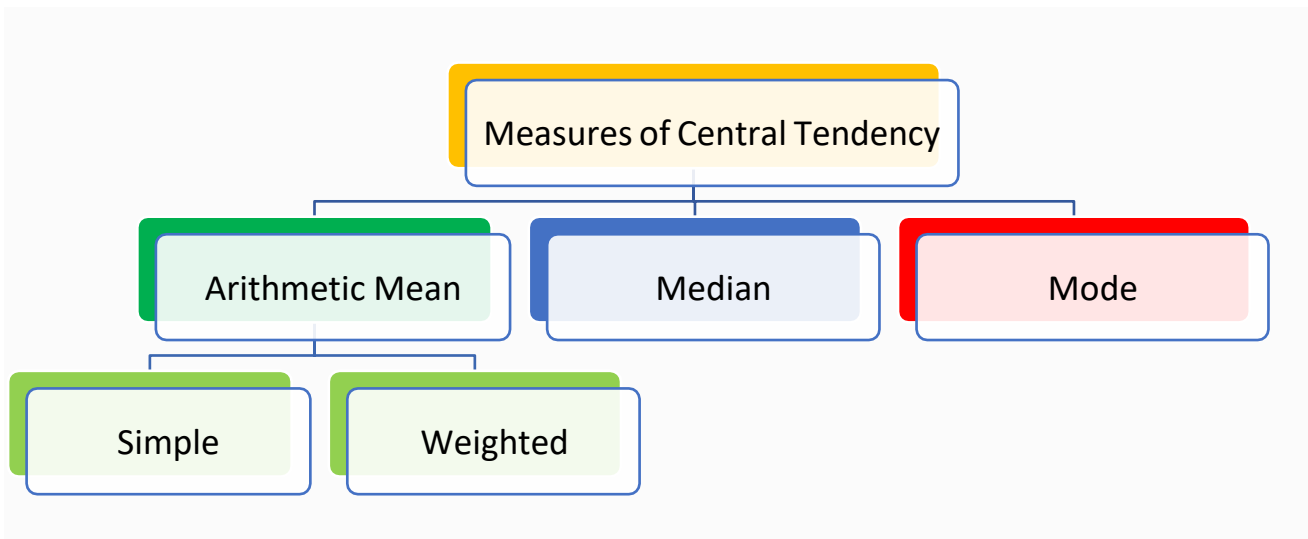
- Arithmetic Mean
- Median
- Mode

### Objectives and functions of averages

1. **To present huge data in a summarised form:** It is difficult to grasp a large amount of data or numerical figures. Averages summarise such data into a single figure which makes it easier to understand and remember.
2. **To facilitate comparison:** Averages are very helpful for making comparative studies as they reduce the mass of statistical data to a single figure or estimate.
3. **To facilitate further statistical analysis:** Various tools of statistical analysis like standard deviation, correlation etc. are based on averages.
4. **To trace precise relationship:** Averages are helpful and even essential when it comes to establishing relationships between different groups of data or variables.
5. **To help in decision-making:** Averages provide values which act as a guideline for decision makers. Most of the decisions to be taken in research or planning are based on the average value of certain variables.

### Essentials of a good average / measure of central tendency

1. **It should be rigidly defined:**
  - An average should be clear and there should be only one form of interpretation.
  - It should have a definite and fixed value irrespective of method of calculations or formulae used.
2. **It should be based on all observations:**
  - Average should be calculated by taking into consideration each and every item of the series.
  - If it is not based on all observations, it will not be representative of the whole group.
3. **It should not be affected much by extreme values:**
  - The value of an average should not be affected much by extreme values.
  - One or two very small or very large values should not unduly affect the value of the average significantly.
4. **It should be least affected by fluctuations of sampling:**
  - An average should possess sampling stability i.e. If we take two or more samples from a given population and compute averages for each, then the values thus obtained from different samples should not differ much from each other.
5. **It should be easy to understand and compute:**
  - The value of an average should be computed by using a simple method without reducing its accuracy and other advantages.
6. **It should be capable of further algebraic treatment:**
  - It should be capable of further mathematical and statistical analysis to expand its utility such as to be further used in calculation of measures of dispersion, correlation etc.



**Arithmetic Mean**-It is defined as the sum of the values of all observations divided by the number of observations.

In general, if there are N observations as  $X_1, X_2, X_3, \dots, X_N$ , then the Arithmetic Mean is given by:

$$\bar{X} = \frac{X_1 + X_2 + X_3 + \dots + X_N}{N}$$

$$\bar{X} = \frac{\Sigma X}{N}$$

For convenience, this will be written in simpler form:

### Calculation of Arithmetic Mean

#### 1-Individual series

##### (i)-Direct method

$$\bar{X} = \frac{\Sigma X}{N}$$

where,  $\Sigma X$  = Sum of all observations and  $N$  = Total number of observations.

The following data shows the weekly income of 10 families. Calculate the arithmetic mean by direct method and interpret the result. (3 marks)

Family	A	B	C	D	E	F	G	H	I	J
Weekly Income (in ₹)	850	700	100	750	5,000	80	420	2,500	400	360

#### Computation of Arithmetic Mean by Direct Method

Family	A	B	C	D	E	F	G	H	I	J	total
Weekly Income (X)	850	700	100	750	5,000	80	420	2,500	400	360	11,160

$$\bar{X} = \frac{\Sigma X}{N} = \frac{11,160}{10} = ₹1,116$$

##### (ii)- Assumed Mean Method

$$\bar{X} = A + \frac{\Sigma d}{N}$$

where,  $d = (X - A)$  ;  $A$  = Assumed mean and  $N$  = Total number of observations.

The following table gives the daily income of ten workers in a factory. Find the arithmetic mean by Assumed Mean Method. (NCERT) (3 marks)

Workers	A	B	C	D	E	F	G	H	I	J
Daily Income (in ₹)	120	150	180	200	250	300	220	350	370	260

Taken Assumed mean 250

**Solution:**

**Computation of Arithmetic Mean by Assumed Mean Method**

Workers	Daily Income (₹) (X)	d = X - 250
A	120	-130
B	150	-100
C	180	-70
D	200	-50
E	250	0
F	300	+50
G	220	-30
H	350	+100
I	370	+120
J	260	+10
<b>N = 10</b>		<b>- 100</b>

$$\bar{X} = A + \frac{\sum d}{N} = 250 + \left(\frac{-100}{10}\right) = 250 - 10 = ₹240$$

Thus, the average daily income of a worker is ₹240.

**(iii) Step Deviation Method**

$$\bar{X} = A + \frac{\sum d' \times c}{N}$$

where, d' = (X - A) ; and C is the common factor in d.

A = Assumed mean and  $\sum f = N =$  Total number of observations

The following data shows the weekly income of 10 families. Calculate the arithmetic mean by step deviation method and interpret the result. (3 marks)

Family	A	B	C	D	E	F	G	H	I	J
Weekly Income (in ₹)	850	700	100	750	5,000	80	420	2,500	400	360
Families	Income (X)		d = X - 850		d' = (X - 850)/10					
A	850		0		0					
B	700		-150		-15					
C	100		-750		-75					
D	750		-100		-10					
E	5000		+4150		+415					
F	80		-770		-77					
G	420		-430		-43					
H	2500		+1650		+165					
I	400		-450		-45					
J	360		-490		-49					
						<b>+266</b>				

$$\bar{X} = A + \frac{\sum d'}{N} \times c = 850 + \frac{266}{10} \times 10 = 850 + 266 = ₹1,116.$$

Interpretation: The average weekly income of a family is ₹1,116.

## 2-DISCRETE SERIES

### (i) Direct Method

$$\bar{X} = \frac{\sum fX}{\sum f}$$

where,  $\sum fX$  = Sum of all observations multiplied by their respective frequency and  $\sum f = N$  = Total number of observations.

Plots in a housing colony come in only three sizes: 100 sq. metre, 200 sq. meters and 300 sq. metre and the number of plots are respectively 200, 50 and 10. Calculate the mean plot size in the housing colony by direct method.

**Solution:** **Computation of Arithmetic Mean by Direct Method**

Plot Size in sq. metre (X)	No. of Plots (f)	f X
100	200	20,000
200	50	10,000
300	10	3,000
	<b>260</b>	<b>33,000</b>

$$\bar{X} = \frac{\sum fX}{\sum f} = \frac{33000}{260} = 126.92$$

Therefore, the mean plot size in the housing colony is 126.92 sq. metre.

### (ii) Assumed Mean Method

$$\bar{X} = A + \frac{\sum fd}{\sum f}$$

where,  $d = (X - A)$  ;  $A$  = Assumed mean and  $\sum f = N$  = Total number of observations.

Plots in a housing colony come in only three sizes: 100 sq. metre, 200 sq. meters and 300 sq. metre and the number of plots are respectively 200, 50 and 10. Calculate the mean plot size in the housing colony by assumed mean method.

**Solution:** **Computation of Arithmetic Mean by Assumed Mean Method**

Plot Size in (Take A = 200)	No. of Plots (f)	d = X-200	fd
100	200	-100	-20,000
200	50	0	0
300	10	+100	+1,000
	<b>260</b>		<b>-19,000</b>

$$\text{Mean plot size } \bar{X} = A + \frac{\sum fd}{\sum f} = 200 + \left( \frac{-19,000}{260} \right) = 200 - 73.08 = 126.92 \text{ sq. metre}$$

### (iii) Step Deviation Method

$$\bar{X} = A + \frac{\sum fd'}{\sum f} \times c$$

where,  $d' = (X - A)$  ; and  $C$  is the common factor in  $d$ .  
 $A$  = Assumed mean and  $\sum f = N$  = Total number of observations.

Plots in a housing colony come in only three sizes: 100 sq. metre, 200 sq. meters and 300 sq. metre and the number of plots are respectively 200, 50 and 10. Calculate the mean plot size in the housing colony by step-deviation method. (3 marks)

**Solution:** **Computation of Arithmetic Mean by Step Deviation Method**

Plot Size in sq. metre (X)	No. of Plots (f)	d' = (X-200)/100	fd'
100	200	-1	-200
<u>200</u>	50	0	0
300	10	+1	10
	<b>260</b>		<b>-190</b>

$$\text{Mean plot size } \bar{X} = A + \frac{\sum fd'}{\sum f} \times c = 200 + \left( \frac{-190}{260} \right) \times 100 = 200 - 73.08 = 126.92 \text{ sq. metre}$$

### 3- CONTINUOUS SERIES

**(i) Direct Method**

$$\bar{X} = \frac{\sum fm}{\sum f}$$

where,  $\sum fm$  = Sum of midpoints of classes multiplied by their respective class frequency  
 $\sum f = N$  = Total number of observations.

Calculate average marks of the following students by using direct method:

(3 marks)

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Students	5	12	15	25	8	3	2

Mark (X)	No. of students (f)	Mid value (m)	fm
(1)	(2)	(3)	(4) = (2) × (3)
0-10	5	5	25
10-20	12	15	180
20-30	15	25	375
30-40	25	35	875
40-50	8	45	360
50-60	3	55	165
60-70	2	65	130
	<b>70</b>		<b>2,110</b>

$$\bar{X} = \frac{\sum fm}{\sum f} = \frac{2,110}{70} = 30.14$$

Therefore, average marks of 70 students is 30.14.



## (ii) Assumed Mean / Shortcut Method

$$\bar{X} = A + \frac{\sum fd}{\sum f}$$

where,  $d = (m - A)$  and  $m$  is the midpoint of the respective class.

$A =$  Assumed mean and  $\sum f = N =$  Total number of observations.

Calculate average marks of the following students by using assumed mean method: (Take  $A = 35$ )

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Students	5	12	15	25	8	3	2

Mark (X)	No. of students (f)	Mid value (m)	$d = m - 35$	fd
(1)	(2)	(3)	(4)	(5) = (2) × (4)
0-10	5	5	-30	-150
10-20	12	15	-20	-240
20-30	15	25	-10	-150
30-40	25	35	0	0
40-50	8	45	10	80
50-60	3	55	20	60
60-70	2	65	30	60
	70			-340

$$\bar{X} = A + \frac{\sum fd}{\sum f} = 35 + \left(\frac{-340}{70}\right) = 35 - 4.86 = 30.14$$

Therefore, Average marks of 70 students is 30.14.

## (iii) Step Deviation Method

$$\bar{X} = A + \frac{\sum fd'}{\sum f} \times c$$

Calculate average marks of the following students by using step deviation method:

(3 marks)

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of Students	5	12	15	25	8	3	2

**Solution:** Computation of Average Marks for Exclusive Class Interval by Step deviation Method

Mark (X)	No. of students (f)	Mid value (m)	$d' = (m - 35)/10$	fd'
(1)	(2)	(3)	(4)	(5) = (2) × (4)
0-10	5	5	-3	-15
10-20	12	15	-2	-24
20-30	15	25	-1	-15
30-40	25	35	0	0
40-50	8	45	1	8
50-60	3	55	2	6
60-70	2	65	3	6
	70			-34

$$\text{Average marks of 70 students, } \bar{X} = A + \frac{\sum fd'}{\sum f} \times c = 35 + \frac{(-34)}{70} \times 10 = 30.14$$

## Weighted Mean

It refers to the average when different items of a series are given different weights according to their relative importance. In case of simple arithmetic mean all items of a series are given equal importance. The Weighted Mean is given by:

$$\bar{X}_w = \frac{W_1 X_1 + W_2 X_2 + \dots + W_n X_n}{W_1 + W_2 + \dots + W_n} = \frac{\sum WX}{\sum W}$$

**For example:**

Find out weighted mean of the following:

Items	Rice	Wheat	Pulses	Cloth	Others
Price	₹100 per kg	₹150 per kg	₹300 per kg	₹15 per metre	₹100 per unit
Weight	6	5	3	2	1

**Solution:**

**Calculation of Weighted Mean**

Items	Price (X)	Weight (W)	WX
Rice	100	6	600
Wheat	150	5	750
Pulses	300	3	900
Cloth	15	2	30
Others	100	1	100
		$\Sigma W = 17$	$\Sigma WX = 2380$

$$\text{Weighted mean } \bar{X}_w = \frac{\Sigma WX}{\Sigma W} = \frac{2,380}{17} = 140$$

**To find the correct mean when incorrect and correct entries are given:**

$$\text{Correct } \bar{X} = \frac{\Sigma X_{(\text{wrong})} + \text{correct values} - \text{incorrect values}}{N}$$

## Arithmetic Mean at a Glance

Ungrouped Data	Grouped Data	
	Discrete Series	Continuous Series
<b>Direct Method</b> $\bar{X} = \frac{\Sigma X}{N}$	<b>Direct Method</b> $\bar{X} = \frac{\Sigma fX}{\Sigma f}$	<b>Direct Method</b> $\bar{X} = \frac{\Sigma fm}{\Sigma f}$
<b>Assumed Mean Method</b> $\bar{X} = A + \frac{\Sigma d}{N}$ <p>where, A = assumed mean  <math>\Sigma d = \Sigma(X - A)</math></p>	<b>Assumed Mean Method</b> $\bar{X} = A + \frac{\Sigma fd}{\Sigma f}$	<p>where, m = mid values</p> <b>Assumed Mean Method</b> $\bar{X} = A + \frac{\Sigma fd}{\Sigma f}$
<b>Step Deviation Method</b> $\bar{X} = A + \frac{\Sigma d' \times c}{N}$ <p>where, c = common factor  <math>d' = \frac{(X - A)}{c}</math></p>	<b>Step Deviation Method</b> $\bar{X} = A + \frac{\Sigma fd' \times c}{\Sigma f}$	<p>where, d = m - A</p> <b>Step deviation method</b> $\bar{X} = A + \frac{\Sigma fd' \times c}{\Sigma f}$ <p>where, <math>d' = \frac{m - A}{c}</math></p>
<b>Combined mean:</b> $\bar{X}_{12} = \frac{N_1 \bar{X}_1 + N_2 \bar{X}_2}{N_1 + N_2}$	<b>Weighted arithmetic mean:</b> $\bar{X}_w = \frac{\Sigma WX}{\Sigma W}$	

## **Arithmetic mean in special cases**

- 1) Cumulative Series (Less-than or More-than series): Cumulative frequency series is first converted into simple frequency series and then mean is calculated in the usual manner.
- 2) Mid-Value series: There is no need to convert the mid-value series into classes since only the midpoint is required for calculation of mean.
- 3) Inclusive series: There is no need to convert inclusive series into exclusive series as the midpoint remains the same in both types of series for calculation of mean.
- 4) Open-ended series: The missing class limits are assumed according to the pattern of class intervals of other classes and then the mean is calculated in the usual manner.
- 5) Unequal class series: Mean can be calculated in the usual manner by first calculating the midpoints of each class even if it is of unequal size.

## **Merits of Arithmetic Mean**

- It is based on all observations i.e it takes into consideration all the values in a given series. It is considered to be more representative of the distribution.
- Its value is always definite and it is rigidly defined.
- It is capable of further algebraic treatment. It is widely used in the computation of various statistical measures such as standard deviation, correlation etc.
- Arithmetic mean is the least affected by fluctuations of sampling.

## **Demerits of Arithmetic Mean**

- It is affected by extreme values : Since arithmetic mean is calculated using all the items of a series, it can be unduly affected by extreme values i.e. very small or very large items.
- It may give absurd results: For example, if a teacher says that average number of students in a class is 28.75, it sounds illogical.
- It cannot be obtained graphically like median or mode.
- Arithmetic mean cannot be computed for qualitative data such as honesty, intelligence etc.
- It gives more stress on items of higher value: Arithmetic mean gives more importance to higher items of a series as compared to smaller items or has an upward bias. If out of five, four values are small but one is of a bigger value, the bigger value item will push up the average considerably.

## Median

Median is defined as the middle value in the data set when its elements are arranged in a sequential order, that is, in either ascending or descending order. It is a positional value. Positional average determines the position of variables in the series.

### (1) INDIVIDUAL SERIES

Steps for calculating median

**Step1:** First arrange the data in ascending order.

**Step2:** Use the given formula to calculate the median.

$$\text{Median} = \text{size of } \left(\frac{N+1}{2}\right)^{\text{th}} \text{ item}$$

where N = Total number of observations

From the following data of the wages of 7 workers, compute the median wage and interpret the result:

Wages (in ₹)	1,100	1,150	1,080	1,120	1,200	1,160	1,400
--------------	-------	-------	-------	-------	-------	-------	-------

**Solution:**

Wages (in ₹)	1,080	1,100	1,120	1,150	1,160	1,200	1,400
--------------	-------	-------	-------	-------	-------	-------	-------

$$\text{Median} = \text{size of } \left(\frac{N+1}{2}\right)^{\text{th}} \text{ item} = \text{size of } \left(\frac{7+1}{2}\right)^{\text{th}} \text{ item} = 4^{\text{th}} \text{ item} = 1,150$$

Therefore, the median wage is ₹1,150.

If there are even numbers in the data, there will be two observations which fall in the middle. The median in this case is computed as the arithmetic mean of the two middle values. However, the same formula for calculating median shall apply.

$$\text{Median} = \text{size of } \left(\frac{N+1}{2}\right)^{\text{th}} \text{ item}$$

### When the number of observations is an even number

The following data provides marks of 20 students. Calculate median marks and interpret the result:

25, 72, 28, 65, 29, 60, 30, 54, 32, 53, 33, 52, 35, 51, 42, 48, 45, 47, 46, 33

**Solution:** Arranging the data in an ascending order, we get

25, 28, 29, 30, 32, 33, 33, 35, 42, 45, 46, 47, 48, 51, 52, 53, 54, 60, 65, 72

$$N = 20. \text{ Median} = \text{size of } \left(\frac{N+1}{2}\right)^{\text{th}} \text{ item} = \text{size of } \left(\frac{20+1}{2}\right)^{\text{th}} \text{ item} = \text{size of } 10.5^{\text{th}} \text{ item}$$

$$\text{Size of } 10.5^{\text{th}} \text{ item} = \frac{10^{\text{th}} \text{ item} + 11^{\text{th}} \text{ item}}{2} = \frac{45 + 46}{2} = 45.5$$

Therefore, Median = 45.5 marks

## (2) DISCRETE SERIES

### Steps for calculating median

**Step 1:** Arrange the data in ascending or descending order.

**Step 2:** Find out the cumulative frequencies.

**Step 3:** Median = size of  $\left(\frac{N+1}{2}\right)^{\text{th}}$  items, where  $N = \sum f$

**Step 4:** The value whose cumulative frequency is equal to  $\frac{N+1}{2}$  or next higher to that, is the median value.

**Solution:** In order to calculate the median income, we calculate the cumulative frequencies.

#### Computation of Median for Discrete Series

Income (in ₹)	No. of persons (f)	Cumulative frequency (c.f.)
100	2	2
200	4	6
300	10	16
400	4	20
$N = \sum f = 20$		

The median is located in the  $\frac{N+1}{2} = \frac{20+1}{2} = 10.5$ th observation.

This can be easily located through cumulative frequency.

The 10.5th observation lies in the c.f. of 16.

The income corresponding to this is ₹300, so the median income is ₹300.

## (3) CONTINUOUS SERIES

### Steps for calculating median

**Step1:** Locate the median class where  $(N/2)^{\text{th}}$  item lies ;  $N= \sum f$ .

**Step2 :** Using the formula given below, calculate the median.

$$\text{Median} = L + \frac{\left(\frac{N}{2} - \text{c.f.}\right)}{f} \times h$$

where,

L = lower limit of the median class

c.f. = cumulative frequency of the class preceding the median class

f = frequency of the median class

h = magnitude of the median class interval

Following data relates to daily wages (in ₹) of persons working in a factory. Compute the median daily wage.

Daily wages	550–600	500–550	450–500	400–450	350–400	300–350	250–300	200–250
No. of workers	7	13	15	20	30	33	28	14

**Solution:** We rearrange the data in ascending order and calculate cumulative frequencies.

**Computation of Median for Continuous Series**

Daily wages (in ₹)	No. of Workers (f)	Cumulative Frequency
200–250	14	14
250–300	28	42
300–350	33	75
350–400	30	105
400–450	20	125
450–500	15	140
500–550	13	153
550–600	7	160

Median class is the value of  $\left(\frac{N}{2}\right)^{\text{th}}$  item =  $\left(\frac{160}{2}\right)^{\text{th}}$  item = 80<sup>th</sup> item of the series, which lies in 350–400 class interval.

$$\text{Median} = L + \frac{\left(\frac{N}{2} - \text{c.f.}\right)}{f} \times h$$

$$\text{Median} = 350 + (80 - 75) \times 50 = 350 + 8.33 = `358.33$$

30

The median daily wage is `358.33.

### Median Formulae at a Glance

Ungrouped Data	Grouped Data	
	Discrete Series	Continuous Series
Median = size of $\left(\frac{N+1}{2}\right)^{\text{th}}$ item where N = number of items	Median = size of $\left(\frac{N+1}{2}\right)^{\text{th}}$ item where N = $\Sigma f$ The position of median can be located through cumulative frequency.	Locate median class where $\left(\frac{N}{2}\right)^{\text{th}}$ item lies.  $\text{Median} = L + \frac{\left(\frac{N}{2} - \text{c.f.}\right)}{f} \times h$ where, L = lower limit of the median class c.f. = cumulative frequency of preceding class f = frequency of the median class h = magnitude of the median class

### Properties of Median

- 1) The sum of absolute deviations of items from the median (ignoring the signs) is the minimum. i.e.  $\Sigma |X - \text{Median}|$  is minimum.
- 2) Median is a positional average so is not affected by change in extreme values.

## Median in special cases

- 1) Cumulative Series (Less-than or More-than series): Cumulative frequency series is first converted into simple frequency series and then median is calculated in the usual manner.
- 2) Mid-Value series: Mid- values are first converted into classes and then median is calculated in the usual manner
- 3) Inclusive series: The inclusive series is first converted into exclusive series and then median is calculated in the usual manner.
- 4) Open-ended series: There is no need to complete the class intervals to calculate the median.
- 5) Unequal class series: Median can be calculated in the usual manner and there is no need to make the class intervals equal.

### Merits of Median

- Its value is always definite and it is rigidly defined.
- It is not affected by extreme values.
- It can be obtained graphically using ogives.
- It is appropriate for qualitative data.
- It can be calculated even in case of open-ended distributions.

### Demerits of Median

- It is not based on all observations.
- It is not capable of further algebraic treatment.
- It is affected by fluctuations of sampling.
- It requires arrangement of data in ascending or descending order of magnitude.

## MODE

Mode is defined as the value occurring most frequently in a given series and around which other items of the set cluster most densely.

The word mode has been derived from the French word '**la Mode**' which signifies the most fashionable values of a distribution, because it is repeated the highest number of times in the series.

### (1) INDIVIDUAL SERIES

The value which occurs maximum number of times is the **mode**.

Calculate the mode from the following data of the marks obtained by 10 students:

10, 27, 24, 12, 27, 27, 20, 18, 15, 30

Since the value 27 occurs the maximum number of times (thrice) in the series, hence the modal marks = 27

## (2) DISCRETE SERIES

There are two methods of calculating mode using grouped data:

- a) Inspection or Observation method                      b) Grouping method

**a) Inspection or observation method:** The value of the variable against the highest frequency will give the **mode**.

Calculate the mode from the following data:

<b>Variable</b>	10	20	30	40	50
<b>Frequency</b>	2	8	20	10	5

Since the maximum frequency is 20 in the given series, hence the value of mode is 30.

### **b) Grouping method**

Under this method, grouping of the data is done by preparing a **Grouping Table** consisting of 6 columns, in addition to a column for the values of the variable.

- In column I, the highest frequency is marked or put in a circle.
- In column II, frequencies are grouped in two's. Find out their total and mark the highest total or put it in a circle.
- In column III, leave the first frequency and then group the remaining in two's. Find out their total and mark the highest total or put it in a circle.
- In column IV, frequencies are grouped in three's. Find out their total and mark the highest total or put it in a circle.
- In column V, leave the first frequency and then group the remaining in three's. Find out their total and mark the highest total or put it in a circle.
- In column VI, leave the first two frequencies and then group the remaining in three's. Find out their total and mark the highest total or put it in a circle.

The highest frequency total in each of the six columns is identified and analysed in the **Analysis Column** to determine mode. The last column will be the analysis column and the mode will be the value against the highest tally in the analysis column.

## (3) CONTINUOUS SERIES

**Step1:** Find the modal class using either inspection or grouping method.

**a) Inspection/ observation method :** The modal class is the class with highest frequency.

Calculate the mode from the following data and interpret the result:

<b>Class Interval</b>	0-5	5-10	10-15	15-20	20-25
<b>Frequency</b>	7	18	25	30	20



By inspection method, the modal class is 15-20 since it has the highest frequency of 30.

By Grouping method (Steps same as in discrete series)

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Analysis Column
Marks	Frequency						
0 - 5	7	25	--	50	--	--	I
5 - 10	18		43		--	II	
10 - 15	25	55			73	75	IIII
15 - 20	30		50				IIII
20 - 25	20						II

By grouping method, the modal class is 15-20 since it has the highest frequency (tally) in the analysis

**Step2:** Using the modal class, mode can be calculated by using the formula:

$$M_o = L + \frac{|f_1 - f_0|}{|f_1 - f_0| + |f_1 - f_2|} \times h$$

Where **L** = Lower limit of the modal class ; **h** = width of the modal class

**f<sub>1</sub>** = frequency of the modal class

**f<sub>0</sub>** = frequency of the class preceding modal class.

**f<sub>2</sub>** = frequency of the class succeeding modal class.

Now, **L** = 15, **f<sub>1</sub>** = 30 ; **f<sub>0</sub>** = 25 ; **f<sub>2</sub>** = 20 ; **h** = 5

**|f<sub>1</sub> - f<sub>0</sub>|** = |30 - 25| = 5 ; **|f<sub>1</sub> - f<sub>2</sub>|** = |30 - 20| = 10

$$M_o = L + \frac{|f_1 - f_0|}{|f_1 - f_0| + |f_1 - f_2|} \times h$$

$$= 15 + \frac{5}{5+10} \times 5 = 15 + 1.67 = 16.67$$

Thus, the mode is 16.67 marks

### Mode in special cases

- 1) Cumulative Series (Less-than or More-than series) Cumulative frequency series is first converted into simple frequency series and then mode is calculated in the usual manner.
- 2) Mid-Value series: Mid-values are first converted into class intervals and then mode is calculated in the usual manner
- 3) Inclusive series: The inclusive series is first converted into exclusive series and then mode is calculated in the usual manner.
- 4) Open-ended series: There is no need to complete the class intervals to calculate the mode.
- 5) Unequal class series: The unequal classes need to be first converted into equal width classes and frequencies are adjusted before calculating the mode in the usual manner.

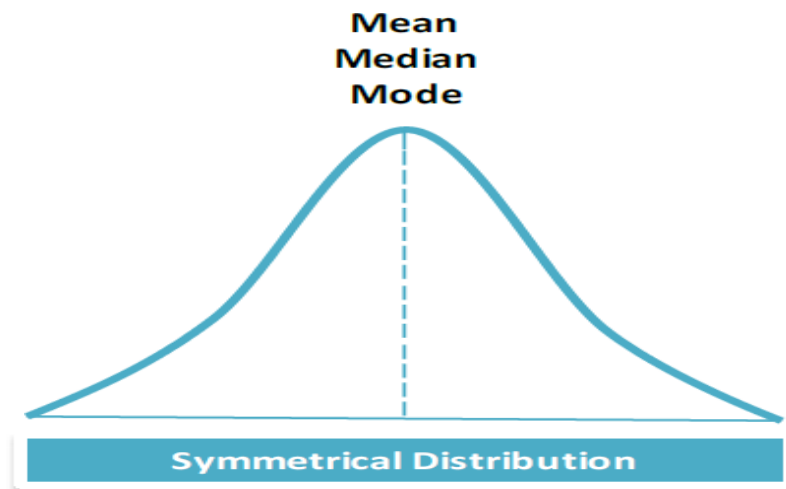
## Merits of Mode

- It is not affected by values of extreme items.
- It can be obtained graphically using histogram.
- It can be used to describe quantitative as well as qualitative data.
- It can be calculated even in case of open-ended distributions without finding class limits.

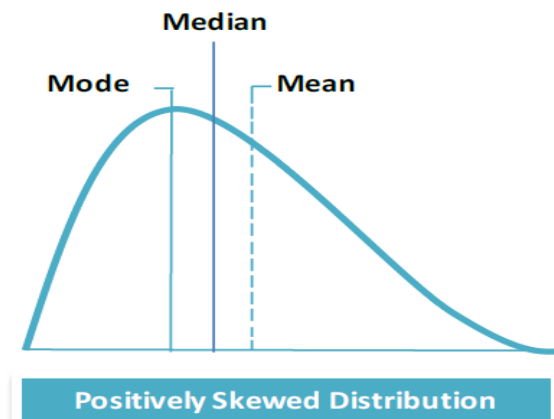
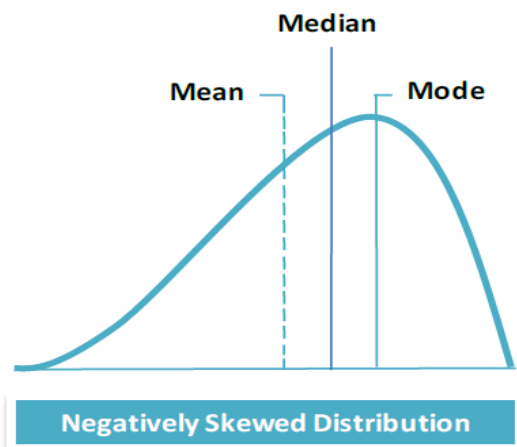
## Demerits of Mode

- It is not rigidly defined.
- It is not based on all observations.
- It is not capable of further algebraic treatment.
- It is affected by fluctuations of sampling.

### Relationship between Mean, Median and Mode



In a symmetrical distribution:  $\text{Mean} = \text{Median} = \text{Mode}$



**In an asymmetrical distribution: Mode = 3 Median – 2 Mean**

Symmetrical/normal distribution	Asymmetrical/skewed distribution
<p>In case of symmetrical/normal distribution:</p> <p style="text-align: center;"><b>Mean = Median = Mode</b></p> <p>Suppose Arithmetic Mean = <math>M_e</math>, Median = <math>M_i</math> and Mode = <math>M_o</math></p> <p style="text-align: center;"><math>M_e = M_i = M_o</math></p>	<p>In case of asymmetrical/skewed distribution:</p> <p style="text-align: center;"><b>Mode = 3 Median – 2 Mean</b></p> <p>The median is always between the arithmetic mean and the mode.</p> <p style="text-align: center;"><math>M_e &gt; M_i &gt; M_o</math> or <math>M_e &lt; M_i &lt; M_o</math></p>

**POINT TO REMEMBER**

- The measure of central tendency summarises the data with a single value, which can represent the entire data.
- Arithmetic mean is defined as the sum of the values of all observations divided by the number of observations.
- The sum of deviations of items from the arithmetic mean is always equal to zero.
- Sometimes, it is important to assign weights to various items according to their importance.
- Median is the central value of a distribution that divides it into two equal parts with 50% items placed above it and the other 50% items placed below it.
- Mode is the value which occurs most frequently in a given series

### 3(ii) COR-RELATION

**Meaning of cor-relation:** Correlation is a statistical tool which studies the relationship between two variables e.g. changes in price leads to change in quantity demanded. Correlation studies, and measures the direction, and intensity of relationship among variables. It measures co-variation not causation. It does not imply cause and effect relation.

#### **Types of Cor-relation**

1. Positive and Negative correlation.
2. Linear and non – linear correlation.
3. Simple and multiple correlations.

**Positive correlation:** When both variables move in the same direction. If one increases other also increases and vice-versa. E.g. sale of Ice cream and temperature move in same direction.

**Negative correlation:** When two variables move in the opposite direction, they are negatively correlated. E.g. when you spend more time in studying chances of your failure decline

**Linear Correlation:** -When two variables change in a constant proportion.

**Non- linear correlation:** -When two variables do not change in the same proportion.

**Simple correlation** – Relationship between two variables are studied.

**Multiple Correction** – Relationship between three or more than three variables are studied.

#### **Degree of Correlation:**

**Perfect Correlation** - When values of both variables changes at a constant rate

**(i)Perfect positive correlation** – when values of both variables changes at a constant ratio in the same direction correlation coefficient value (r) is + 1

**(ii)Perfect negative correlation** – When values of both the variables change at a constant ratio in opposite direction. Value of coefficient of correlation is -1

**Absence of correlation:** When there is no relation between the variables  $r = 0$

**Limited degree correlation:** The value of r varies between more than 0 and less than 1

- a) High: r lies between  $\pm 0.7$  &  $0.999$
- b) Moderate = r lies between  $\pm 0.5$  and  $+ 0.699$
- c) Low:  $r < \pm 0.5$

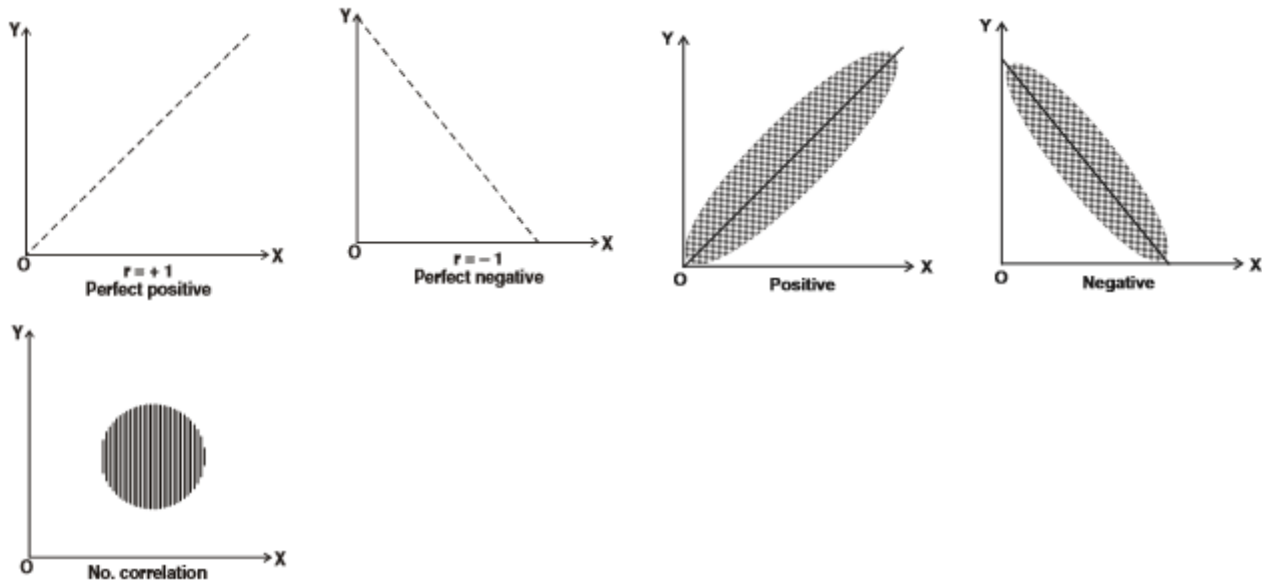
#### **Methods of estimating correlation:**

1. Scatter diagram
2. Karl person's coefficient of correlation.
3. Spearman's rank correlation.

#### **1. Scatter diagram**

Scatter diagram offers a graphic expression of the direction and degree of correlation. To construct a scatter diagram, x variables taken on X-axis and y variable is taken on Y-axis.

The cluster of points, plotted is referred to as a scatter diagram. In this, the degree of closeness of scatter points and their overall direction enables us to examine the relationship.



## 2. Karl person's coefficient of correlation.

Karl person's coefficient of correlation is a quantitative method of calculating correlation. It gives a precise numerical value of the degree of linear relationship between two variables. Karl person's coefficient of correlation is also known as product moment correlation.

Formula: 
$$r = \frac{\sum xy}{N\sigma_x \sigma_y}$$

Here

$r$  = Coefficient of correlation

$$x = (X - \bar{X})$$

$$y = (Y - \bar{Y})$$

$\sigma_x$  = Standard deviation of X-series.

$\sigma_y$  = Standard deviation of Y-series.

$N$  = Number of observations

Karl Person's coefficient of correlation is calculated by following methods:

(a) **Actual mean method:**

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}}$$

Here,

r = Coeff. Of correlation

$$x = (X - \bar{X})$$

$$y = (Y - \bar{Y})$$

### (b) Assumed Mean method:

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N})(\sum Y^2 - \frac{(\sum Y)^2}{N})}}$$

$$r = \frac{N \sum dx \cdot dy - (\sum dx)(\sum dy)}{\sqrt{N \sum dx^2 - (\sum dx)^2} \sqrt{N \sum dy^2 - (\sum dy)^2}}$$

Here,

dx = Deviations of x-series from assumed mean = (X - A)

dy = Deviation of Y-series from assumed mean = (Y - A)

$\sum dx \cdot dy$  = Sum of multiple of dx and dy.

$\sum dx^2$  = Sum of the square of dx.

$\sum dy^2$  = Sum of the square of dy

$\sum dx$  = Sum of the deviation of x-series

$\sum dy$  = Sum of the deviation of Y-series

N = Number of pairs of observations

When value of the variables are large, we use step deviation method to reduce the burden of calculation.

### (c) Step deviation method

$$r = \frac{\sum dx' \cdot dy' - \frac{\sum dx' \times \sum dy'}{n}}{\sqrt{\sum dx'^2 - \frac{(\sum dx')^2}{n}} \sqrt{\sum dy'^2 - \frac{(\sum dy')^2}{n}}}$$

Here,  $dx' = \frac{dx}{C_1}$

$$dy = \frac{dy}{C_2}$$

dx = deviation of X-series from assumed mean = (X-A)

dy = deviation of Y-series from assumed mean = (Y-A)

$\sum dx \cdot dy$  = Sum of multiple of dx and dy.

$\sum dx^2$  = Sum of the square of dx.

$\sum dy^2$  = Sum of the square of dy

$\sum dx$  = Sum of the deviation of x-series

$\sum dy$  = Sum of the deviation of Y-series

N = Number of pairs of observations

C1 is common factor for series -x

C2 is common factor for series -y

### Properties of correlation coefficient(r)

(i) Correlation coefficient (r) has no unit.

(ii) A negative value of r indicates an inverse relation.

(iii) If r is positive then two variables move in the same direction.

(iv) The value of r lies between minus - 1 and +1, i.e.  $-1 \leq r \leq 1$

(v) If r is zero, the two variables are uncorrelated.

(vi) If  $r = + 1$  or  $r = - 1$ , the correlation is perfect.

(vii) A high value of r indicates strong linear relationship and a low value or indicates a weak linear relationship.

(viii) The value of r is unaffected by the change of origin and change of scale.

### 3. Spearman's rank correlation

It is used to calculate coefficient of correlation of qualitative variables such as beauty, bravery, wisdom, ability virtue etc. It was developed by British Psychologist C.E. Spearman.

$$\text{Formula } r = 1 - \frac{6\sum D^2}{N^3 - N}$$

Here,

$r_s$  = Coefficient of rank correlation.

D = Rank differences

N = Numbers of rank

When ranks are repeated the formula is:

$$r_s = 1 - \frac{6 \left[ \sum d^2 + \frac{(m_1^3 - m_1)}{12} + \frac{(m_2^3 - m_2)}{12} + \dots \right]}{N^3 - N}$$

Where  $m_1, m_2, \dots$  are number of repetitions of ranks.

### Importance or Significance of Correlation

- The study of correlation shows the direction and degree of relationship between the variables.
- Correlation coefficient sometimes suggests cause and effect relationship.
- Correlation analysis facilitates business decisions because the trend path of one variable may suggest the expected changes in the other.
- Correlation analysis also helps policy formulation.

## QUESTIONS AND ANSWERS

Q 1. The unit of correlation coefficient between height in feet and weight in kgs is

- (a) kg/feet
- (b) Percentage
- (c) Non-existent

Answer: (c) Correlation coefficient (r) has no unit. It is a pure number.

Q.2. The range of simple correlation coefficient is

- (a) 0 to infinity
- (b) minus one to plus one
- (c) minus infinity to infinity

Answer: (b) The value of the correlation coefficient lies between minus one and plus one,  $-1 \leq r \leq 1$ . If the value of r is outside this range it indicates error in calculation.

Q. 3. If  $r_{XY}$  is positive the relation between X and Y is of the type

- (a) when Y increases X increases
- (b) when Y decreases X increases
- (c) when Y increases X does not change

Answer: (a) If r is positive the two variables move in the same direction. e.g., when the price of coffee rises, the demand for tea also rises as coffee is a substitute of tea. Therefore, the r between price of coffee and demand for tea will be positive.

Q. 4. If  $r_{XY} = 0$ , the variable X and Y are

- (a) Linearly related
- (b) Not linearly related
- (c) independent

Answer: (b) If  $r_{XY} = 0$ , it means the two variables are uncorrelated and there is no linear relation between them. However, other types of relation may be there and they may not be independent.

Q. 5. Of the following three measures which can measure any type of relationship?

- (a) Karl Pearson's coefficient of correlation
- (b) Spearman's rank correlation
- (c) Scatter diagram

Answer: (c) The scatter diagram gives a visual presentation of the relationship and is not confined to linear relations. Karl Pearson's coefficient of correlation and Spearman's rank correlation are strictly the measures of linear relationship.



Q. 6. If precisely measured data are available the simple correlation coefficient is

- (a) more accurate than rank correlation coefficient
- (b) less accurate than rank correlation coefficient
- (c) as accurate as the rank correlation coefficient

Answer: (a) Rank correlation should be used only when the variables cannot be measured precisely, generally it is not as accurate as the simple correlation coefficient as all the information concerning the data is not utilised in this.

Q. 7. Why is  $r$  preferred to covariance as a measure of association?

Answer: Both, correlation coefficient and covariance measure the degree of linear relationship between two variables, but correlation coefficient is generally preferred to covariance due to the following reasons

- The correlation coefficient ( $r$ ) has no unit.
- The correlation coefficient is independent of origin as well as scale.

Q. 8. Can  $r$  lie outside the -1 and 1 range depending on the type of data?

Answer: No the value of the correlation coefficient lies between minus one and plus one,  $-1 \leq r \leq 1$ . If the value of  $r$  is outside this range in any type of data, it indicates error in calculation.

Q. 9. Does correlation imply causation?

Answer: No, correlation measures do not imply causation. Correlation measures co-variation and not causation. Correlation does not imply cause and effect relation. The knowledge of correlation only gives us an idea of the direction and intensity of change in a variable when the correlated variable changes. The presence of correlation between two variables  $X$  and  $Y$  simply means that when the value of one variable is found to change in one direction, the value of the other variable is found to change either in the same direction (i.e. positive change) or in the opposite direction (i.e., negative change), in a definite way.

Q. 10. When is rank correlation more precise than simple correlation coefficient?

Answer: Rank correlation is more precise than simple correlation coefficient in the following situations

- When the Measurements of the Variables are Suspect e.g., in a remote village where measuring rods or weighing scales are not available, height and weight of people cannot be measured precisely but the people can be easily ranked in terms of height and weight.
- When Data is Qualitative It is difficult to quantify qualities such as fairness, honesty etc. Ranking may be a better alternative to quantification of qualities.
- When Data has Extreme Values Sometimes the correlation coefficient between two variables with extreme values may be quite different from the coefficient without the extreme values. Under these circumstances rank correlation provides a better alternative to simple correlation.

Q. 11. Does zero correlation mean independence?

Answer: No, zero correlation does not mean independence. If there is zero correlation ( $r_{XY} = 0$ ), it means the two variables are uncorrelated and there is no linear relation between them. However, other types of relation may be there and they may not be independent.

Q. 12. Can simple correlation coefficient measure any type of relationship?

Answer: No, simple correlation coefficient can measure only linear relationship.

Q. 13. List some variables where accurate measurement is difficult.

Answer: Accurate measurement is difficult in case of

- Qualitative variables such as beauty, intelligence, honesty, etc.
- It is also difficult to measure subjective variables such as poverty, development, etc which are interpreted differently by different people.

Q. 14. Interpret the values of r as 1, -1 and 0.

Answer:

- If  $r = 0$  the two variables are uncorrelated. There is no linear relation between them. However, other types of relation may be there and hence the variables may not be independent.
- If  $r = 1$  the correlation is perfectly positive. The relation between them is exact in the sense that if one increases, the other also increases in the same proportion and if one decreases, the other also decreases in the same proportion.
- If  $r = -1$  the correlation is perfectly negative. The relation between them is exact in the sense that if one increases, the other decreases in the same proportion and if one decreases, the other increases in the same proportion.

Q. 15. Calculate the correlation coefficient between X and Y and comment on their relationship.

<b>X</b>	-3	-2	-1	1	2	3
<b>Y</b>	9	4	1	1	4	9

Answer:

<b>X</b>	<b>Y</b>	<b>XY</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>
-3	9	-27	9	81
-2	4	-8	4	16
-1	1	-1	1	1
1	1	1	1	1
2	4	8	4	16
3	9	27	9	81
$\Sigma X=0$	$\Sigma Y=28$	$\Sigma XY=0$	$\Sigma X^2=28$	$\Sigma Y^2=196$

$$r = \frac{\Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{N}}{\sqrt{\Sigma X^2 - \frac{(\Sigma X)^2}{N}} \sqrt{\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}}} = \frac{0 - \frac{0 \times 28}{6}}{\sqrt{28 - \frac{(28)^2}{6}} \sqrt{196 - \frac{(196)^2}{6}}}$$

$$= \frac{0}{\sqrt{28 - \frac{(28)^2}{6}} \sqrt{196 - \frac{(196)^2}{6}}} = 0$$

As the value of r is zero, so there is no linear correlation between X and Y.

Q. 16. Why does rank correlation coefficient differ from Pearson's correlation coefficient?  
 Answer: Rank correlation coefficient differs from Pearson's correlation coefficient in the following ways

- Rank correlation coefficient is generally lower or equal to Karl Pearson's coefficient.
- Rank correlation coefficient is preferred to measure the correlation between qualitative variables as these variables cannot be measured precisely.
- The rank correlation coefficient uses ranks instead of the full set of observations that leads to some loss of information.
- If extreme values are present in the data, then the rank correlation coefficient is more precise and reliable.

Q. 17. Calculate the correlation coefficient between the heights of fathers in inches (X) and their sons (Y).

<b>X</b>	65	66	57	67	68	69	70	72
<b>Y</b>	67	56	65	68	72	72	69	71

Answer:

X	Y	XY	X <sup>2</sup>	Y <sup>2</sup>
65	67	4355	4225	4489
66	56	3696	4356	3136
57	65	3705	3249	4225
67	68	4556	4489	4624
68	72	4896	4624	5184
69	72	4968	4761	5184
70	69	4830	4900	4761
72	71	5112	5184	5041
<b>Σ X = 534</b>	<b>Σ Y = 540</b>	<b>Σ XY = 36118</b>	<b>Σ X<sup>2</sup> = 35788</b>	<b>Σ Y<sup>2</sup> = 36644</b>

$$\begin{aligned}
 r &= \frac{\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\Sigma X^2 - \frac{(\Sigma X)^2}{N}} \sqrt{\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}}} \\
 &= \frac{36118 - \frac{534 \times 540}{8}}{\sqrt{35788 - \frac{(534)^2}{8}} \sqrt{36644 - \frac{(540)^2}{8}}} \\
 &= \frac{36118 - \frac{288360}{8}}{\sqrt{35788 - \frac{285156}{8}} \sqrt{36644 - \frac{291600}{8}}} \\
 &= \frac{36118 - 36045}{\sqrt{35788 - 35644.5} \sqrt{36644 - 36450}} \\
 &= \frac{73}{\sqrt{143.5} \sqrt{194}} = \frac{73}{11.98 \times 13.93} = \frac{73}{166.88} = 0.44
 \end{aligned}$$

Note Answer: printed in NCERT is incorrect.

Q. 18. Calculate the correlation coefficient between X and Y and comment on their relationship.

<b>X</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>7</b>	<b>8</b>
<b>Y</b>	<b>2</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>14</b>	<b>16</b>

Solution

<b>x</b>	<b>y</b>	<b>xy</b>	<b>x<sup>2</sup></b>	<b>y<sup>2</sup></b>
1	2	2	1	4
3	6	18	9	36
4	8	32	16	64
5	10	50	25	100
7	14	98	49	196
8	16	128	64	256
$\Sigma X=28$	$\Sigma Y=56$	$\Sigma XY=328$	$\Sigma X^2=164$	$\Sigma Y^2=656$

$$\begin{aligned}
 r &= \frac{\Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{N}}{\sqrt{\Sigma X^2 - \frac{(\Sigma X)^2}{N}} \sqrt{\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}}} = \frac{328 - \frac{28 \times 56}{6}}{\sqrt{164 - \frac{(28)^2}{6}} \sqrt{656 - \frac{(56)^2}{6}}} \\
 &= \frac{328 - \frac{1568}{6}}{\sqrt{164 - \frac{784}{6}} \sqrt{656 - \frac{3136}{6}}} = \frac{328 - 261.33}{\sqrt{164 - 130.67} \sqrt{656 - 522.67}} \\
 &= \frac{66.67}{\sqrt{33.33} \sqrt{133.33}} \\
 &= \frac{66.67}{5.77 \times 11.55} = \frac{66.6}{66.6} = 1.00 = 1
 \end{aligned}$$

As the correlation coefficient between the two variables is + 1, so the two variables are perfectly positive correlated.

### **3 (iii) Index Number**

**1.1 Meaning:** Index numbers is a statistical tool for measuring relative change in a group of related variables over two or more different times.

**1.2 Definition:** According to Croxton and Cowden, “Index numbers are devices for measuring Differences in the magnitude of a group of related variables”.

#### **1.3 Features of an Index Number**

- A. They are expressed in percentages.
- B. They are special types of averages.
- C. They measure the effect of change over a period of time.

#### ***1.4 Problems in construction of Index Numbers***

- ❖ Defining the purpose of index numbers
- ❖ Selection of items
- ❖ Selection of base period
- ❖ Selection of prices
- ❖ Selection of weights
- ❖ Choice of an average
- ❖ Choice of the formulae

#### ***1.5 Advantages/uses/ importance of index numbers***

- ❖ It simplifies of complexity
- ❖ It facilitates comparative study
- ❖ Use in business sphere
- ❖ Helpful and fixation of salary and allowances
- ❖ To measure the change in value of money

#### ***1.6 Limitations of Index Number***

- ❖ Not completely true
- ❖ International comparison is not possible
- ❖ Difference of time
- ❖ Limited use
- ❖ Lack of retail price index number

## 1.7 Price index is of two types-

**A. Simple Index Number:** These are the index numbers in which all items of the series are accorded equal weightage or importance.

**B. Weighted price Index numbers:** These are the index numbers in which different items of the series are accorded different weightage, depending upon their relative importance.

### 1.7.1 Construction of simple Index Numbers:-

#### A. Simple aggregate Method

$$P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$$

**Current year:** Current year is the year for which average change is to be measured or index of index number is to be calculated.

**Base year:** Base year is the year of reference from which we want measure extent of change in the current year. The index number of base year is generally assumed to be 100.

#### Example

Given the following data and assuming 2011 as the base year. Find out index value of the prices of different commodities for the year 2019.

Commodity	A	B	C	D	E
Price 2011	50	40	10	5	2
Price 2019	80	60	20	10	6

#### Solution

Commodity	2011 Price (Rs) (P <sub>0</sub> )	2019 Price (Rs) (P <sub>1</sub> )
A	50	80
B	40	60
C	10	20
D	5	10
E	2	6
	$\sum P_0 = 107$	$\sum P_1 = 176$

$$P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$$

$$= 164.49$$

Simple Average of price relative method

$$P_{01} = \frac{\sum (P_1 / P_0 \times 100)}{N}$$

## B. Simple Average Price Relative Method

$$P_{01} = \frac{\sum (P_1/P_0 \times 100)}{N}$$

### Example

Given the following data and using the price relative method construct an index number for the year 2022 in relation to 2014.

Commodity	Wheat (per qt.)	Ghee(per kg)	Milk (per lt.)	Rice(per rqt.)	Sugar(per kg)
2014 Price(Rs.)	100	8	2	200	1
2022 Price (rs.)	200	40	16	800	6

### Solution

Commodity	Base Year 2014 (P <sub>0</sub> )	Current Year 2022 (P <sub>1</sub> )	Price relatives $\frac{\sum P_1 \times 100}{\sum P_0}$
Wheat	100	200	200
Ghee	8	40	500
Milk	2	16	800
Rice	200	800	400
Sugar	1	6	600
N=5			$\frac{\sum P_1 \times 100}{\sum P_0}$ <b>= 2500</b>

$$P_{01} = \frac{\sum (P_1/P_0 \times 100)}{N}$$

$$2500/5 = 500$$

## 1.8 Weighted Index Numbers

**A. Weighted Aggregate method:** - In this method commodities are assigned weights on the basis of quantities purchased. Some of the well-known are as under

Items	2014 Base year		2022 Current Year	
	Price	Quantity	Price	Quantity
A	10	10	20	25
B	35	3	40	10
C	30	5	20	15
D	10	20	8	20
E	40	2	40	5

**(i) Laspeyre's Method:** Laspeyre uses base year quantities ( $q_0$ ) as weights of different items. As formula

$$P_{01} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$$

**(ii) Paasche's Method:** Paasche's uses current years quantities ( $q_1$ ) as weight.

$$P_{01} = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100$$

**(iii) Fisher's Method:** Fisher has combined the techniques of Laspeyre's and Paasche's method. He used both base year as well as current year quantities ( $q_0, q_1$ ) as weight

$$P_{01} = \sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_1} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_0}} \times 100$$

Items	2014 Base year		2022 Current Year		$(P_0 Q_0)$	$(P_0 Q_1)$	$(P_1 Q_0)$	$(P_1 Q_1)$
	Price ( $P_0$ )	Qty( $Q_0$ )	Price ( $P_1$ )	Qty ( $Q_1$ )				
A	10	10	20	25	100	250	200	500
B	35	3	40	10	105	350	120	400
C	30	5	20	15	150	450	100	300
D	10	20	8	20	200	200	160	160
E	40	2	40	5	80	200	80	200
Total					635	1450	660	1560



(i) Laspeyre's Method:

$$P_{01} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$$

$$= 103.94$$

(ii) Paasche's Method:

$$P_{01} = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \times 100$$

$$= 107.59$$

(iii) Fisher's Method:

$$P_{01} = \sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_1} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_0}} \times 100$$

$$= 105$$

**B. Weighted Average of Price Relative Method:-**

Under this method commodities are assigned weight on the basis of base's year value ( $W = P_0 Q_0$ ) or fixed weights ( $W$ ) are used.

$$P_{01} = \frac{\sum RW}{\sum W} \times 100$$

Where  $R = \frac{P_1}{P_0} \times 100$

$W$  = value in the base year ( $P_0 Q_0$ ) or fixed weights

**Example**

Construct cost of living for 2014 based on 2022 from the following data:

Group	Food	Housing	Clothing	Fuel & light	Misc.
Group Index No. for 2022 (based on 2014)	122	140	112	116	106
Weights	32	10	10	6	42

Group	Group Index No. (R)	Weights (W)	Weighted relatives (RW)
Food	122	32	3904
Housing	140	10	1400
Clothing	112	10	1120
Fuel & light	116	6	696
Misc.	106	42	4452
Total		$\sum W = 100$	$\sum RW = 11572$

Cost of living index no.  $P_{01} = \frac{\sum RW}{\sum W}$

**= 115.72 Ans.**

## **1.9 Types of Index Numbers**

- |   |                                       |                                     |                              |
|---|---------------------------------------|-------------------------------------|------------------------------|
| <b>A. Consumer Price Index/Cost of living Index (CPI)</b> | <b>B. Whole Sale Production (WPI)</b> | <b>C. Index of Industrial (IIP)</b> | <b>D. SENSEX Price Index</b> |
|---|---------------------------------------|-------------------------------------|------------------------------|

**1.9.1 Consumer Price Index: - (CPI)** the methods of constructing CPI are

- **Aggregate Expenditure Method**  $P_{01} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$
- **Family Budget Method**  $P_{01} = \frac{\sum RW}{\sum W} \times 100$   
 Where  $R = \frac{P_1}{P_0}$

Where,  $W = P_0 Q_0$  or fixed weights

### **1.10 Uses of Consumer Price Index: - (CPI)**

- ❖ It is used in calculating purchasing power of money
- ❖ It is used for grant of Dearness Allowance.
- ❖ It is used by government for framing wage policy, price policy etc.
- ❖ CPI is used as price deflator of income
- ❖ CPI is used as indicator of price movements in retail market.

### **1.11 Wholesale Price Index (WPI):-**

- ❖ It measures the relative change in the price of commodities traded in wholesale market.
- ❖ It indicates the change in the general price level.
- ❖ It does not include services
- ❖ It measures the changes in the prices of goods sold and traded in bulk by wholesale businesses to other businesses.
- ❖ Published by the Office of Economic Adviser, Ministry of Commerce and Industry.
- ❖ It is the most widely used inflation indicator in India.
- ❖ Major criticism for this index is that the general public does not buy products at wholesale price.
- ❖ The base year of All-India WPI has been revised from 2004-05 to 2011-12 in 2017.

## 1.12 Uses of WPI

- ❖ Basis of Dearness Allowance
- ❖ Indicator of changes in economy
- ❖ Measures the rate of inflation

### Difference between WPI and CPI

- WPI tracks inflation at the producer level and Consumer Price Index (CPI) captures changes in prices levels at the consumer level.
- Both baskets measure inflationary trends (the movement of price signals) within the broader economy, the two indices differ in which weightages are assigned to food, fuel and manufactured items.
- WPI does not capture changes in the prices of services, which CPI does.
- In WPI, more weightage is given to manufactured goods, while in CPI, more weightage is given to food items.
- Base year of WPI is 2011-2012 while for CPI is 2012.

**Index of industrial production (IIP):** IIP is used to measure the relative increase or decrease in the level of industrial production.

$$\frac{\sum \left[ \frac{q_1}{q_0} \times 100 \right] W}{\sum W}$$

Here,  $q_1$  = Level of Production in the current year

$q_0$  = Level of production in the base year

W = Weight

### Inflation and index numbers:

Inflation is described a situation characterized by a sustained increase in the general price level. Generally, inflation is measured in terms of wholesale price index.

Rate of inflation

$$\frac{A_2 - A_1}{A_1} \times 100$$

Here,  $A_1$  = WPI for week first ((1

$A_2$  = WPI for week second ((2

## 1.13 Uses of Index Numbers

- ❖ Helps us to measure changes in price level
- ❖ Help us to know changes in cost of living
- ❖ Help government in adjustment of salaries and allowances
- ❖ Useful to Business Community
- ❖ Information to Politicians
- ❖ Information regarding foreign trade

### **Problems in construction of index numbers:**

- ❖ Purpose of index number.
- ❖ Selection of base year.
- ❖ Selection of items.
- ❖ Selection of the prices of items.
- ❖ Selection of method of weighting
- ❖ Selection of sources of data

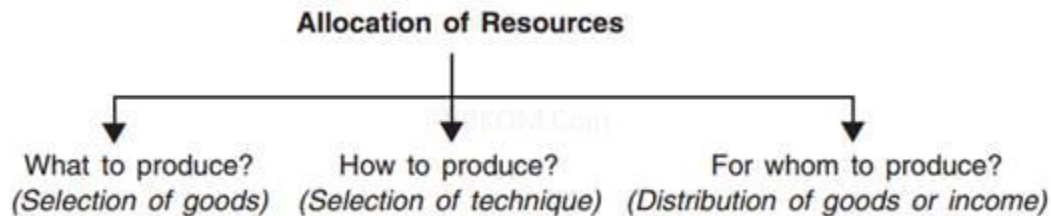
## (Part B) INTRODUCTORY MICROECONOMICS

### UNIT4- INTRODUCTION

1. Study of Economics is divided into two branches

- :(a) Micro economics
- (b) Macro economics

2. **Micro economics** studies the behavior of individual economic units.Ex-Consumer equilibrium, producers equilibrium, product pricing, factor pricing etc.
3. Micro economics is also called price theory.
4. **Macro economics** studies the behavior of the economy as a whole.Ex- National income, aggregate demand, aggregate supply, general price level, Inflation etc.
5. Macro economics is also called theory of income and employment.
6. **Economy** is a system in which people earn a living to satisfy their wants through process of production, consumption, investment and exchange.
7. **Economic problem** is the problem of choice arising from use of limited means which have the alternative use for the satisfaction of various wants.
8. Cause of economic problems are :(a) Unlimited Human Wants(b) Limited Economic Resources (c) Alternative uses of Resources.
9. **Central Problems of an Economy**



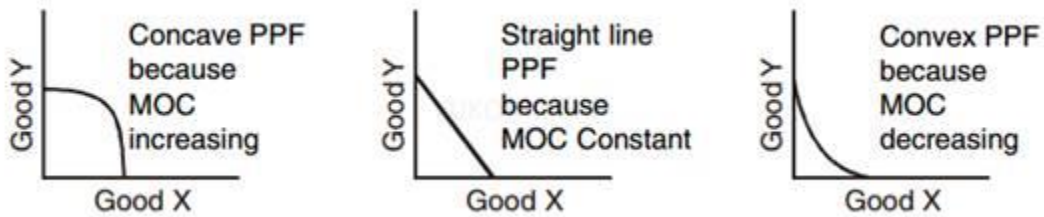
10. The central problem of “what to produce” refers to which goods and services will be produced in an economy and in what quantities. An economy has to produce those goods and services where there will be maximum social utility. This problem is studied under price theory.

The central problem of “how to produce” refers to what technique of production (i.e., labour intensive or capital intensive) should be used to produce goods. An economy has to select that technique which maximizes the output at minimum cost. This problem is studied under theory of production.

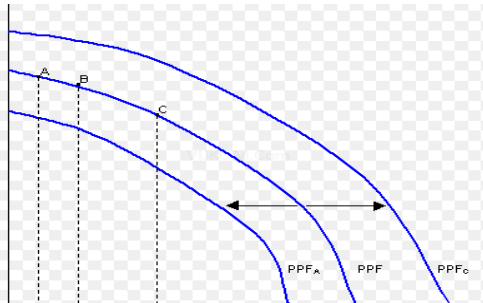
The central problem “for whom to produce” is related to distribution of produced goods and services(i.e., income and wealth) among factors of production in the form of rent, wages, interest and profit.This is explained under the theory of distribution.

11. For the selection of an opportunity, the sacrifice of next best alternative use is called **opportunity cost**.In other words, it is the amount of one commodity that is to be sacrificed to increase the production of other commodity.
12. **Production possibility frontier or production possibility curve** shows all possible combinations of two set of goods that an economy can produce with available resources and given technology, assuming that all resources are fully and efficiently utilized.
13. **Economizing of resources** means utilisation of resources in best possible manner to maximize output.
14. **Production Possibility Frontier or CurveFeatures**(a) Slopes downward from left to right because if production of one commodity is to be increased then production of other commodity has to be sacrificed as there is scarcity of resources.

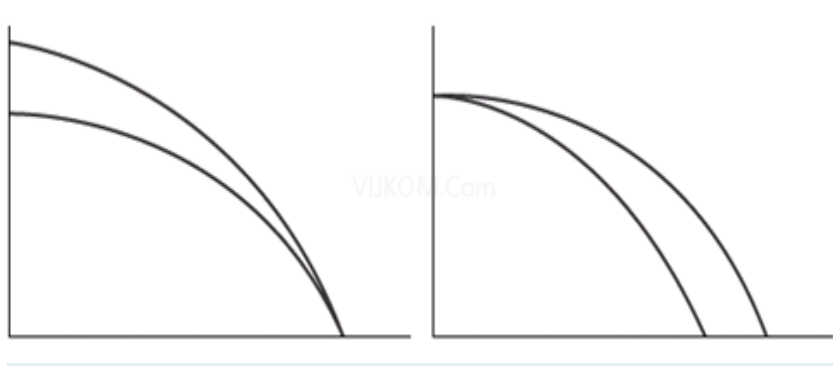
(b) Concave to the origin because of increasing marginal opportunity cost or (MRT)



15. **The Production possibility curve will shift under following two condition:**(a) change in resources, (b) Change in technology of production for both the goods.



16. **Rightward shift of PPF** shows increase in resources or improvement in technology. Ex- Labour becoming more skilled, improvement in technology, increase in productivity of land.  
 17. **Leftward shift of PPF** shows the decrease in resources or degradation of technology in the economy.  
 18. **The Production possibility curve will rotate outward under following two condition:** (a) Improvement in technology in favour of one commodity (b) Growth of resources for the production of one commodity



19. **Marginal Rate of Transformation (MRT)**– It is the amount of one commodity that is to be sacrificed to increase the production of other commodity by one unit.  
 20. **MRT can also called Marginal Opportunity Cost.** It is defined as the additional cost in terms of number of units of a good sacrificed to produce an additional unit of the other good.  
 21. **MARGINAL RATE OF TRANSFORMATION:** MRT is the ratio of units of one good sacrificed to produce

$$\text{MRT} = \frac{\text{Unit of good Y sacrificed}}{\text{Unit of good X produced}} = \frac{\Delta y}{\Delta x}$$

one more unit of other good.

(Marginal= at the border or adjacent/next to/adjoining)

(Transformation= a change in form, shape appearance or size)

**ECONOMY:** It is a system spread over a particular area that reveals the nature and level of economic activities in that area. It shows how people of a particular area earn their living.

**SERVICES:** A type of economic activity that is intangible, is not stored and does not result in ownership. A service is consumed at the point of sale. Services are one of the two key components of economics, the other being goods.e.g; services of a doctor.

**WANTS:** Wants are mere desires to buy the object irrespective of price and capacity.

**RESOURCES:** service or asset which is used to produce goods and services that meet human needs and wants are called resources.

**GOODS:** All physical and tangible things which are used to satisfy people's want, provide utility and have an economic value. e.g. books

**HOUSEHOLD:** All persons living under one roof having either direct access to the outside or a separate cooking facility. Where member of a household is related by blood or law, they constitute a family.

**FIRMS:** Firm is an organisation that employ productive resources to obtain products and/or services which are offered in the market with the aim of making a profit.

**PRODUCTION:** Production is a process through which inputs are transformed into output(i.e. in order to make something for consumption).

**CONSUMPTION:** The process of using up of goods and services for direct satisfaction of individual or collective human wants are called consumption.

**MICROECONOMICS:** It is that branch of economics which deals with the behavior of individual economic units of the economy such as individuals or households.

**MACROECONOMICS:** Macroeconomic is that branch of economics which deals with the behaviour of the economy or as a whole. It is the study of aggregates such as national income, full employment, aggregate consumption etc.

**ECONOMIC PROBLEM:** Economic problem is the problem of choice arising out of fact that, resources are scarce and it has the alternative uses.It is mainly the problem of choice.

**MARGINAL OPPORTUNITY COST:** It is the rate at which the quantity of output of one commodity is sacrificed to produce one more unit of other commodity.

**Example of Opportunity Cost:** Mohan decides to use the train to get to work rather than driving each day. The train fare each month will be Rs.350. After one month, he calculates that he is spending Rs.250 less on petrol and about Rs.25 less on maintaining her car. What is the opportunity cost of using the train?

Cost of using train pm= Rs.350. Cost of using the car pm = Rs.250 + Rs.25 = Rs.275. Opportunity cost of using the train = Rs.350 – Rs.275 = Rs.75 per month

**PRODUCTION POSSIBILITIES:** Different combination of goods and services which an economy can produce with its available resources and given technology.

**A PRODUCTION POSSIBILITY CURVE:** It is a curve which depicts all possible combination of two goods that an economy can produce with the utilization of available resources and technique of production. It is an important tool to solve central economic problem. It is also known as transformation curve or production possibility frontier.

**LABOUR-INTENSIVE TECHNOLOGY:** When goods are produced using large quantity of labor and only a very few simple machines it is L I technology.

The degree of labor intensity is typically measured in proportion to the amount of capital required to produce the goods or services; the higher the proportion of labor costs required, the more labor intensive the business.

**CAPITAL-INTENSIVE TECHNOLOGY:** Under this technique, capital is used more than labour. That is investment in purchase, maintenance, and amortization of capital equipment is more than labour. It is C I technology.

**CAUSES OF ECONOMIC PROBLEM:**

i) Scarcity of resources

ii) Unlimited wants

iii) Limited resources having alternate uses (Scarcity= a state of being in short supply) (Alternate = happen/do by turns /; alternate uses = other uses)

**Features of resources** -1) limited 2) alternate uses

**Features of wants** – 1) unlimited 2) recurring 3) can be satisfied by using goods and services.

## CENTRAL ECONOMIC PROBLEMS

### i) Allocation of resources

- a) What to produce and of what quality :- consumer goods or capital goods, war time goods or peace time goods
- b) How to produce:- technology –capital intensive or labour intensive
- c) For whom to produce:- functional distribution or personal distribution

ii). **Efficient Utilization of resources**-no wastage- no over utilization nor underutilization. Economic efficiency refers to efficiency in production and efficiency in distribution.

iii.) **Growth of resources**:-It refers to increase in productivity of resources through improvement in technology. (Allocation = the act of sharing something/ an amount of resources allowed or assigned for something)

**SCARCITY OF RESOURCES**: Scarcity of resources means shortage of resources in relation to their demand.

**OPPORTUNITY COST**: It is the cost of next best alternative foregone.

**Positive Economics**:- It deals with What is , what was and what will happen in the economy. It deals with facts actual data and figures . Example: There is poverty in our country , population is increasing , GDP is growing etc.

**Normative Economics** : It deals with What should be and what ought to happen in the economy. It deals with ideal situations .Example: Government should take steps to reduce population growth rate, steps should be taken to reduce poverty etc.

### Competency Based Questions

1. A growth of resources in an economy is shown in PPF by.

- (a) Leftward Shift
- (b) Unchanged PPC
- (c) Rightward Shift
- (d) None of the above

2. . The primary assumption about resources while drawing a PPC is

- (a) Resources are limited
- (b) Resources depend on the kind of products produced
- (c) Resources can be put to a particular use
- (d) Resources are constant and given

3. Which of the following is a statement of normative nature in economics

- (a) Economics is a study of choices /alternatives
- (b)The government should be concerned with how to reduce unemployment
- (c) According to the estimate, in spite of severe shortage, more than 10% of houses in Indian cities are vacant
- (d) Accommodation of refugees is posing a big problem for Europe



4. What do you mean by economising of resources?
5. Which of the following is a type of economic activities?
- (a) Production
  - (b) Consumption
  - (c) Exchange and Investment
  - (d) All of these

6. Assertion (A): Tools of microeconomics are demand and supply.

Reason (R): Microeconomics studies the behaviour of individual units of an economy.

- a) Both assertion (A) and Reason(R) are true and Reason (R) is the correct explanation of Assertion (A).
- b) Both assertion (A) and Reason(R) are true and Reason (R) is not the correct explanation of Assertion (A).
- c) Assertion (A) is true but Reason (R) is false.
- d) Assertion (A) is False but Reason (R) is True.

7. Assertion (A): Positive Economics avoids economic value judgments.

Reason (R): Positive Statements can be verified as true or false by comparing with actual data.

- a) Both assertion (A) and Reason(R) are true and Reason (R) is the correct explanation of Assertion (A).
- b) Both assertion (A) and Reason(R) are true and Reason (R) is not the correct explanation of Assertion (A).
- c) Assertion (A) is true but Reason (R) is false.
- d) Assertion (A) is False but Reason (R) is True

Read the following hypothetical text and answer the given questions: Each economy has scarce resources and will have possibility of being exhausted gradually after a continuous use. Growth of resources, therefore, becomes a basic problem of the economy. It can achieve this objective through technological advancement. Under-developed countries like India, Pakistan, Thailand etc. have remained poor because of poor growth of their resources. Besides fuller utilization of resources, these countries should try to raise their productive capacities, by exploring further availability of natural resources and discovering better techniques for their use. Moreover, full use of productive capacity is also indispensable for the growth of the economy. Since economic theory is classified into Micro and Macro Theory. Microeconomic theory deals with the allocation of resources in the market economy. In this theory, decisions regarding 'what', 'how' and 'for whom' to produce are decided on the basis of price mechanism. Goods are freely bought and sold in the market economy on an agreed price. Macroeconomic theory deals with the fuller and efficient use of resources. It also deals with the growth of resources and problems relating saving, investment, inflation, unemployment etc. Development economics deals with the problem of growth of resources Which is a central problem of an economy?

8. Which is a central problem of an economy?

- (a) Allocation of resources
- (b) optimum utilization of resources
- (c) Economic development
- (d) all of these

9. To which factor, economic problem is basically related to:

- (a) Choice
- (b) Consumer selection
- (c) firm selection
- (d) none of these

10. Macro Economics deals with the .....

- (a) Allocation of resources
- (b) Aggregate use of resources
- (c) both (a) & (b)
- (d) none of these

**Answer Key:**

- 1. C- rightward shift
- 2. D – Resources are constant and given
- 3. A - Economics is a study of choices /alternatives
- 4. Making optimum use of resources
- 5. D – all of these
- 6. Option b
- 7. Option b
- 8. D - All of these
- 9. A – choice
- 10. B - Aggregate use of resources

## Unit – 5

### Consumer Equilibrium and Demand

**Introduction** – a consumer is one who buy goods & services for satisfaction of wants. He takes decision with regard to the kind of goods to be purchase in order to satisfy his wants.

The two main approaches to study consumer’s behavior and consumer’s equilibrium are: -

1. Cardinal Utility Approach.
2. Ordinal Utility Approach.

**Meaning of utility** – “Utility refers to wants satisfying power of a commodity”.

**Total utility** – Total Utility refers to the total satisfaction obtained from the consumption of all possible units of a commodity.

**TOTAL UTILITY -  $TU_n = U_1+U_2+U_3.....U_n$**

**MARGINAL UTILITY** – marginal utility refers to the additional utility derived from the consumption of one more unit of the given commodity.

**$MU_n = TU_n - TU_{n-1}$**

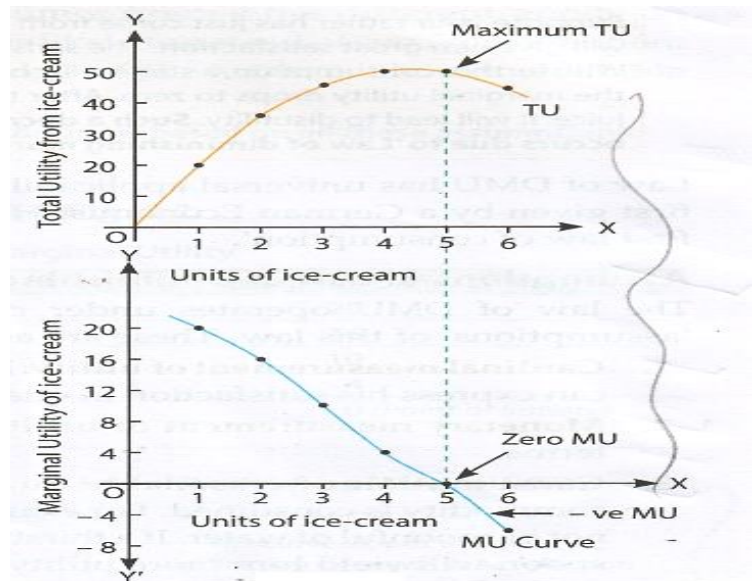
OR

$$MU = \frac{\text{CHANGE IN TOTAL UTILITY}}{\text{CHANGE IN NUMBER UNITS}} = \frac{\Delta TU}{\Delta Q}$$

#### Concepts of TU and MU

:

Ice-creams Consumed	Marginal Utility (MU)	Total Utility (TU)
1	20	20
2	16	20+16=36
3	10	20+16+10=46
4	4	20+16+10+4=50
5	0	20+16+10+4+0=50
6	-6	20+16+10+4+0(-6)=44



## Relationship between TU and MU

Table and Fig. shows the following points of relationship:

1. TU increases with an increase in consumption of a commodity as long as MU is positive, i.e. till the 4th ice-cream. In this phase, TU increases, but at a diminishing rate as MU from each successive unit tends to diminish.
2. When TU reaches its maximum, MU becomes zero, i.e. when 5th ice-cream is consumed. This is known as point of satiety. TU curve stops rising at this stage.
3. When consumption is increased beyond the point of satiety, TU starts falling as MU becomes negative.

### LAW OF DIMINISHING MARGINAL UTILITY

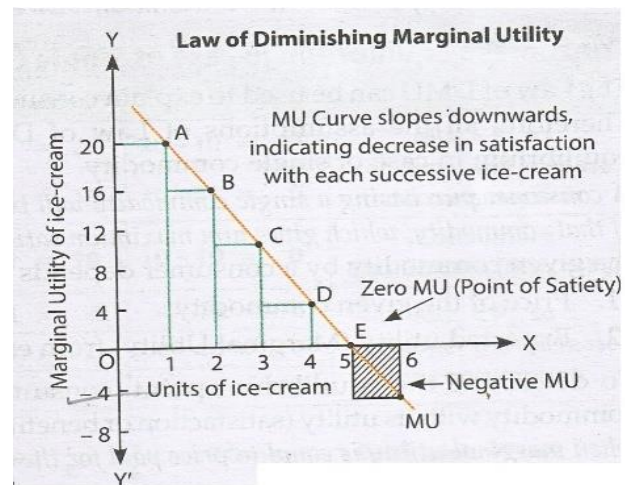
Law of diminishing marginal utility (DMU) states that as we consume more and more units of a commodity, the utility derived from such successive unit goes on decreasing.

Assumption of Law of Diminishing marginal Utility –

1. Cardinal measurement of utility
2. Monetary measurement of utility
3. Consumption of reasonable quantity
4. Continuous consumption
5. No change in Quality
6. Rational consumer
7. Independent utilities
8. MU of money remains constant
9. Fixed Income and prices
10. Perfect knowledge

### **Diagrammatic Explanation of Law of DMU**

Ice-creams Consumed	Marginal Utility (MU)	Total Utility (TU)
1	20	20
2	16	36
3	10	46
4	4	50
5	0	50 (Point of Satiety)
6	-6	44



## CONSUMER EQUILIBRIUM

Consumer's Equilibrium refers to the situation when a consumer is having maximum satisfaction with limited income and has no tendency to change his way of existing expenditure.

Consumer's equilibrium can be discussed under two different situations:

1. **Consumer spends his entire income on a Single Commodity**
2. **Consumer spends his entire income on Two Commodities**

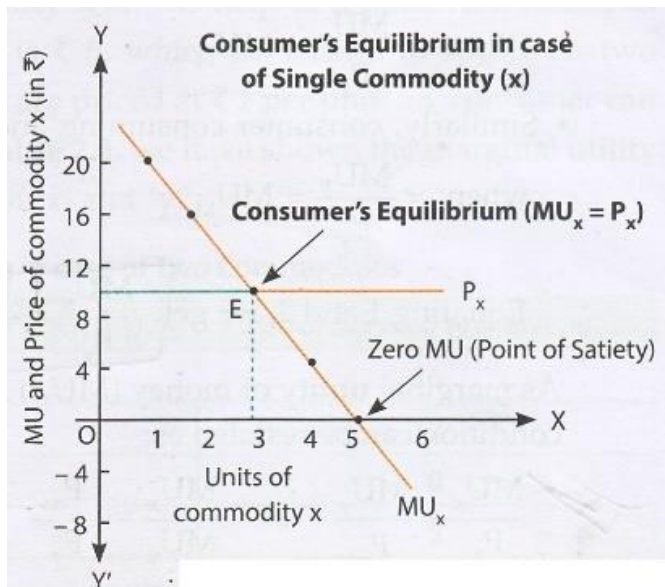
A consumer purchasing a single commodity will be at equilibrium, when he is buying such a quantity of that commodity, which gives him maximum satisfaction. The number of units to be consumed of the given commodity by a consumer depends on 2 factors:

1. Price of the given commodity;
2. Expected utility (Marginal Utility) from each successive unit.

$$\text{Marginal Utility in terms of Money} = \frac{\text{Marginal Utility in utils}}{\text{Marginal Utility of one rupee } MU_M}$$

**Table: Consumer's Equilibrium in case of Single Commodity**

Units of X	Price (P <sub>x</sub> ) (₹)	Marginal utility (utils)	Marginal utility in ₹ (MU <sub>x</sub> ) IN ₹ 1 util = ₹ 1	Difference MU <sub>x</sub> and P <sub>x</sub>	REMARK
1	10	20	20/1 = 20	20-10 = 10	MU <sub>x</sub> > P <sub>x</sub> so Consumer will increase the consumption
2	10	16	16/1 = 16	16 - 10 = 6	
<b>3</b>	<b>10</b>	<b>10</b>	<b>10/1 = 10</b>	<b>10 - 10 = 0</b>	<b>Consumer's Equilibrium (MU<sub>x</sub> = P<sub>x</sub>)</b>
4	10	4	4/1 = 4	4-10 = -6	MU <sub>x</sub> < P <sub>x</sub> so Consumer will decrease the consumption
5	10	0	0/1 = 0	0-10 = -10	
6	10	-6	-6/1 = -6	-6-10 = -16	



### Consumer's Equilibrium in case of Two Commodities

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = MU_M$$

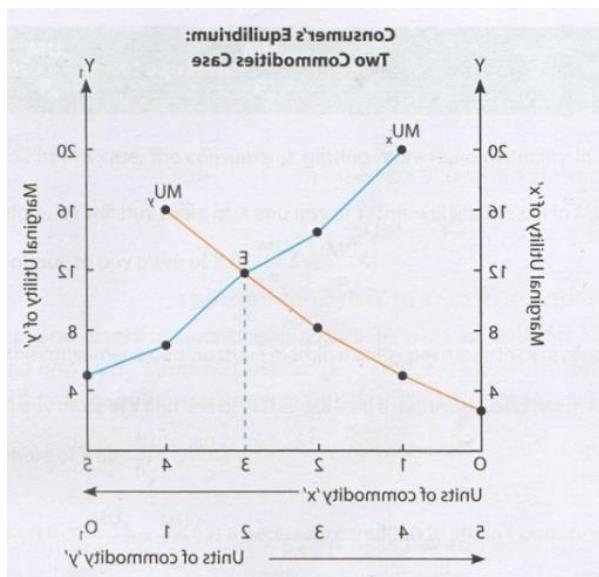
$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y} \text{ or } \frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

When  $P_x = P_y$  then the equilibrium condition can be restated as  $MU_x = MU_y$

A consumer in consumption of two commodities will be at equilibrium when he spends his limited income in such a way that the ration of marginal utilities of two commodities and their respective prices are equal and MU falls as consumption increases.

**Table For Consumer's Equilibrium in case of Two Commodities**

Units	MU of commodity 'x' (in units)	MU of commodity 'y' (in units)
1	20	16
2	14	12
3	12	8
4	7	5
5	5	3

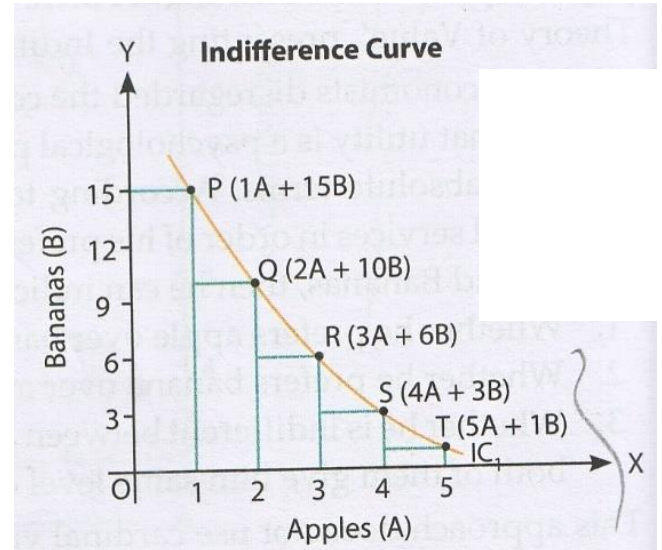


**ORDINAL UTILITY APPROACH**  
**(INDIFFERENCE CURVE OR HICKSIAN ANALYSIS)**

**Meaning of Indifference Curve** - refers to the graphical representation of various alternative combinations of bundles of two goods\*\* among which the consumer is indifferent.

**Indifference Curve Schedule**

Combination of Apples & Bananas	Apple (A)	Bananas (B)
P	1	15
Q	2	10
R	3	6
S	4	3
T	5	1

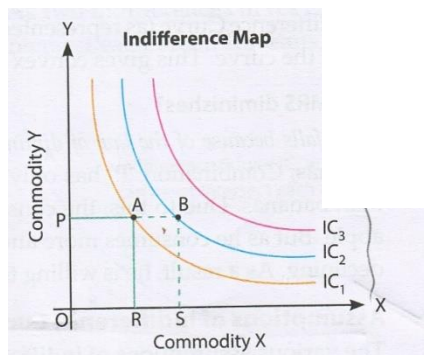


**Important Points**

- **Increase of one Good requires Decrease of other good and vice-versa:** In case of Indifference Curve, each combination of two goods gives equal satisfaction. So, when a consumer increases the consumption of one good, then consumption of other good must be decreased, so as to maintain same level of satisfaction. For example, as seen in Table 2.5, when consumer moves from combination P to Q, consumption of Apples increases by 1 unit, while that of Bananas decreases by 5 units.
- **Why Does it Happen?** It happens because if consumption of Apples is increased, while that of bananas is not decreased or vice-versa, then in such combination, consumer will have more quantity of 1 good, which means more satisfaction as compared to other combinations, which is against the basic assumption of indifference schedule that each combination has same satisfaction.

**INDIFFERENCE MAP**

**Meaning of Indifference Map** - refers to the family of indifference curves that represent consumer preferences over all the bundles of the two goods.



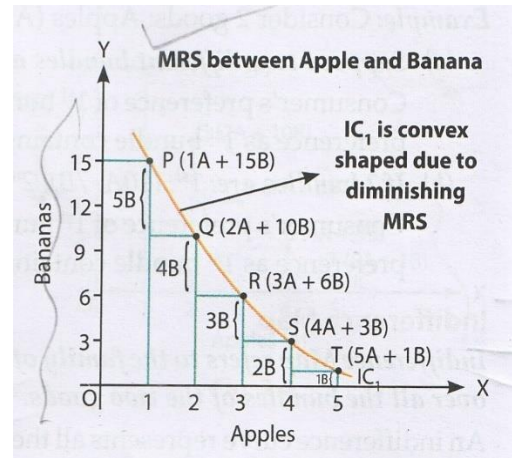
## Marginal Rate of Substitution (MRS)

MRS refers to the rate at which the commodities can be substituted with each other, so that total satisfaction of the consumer remains the same.

$$\text{MRS}_{AB} = \frac{\text{Units of Bananas (B) willing to Sacrifice}}{\text{Units of Apples (A) willing to Gain}}$$

$$\text{MRS}_{AB} = \frac{\Delta B}{\Delta A}$$

Combination	Apple (A)	Bananas (B)	MRS <sub>AB</sub>
P	1	15	-
Q	2	10	5B:1A
R	3	6	4B:1A
S	4	3	3B:1A
T	5	1	2B:1A



### **Assumptions of Indifference Curve**

1. Two commodities:
2. Non-Satiety:
3. Ordinal Utility:
4. Diminishing marginal rate of substitution:
5. Rational Consumer:

### **Properties of Indifference Curve**

1. Indifference curves are always convex to the origin:
2. Indifference curve slope downwards:
3. Higher Indifference curves represent higher levels of satisfaction:
4. Indifference curves can never intersect each other:

## BUDGET LINE

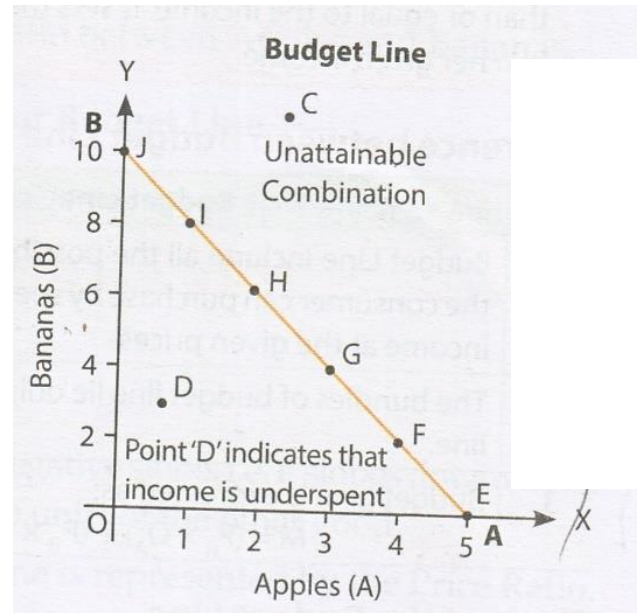
Meaning of Budget line - is a graphical representation of all possible combinations of two goods which can be purchased with given income and prices, such that the cost of each of these combinations is equal to the money income of the consumer.



## Schedule OF Budget Line

Combination of Apples & Bananas	Apple (A) (₹ 4 each)	Bananas (B) (₹ 4 each)	Money Spent = Income (₹)
E	5	0	$(5 \times 4) + (0 \times 2) = 20$
F	4	2	$(4 \times 4) + (2 \times 2) = 20$
G	3	4	$(3 \times 4) + (4 \times 2) = 20$
H	2	6	$(2 \times 4) + (6 \times 2) = 20$
I	1	8	$(1 \times 4) + (8 \times 2) = 20$
J	0	10	$(0 \times 4) + (10 \times 2) = 20$

## Diagrammatic Explanation of Budget Line



## Difference between Budget Line and Budget Set

S. No.	Budget Line	Budget Set
1.	Budget Line include all the possible bundles that the consumer can purchase by spending his entire income at the given prices.	Budget Set include all the possible bundles which cost less than or equal to consumer's money income at the given prices.
2.	The bundles of budget line lie only on the budget The bundles of budget set lie either on or below line.	The bundles of budget set lie either on or below the budget line
3.	Budget Line is expressed as: $M = (P_A \times Q_A) + (P_B \times Q_B)$	Budget set is expressed as: $M \geq (P_A \times Q_A) + (P_B \times Q_B)$

## Properties of Budget Line

1. Budget Line is Downward Sloping:
2. Budget Line is a straight line:

## Multiple Choice Questions

1. Indifference curves are convex to the origin because of:  
(a) Increasing MRS  
(c) Law of Diminishing Marginal Utility  
 (b) **Diminishing MRS**  
(d) Law of Equal-Marginal Utility
2. When we add up derived from consumption of all the units of the commodities, we get:  
 (a) **Total Utility**  
(c) Marginal Utility  
(b) Initial Utility  
(d) None of these
3. According to the Law of diminishing marginal utility, satisfaction obtained from consumption of each successive unit:  
(a) Increase  
(c) Remain same  
 (b) **Decrease**  
(d) Either increase or decrease.
4. Indifference Map refers to:  
(a) Highest Indifference curve  
(c)  **Family of indifference curves**  
(b) Lowest Indifference curve  
(d) None of these
5. Budget set includes:  
(a) All those combinations of two goods which a consumer already processes.  
(b) All those combinations of two goods which a consumer cannot afford.  
(c) All those combinations of two goods which a consumer is willing to buy.  
 (d) **All those combinations of two goods which a consumer can afford.**
6. Indifference curve are:  
(a) Concave to the origin.  
 (b) **Convex to the origin.**  
(b) Upward sloping straight line passing from the origin.  
(c) None of these.
7. If the consumption of an additional unit of a commodity causes no change in TU, then the resultant MU is:  
 (a) **Zero.**  
(b) Positive.  
(c) Negative.  
(d) Constant.
8. Total utility is.....at the point of satiety:  
(a) Minimum  
 (b) **Maximum**  
(c) Zero  
(d) None of these
9. In case of cardinal utility approach, utility is measured in:  
(a) Rupees  
(b) Ranks  
 (c) **Utils**  
(d) None of these
10. For consumer's equilibrium to be stable, the requirement is:  
(a) Constant MRS  
(b) Increasing MRS  
 (c) **Diminishing MRS**

- (d) None of these
11. Marginal Utility:
- (a) is always positive
  - (b) is always negative
  - (c) can be positive or negative but not zero
  - ✓ (d) **Can be positive or negative or zero**
12. Budget line shows:
- ✓ (a) Possible combination of two goods that a consumer can buy by spending his entire income at the given prices.
  - (b) Possible combination of two goods which cost less than or equal to consumer's money income.
  - (c) Possible combination of two goods among which the consumer is indifference.
  - (d) All of these
13. At the point of satiety:
- (a) MU is Negative
  - ✓ (b) **MU is Zero**
  - (b) MU is Rising
  - (c) None of these

### Very Short Answer Type Question (VSAQs)

- Q.1. Define Utility.  
 Ans. Utility is the want satisfying power of a commodity.
- Q.2. Define total utility.  
 Ans. Total utility refers to the total satisfaction obtained from consumption of all possible units of a commodity.
- Q.3. How is total utility derived from marginal utility?  
 Ans.  $TU = \sum MU$
- Q.4. What happens to marginal utility, when the total utility is maximum?  
 Ans. Marginal utility is zero.
- Q.5. What is law of diminishing marginal utility?  
 Ans. Law of diminishing marginal utility states that as we consume more and more units of a commodity, utility derived from each successive unit goes on decreasing.
- Q.6. What is meant by consumer's equilibrium?  
 Ans. Consumer's Equilibrium refers to a situation when a consumer is having maximum satisfaction with his limited income and has no tendency to change his existing way of expenditure.
- Q. 7. What is meant by MU of one rupee?  
 Ans. MU of one rupee refers to the utility obtained from purchase of commodities with one rupee.
- Q.8. Define an indifference curve.  
 Ans. Indifference curve refers to the graphical representation of various alternative combinations of bundles of two goods among which the consumer is indifferent.
- Q. 9. Define an indifference map.  
 Ans. Indifference Map refers to the family of indifference curves that represent consumer preferences over all the bundles of the two goods.
- Q.10. Define a budget line.  
 Ans. Budget line is a graphical representation of all possible combinations of two goods which can be purchased with given income and prices, such that the cost of each of these combinations is equal to the money income of the consumer.

Q.11. Define budget set.

Ans. Budget set is the set of all possible combinations of the two goods which a consumer can afford, given his income and prices in the market.

Q.12. Why budget line is a straight line?

Ans. The slope of Budget line is represented by the Price Ratio. As Price Ratio is constant throughout, the budget line is a straight line.

## DEMAND

**Meaning of demand** – Demand is the quantity of a commodity that a consumer is willing and able to buy, at each possible price during a given period of time.

**Essential elements of Demand** –

1. Quantity of commodity
2. Willingness to buy
3. Price of commodity
4. Period of time

**Types of Demand**

1. Individual Demand
2. Market Demand

### **DETERMINANTS OF DEMAND INDIVIDUAL DEMAND**

1. Price of the given commodity:
2. Price of Related Goods:
  - (i) Substitute Goods:
  - (ii) Complementary Goods:
- (iii) Income of the consumer:
- (iv) Tastes and Preferences:
- (v) Expenditure of Change in the Price in Future:

### **DETERMINATION OF MARKET DEMAND**

1. Size and Composition of Population:
2. Season and Weather
3. Distribution of Income

**DEMAND FUNCTION**-Demand function shows the relationship between quantity demanded for a particular commodity and the factors influencing it.

**INDIVIDUAL DEMAND FUNCTION** –

$$D_x = f(P_x, P_r, Y, F, T)$$

Where,

$D_x$  = Market demand of commodity x:

$P_x$  = Price of given commodity x;

$P_r$  = Prices of Related Goods

$Y$  = Income of the consumers;

$T$  = Tastes and Preferences;

$F$  = Expectation of Change in Price in future;

## MARKET DEMAND FUNCTION –

$$D_x = f(P_x, P_r, Y, P_o, F, T, S, D)$$

Where,

$D_x$  = Market demand of commodity x:

$P_x$  = Price of given commodity x;

$P_r$  = Prices of Related Goods

$Y$  = Income of the consumers;

$T$  = Tastes and Preferences;

$F$  = Expectation of Change in Price in future;

$P_o$  = Size and Composition of population;

$S$  = Season and Weather;

$D$  = Distribution of Income

## DEMAND SCHEDULE

Demand schedule is a tabular statement showing various quantities of a commodity being demanded at various levels of price, during a given period of time.

### Individual demand schedule

Price (in ₹)	Quantity Demanded of commodity x (in units)
5	1
4	2
3	3
2	4
1	5

### Market Demand Schedule

Market demand schedule refers to a tabular statement showing various quantities of a commodity that all the consumers are willing to buy at various levels of price, during a given period of time.

Price (in ₹)	Individual demand (in units)		Market Demand (in units) ( $D_A + D_B$ )
	Household A ( $D_A$ )	Household A ( $D_B$ )	
5	1	2	1+2=3
4	2	3	2+3=5
3	3	4	3+4=7
2	4	5	4+5=9
1	5	6	5+6=11

## DEMAND CURVE

Demand curve is graphical representation of demand schedule. It is the locus of all the points showing various quantities of a commodity that a consumer is willing to buy at various levels of price. During a given period of time, assuming no change in other factors.

It shows the inverse relationship between the quantity demanded of a commodity with its price, keeping other factors constant.

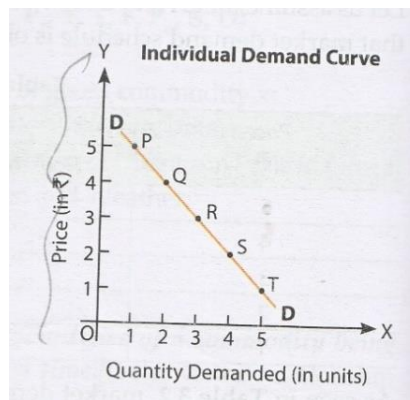
It can be drawn for any commodity by plotting each combination of demand schedule on a graph.

Like demand schedule, demand curves can also be drawn both for individual buyers and for the entire market.

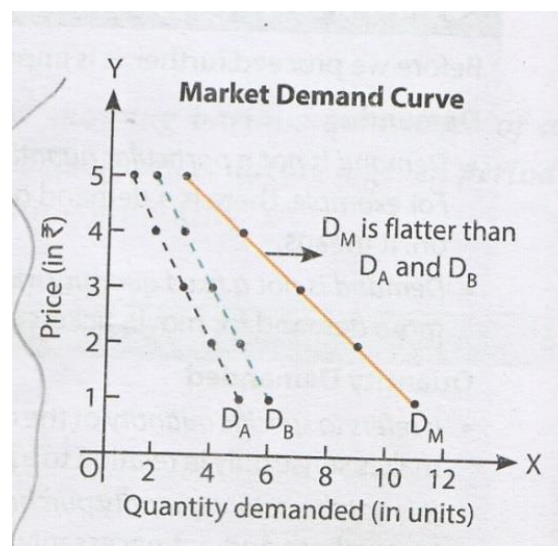
So, demand curve is of two types.

- (i) Individual Demand Curve
- (ii) Market Demand Curve

**Individual Demand Curve**-Individual demand curve refers to a graphical representation of individual demand schedule.



**Market Demand Curve**-Market Demand Curve refers to a graphical representation of market demand schedule.



## Law of Demand

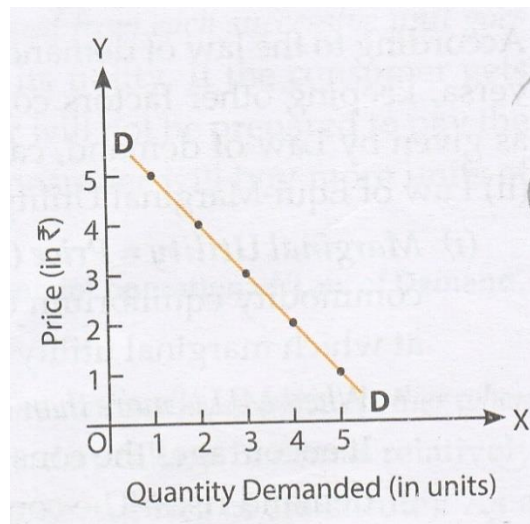
Law of demand states the inverse relationship between price and quantity demanded, keeping other factors constant (*ceteris paribus*).

### Assumptions of Law of Demand

1. Prices of substitute goods do not change.
- 2.. Prices of complementary goods remain constant.
3. Income of the consumer remains the same.
4. There is no expectation of change in price in the future.
5. Tastes and preferences of the consumer remain the same.

### Demand Schedule

Price (in ₹)	Quantity Demanded (in units)
5	1
4	2
3	3
2	4
1	5



### Important Facts about Law of Demand

1. Inverse Relationship
2. Quality, not Quantitative
3. No Proportional Relationship
4. One-Sided.

### Reasons for Law of Demand

1. Law of Diminishing Marginal Utility
2. Substitution Effect
3. Income Effect
4. Additional Customers
5. Different Uses

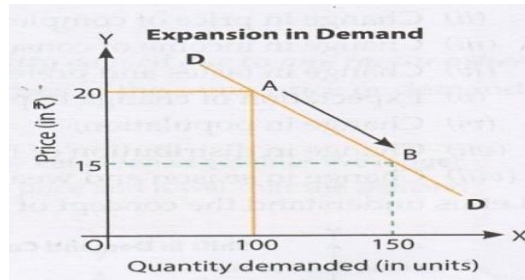
### Exceptions to Law of Demand

1. Giffen Goods
2. State Symbol Goods or Goods of Ostentation
3. Fear of Shortage
4. Ignorance
5. Fashion related goods
6. Necessities of Life
7. Change in Weather

## Movement along the demand curve (Change in Quantity Demanded)

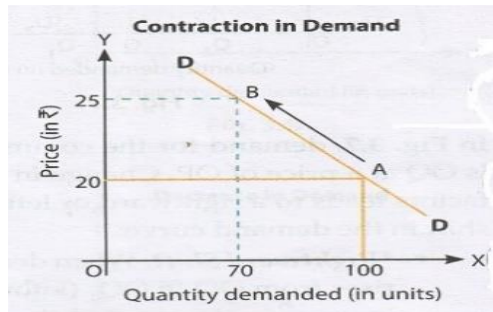
**Expansion in Demand**-Expansion in demand refers to a rise in the quantity demanded due to fall in the price of commodity other factors remaining constant.

Price (in ₹)	Demand (in units)
20	100
15	150



**Contraction in Demand**-Contraction in demand refers to a fall in the quantity demanded due to a rise in the price of commodity. Other factors remaining constant.

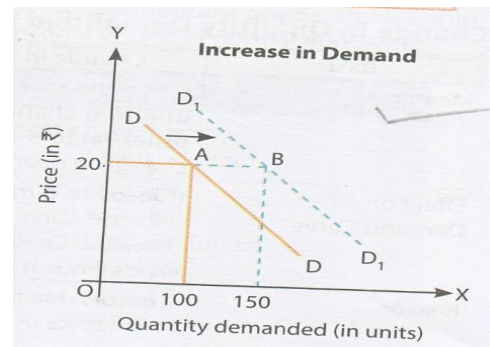
Price (in ₹)	Demand (in units)
20	100
25	70



## SHIFT IN DEMAND (CHANGE IN DEMAND)

**INCREASE IN DEMAND**-Increase in Demand refers to a rise in the demand of a commodity caused due to any factors other than the own price of commodity. In this case demand rises at the same price of demand remain same even at higher price.

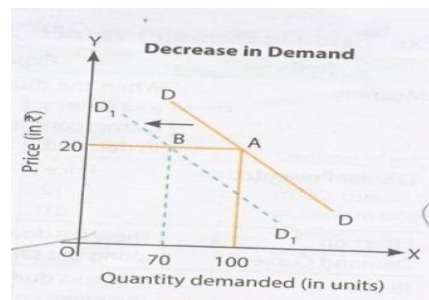
Price (in ₹)	Demand (in units)
20	100
20	150





**DECREASE IN DEMAND-** Decrease in demand refers to a fall in the demand of a commodity caused due to any factors other than the own price of commodity. In this case demand falls at same price or demand remains same even at lower price.

Price (in ₹)	Demand (in units)
20	100
20	70



### Difference between Substitute Goods vs Complementary Goods

Basis	Substitute Goods	Complementary Goods
Meaning	Substitute goods refer to those goods which can be used in place of one another to satisfy a particular demand.	Complementary goods refer to those goods which are used together to satisfy a particular want.
Nature of Demand	Substitute goods have competitive demand	Complementary goods have joint demand.
Relation	Price of one substitute good has positive relationship with quantity demanded of another substitute good.	Price of a complementary good has negative relationship with quantity demanded of another complementary good.
Examples	(i) Tea and Coffee;	(ii) Car and Petrol.

### Difference between Normal Goods vs Inferior Goods

Basis	Normal Goods	Inferior Goods
Meaning	Normal goods refer to those goods whose demand increases with an increase in income.	Inferior goods refer to those goods whose demand decreases with an increase in income.
Income Effect	Income effect is positive in case of normal goods.	Income effect is negative in case of inferior goods.
Law of Demand	Normal good always follow the law of demand i.e. there always exists inverse relation between price of the commodity and its quantity demanded.	Law of demand may fall in case of inferior goods i.e. there may or may not be an inverse relation between price of the commodity and its quantity demanded.
Examples	'Full cream milk' is a normal goods if its demand increases with an increase in income.	'Toned Milk' is an inferior good if its demand decreases with an increase in income.

### Multiple Choice Question -

1. Which of the following is an example of complementary goods:  
(a) Tea and Coffee (b) Coke & Pepsi  
(c) Rice and Wheat  (d) **None of these**
2. Increase in price of substitute food leads to:  
(a) Expansion in demand  (b) **Increase in Demand**  
(c) Decrease in Demand (d) Contraction in demand
3. Expansion in demand leads to:  
**(a) Rightward Shift in demand curve**  (b) **Downward movement along in the demand curve**  
(c) Upward Movement along the demand curve (d) None of these
4. Cross demand states the relationship between:  
 (a) **Demand of given commodity and price of related goods.**  
(b) Demand of given commodity and income of related goods.  
(c) Demand of given commodity and taste and preferences.  
(d) None of these.
5. Which of the following is not an assumption of law of demand?  
(a) Price of substitute goods do not change.  
(b) Income of the consumers remain same.  
(c) There is no change in taste and preferences of the consumers.  
 (d) **Price of the given commodity does not change.**
6. Which of the following is a determinant of demand:  
(a) Income of the consumers.  
(b) Season and weather.  
(c) Price of related consumers.  
 (d) **All of the above.**
7. If price of good 'X' rises and it leads to a fall in demand for good 'Y' then the goods are:  
(a) Substitute goods.  
 (b) **Complementary goods.**  
(c) Normal goods.  
(d) Inferior goods.
8. Expansion and contraction in demand are caused by:  
 (a) **Change in price of the given good.**  
(b) Change in income.  
(c) Change in price related goods.  
(d) Change in population.
9. The slope of demand curve is generally:  
 (a) **Negative.** (c) Constant.  
(b) Positive. (d) Either (a) or (b).
10. Which of the following is a reason for Change in Demand:  
(a) Change in Income.  
(b) Change in price of related goods.  
(c) Population increase.  
 (d) **All of thes**

## Very Short Answer Type Questions (VSAQs)

Q. 1. Define demand for a good.

Ans. Demand is the quantity of a commodity that a consumer is willing and able to buy, at each possible price during a given period of time.

Q. 2. Define market demand.

Ans. Market demand refers to the quantity of a commodity that all the consumers are willing and able to buy, at a particular price during a given period of time.

Q. 3. Define substitute goods.

Ans. Substitute goods are those goods, which can be used in place of each other for satisfaction of a particular want. For example, Tea and Coffee, Pepsi and Coke.

Q. 4. What is meant by complementary goods?

Ans. Complementary goods are those goods which are used together to satisfy a particular want. For example, Car and Petrol, Tea and sugar.

Q. 5. When a good is called an 'inferior good'?

Ans. A good is called an 'inferior good' when its demand falls with a rise in the income of consumer. For example, 'Toned Milk' is an inferior good if its demand decreases with an increase in income.

Q.6. What is Law of demand?

Ans. Law of demand states the inverse relationship between price and the quantity demanded, keeping other factors constant.

Q.7. Define 'change in demand.

Ans. When the demand changes due to a change in the other factors, at the same price, it is termed as change in demand.

Q. 8. What is meant by the purchasing power of money?

Ans. Purchasing power of money means the power of money to command other commodities in its exchange.

**PRICE ELASTICITY OF DEMAND**-Price Elasticity of Demand means the degree of responsiveness of demand for a commodity with reference to change in the price of such commodity.

**PERCENTAGE METHOD FOR MEASURING PRICE ELASTICITY OF DEMAND**

Elasticity of Demand ( $E_d$ ) =  $\frac{\text{Percentage change in Quantity demanded}}{\text{Percentage change in Price}}$

Where:

1. Percentage change in Quantity demanded =  $\frac{\text{Change in Quantity } (\Delta Q)}{\text{Initial Quantity } (Q)} \times 100$
2. Change in Quantity ( $\Delta Q$ ) =  $Q_1 - Q$
3. Percentage change in Price =  $\frac{\text{Change in Price } (\Delta P)}{\text{Original Price } (P)} \times 100$
4. Change in Price ( $\Delta P$ ) =  $P_1 - P$

**Proportionate Method**

The percentage method can also be converted into the proportionate method. Putting the values of 1, 2, 3 and 4 in the formula of percentage method, we get:

$$E_d = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Where,

Q = initial Quantity demanded

$Q_1$  = New Quantity demanded

$\Delta Q$  = Change in the Quantity demanded

P = Initial Price

$P_1$  = New Price

$\Delta P$  = Change in Price

**Example = Q. 1.** Calculate price elasticity of demand if demand increases from 4 units to 5 units due to fall in price from ₹ 10 to ₹ 8.

**Solution:**

Elasticity of demand in the given case will be:

$$\text{Elasticity of Demand } (E_d) = \frac{\text{Percentage change in Quantity demanded}}{\text{Percentage change in Price}}$$

$$\text{Percentage change in Quantity demanded} = \frac{\text{Change in Quantity } (\Delta Q)}{\text{Initial Quantity } (Q)} \times 100$$

$$= \frac{(5-4)}{4} \times 100 = 25\%$$

$$\text{Percentage change in Price} = \frac{\text{Change in Price } (\Delta P)}{\text{Original Price } (P)} \times 100$$

$$= \frac{(8-10)}{10} \times 100 = 20\%$$

$$E_d = \frac{25\%}{-20\%} = -1.25 \text{ (or 1.25 as only numerical or absolute value ins taken)}$$

**Q. 2** When price rises from ₹ 10 to ₹ 8 the demand falls from 5 units to 4 units. Calculate price elasticity of demand.

**Solution**

$$\text{Elasticity of Demand (E}_d\text{)} = \frac{\text{Percentage change in Quantity demanded}}{\text{Percentage change in Price}}$$

$$\begin{aligned}\text{Percentage change in Quantity demanded} &= \frac{\text{Change in Quantity } (\Delta Q)}{\text{Initial Quantity (Q)}} \times 100 \\ &= \frac{(4-5)}{5} \times 100 = -20\%\end{aligned}$$

$$\text{Percentage change in Price} = \frac{\text{Change in Price } (\Delta P)}{\text{Original Price (P)}} \times 100$$

$$\begin{aligned}&= \frac{(10-8)}{8} \times 100 = 25\% \\ E_d &= \frac{-20\%}{25\%} = -0.8\end{aligned}$$

### **FACTORS AFFECTED PRICE ELASTICITY OF DEMAND**

1. Nature of commodity:
2. Availability of substitutes:
3. Income Levels:
4. Levels of price:
5. Postponement of Consumption:
6. Number of Uses:
7. Share in Total Expenditure:
8. Time Period:
9. Habits:

### **Multiple Choice Questions**

1. If there is no change in demand for commodity 'X' even after rise in its price, then its demand is:  
(a) Perfectly Elastic  
(c) Less Elastic  
 (b) **Perfectly inelastic**  
(d) Highly Elastic
2. The elasticity of demand for a product will not be higher:  
 (a) **When it is considered a necessity by its buyers**  
(b) when more substitutes for product are available  
(c) When it has several uses  
(d) When it is an expensive

3. Which of the following will have elastic demand?  
 (a) Matchbox (b) NCERT Textbooks  
 (c) Medicines  (d) **Air Conditioners**
4. If the percentage increase in the quantity demanded of a commodity is less than the percentage fall in its price, then elasticity of demanded is:  
 (a)  $E_d > 1$  (b)  $E_d = 1$   
 (c)  **$E_d < 1$**  (d)  $E_d = 0$
5. Price elasticity of demand is best defined as:  
 (a) Change in the tastes of consumers at different prices  
 (b) Change in demand when income of the consumer increases  
 (c) **The rate of response of demand to a change in price**  
 (d) the rate of response of demand to change in price of related goods
6. Which of the following influence price elasticity of demand?  
 (a) Nature of the commodity (b) Income Level  
 (c) Availability of substitutes  (d) **All of these**
7. If the demand for a good is made by a rich consumer, its demand is generally:  
 (a) **Less elastic** (b) Highly elastic  
 (c) Unitary elastic (d) Perfectly inelastic, vertical straight line
8. With increase in price of burgers by 22% its demand falls by 25%. This indicates that demand for burgers is:  
 (a) **Elastic** (b) Inelastic  
 (c) Unitary elastic (d) Perfectly elastic
9. The Indian Government imposed heavy taxes on commodity to reduce its consumption by the public. Such heavy taxes will decrease the demand of the commodity only when:  
 (a)  $E_d = 0$   (b)  **$E_d > 1$**   
 (c)  $E_d < 1$  (d)  $E_d = 1$

### Very Short Answer Type Question (VSAQs)

Q.1. Define price elasticity of demand.

Ans. Price elasticity of demand means the degree of responsiveness of demand for a commodity with reference to change in the price of such commodity.

Q.2. Why is price elasticity of demand generally negative?

Ans. Price elasticity of demand is generally negative because of the inverse relationship between price and quantity demanded.

Q.3. Give the formula for measuring price elasticity of demand according to percentage method?

Ans. Elasticity of Demand ( $E_d$ ) =  $\frac{\text{Percentage Change in Demand}}{\text{Percentage Change in Price}}$

Q.4. How is price elasticity of related to horizontal straight line demand curve?

Ans. A horizontal straight line demand curve is perfectly elastic ( $E_d = \infty$ )

Q.5. How is price elasticity of related to a vertical straight line demand curve?

Ans. A vertical straight line demand curve is perfectly inelastic ( $E_d = 0$ )

Q.6. What is meant by unitary elastic demand?

Ans. When percentage change in the quantity demanded is equal to percentage change in price, then demand for such a commodity is said to be unitary elastic.

Q.7. What is meant by highly elastic demand?

Ans. When percentage change in the quantity demanded is more than the percentage change in price, then demand for such a commodity is said to be highly elastic.

Q.8. State 3 factors which affect price elasticity of demand?

Ans. (i) Nature of commodity; (ii) Availability of substitutes; (iii) Income Level.

Q.9. Why is demand for water Inelastic?

Ans. Because it is a necessity.

Q.10. A rise in the price of a good results in an increase in expenditure on it. Is its demand elastic or Inelastic?

Ans. The Demand is Inelastic.

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## **Unit 6: PRODUCER BEHAVIOUR AND SUPPLY**

**Production**—Production refers to the transformation of inputs into outputs. Production is creation of utility.

**Production Function**\_: The production function is an expression of the technological relationship between the physical inputs and outputs of a good.

It can be expressed as  $Q = (f_1, f_2, f_3, \dots, f_n)$ .

Where  $Q$  = Physical output of a good;  $f_1, f_2, f_3, \dots, f_n$  = Physical inputs.

### **VARIABLE AND FIXED FACTORS**

**Variable Factors** – Variable factors refer to those factors which can be changed in the short run. They vary directly with the level of output. As output increases, the requirement for variable factors also rises and vice versa. Variable factors are not required in case of zero output. For example, raw materials, casual labour, power, fuel, etc.

**Fixed Factors** – Fixed factors refer to those that cannot be changed in the short run. The number of fixed factors remains the same in the short run, irrespective of the output level. They do not change whether the level of output rises, falls, or becomes zero. For example, plant and machinery, buildings, land, etc.

### **Types of Production Function :**

**1. Short-run Production Function** : Short run refers to a period in which output can be changed by changing only variable factors. In the short run, fixed factors like a plant, machinery, building, etc., cannot be changed. Therefore production can be raised only by increasing variable factors until the extent of the capacity of the fixed factors.

For example—if a producer wants to increase output in the short run, he can do so by using more raw materials or increasing the number of workers with the existing factory building, plant, and equipment. One cannot immediately expand the factory building, additional plant, and equipment. So, in the short run, some factors are fixed, and some are variable and fixed factors cannot be changed during such a short period.

The period of the short run is not a fixed time. The period is a rather functional concept that depends on production conditions. It varies from firm to firm and industry to industry.

### **2. Long-run Production Function:**

The long run refers to a time in which output can be changed by changing all factors of production. In the long run, there are no fixed factors, as all factors can be varied. In the long run, it is enough for the firm to adjust all its inputs according to changes in the conditions. In the long run, a firm can change its factory size, switch to new production techniques, purchase new machinery, etc.

Therefore, if a producer wants to increase his output in the long run, he can do so by changing any of the factors of production, including factory building, plant machinery, etc.

**Total product or Total physical product (TP)** refers to total quantity of goods and services produced by a firm in a given period of time.

$$TP = \sum MP$$



**Average Product (AP)** refers to average production is the per unit production of variable factor.

$$AP = \frac{TP}{\text{Variable input}}$$

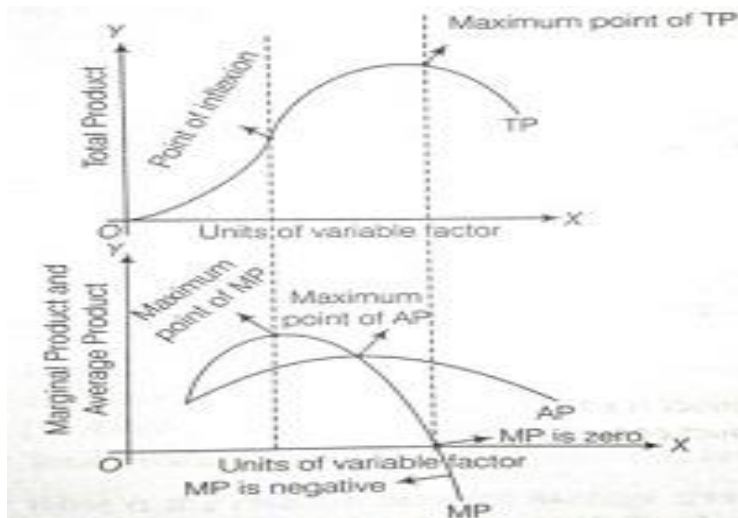
**Marginal product(MP)** refers to the change in total product resulting from the employment of an additional unit of variable factor. In other words, it is the contribution of each additional unit of variable factor to output.

$$MP = \frac{\Delta TP}{\Delta L} \text{ or } MP_n = TP_n - TP_{n-1}$$

### Relation between TP and MP

1. When TP increases at an increasing rate, MP also increases.
2. When TP increases at a diminishing rate, MP declines.
3. When TP is maximum, MP=0.
4. When TP begins to decline, MP becomes negative.

Labour	MP	TP	AP
1	2	2	2
2	3	5	2.5
3	4	9	3
4	3	12	3
5	1	13	2.6
6	0	13	2.16
7	-2	11	1.6



### Relation between MP and AP

When  $MP > AP$ , AP rises.

When  $MP = AP$ , AP is maximum and constant.

When  $MP < AP$ , AP falls.

MP may be zero or negative, but AP continues to be positive.

AP increases, even when MP falls but MP should lie above AP.

### CONCEPT OF COST

**Explicit Cost** : Actual money expenditure incurred by a firm on the purchase and hiring the factor inputs for the production is called explicit cost. These are entered into books of accounts. For example-payment of wages, rent, interest, purchases of raw materials etc.

**Implicit cost** is the cost of self owned resources of the production used in the production process. Or estimated value of inputs supplied by the owner itself. These are not entered into books of accounts.

**Economic Cost** : It is the sum total of explicit and implicit cost.

**SHORT RUN COSTS** - it consists of fixed costs and variable costs since in the short run some factors are fixed and some are variable factors.

**The sum total of fixed cost and variable cost is called as TOTAL COST(TC)**

<u>Fixed Cost</u>	<u>Variable Cost</u>
The cost which does not change with the change in output is called fixed cost	The cost which changes with change in output is called variable cost.
It is the cost incurred on fixed inputs.	It is the cost incurred on variable inputs
Examples: Rent of business premises, salary of permanent staff, interest paid on borrowed funds, licence fees, etc.	Examples: Wages, expenditure on raw materials, etc.

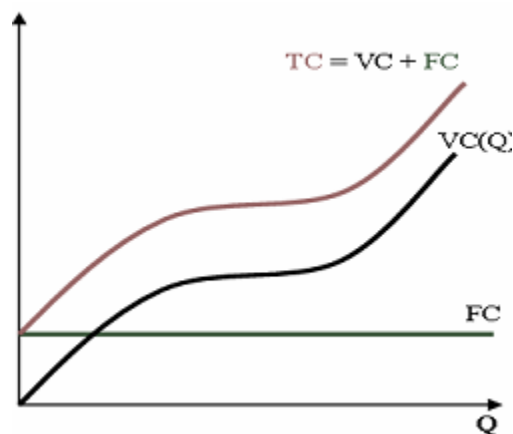
**Total cost** refers to the total amount of money which is incurred by a firm on production of a given amount of a commodity. Total cost is the sum of total fixed cost and total variable cost.  $TC = TFC + TVC$  or  $TC = AC \times Q$

**Total fixed cost:-** It is also called supplementary cost. It is the total expenditure incurred by the producer for employing fixed inputs. Ex- Rent of land and building, interest on capital, licence fee etc.

$$TFC = TC - TVC \text{ or } TFC = AFC \times Q$$

**Total variable cost** is the cost which varies with the quantity of output produced. It is zero at zero level of output. TVC curve is parallel to TC curve. Ex-cost of raw material, expenses on power etc.

$$TVC = TC - TFC \text{ or } TVC = AVC \times Q$$



### RELATION BETWEEN TC, TVC AND TFC

- $TC = TFC + TVC$ . Therefore, the TC curve is the vertical summation of TVC and TFC
- Since  $TC = TFC + TVC$  and TFC remains constant at all levels of output, therefore an increase in TC is equal to increase in TVC.
- At zero level of output,  $TVC = 0$  since the firm does not need to employ any variable inputs.
- Therefore, TVC curve starts from the origin. At zero level of output,  $TC = TFC$  since  $TVC = 0$  at zero level of output. Therefore, TC curve starts from Y-axis at a vertical distance of TFC from the origin.
- Since  $TC - TVC = TFC$  and TFC is constant at all levels of output, therefore the vertical distance between TC and TVC curves remains the same. In other words, TC and TVC curves remain parallel to each other.
- As output increases, TVC and TC both initially increase at decreasing rate and after a point increase at increasing rate. Therefore, both TVC and TC curve look like inverse S shaped. TC and TVC curves both are concave in the beginning and convex afterwards.

**Average cost** is per unit cost of production of a commodity. It is obtained by adding Average Fixed Cost and Average Variable cost.

$$AC = AFC + AVC$$

**Average fixed cost (AFC)** is per unit fixed cost of production of a commodity

$$AFC = \frac{TFC}{Q} \quad \text{or} \quad AFC = AC - AVC$$

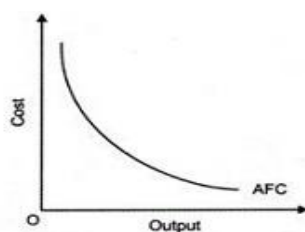
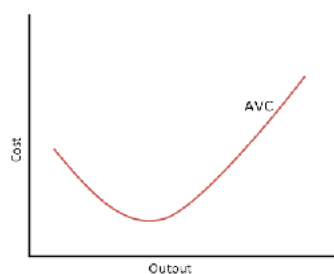


Figure-6: AFC Curve

**Average variable cost (AVC)** is per unit variable cost of production of a commodity. AVC is U-shaped due to the law of variable proportion.

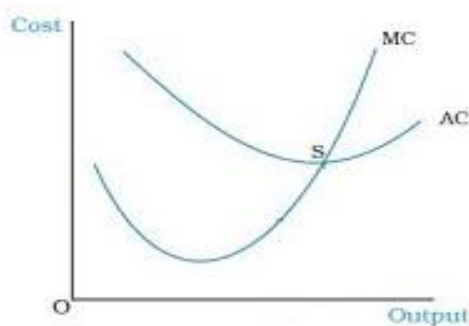
$$AVC = \frac{TVC}{Q} \quad \text{or} \quad AVC = AC - AFC$$



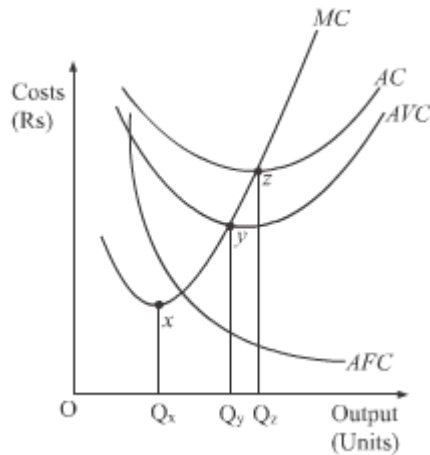
**Marginal Cost** It refers to change in TC, due to additional units of a commodity being produced.

$MC = \Delta TC / \Delta Q$  or  $MC_n = TC_n - TC_{n-1}$ . But in the short run, it is calculated from TVC.

$$MC_n = TVC_n - TVC_{n-1} \quad \text{or} \quad MC = \frac{\Delta TVC}{\Delta Q}$$



## RELATION BETWEEN MC ,AC AND AVC



### Relation between MC and AVC.

1. When  $MC < AVC$ , AVC falls.
2. When  $MC = AVC$ , AVC is constant and minimum
3. When  $MC > AVC$ , AVC rises.

### Relationship between MC and AC

1. When  $MC < AC$ , AC falls.
2. When  $MC = AC$ , AC is constant and minimum
3. When  $MC > AC$ , AC rises.

## RELATION BETWEEN AC,AFC AND AVC

- Average cost is the sum of average fixed cost and average variable cost ( $AC = AFC + AVC$ ). AC curve lies above the AVC curve because AC includes both AFC and AVC at all levels of output and AFC is positive. Thus, AC curve lies above the AVC curve with a vertical distance being equal to the value of AFC.
- Since  $AC = AFC + AVC$ , therefore,  $AC - AVC = AFC$ .
- Since  $AFC = TFC/\text{output}$  and TFC remains constant at all levels of output, therefore as output increases AFC falls because the constant value of TFC is divided by incremental units of output. So, the difference between AC and AVC decreases with increase in output. Hence, the vertical distance between AC and AVC curves goes on falling. However, AC and AVC curves can never intersect because AC and AVC can never be equal at any level of output. This is so because AFC can never be zero since TFC is a constant and is positive.

## CONCEPT OF REVENUE

The money income which a producer gets from the sale of his product is known as revenue of the firm. It is also called sale proceeds of the firm..The concept of revenue should not be confused with the concept of profit. Profit of a firm is estimated as the difference between revenue and cost related to the production of a commodity (Profit = Revenue – Cost).

**Total Revenue (TR)**-Total revenue refers to money receipts of a firm from the sale of its total output. It is estimated as the multiple of price and quantity of output.

$TR = P \times Q$  (Here, TR = Total revenue, P = Price per unit of output, and Q = Quantity (or units) of output.)

Total revenue is the sum of money receipts of a producer corresponding to a given level of output.

**Average Revenue (AR)**-Average revenue is the revenue per unit of output. It is equal to total revenue divided by total output.

$AR = TR/Q$  (Here, AR = Average Revenue, TR = Total Revenue, and Q = Total Output)

Average revenue is the per unit revenue corresponding to a given level of output of a firm.Average Revenue is the same as Price of the Commodity.

$AR = TR/Q$

$AR = (P \times Q)/Q$  [Since  $TR = P \times Q$ ]

**AR = P** it implies that average revenue is nothing but the price of the commodity.

**Marginal Revenue (MR)**-Marginal revenue is the additional revenue that a producer expects from the sale of one more unit of a commodity. In other words, it is the change in total revenue which results from the sale of one more (or one less) unit of a commodity. It is expressed as:

$MR = \Delta TR/\Delta Q = TR_n - TR_{n-1}$

(Here, MR = Marginal revenue,  $\Delta TR$ = Change in total revenue,  $\Delta Q$ = Change in output,  $TR_n$ = Total revenue from 'n' units of the output and  $TR_{n-1}$ = Total revenue from 'n – 1' units of the output.)

Marginal revenue is the addition to total revenue on account of sale of one more unit of output.

output(Unit s)	Price = Average Revenue	Total revenue(PXQ)	Marginal Revenue
1	10	10	10-0=10
2	10	20	20-10=10
3	10	30	30-20=10
4	10	40	40-30=10
5	10	50	50-40=10

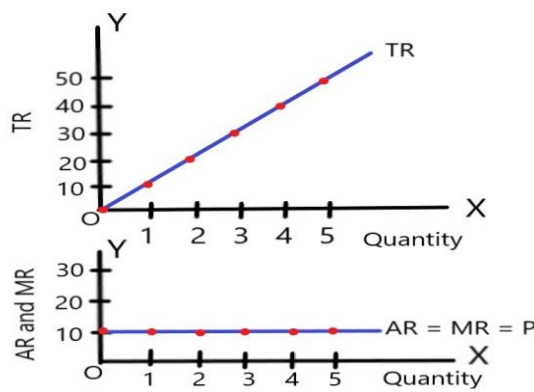
Above Table is drawn on the assumption that price is constant at Rs 10 per unit of output.

## Relation between TR, AR and MR

Relation between TR, AR and MR is discussed with reference to two situations

**(a) WHEN PRICES ARE CONSTANT**-When  $AR(=P)$  is given to a firm, it implies that AR is constant for a firm.

Constant AR implies that MR should also be constant, and equal to AR. Both AR and MR curves are horizontal straight line parallel to X-axis. It is a situation when a firm has no control over price and has to sell its product at the given price. Now, when AR and MR are constant and are equal to each other, corresponding to every additional unit of output, a firm should be adding a constant amount to its TR. Thus, firm's TR should increase at a constant rate



**(b) WHEN PRICES ARE NOT CONSTANT**- Accordingly, a firm can plan to increase its sales by lowering price showing a negative relationship between price and output.

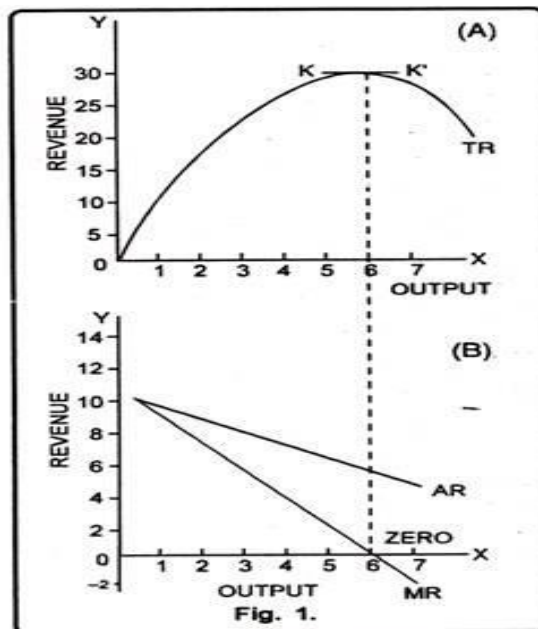
### **Observations:**

- (i) When the marginal revenue curve declines in part 'B', total revenue is increasing at a diminishing rate in part 'A'.
- (ii) When marginal revenue becomes zero, total revenue is at its maximum (K)
- (iii) When marginal revenue falls, the average revenue also falls but lies above the marginal revenue curve because  $AR=P$  and price cannot be negative.
- (iv) When marginal revenue becomes negative. Now total revenue starts diminishing.

**NOTE**-Marginal revenue can be positive, zero or negative but average revenue (or price) cannot be negative.

Output	AR(=P)	TR	MR
1	10	10	10-0=10
2	9	18	18-10=8
3	8	24	24-18=6
4	7	28	28-24=4
5	6	30	30-28=2
6	5	30	30-30=0
7	4	28	28-30=-2

Prices are falling(not constant) as a result, AR and MR are falling.





## CONCEPT OF PRODUCERS EQUILIBRIUM.

Equilibrium refers to a state of rest when no change is required. A firm (producer) is said to be in equilibrium when it has no inclination to expand or to contract its output. This state either reflects maximum profits or minimum losses.

### Method for determination of Producer's Equilibrium:

#### **Marginal Revenue and Marginal Cost Approach (MR-MC Approach)**

According to MR-MC approach, producer's equilibrium refers to stage of that output level at which

##### 1. $MC = MR$ :

We know, MR is the addition to TR from sale of one more unit of output and MC is addition to TC for increasing production by one unit. Every producer aims to maximise the total profits. For this, a firm compares its MR with its MC. Profits will increase as long as MR exceeds MC and profits will fall if MR is less than MC.

So, equilibrium is not achieved when  $MC < MR$  as it is possible to add to profits by producing more. Producer is also not in equilibrium when  $MC > MR$  because the benefit is less than the cost. It means, the firm will be at equilibrium when  $MC = MR$ .

##### 2. $MC$ is greater than $MR$ after $MC = MR$ output level:

$MC = MR$  is a necessary condition, but not sufficient enough to ensure equilibrium. It is because  $MC = MR$  may occur at more than one level of output. However, out of these, only that output level is the equilibrium output when MC becomes greater than MR after the equilibrium.

It is because if MC is greater than MR, then producing beyond  $MC = MR$  output will reduce profits. On the other hand, if MC is less than MR beyond  $MC = MR$  output, it is possible to add to profits by producing more. So, first condition must be supplemented with the second condition to attain the producer's equilibrium.

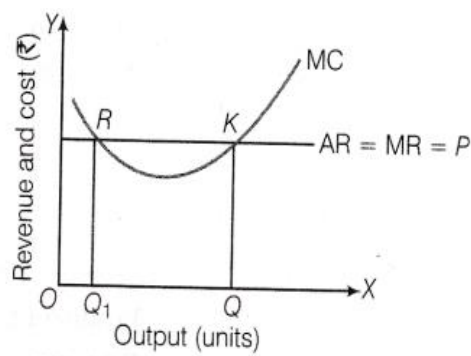
OUTPUT(Q)	PRICE(P)	TR(PXQ)	TC	MR	MC
1	12	12	13	12	13
2	12	24	25	12	12
3	12	36	34	12	9
4	12	48	42	12	8
5	12	60	54	12	12
6	12	72	68	12	14

According to Table,  $MC = MR$  condition is satisfied at both the output levels of 2 units and 5 units. But the second condition, 'MC becomes greater than MR' is satisfied only at 5 units of output. Therefore, Producer's Equilibrium will be achieved at 5 units of output.

### EQUILIBRIUM WHEN PRICES ARE CONSTANT

Producer's Equilibrium is determined at OQ level of output corresponding to point K. Both AR and MR curves are straight line parallel to the X-axis. MC curve is U-shaped. Producer's equilibrium will be determined at OQ level of output corresponding to point K because only at point K, the following two conditions are met:

1.  $MC = MR$ ; and
2. MC is greater than MR after  $MC = MR$

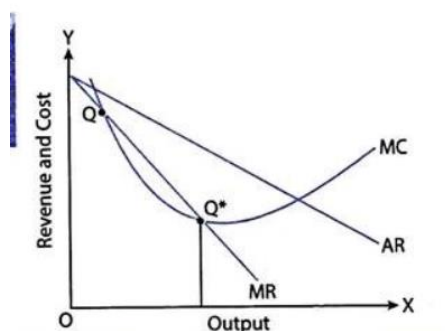


Although  $MC = MR$  is also satisfied at point R, it is not the point of equilibrium as it satisfies only the first condition (i.e.  $MC = MR$ ). So, the producer will be at equilibrium at point K when both the conditions are satisfied.

**EQUILIBRIUM WHEN PRICES FALLS WITH OUTPUT**-Producer's Equilibrium is at  $Q^*$  as at this point:

- (i)  $MC = MR$ ; and
- (ii) MC is greater than MR after  $MC = MR$  output level.

AR and MR curves falls because prices are falling with rise in output.



$Q^*$  is the point of equilibrium when:  
(i)  $MR = MC$ , and (ii) MC is rising.

## CONCEPT OF SUPPLY

**Supply** refers to the different quantities of a commodity that a producer/firm would be willing to sell at different prices.

**Stock:** Refers to the total quantity of a particular commodity available with the firm at a particular point of time.

**Law of Supply**-Law of supply states that 'other things remaining the same', an increase in the price of a commodity leads to an increase in its quantity supplied and vice-versa. In other words, more of a commodity is supplied at higher prices than at lower prices. 'Other Things remaining the same' in the law of supply means:

- (i) Input prices (or prices of factors of production) remain the same.
- (ii) There is no change in technique of production.
- (iii) Prices of other goods in production remain unchanged.
- (iv) Tax on the commodity (e.g., GST) does not change.

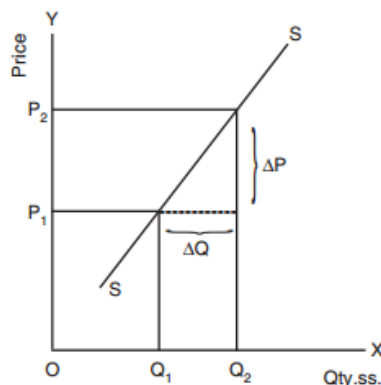
### Supply schedule

Supply schedule is a tabular presentation showing the different quantities of a good that a firm is willing to supply at different prices during a given period of time.

price(Rs)	Quantity Supplied(units)
10	100
15	200
20	300

Table shows that as the price of the good X increases from Rs10 to Rs20, the quantity supplied increases from 100 units to 300 units. Thus, there is a positive relationship between price and quantity supplied of good X.

**Supply curve**-Supply curve is a graphical presentation which shows the quantities of a commodity supplied at various prices during a given period of time.



### Reason behind the law of supply

An increase in price leads to higher profit margin of the producer, inducing him to produce more quantity of the commodity. Similarly, when the price of the commodity falls, it leads to reduced profit margin of the producer, forcing him to produce lesser quantity.

Thus, there is a positive (direct) relation between price and quantity supplied of a commodity. Therefore, supply curve is an upward sloping curve.

### Exceptions to law of supply

#### (a) Future expectations:

(i) The law will not apply if there are future expectations for further change in prices.

(ii) For example, if sellers expect further fall in prices in future, they would be ready to sell more even at low prices.

(b) Agricultural goods: The supply of agricultural goods depends more on natural factors such as drought, floods, natural calamities etc. and less on their prices.

(c) Perishable goods: The supply of perishable goods, like milk, vegetables, fish, eggs, etc. is also not affected by their prices. Sellers cannot hold these goods for long.

#### (d) Rare articles:

(i) In case of some precious and rare goods also, the law of supply does not apply.

(ii) Artistic goods of high quality and poems written by top class poets come under this category. Their supply cannot be increased even when their prices rise.

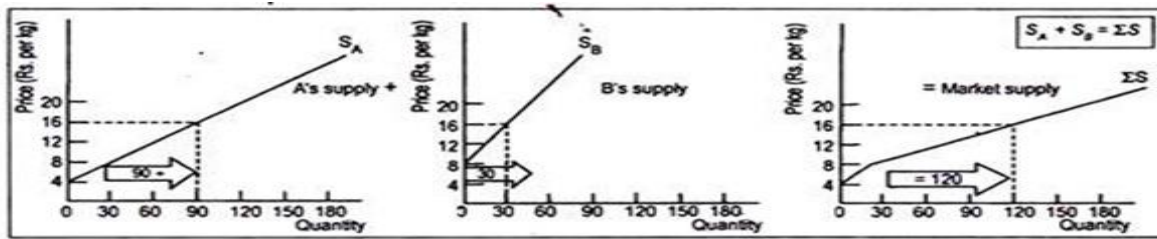
**Individual Supply:** Refers to the quantity of a commodity that an individual firm is willing and able to offer for sale at different prices during a given period of time.

**Market supply:** It is the sum total of quantity supplied of a commodity by all sellers or all firms in the market at different prices and in a given period of time.

**Supply schedule** of producer A, producer B and market supply schedule of producers A and B is given in the table

Price (Rs. per kg)	Quantities supplied		
	Producer A (kg per month)	Producer B (kg per month)	Market Supply (kg per month) (ii + iii)
(i)	(ii)	(iii)	(iv)
4	0	0	0
8	30	0	30
12	60	15	75
16	90	30	120
20	120	45	165

**Market supply curve** is obtained by horizontal summation of individual supply curves of A and B as shown in the supply curves



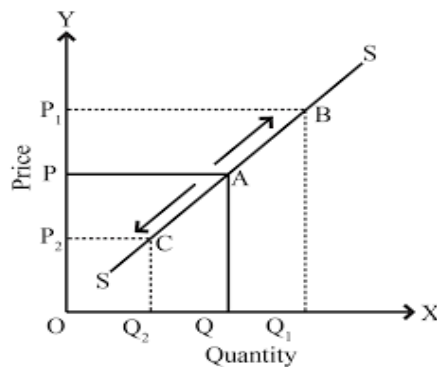
## Factors affecting Supply of a commodity

**1. Change in own price of the good**-Other factors like technology and prices of factors of production remaining constant, an increase in the price of a commodity leads to an increase in quantity supplied. This is because an increase in price leads to higher profit margin of the producer, inducing him to produce more quantity of the commodity.

**There will be upward movement along the same supply curve.**

Figure shows that the supply of the good X increases from OQ to OQ<sub>1</sub> as a **result of rise in price** from OP to OP<sub>1</sub>.

When the **price of the commodity falls**, it leads to reduced profit margin of the producer, forcing him to produce lesser quantity. There will be downward movement along the same supply curve. Figure shows that the supply of the good X decreases from OQ to OQ<sub>2</sub> as a result of rise in price from OP to OP<sub>2</sub>



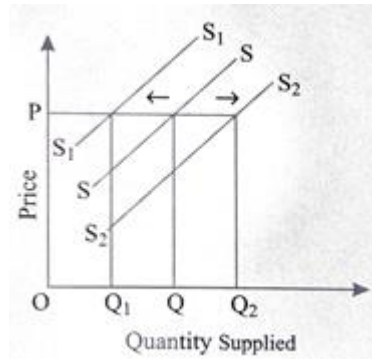
## **2. State of technology-**

(i) Technological progress (improvement in technique of production) raises productivity and brings down per unit cost of production. So, the profit margin of the producer rises and hence the producer will be induced to produce more quantity of the commodity at the given price. Supply curve of the commodity will shift rightward.

Figure Shows that the supply of the good X increases from OQ to OQ<sub>2</sub> at the same price OP due to improvement in technique of production. It leads to a rightward shift in the supply curve of good X from S to S<sub>2</sub>

(ii) On the contrary, if technology becomes obsolete, productivity decreases. So, per unit cost of production, i.e., average cost increases. Price of the product remaining unchanged, increase in average cost decreases profits. Therefore, the producer decreases supply of output at the same price. As a result, supply curve shifts

leftwards. Figure shows that the supply of the good X decreases from OQ to OQ<sub>1</sub> at the same price OP when the technology becomes obsolete. It leads to a leftward shift in the supply curve of good X from SS to S<sub>1</sub>S<sub>1</sub>



### 3. Change in prices of factors of production (Change in input prices)

(i) When the price of factor input falls, the profit margin of the producer rises, inducing him to produce more quantity of the good at the given price. Supply curve of the good will shift rightward. Figure shows that the supply of the good X increases from OQ to OQ<sub>1</sub> at the same price OP when prices of factor inputs fall. It leads to a rightward shift in the supply curve of good X from SS to S<sub>2</sub>S<sub>2</sub>

(ii). On the other hand, when the price of factor input producing the Good X rises, e.g., if the wage rate of labour rises, the profit margin of the producer falls, forcing him to produce less quantity of Good X at the given price. Supply curve of Good X will shift leftwards. Figure shows that the supply of the good X Decreases from OQ to OQ<sub>1</sub> at the same price OP. It leads to a leftward shift in the supply curve of good X from SS to S<sub>1</sub>S<sub>1</sub>

### 4. Government Taxation Policy

(i) If the government increases taxes, e.g., Goods and Services Tax (GST), the cost of production increases. Therefore, profit margin of the producers falls, forcing him to produce less quantity of Good X at the given price. Supply curve of Good X will shift leftwards. Figure shows that the supply of the good X decreases from OQ to OQ<sub>1</sub> at the same price OP if the government increases taxes. It leads to a leftward shift in the supply curve of good X from SS to S<sub>1</sub>S<sub>1</sub>

(ii) On the other hand, if the government decreases taxes, the cost of production will fall. Therefore, the profit margin of the producer rises, inducing him to produce more quantity of the good at the given price. Supply curve of the good will shift rightwards. Figure shows that the supply of the good X increases from OQ to OQ<sub>2</sub> at the same price OP, it leads to a rightward shift in the supply curve of good X from SS to S<sub>2</sub>S<sub>2</sub>

### 5. Change in prices of other goods in production

Suppose a firm produces two goods X and Y. X is the given good and Y is the other good in production. If price of good Y rises, it becomes relatively more profitable to produce good Y in comparison to the given good X. This results in diversion of resources from the production of good X to good Y. Therefore, the supply of the good X decreases at the same price. As a result, the supply curve of the good X shifts leftwards. Similarly, fall in the price of other good Y increases the supply of the given good X leading to a rightward shift of its supply curve at the same price.

**6. Subsidy**-Subsidy is a form of financial/economic assistance given by the government to the firms and households, with a motive of general welfare.

Suppose the government gives subsidy on production of the good. This raises total revenue. Cost remaining unchanged, profits rise. This provides incentive to the producers to supply more units of output at the same price. Therefore, supply curve shifts rightwards.

Similarly, fall in the subsidy decreases the profit margin and hence supply of the given good decreases X leading to a leftward shift of its supply curve at the same price.

## Change in Quantity Supplied Vs change in Supply:

### a) Change in Quantity Supplied or Movement along supply curve-

**Expansion of supply:** increase in quantity supplied due to increase in prices of the commodity. It causes an upward movement along the same supply curve.

**Contraction in Supply:** decrease in quantity supplied due to fall in the prices of the commodity. It causes Downward movement along the same supply curve.

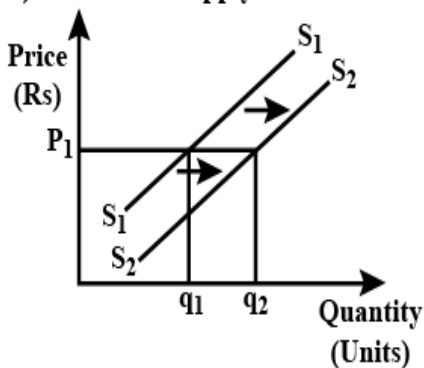
### b) Change in Supply or Shift in supply curve

**Increase in supply:** increase in supply due to any other factor, prices of the commodity remain constant. It causes a rightward shift in the supply curve.

**Decrease in supply:** Decrease in supply due to any other factor, prices of the commodity remain constant. It causes a leftward shift in the supply curve

IMAGE 1

#### 1) Increase in Supply



#### 1) Expansion of Supply

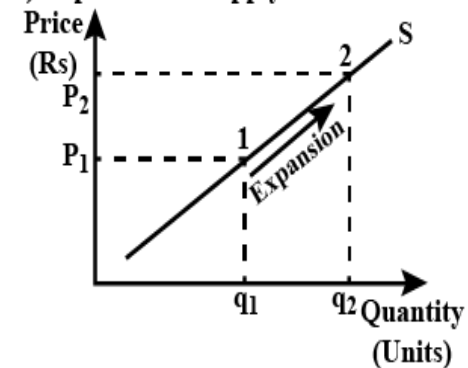
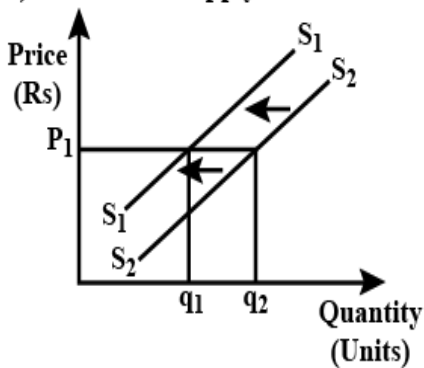
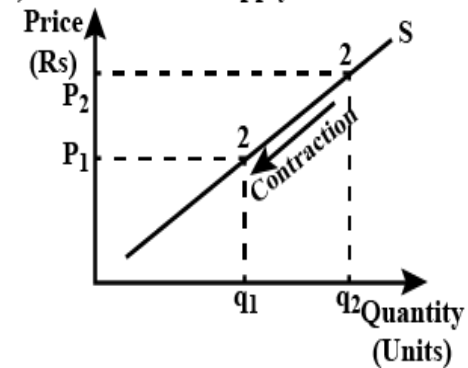


IMAGE 2

#### 2) Decrease in Supply



#### 2) Contraction of Supply



**Price Elasticity of Supply:** it refers to the degree of responsiveness of supply of a commodity with reference to a change in price of the commodity. It is always positive due to the direct relationship between price and quantity supplied.

$$\text{Price Elasticity of Supply (Es)} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$Es = \frac{\% \text{ change in a quantity supplied}}{\% \text{ change in price}}$$

$$\text{Or } Es = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

### **Factors influencing price elasticity of supply**

- Various factors influence the price elasticity of the supply of goods and services.
- The type of industry is a major defining factor in price elasticity. Industries such as toy factories will be more elastic due to the easy production. However, the supply of goods such as precious gems will be less elastic as the production will only rise at a low rate.
- The nature of the commodity being supplied also influences the price elasticity of supply. Goods that can be substituted with other goods will be more elastic.
- Environmental restrictions or production limits can also affect supply. Quick production of goods such as rubber will be challenging due to the time taken by rubber trees to grow.
- Risk-taking by the producer is another factor that influences price elasticity.
- Time also plays a vital role in impacting price elasticity. The supply of goods is more elastic in the short run than in the long run.
- The cost of production is an influencing factor in the price elasticity of supply.
- The technique or method used by producers to produce goods can also determine the price elasticity of supply.

### **QUESTION BANK**

1. \_\_\_\_\_ is an expression of the technological relationship between inputs and outputs of an item.

- (a) Production (b) Revenue function (c) Production function (d) All of the above

**Answer:c**

2. \_\_\_\_\_ refers to the transformation of inputs into output.

- (a) Production (b) Revenue function (c) Production function (d) All of the above

**Answer:a**



3. Production function specifies\_\_\_\_\_.

- (a) Maximum output produced with a given output (b) Minimum quantity of inputs needed to produce  
(c) Both (a)&(b) (d) None of the above

**Answer:c**

4.If the market supply curve for a product shifts rightwards, what is the best possible explanation for this shift?

- (a)increase in the price of raw materials  
(b)Introduction of a tax on that product by the government  
(c)Introduction of a new technique that makes the production of that commodity cheaper  
(d)An advertising campaign that is successful in promoting the product

**Answer: c**

5. A period in which output can be changed by changing only variable factors

- (a) Long run (b) Short-run (c) Fixed run (d) Factor run

**Answer:b**

6. When the marginal cost curve cuts the average cost curve, then the \_\_\_\_\_.

- (a)The average cost will be equal to the marginal cost  
(b)The average cost will be less than the marginal cost  
(c)The average cost will be greater than the marginal cost  
(d)None of the above

**Answer: a**

7. Which of the following are fixed inputs?

- (a) Plant (b) Machinery (c) Building (d) All of the above

**Answer:d**

8.Which of the following statements is true?

- (a)When the production is zero, the total cost will also be zero  
(b)When the production is zero, the total cost will be equal to variable cost  
(c)When the production is zero, the total cost will be equal to the total fixed cost  
(d)When the production is zero, the total cost will be equal to marginal cost

**Answer: c**

9. In a particular year, the farmers experienced dry weather. If all other factors remain the same, the supply curve of wheat for farmers will shift to the \_\_\_\_\_ direction.

- (a) Downward                      (b) Rightward                      (c) Leftward                      (d) None of the above

**Answer: c**

10. Read the following statement given below and choose the correct alternative

Statement 1- Input refers to the volume of goods produced by a firm or an industry During a specific period.

Statement 2- Total product is the total quantity of goods produced by a firm in a given period with given inputs

- (a) Statement 1 is incorrect and statement 2 is correct                      (b) Both are correct  
(c) Statement 1 is correct and statement 2 is incorrect                      (d) Both are incorrect

**Answer:(a)**

11. Read the following statement given below and choose the correct alternative.

Statement 1- Output per unit of a variable input is termed as an average product.

Statement 2- Average product is also known as an average return.

- (a) Statement 1 is incorrect and statement 2 is correct                      (b) Both are correct  
(c) Statement 1 is correct and statement 2 is incorrect                      (d) Both are incorrect

**Answer:(b)**

12. Read the following statement given below and choose the correct alternative.

Statement 1- Addition to total product when more units of the variable factor are employed is known as Average product.

Statement 2-  $MP = TP - TP_1$

- (a) Statement 1 is incorrect and statement 2 is correct                      (b) Both are correct  
(c) Statement 1 is correct and statement 2 is incorrect                      (d) Both are incorrect

**Answer:(d)**

13. \_\_\_\_\_ refers to the increase in the total product when only one factor is increased.

- (a) Production factor                      (b) Returns to a factor  
(c) Returns to inputs                      (d) Law of Diminishing returns

**Answer(b)**

14. Would an increase in demand for a product cause the supply curve to shift in any direction?

- (a) No effect on supply (b) Change in the slope of a supply curve  
(c) The supply curve will move to the right (d) The supply curve will move to the left

**Answer: a**

15. Which of the following is an example of a fixed cost?

- The wages and salaries of employees The interest on fixed capital  
The electricity bill None of the above

**Answer: b**

16.. In May 2019, a firm was providing 5000 kg of sugar at a market price of Rs. 30 per kg. But in June 2019, the supply of sugar decreased to 4500 kg at a market price of Rs. 20 per kg. This change shows that the supply of sugar is \_\_\_\_\_.

- (a) More elastic (b) Less elastic (c) Perfectly inelastic (d) Perfectly elastic

**Answer: b**

17. Which of the following are the reasons for diminishing returns to a factor?

- (a) Over utilisation of fixed factors (b) Indivisibility of fixed factors  
(c) Increased efficiency of variable factors. (d) All of the above

**Answer(a)**

18. If the elasticity of supply is greater than one, the supply curve would be \_\_\_\_\_.

- (a) Touching y-axis (b) Passing through the origin  
(c) Vertical (d) Horizontal

**Answer: a**

19. Read the following statement given below and choose the correct alternative.

Assertion- At Zero output, TC is equal to TFC.

Reason- As TVC rises with an increase in the output, the distance between TFC and TC curves also goes on increasing.

- (a) Both Assertion and Reason are true. The reason is the correct explanation of the assertion  
(b) Both Assertion and Reason are true. The reason is not the correct explanation of assertion.  
(c) Assertion is true but the reason is not.  
(d) Reason is true but the assertion is not

**answer(b)**

20. Read the following statement given below and choose the correct alternative.

Assertion- AFC can never touch the X-Axis.

Reason- TFC can never be zero

- (a) Both Assertion and Reason are true. The reason is the correct explanation of the assertion
- (b) Both Assertion and reason are not true. The reason is not the correct explanation of assertion.
- (c) Assertion is true but the reason is not.
- (d) Reason is true but the assertion is not

**answer:(a)**

21. Read the following statement given below and choose the correct alternative.

Statement 1- When MR is positive, TR increases.

Statement 2- When MR is zero, TR is maximum.

- (a) Statement 1 is incorrect and statement 2 is correct
- (b) Both are correct
- (c) Statement 1 is correct and statement 2 is incorrect
- (d) Both are incorrect

**answer(b)**

22. When  $MR = AR$ , AR is

- (a) Maximum
- (b) Constant
- (c) Both (a)&(b)
- (d) None of the above

**answer(c)**

**Perfect Competition:** - It refers to the market situation in which there are large no of buyers and sellers dealing in a of homogenous product. Price is determined by the industry and only one price prevails in the market.

### Features of Perfect Competition

#### 1. **VERY LARGE NO OF BUYERS AND SELLERS –**

- (i) As there are large number of sellers' individual seller cannot influence market supply or price. Similarly one buyer cannot affect market demand or price.
- (ii) Firms become price takers as they have to accept the equilibrium price that market demand & supply decide. So market or industry is price maker.
- (iii) Due to large number of buyers firm can sell any amount of good at equilibrium price. Hence they have perfectly elastic, horizontal Average Revenue (AR) curve.

#### 2. **HOMOGENEOUS PRODUCT** - Perfect competition market has homogenous goods which are same in shape, size, color, price etc.

- (I) So it is easy for new firms to enter into and exit from the market.
- (II) There is no selling cost as there is no need for advertising the good.
- (III) So one firm cannot effect price market decides the price.

#### 3. **FREE ENTRY AND EXIT OF FIRM** - If in Short Run there is abnormal profit firms will enter the market & if there are abnormal losses firms will exit the market. Hence in the Long run firms will earn Normal Profits.

#### 4. **PERFECT KNOWLEDGE** - Buyers as well as sellers have complete knowledge of the product.

#### 5. **PERFECT MOBILITY OF FACTORS OF PRODUCTION** - There is no geographical restriction on their movement. The factors are free to move to the industry in which they get the best price.

#### 6. **LACK OF SELLING COST** – Selling cost refers to cost of advertisement of the Product. As all firms sell identical product so need of selling cost.

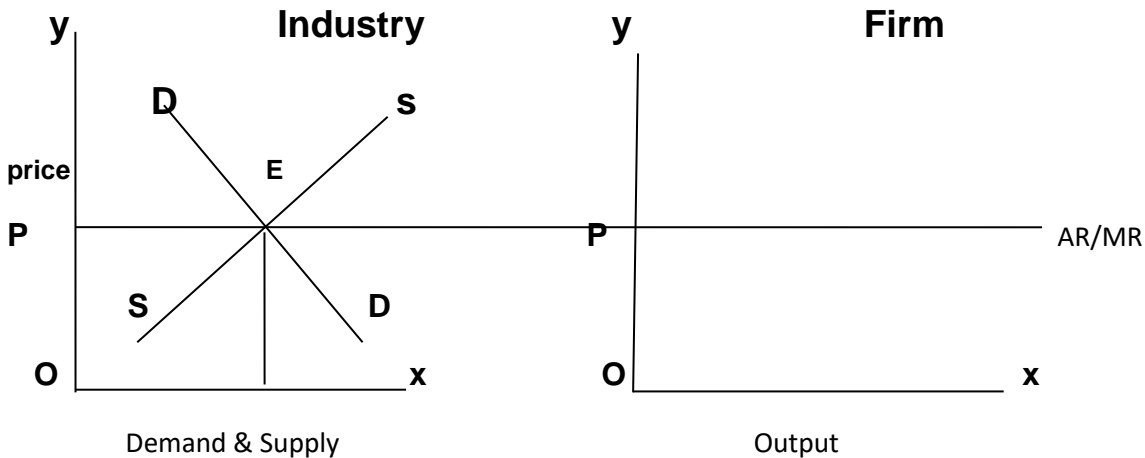
#### 7. **LACK OF TRANSPORTATION COST** - No transportation cost is involved in market because sellers and buyers have the perfect knowledge about the market.

➤ **PURE COMPETITION-** Pure competition is the one which has following features –

- (i) Large no of buyers and sellers;
- (ii) Homogeneous Product;
- (iii) Free from restriction.

➤ **Firm under perfect competition is a price taker not a price maker?**

A firm under perfect competition is a price taker not a price maker because the price is determined by the market forces of demand and supply. This price is known as equilibrium price. All the firms in the industry have to sell their outputs at this equilibrium price. The reason is that, number of firms under perfect competition is so large. So no firm can influence the price by its supply. All firms produce homogeneous product.



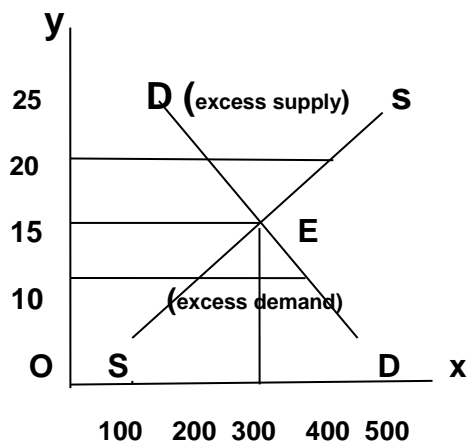
**PRICE DETERMINATION UNDER PERFECT COMPETITION:**

**PRICE DETERMINATION:** - In a market, price of a commodity is determined by the market forces of demand and supply. These forces of demand and supply act and react in such a manner that the quantity demanded is exactly equal to quantity supplied. In this course price is known as the equilibrium price. Intersection of market demand and market supply curves decides the price of a product.

**Market Equilibrium Under perfect competition :**

Equilibrium price is that price which is determined by market forces of demand and supply. At this price both demand and supply are equal to each other. Diagrammatically it is determined at the point where demand curve and supply curve intersect each other. At this point price is known as equilibrium price and quantity is known as equilibrium quantity.

Price (Rs.)	Quantity Demand (Units)	Quantity Supply(Units)
5	500	100
10	400	200
<b>15</b>	<b>300</b>	<b>300</b>
20	200	400
25	100	500

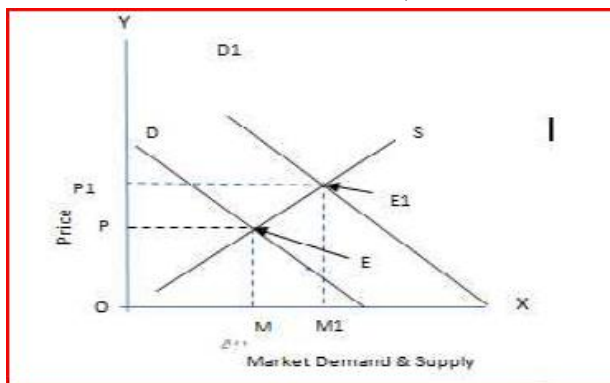


**EXCESS DEMAND:** - When Excess Demand in the market at a given price, the competition among the buyers to purchase the required quantity. Hence they start offering higher prices. With rising market prices, demand contracts and supply expands. This market adjustment continues till the market reaches equilibrium.

**EXCESS SUPPLY:** - When Excess Supply in the market at a given price, the competition among the sellers to dispose-of their output. Hence, they start offering lower prices. With fall in the market prices, demand expands and supply contracts. This market adjustment continues till the market reaches equilibrium.

### SHIFT (CHANGE) IN DEMAND AND MARKET EQUILIBRIUM

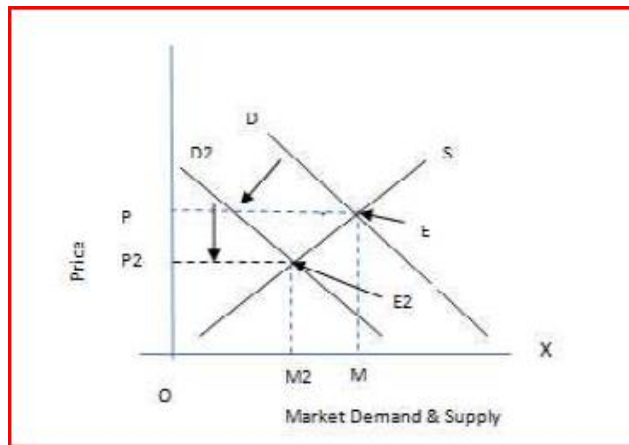
**(1) Increase in Demand:-** In case of increase in demand, demand curve shift to the right.



Increase in demand shift the demand curve from D to D1 to right leading to excess demand E E1 at the given price OP.

- There will be competition among buyers leading to rise in price.
- As price rise supply starts rising (along S) demand starts falling.
- These changes continues till  $D=S$  at a new equilibrium at E1
- The quantity rises to OM to OM1 and price rises OP to OP1

**(2) Decrease in Demand:-** In case of decrease in demand, demand curve shift to the leftward.

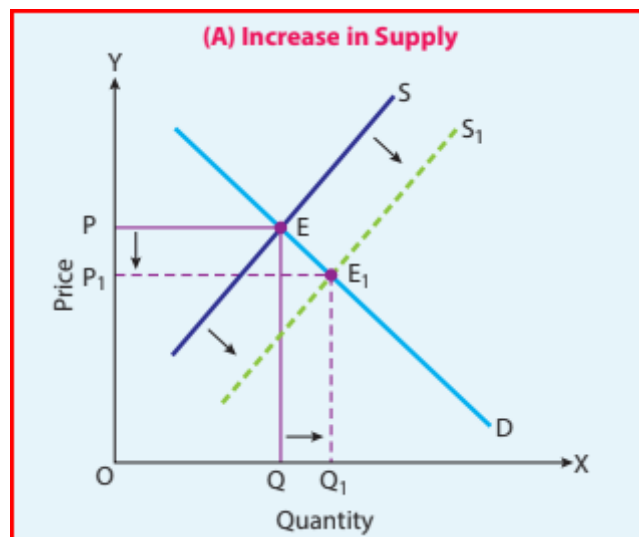


Decrease in demand shift the demand curve from  $D$  to  $D_2$  to left leading to decrease demand  $E$   $E_2$  at the given price  $OP$ . as a result there is excess supply at price  $P$ .

- There will be competition among sellers leading to fall in price
- As price fall supply starts falling (along  $S$ ).
- These changes continues till  $D=S$  at a new equilibrium at  $E_2$  The quantity fall to  $OM$  to  $OM_2$  and price fall  $OP$  to  $OP_2$ .

### SHIFT (CHANGE) IN SUPPLY AND MARKET EQUILIBRIUM

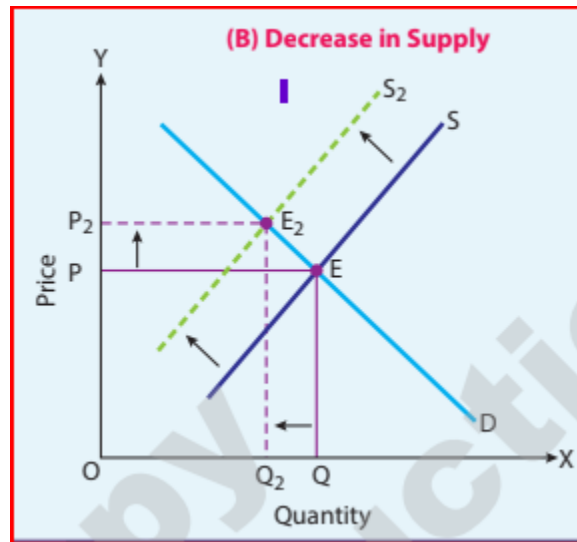
**1. Increase in supply:-** In case of increase in supply, the supply curve shifts to the right.



- Increase in supply shift the supply curve from  $S$  to  $S_1$  to right leading to excess supply  $E$   $E_1$  at the given price  $OP$ .
- There will be competition among sellers leading to fall in price
- As price fall Demand starts rising (along  $D$ )
- These changes continues till  $D=S$  at a new equilibrium at  $E_1$ .
- The quantity rises to  $OQ$  to  $OQ_1$  and price fall  $OP$  to  $OP_1$ .



**2. Decrease in supply:-** In case of decrease in supply, the supply curve shifts to the leftward.



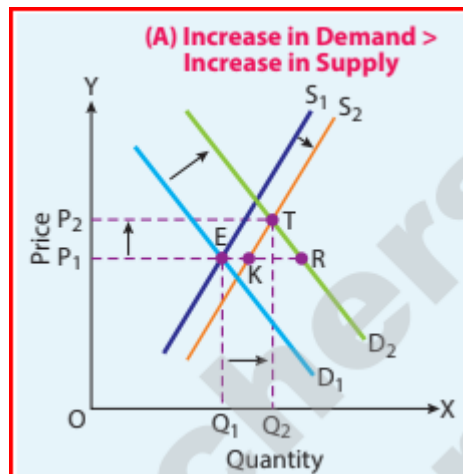
decrease in supply shift the supply curve from S to S<sub>2</sub> to left leading to fall supply E to E<sub>2</sub> at the given price OP. as a result there is excess demand in the market.

- There will be competition among buyers leading to increase in price.
- As price increase Demand starts falling (along D).
- These changes continues till D=S at a new equilibrium at E<sub>2</sub>
- price rises OP to OP<sub>2</sub> and The quantity fall to OQ to OQ<sub>1</sub>

### SIMULTANEOUS SHIFT (CHANGE) IN BOTH DEMAND AND SUPPLY AND MARKET EQUILIBRIUM

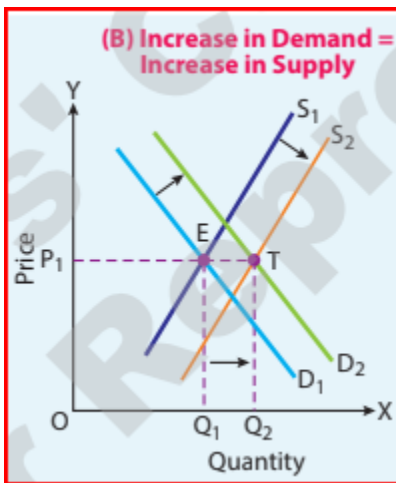
(1) **SIMULTANEOUS INCREASE IN DEMAND AND SUPPLY** : Simultaneous increase in demand and supply must lead to increase in equilibrium quantity of commodity. But change in price depends on whether:

**(A) Increase in demand > Increase in supply** :- When demand increases more than supply price and quantity both will increase.



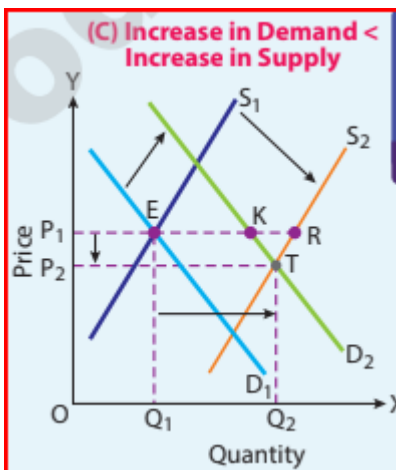
When increase in demand is more than increase in supply price increases from OP1 to OP2. Quantity increases from OQ1 to OQ2. Increase in price is less than increase in quantity.

**(B) Increases in demand = Increase in supply:-** When demand and supply increases equally then equilibrium price remain same.



When increase in demand is equal to increase in supply price remains unchanged at OP1. Quantity exchanged increases from OQ1 to OQ2.

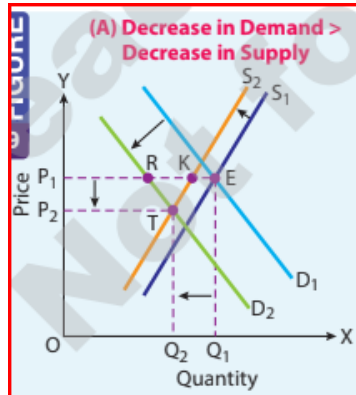
**(C) Increases in demand < Increases in supply:-** When demand increases less than supply, price will fall but quantity will rise



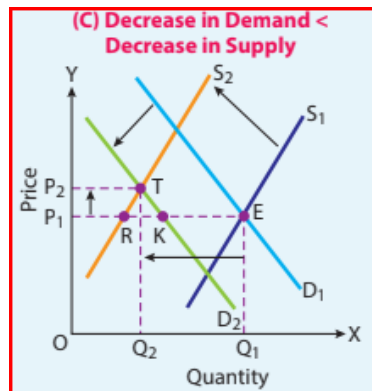
When supply increases more than demand price falls from OP1 to OP2 and quantity demand increases from OQ1 to OQ2. Decrease in price is less than increase in quantity

(2) **SIMULTANEOUS DECREASE IN DEMAND AND SUPPLY** :- Simultaneous decrease in demand and supply must lead to increase in equilibrium quantity of commodity. But change in price depends on whether:

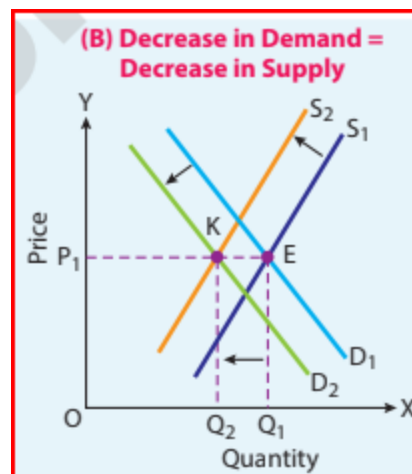
**(A) Decrease in demand > Decrease in supply:** When demand decreases more than supply, price and quantity both will decrease.



**(B) Decreases in demand < Decreases in supply:** When demand decreases less than supply, price will increase but quantity will rise.



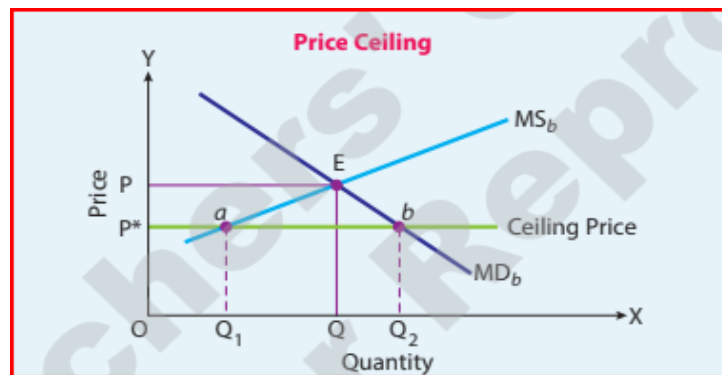
**(C) Decreases in demand = Decrease in supply:** When demand and supply decrease equally, the equilibrium price remains the same but the quantity will fall.



## SIMPLE APPLICATION OF DEMAND AND SUPPLY

**Price ceiling:** Price ceiling means maximum price of a product that the sellers can charge from the buyers. Often, the government fixes this price much below the equilibrium market price so that the essential commodities are within the reach of the poorer section of the society. In terms of demand and supply curves, price ceiling means fixing price by the government below the equilibrium price when the equilibrium price is presumed to be too high.

- Price ceiling is generally imposed by the govt. on necessary items wheat, rice, kerosene, sugar, medicines during in times of 'shortages'
- To ensure availability of the product to everyone ration coupons are issued to the buyers so that no individual can buy more than a certain amount of the commodity and this stipulated amount of the commodity is sold through ration shops or fair price shops.



**Price floor:** When the government imposed lower limit on the price that they may be charged for the particular commodity is called price floor. In other words price being fixed above the equilibrium price.

- Most well-known examples of imposition of price floor are agricultural price support programme and the minimum wage legislation.
- These programmes are meant to insulate farmers and labours from income fluctuations resulting from price variations in the free market.
- Through an agricultural price support programmes, the govt. imposes a lower limit on the purchase price for some of the agricultural goods and the floor is normally set at a higher level than the equilibrium price of these goods.



**Multiple Choice Questions**

1. At a price above the equilibrium price, there is:

- (a) Excess supply**      (b) Excess demand      (c) Ceiling      (d) Flooring

2. At a price below the equilibrium price, there is:

- (a) Excess supply      **(b) Excess demand**      (c) Ceiling      (d) Flooring

3. Equilibrium price and output changes when:

- (a) Demand changes      (b) Supply changes  
(c) Both demand and supply changes      **(d) All of the above**

4. When demand increases with no change in supply, equilibrium price .....and quantity.....

- (a) Rises, rises**      (b) Rises, falls      (c) Falls, falls      (d) Falls, rises

5. When demand decreases and there is no shift in supply, the equilibrium price ..... and quantity.....

- (a) Rises, rises      (b) Rises, falls      **(c) Falls, falls**      (d) Falls, rises

6. When supply increases and there is no change in demand, then equilibrium price ..... and quantity.....

- (a) Falls, rises**      (b) Rises falls      (c) Rises rises      (d) Falls, falls

7. When supply decreases and there is no change in demand, then equilibrium price ..... and quantity.....

- (a) Falls, rises      **(b) Rises, falls**      (c) Rises, rises      (d) Falls, falls

8. When both demand and supply increases in the same proportion then equilibrium price will:

- (a) Remain the same**      (b) Rise      (c) Fall      (d) None of the above

9. When both demand and supply decreases in the same proportion, then equilibrium price will:

- (a) Remain the same**      (b) Rise      (c) Fall      (d) None of the above

10. When both demand and supply increase in the same proportion then equilibrium quantity will:

- (a) Remain the same      **(b) Rise**      (c) Fall      (d) None of the above

11. When both demand and supply decrease in the same proportion, then the equilibrium quantity will:

- (a) Remain the same      (b) Rise      **(c) Fall**      (d) None of the above

12. When increase in demand is more than increase in supply, then equilibrium price will:

(a) Remain the same            **(b) Rise**                            c) Fall                            (d) None of the above

13. When increase in demand is more than increase in supply, then equilibrium quantity will:

(a) Remain the same            **(b) Rise**                            (c) Fall                            (d) None of the above

### QUESTIONS FOR PRACTICE

Q1. If the equilibrium price of a good is greater than its market price, explain all the changes that will take place in the market. Use diagram. (AI2013)

Q2. Explain the effect of increase in demand for a good on its equilibrium price and equilibrium quantity. (F 2013)

Q3. Market of commodity is in equilibrium. Demand for the commodity increases. Explain the change of effects of this change till the market again reaches equilibrium. Use diagram.

Q4. Market of commodity is in equilibrium. Demand for the commodity decreases. Explain the change of effects of this change till the market again reaches equilibrium. Use diagram.

Q5. Market for a product is in equilibrium. Supply of the product decreases. Explain the change of effects of this change till the market again reaches equilibrium. Use diagram.

Q6. What is meant by excess supply of a good in a market? Explain its chain of effects on the market for the good. Use diagram. (F 2014)

Q7. Market for a good is in equilibrium. Supply of the good increases. Explain the chain of effects of this change. (Delhi 2015; AI2015)

Q8. Explain the effects of maximum price ceiling on the market of a good. Use diagram. (Delhi 2015)

Q9. What are the effects of price floor (minimum price ceiling) on the market of a good? Use diagram. (AI2015)

Q10. What is maximum price ceiling? on what type of goods is it normally imposed. Use diagram. (F 2015)

Q11. What is minimum price ceiling? Explain its implications. (AI 2016)

Q12. What is maximum price ceiling? Explain its implications. (Delhi 2016)

Q13. If the prevailing market price is above the equilibrium price, explain its chain of effects. (AI 2016)

Q14. Explain through a diagram the effect of a rightward shift of both the demand and supply curves on equilibrium price and quantity.

Q15. How the equilibrium price of a commodity determined under perfect competition? Explain with the help of a schedule and diagram.

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