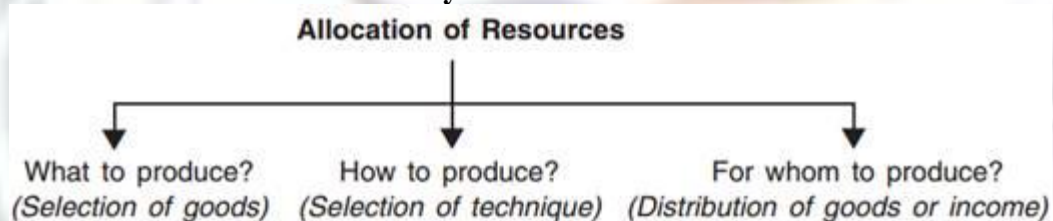# Puna International School
## Shree Swaminarayan Gurukul, Zundal

# Grade – XI
# ECONOMICS
# Specimen copy

## Year 2021-2020

# CH -1 INTRODUCTION TO MICRO ECONOMICS

1. Study of Economics is divided into two branches:
   (a) Micro economics
   (b) Macro economics
2. **Micro economics** studies the behaviour 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 sastisfy 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**



Allocation of Resources

What to produce? How to produce? For whom to produce?
(Selection of goods) (Selection of technique) (Distribution of goods or income)

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 studies 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 studies 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 Curve**
    **Features**
    (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)
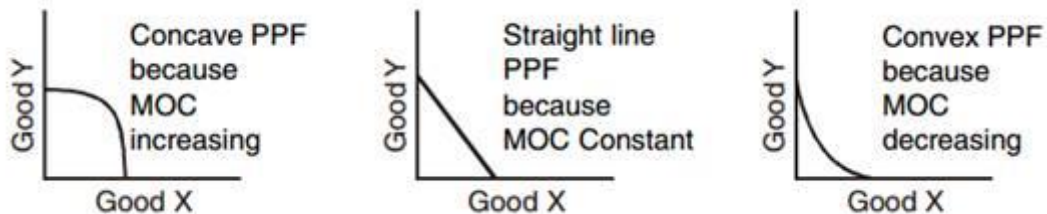


15. **The Production possibility curve will shift under following two condition**:(a) change in resources, Change in technology of production for both the goods.
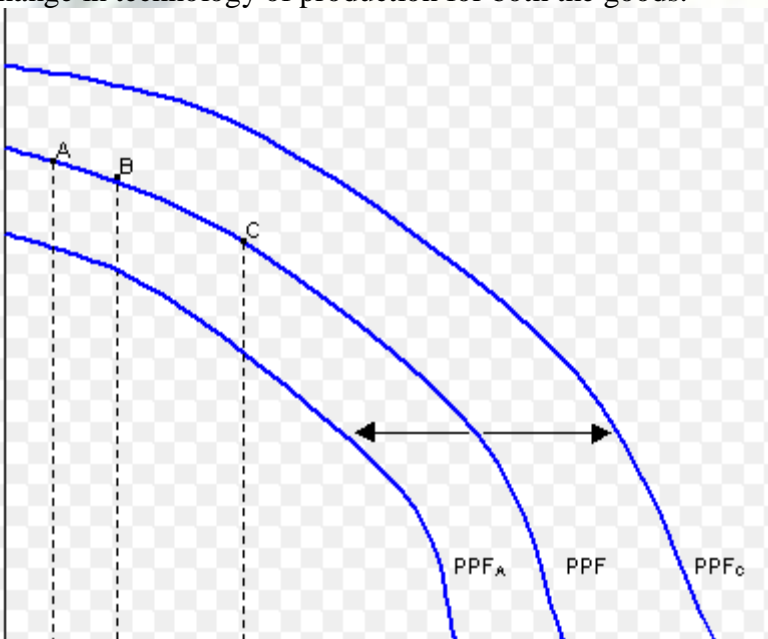


16. **Rightward shift of PPF** shows increase in resources or improvement in technology.Ex- Labour becoming more skilled, improvement in technology, increase in productivity of land.
17. **Leftward shift of PPF** shows the decrease in resources or degradation of technology in the economy.
18. **The Production 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
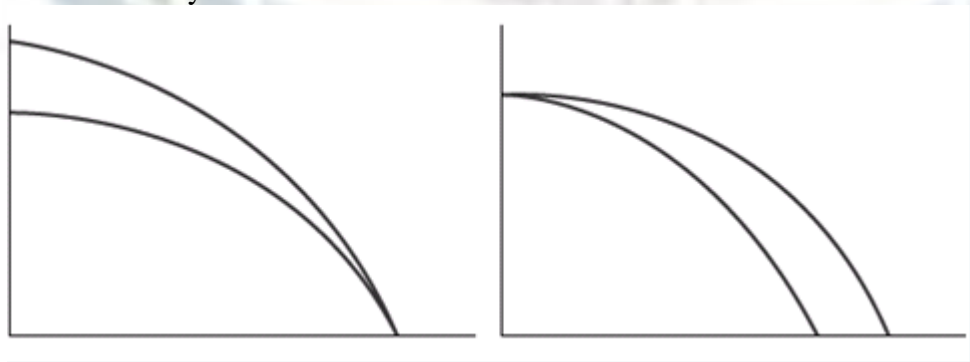


19.
20. **Marginal Rate of Transformation (MRT)**- It is the amount of one commodity that is to be sacrificed to increase the production of other commodity by one unit.
21. **MRT can also called Marginal Opportunity Cost**. It is defined as the additional cost in terms of number of units of a good sacrificed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

22. **MARGINAL RATE OF TRANSFORMATION:** MRT is the ratio of units of one good sacrificed to produce one more unit of other good.

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

(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: (i)** 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. Opportunity cost of using the train = Rs.350 - Rs.275 = Rs.75 per month

**(ii)** Ruth has a mobile shop. She wants to employ 2 students to work for her between June and August. She expects each employee to generate Rs.250 a day each of the 78 working days of this period. However, if she lost 2 days at the start of the period and fully trained her employees they could generate Rs.260 a day. What is the opportunity cost of not training her employees?

Earnings from her 2 employees without training = (Rs.250 x 78) x 2 = Rs.39000 If she trained the employees she would lose 2 working days worth of revenue. The revenue would be = (260 x 76) x 2 = Rs.39520 The opportunity cost of not training her employees = Rs.39520 - Rs.39000 = Rs.520

**(iii)** Jim, a consultant, earns Rs.85 an hour. Instead of working one night, he goes to a Premier League cricket match in Delhi which costs him Rs.55 and lasts two hours. What is the opportunity cost of watching the football instead of working?

Jim earns Rs.85 per hour. In 2 hours he earns 2 x 85 = Rs.170

Opportunity of attending match = Rs.170 + 55 = Rs.225

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

**A PRODUCTION POSSIBILITY CUVRE:** 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.

# CH- 2 CONSUMERS EQUILIBRIUM & DEMAND

**Consumer :** is an economic agent who consumes final goods or services for a consideration.

**Utility:** is want satisfying power of a commodity.

**Total utility:** It is the total satisfaction derived from consumption of given quantity of a commodity at a given time. In other words, It is the sum total of marginal utility.

**Marginal Utility:** It is the change in total utility resulting from the consumption of an additional unit of the commodity.In other words, It is the utility derived from each additional unit.
**$Mu_n = Tu_n - Tu_{n-1}$**

### Relation between total utility and marginal utility

| UNITS | Mu | Tu |
|---|---|---|
| 1 | 10 | 10 |
| 2 | 8 | 18 |
| 3 | 6 | 24 |
| 4 | 4 | 28 |
| 5 | 2 | 30 |
| 6 | 0 | 30 |
| 7 | -2 | 28 |



Fig. 1
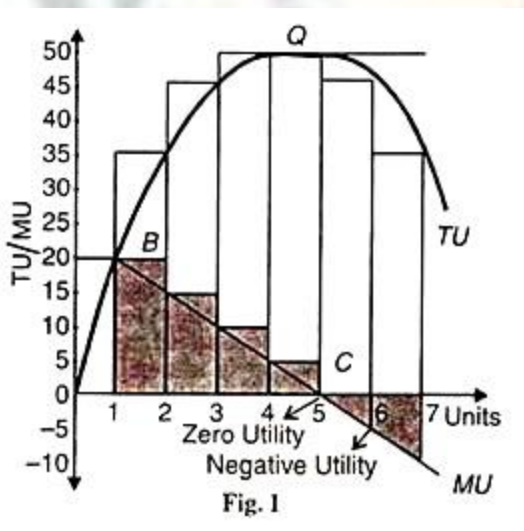
i.    when Mu diminishes but positive Tu increases at a diminishing rate.
ii.   when Mu is zero, Tu is maximum.
iii.  when Mu is negative, Tu diminishes.

**Law of Diminishing Marginal Utility :** As consumer consumes more and more units of commodity the Marginal utility derived from each successive units go on declining. This is the basis of law of demand.

**Consumer's Bundle :**It is a quantitative combination of two goods which can be purchased by a consumer from his given income.

**Law of equi-marginal utility-** It states that when a consumer spends his income on different commodity he will attain equilibrium or maximize his satisfaction at that point where ratio between marginal utility and price of different commodities are equal and which in turn is equal to marginal utility of money.

**Budget set :**It is quantitative combination of those bundles which a consumer can purchase from his given income at prevailing market prices.

**Consumer Budget :**It states the real purchasing power of the consumer from which he can purchase the certain quantitative bundles of two goods at given price.

**Budget Line :** A graphical representation of all those bundles which cost the amount just equal to the consumers money income gives us the budget line.

**Monotonic Preferences :**Consumer's preferences are called monotonic when between any two bundles, one bundle has more of one good and no less of other good as it offers him a higher level of satisfaction.

**Change in Budget Line :**There can be parallel shift (leftwards or rightwards) due to change in income of the consumer and change in price of goods. A rise in income of the consumer shifts the budget line rightwards and vice-versa.In case of change in price of one good, there will be rotation in the budget line. Fall in price cause outward rotation due to rise in purchasing power and vice-versa.
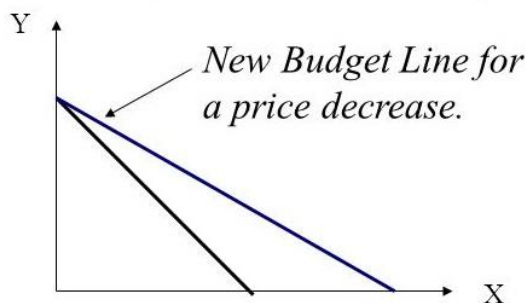


# Changes in the Budget Line

- Changes in Income
    - Increases lead to a parallel, outward shift in the budget line.
    - Decreases lead to a parallel, downward shift.
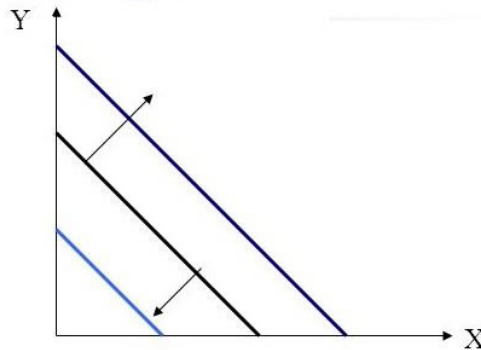
- Changes in Price
    - A decreases in the price of good X rotates the budget line counter-clockwise.
    - An increases rotates the budget line clockwise.

*New Budget Line for a price decrease.*

**Marginal Rate of Substitution (MRS) :**It is the rate at which a consumer is willing to substitute (good Y/ good X) one good to obtain one more unit of the other good. Generally, It is the slope of indifference

curve.

$$MRS = \frac{\text{Loss of Good Y}}{\text{Gain of Good X}} \quad \text{or} \quad -\frac{\Delta Y}{\Delta X}$$

**Indifference Curve :** is a curve showing different combination of two goods, each combinations offering the same level of satisfaction to the consumer.

**Characteristics of IC**

1. Indifference curves are negatively sloped(i.e. slopes downward from left to right).
2. Indifference curves are convex to the point of origin. It is due to diminishing marginal rate of substitution.
3. Indifference curves never touch or intersect each other. Two points on different IC cannot give equal level of satisfaction.
4. Higher indifference curve represents higher level of satisfaction.

**Consumer's Equilibrium :** A consumer is said to be in equilibrium when he maximizes his satisfaction, given his money income and prices of two commodity. He attains equilibrium at that point where the slope of IC is equal to the slope of budget line.



$(x1^*,x2^*)$ is the most preferred affordable bundle.
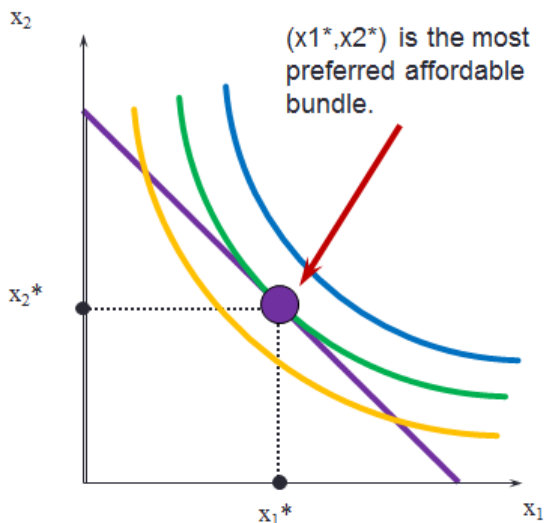
**Condition of Consumer's Equilibrium**
**(a) Cardinal approach (Utility Analysis) :** According to this approach utility can be measured. "Utils" is the unit of utility.

**Condition :**

i. **In case of one community**

$$MUm = \frac{MUx}{Px} \left[ \text{If } MUm = 1, MUx = Px \right]$$

Where, MUm = Marginal utility of money
MUx = Marginal utility of 'x', Px = Price of 'x'

8

ii.    In case of two commodity.

$$\frac{MUx}{Px} = \frac{MUy}{Py} = MUm$$

xy and MU must be decreasing

| Units | MUx | MUy | MUx/Px | MUy/Py |
|-------|-----|-----|--------|--------|
| 1 | 36 | 40 | 12 | 10 |
| 2 | 33 | 36 | 11 | **9** |
| 3 | 30 | 32 | 10 | 8 |
| 4 | 27 | 28 | **9** | 7 |
| 5 | 24 | 24 | 8 | 6 |
| 6 | 21 | 20 | 7 | 5 |

Assumption, Px = Rs.3, Py = Rs.4
Y = Rs.20 Here, MUm = 9

**(b)** Ordinal approach (Indifference Curve Analysis): According to this approach utility cannot be measured but can be expressed in order or ranking.

**Condition of Equilibrium:**

i.
$$MRSxy = \frac{Px}{Py} \quad \begin{bmatrix} Px = \text{Price of 'x'} \\ Py = \text{Price of 'y'} \end{bmatrix}$$

   or budget line must be tangent to indifference curve.
ii.   MRS must be diminishing or,
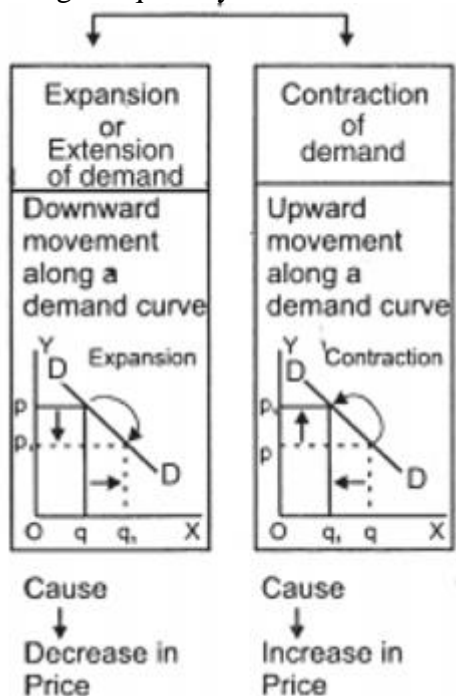      Indifference curve must be convex to the origin.

**Quantity Demanded :** It is that quantity which a consumer is able and is willing to buy at particular price and in a given period of time.
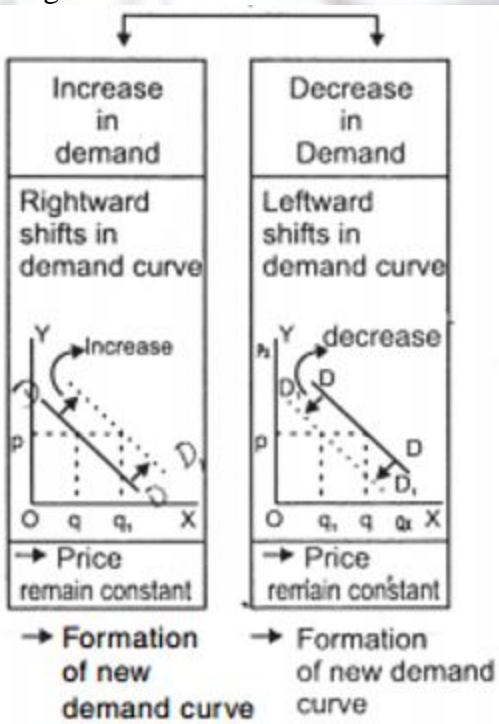
**Determinants of Demand:**

   a.  Price of Good
   b.  Income of Consumers
   c.  Taste & Preference of Consumer
   d.  Change in Price of Related Goods
   e.  Future Expectation to Change in price

**Change of Demand :**

a. Change in quantity Demanded or Movement along Demand curve



| Expansion or Extension of demand | Contraction of demand |
|---|---|
| Downward movement along a demand curve | Upward movement along a demand curve |

Cause → Decrease in Price

Cause → Increase in Price

b. Change in Demand or Shift in Demand



| Increase in demand | Decrease in Demand |
|---|---|
| Rightward shifts in demand curve | Leftward shifts in demand curve |

→ Price remain constant

→ Price remain constant

→ Formation of new demand curve

→ Formation of new demand curve

**Market Demand :**It is the total quantity of the commodity demanded in the market by all consumers at different prices at a point of time.

**Demand Function :**It is the functional relationship between the demand for a commodity and factors affecting demand.

**Law of demand :** The law states that when all other thing remains constant then there is inverse relationship between price of the commodity and quantity demanded of it. That is, higher the price, lower the demand and lower the price, higher the demand.

**Change in Demand :** When demand changes due to change in any one of its determinants other than the price.

**Change in Quantity Demanded :** When demand changes due to change in its own price keeping all other factors constant.

**Demand curve and demand schedule :** The tabular presentation of price and quantity demanded is called demand schedule and a demand curve is the graphical representation of the demand schedule.

**Demand curve and its slope :**
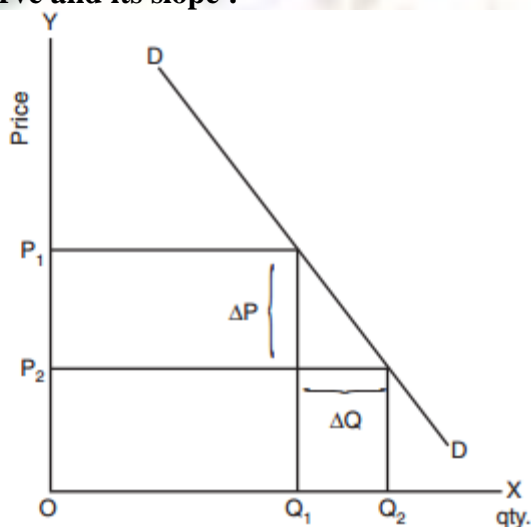


$$\text{slope of demand curve} = \frac{\text{Change in price}}{\text{Change in qty.dd.}}$$

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

**Price Elasticity of Demand :** Price Elasticity of Demand is a measurement of change in quantity demanded in response to a change in price of the commodity.



Methods of Measurement of Price
Elasticity of Demand

Percentage Method     Total Expenditure Method     Geometric Method
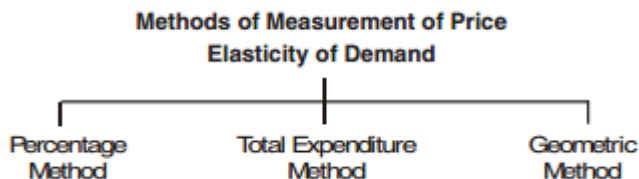
**Percentage Method :**

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

$E_p \rightarrow$ Elasticity of Demand

$\Delta Q \rightarrow$ Change in quantity

$\Delta P \rightarrow$ Change in Price

$P \rightarrow$ Initial Price

$Q \rightarrow$ Initial Quantity

Or

$$E_p = \frac{\text{Percentage Change in Quantity demand of a com.}}{\text{Percentage Change in Price}}$$

**Total Expenditure Method :** It measures price elasticity of demand on the basis of change in total expenditure incurred on the commodity by a household due to change in its price.
There are three conditions :

1. $E_d=1$ When due to rise or fall in price of a good, total expenditure remains unchanged.
2. $E_d >1$ When due to fall in price, total expenditure goes up and due to rise in price, total expenditure goes down.
3. $E_d<1$ when due to fall in price, total expenditure goes down and due to rise in price, total expenditure goes up.

**Geometric Method :** Elasticity of demand at any point is measured by dividing the length of lower segment of the demand curve with the length of upper segment of demand curve at that point.
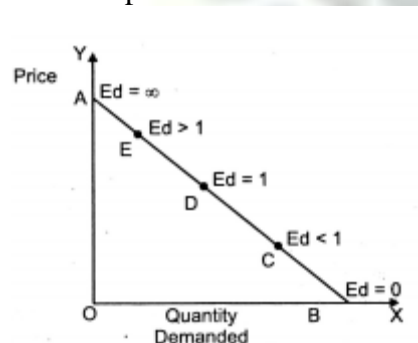The value of ed is unity at mid point of any linear demand curve.

**Diagram to show Geometric or point method :**
Elasticity of demand at given point.

$$Ed = \frac{\text{Lower segment of the demand curve}}{\text{Upper segment of the demand curve}}$$

D is mid point of the demand curve.
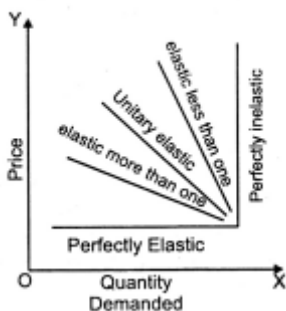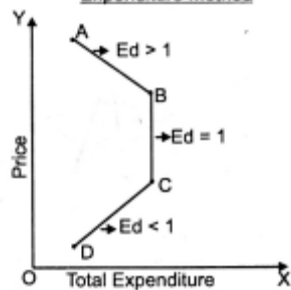
Degree of Price Elasticity



Diagram of total Expenditure Method



**Factors influencing Price elasticity of Demand**

    a. Nature of the Commodity.
    b. Availability of Substitute goods.
    c. Income level of the consumer.
    d. Price level of the commodity.
    e. Time Period.
    f. Different use of the commodity.
    g. Behavior of the consumer.
    h. Postponement of consumption.

# CH – 3 PRODUCER BEHAVIOUR AND SUPPLY

1. **Production Function :** It shows the functional relation between physical inputs and physical output of a good. It can be expressed as Q = (f1, f2, f3......... fn).
Where Q = Physical output of a good; f1, f2, f3, .......fn= Physical inputs.
2. **Production is creation of utility.**
3. **Types of Production Function :**
There are two types of Production Function.
1. **Short-run Production Function :** In this production function one factor of production is variable and all others are fixed. So, law of return to a factor is applied. It is also called variable proportion type of production function.
**It is a time period which is not enough to make change in all inputs. In this level of production can be changed by changing the variable factors.**
**2. Long-run Production Function** : In this production function all the factors of production are variable. So, law of returns to scale is applied. It is also called constant proportion type of production function.
**It is a time period which is enough to make change in all inputs, all inputs are variable in the long run. In this level of production can be changed by changing all inputs.**
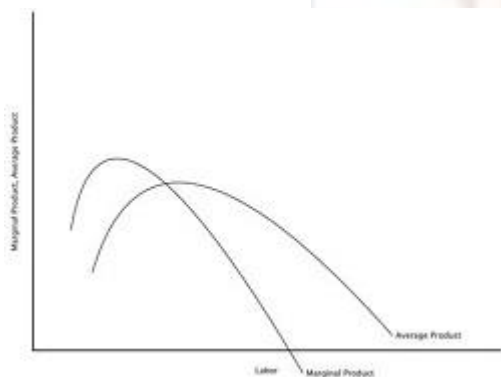4. **Total product or Total physical product** refers to total quantity of a goods and services produced by a firm in a given period of time.
TP = $\sum\sum$MP
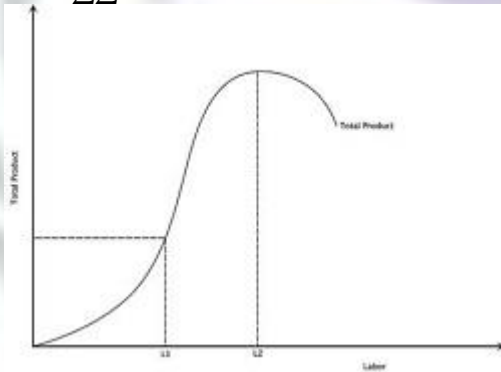


5. **Average production** is the per unit production of variable factor.

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

6. Marginal product 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.

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

7. **Relation between Total, Average and Marginal Product**
   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 |
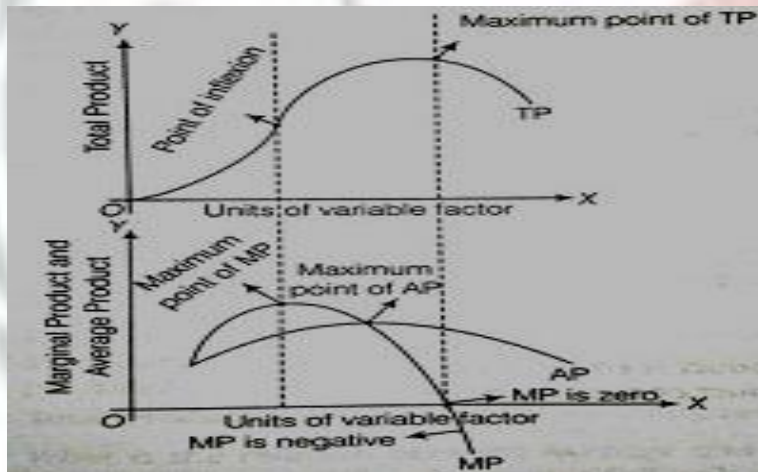


8.
   1. When MP > AP, AP rises.
   2. When MP = AP, AP is maximum and constant.
   3. When MP < AP, AP falls.
   4. MP may be zero or negative, but AP continues to be positive.
   5. AP increases, even when MP falls but MP should lie above AP.
9. **Returns to a factor :** It refers to the behaviour of output when only one variable factor of production in increased in short run and fixed factors remain constant.

10. **Law of variable proportion :** The law states that when more and more units of variable factors are employed to increase the output, initially output increases at an increasing rate and finally falls.
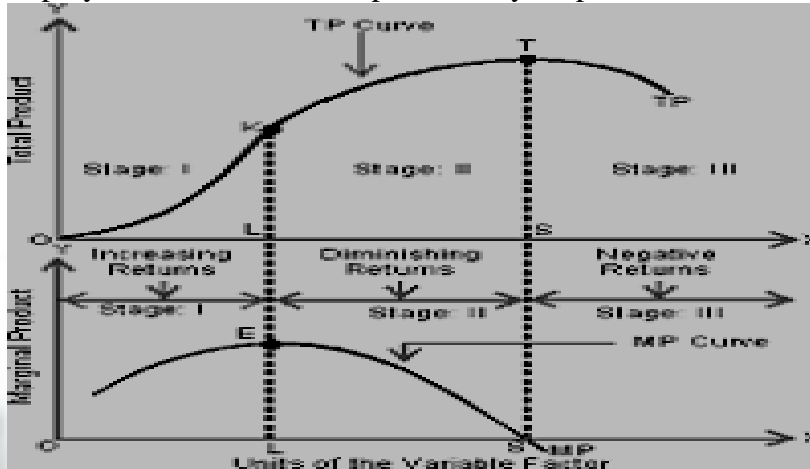


11. **Stage I (Stage of Increasing Return to factor):** TP Increases at increasing rate : In the initial phase as more and more units of variable factors are employed with fixed factor total physical production increases at increasing rate, MP increases.
12. **Cause for increasing return:** (a) Under utilisation of fixed factor (b) Indivisibility of factor (c) Increased efficiency of variable factor
13. **Stage II(Stage of Diminishing Return to factor) :** TP increases at decreasing rate :As more and more units of variable factors are employed with fixed factors then total product increases at diminishing rate, MP decreases but is positive. At the end of this phase TP maximum and MP becomes zero.
14. **Cause of diminishing return:** (a) optimal use of fixed factor (b) imperfect factor substitutability
15. **Stage III(Stage of negative return to factor) :** TP falls :As more and more units of variable factors are employed with fixed factors, total production starts decreasing and marginal product becomes negative.
16. **Cause of negative return:** (a) Poor co-ordination between fixed factor and variable factor. (b) Over utilisation of fixed factor
17. **Economic Cost :** It is the sum total of explicit and implicit cost.
18. **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.
19. **Implicit cost** is the cost of self owned resources of the production used in production process. Or estimated value of inputs supplied by owner itself. These are not entered into books of accounts.
20. **Normal Profit** : It is the minimum amount required to keep the producers into business. In other words, it is the minimum supply price of the entrepreneur. It is also called the wage off an entrepreneur.
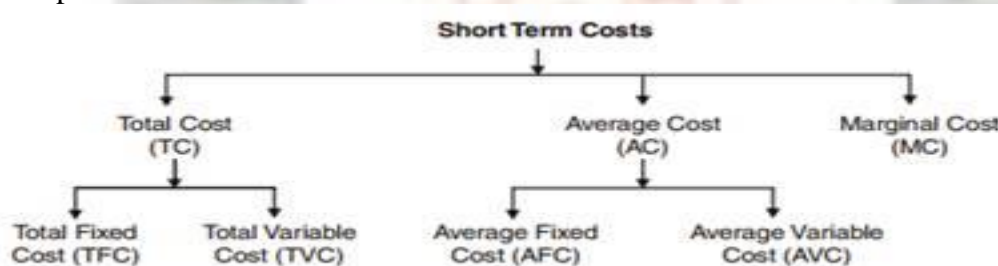


21. **Total cost** refers to total amount of money which is incurred by a firm on production of a given amount of a commodity.

Total cost is the sum of total fixed cost and total variable cost.

TC = TFC + TVC or TC = AC × 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,license fee etc.

TFC = TC – TVC or TFC = AFC × Q

22. **Features of Total Fixed Cost:-** (a) It remains constant at all levels of output. *It is not zero even at zero output level.* Therefore, **TFC curve is parallel to X-axis**. (b) **Total cost at zero level of output is equal to total fixed cost.**
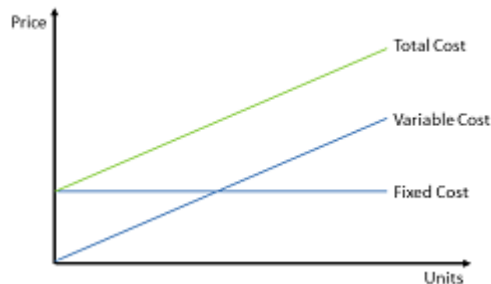


23. **Total variable cost** is the cost which vary with the quantity of output produced. It is zero at zero level of output. TVC curve is parallel to TC curve.Ex-cost of raw material,expenses on power etc.

TVC = TC – TFC or TVC = AVC × Q

**Features of Total variable cost:-** (a) It is zero when output is zero. (b) It increases with increase in output. (c) Initially TVC increases at diminishing rate due to increasing returns and later it increases at an increasing rate due to diminishing return.

24. **Average cost** is per unit cost of production of a commodity. It is the sum of average fixed cost and average variable cost.

$$AC = \frac{TC}{Q} \quad or \quad AC = AFC + AVC$$

25. **Average fixed cost** is per unit fixed cost of production of a commodity.

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

26. **Features of AFC:-** (a) AFC diminishes with increase in output. (b) AFC curve is a rectangular hyperbola.(c) It can not intersect X-axis or Y-axis.
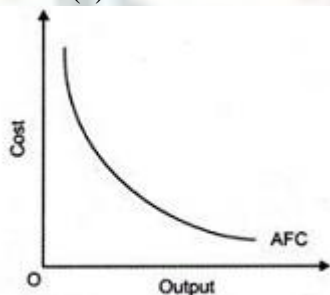


**Figure-6: AFC Curve**

27. **Average variable cost** is per unit variable cost of production of a commodity. AVC is U-shaped due to law of variable proportion.
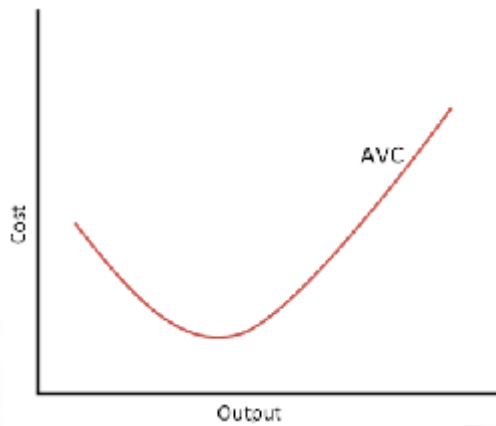
$$AVC = \frac{TVC}{Q} \quad \text{or} \quad AVC = AC - AFC$$

28. **Marginal Cost -** It refers to change in TC, due to additional unit of a commodity is produced. MC = $\Delta TC/\Delta Q$ or $MC_n = TC_n - TC_{n-1}$. But under short run, it is calculated from TVC.

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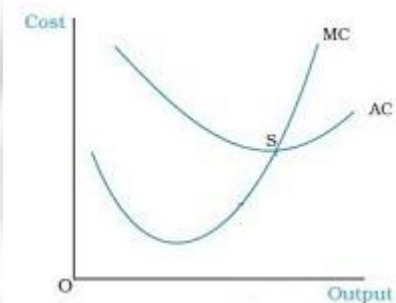


**Relation Between Short-Term Costs**

29. **Total cost curve and total variable cost curve** remains parallel to each other. The vertical distance between these two curve is equal to total fixed cost.
TFC curve remains parallel to X-axis and TVC curve remains parallel to TC curve.
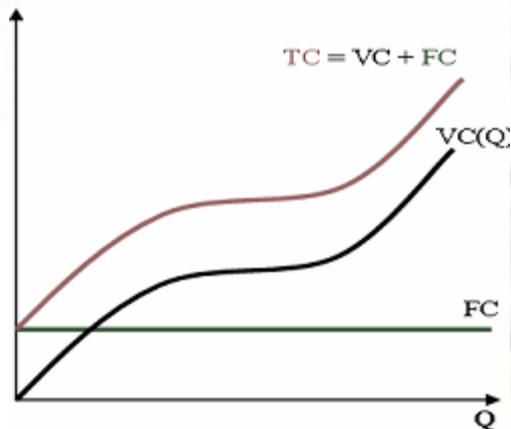


With increase in level of output, the vertical distance between AFC curve and AC curve goes on increasing. On contrary the vertical distance between AC curve and AVC curve goes on decreasing

but these two curves never intersect because average fixed cost is never zero.
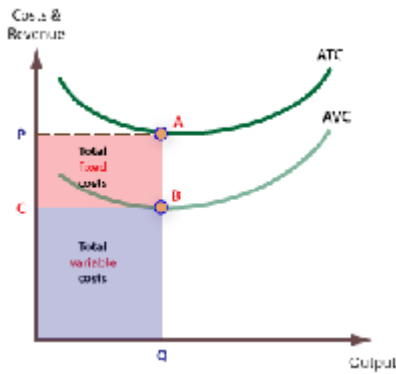


30. **Relation between MC and AVC.**
When MC < AVC, AVC falls.
When MC = AVC, AVC is minimum and constant
When MC > AVC, AVC rises. MC curve cuts AVC curve at its lowest point. Both curves are U-shaped and starts from same point.
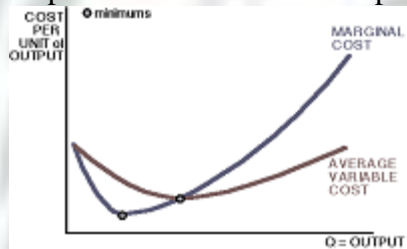


31. **Relation between MC and AC:-** (i) when AC falls, MC < AC. (ii) when AC rises, MC > AC. (iii) when AC is constant and minimum, MC = AC.
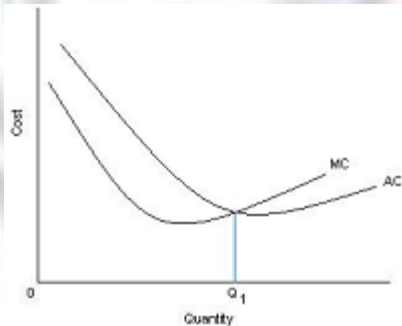


32. **Money received from the sale of product is called revenue.**
33. **Total revenue** is the total amount of money received by a firm from the sale of given units of a commodity.

$$TR = AR \times Q \quad Or \quad TR = \sum MR$$

$$TR = Price \times Quantity\ Sold.$$

$$Price. = AR$$

34. Per unit revenue received from the sale of given units of a commodity is called **average revenue**. Average revenue is equal to price. Per unit price of a commodity it also called AR.

$$AR = \frac{TR}{Q} \quad or \quad \frac{P \times Q}{Q} = P = Price.$$

35. Marginal revenue is net addition to total revenue when one additional unit of output is sold.

$$MR = \frac{\Delta TR}{\Delta Q} \text{ Or } MR_n = TR_n - TR_{n-1}$$

36. **Relation b/w TR, AR, and MR when more quantity sold at the same price : under perfect competition.**
    (a) Average revenue and marginal revenue remains constant at all levels of output and AR and MR curves are parallel to ox-axis.
    AR= MR.
    (b) Total revenue increases at constant rate MR is constant and TR curve is positively sloped straight line passing through the origin.

37. **Relation between TR, AR and MR** when more quantity by sold at the lower price or there is monopoly or monopolistic competition in the market.
    (a) Average revenue and marginal revenue curves have negative slope. MR curve lies below AR curve. AR > MR
    (b) Marginal revenue falls, twice the rate of average revenue.

$$MR = \frac{1}{2}AR$$

(c) So long as marginal revenue decreases and positive, total revenue increases at diminishing rate. When marginal revenue is zero, total revenue is maximum and when marginal revenue becomes negative, TR starts falling.
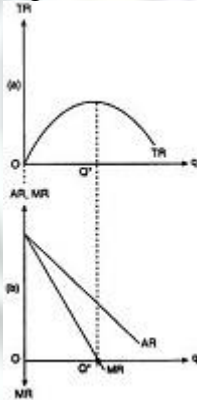


38. Relation b/w AR and MR (General relationship)
    When MR = AR, AR is maximum and constant. MR can be negative, but not AR.
    When MR < AR, AR falls. When TR increases at an increasing rate, MR and AR also increases.
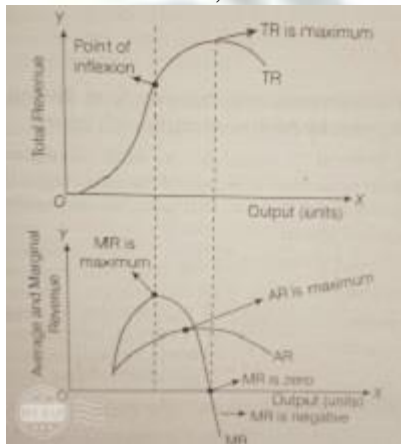
39. **Concept of Producer's Equilibrium:** If refers the stage where producer is getting maximum profit with given cost and he has no incentive to increase or decrease the level of output.

(**A**) **MR and MC Approach:** Conditions of producers equilibrium according to this approach are :

(a) MC = MR and also AR = MR, hence AR = MR = MC. MC should be rising.

(b) MC curve should cut the MR curve from below at the point of equilibrium.

Or

MC should be more than MR after the equilibrium point, with increase in output.



Firm's equilibrium point (Perfect competition)
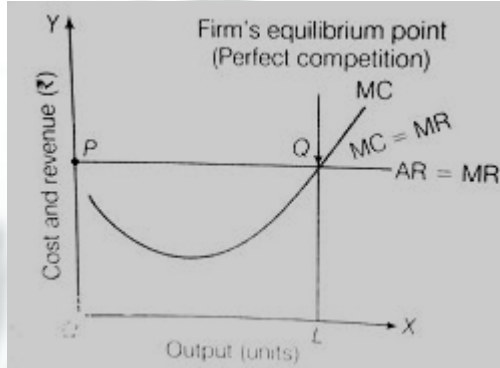
40. **Normal Profit:-** It is a no profit no loss situation, it is achieved when P = AC.It is the minimum return that a producer expects from his capital invested in the business.
41. **Break-even Point:-** It occurs when AR = AC or (TR = TC). At this point, firm
42. is earning zero economic profit or normal profit. OR we can say it is just covering all its costs.
43. **Shut-down Point:-** It occurs when a firm is covering its variable costs only, here, the firm is incurring loss of fixed cost. (TR < TVC OR AR < AVC)
44. **Supply:** Refers to the amount of the commodity that a firm or seller is willing to sell at different prices during a given period of time.
45. **Factors affecting supply of a commodity:**

Price of the commodity.

Prices of other related goods.

Level of Technology.

Prices of inputs.

No. of firms.

Government policy regarding Taxation and subsidies.

Goals of the firm.
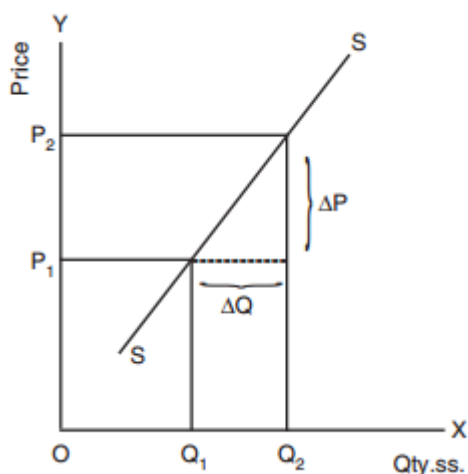
46. **Individual Supply:** Refers to quantity of a commodity that an individual firm is willing and able to offer for sale at different price during a given period of time.
47. **Market supply:** It is the sum total of quantity supplied of a commodity by all sellers or all firms in the market at different price and in a given period of time.
48. **Stock:** Refers to the total quantity of a particular commodity available with the firm at a particular point of time.
49. **Supply Schedule:** Refers to a tabular presentation which shows various quantities of a commodity that a producer is willing to supply at different prices, during a given period of time.
50. **Supply curve:** Refers to the graphical representation of supply schedule which represents various quantities of a commodity that a producer is willing to supply at different prices during given period of time.
51. **Slope of supply curve** = $\Delta P/\Delta Q$. A supply curve has a positive slope.
52. **Law of Supply:** States the direct relationship between price and supply of a commodity, keeping other factors constant. i.e. higher the price, higher the supply and lower the price, lower the supply.
53. **Price Elasticity of Supply**: 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 direct relationship between price and quantity supplied.

$$\text{Price Elasticity of Supply (Es)} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

54. **Methods for measuring price elasticity of supply:**
    1. Percentage Method

$$Es = \frac{\% \text{ change in a quantity supplied}}{\% \text{ change in price}}$$

$$\text{Or } Es = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

    2. Geometric Method

$$Es = \frac{\text{Supply curve intercept on X} - \text{axis}}{\text{Quantity supplied}}$$

55. There are three possibilities of Elasticity of Supply:
    (a) If a straight line supply curve passes through the point of origin doesn't matter what it makes angles, Es at any point is equal to unity.
    (b) If a straight line supply curve passes through left side of point of origin and intersect Y-axis, Es > 1.
    (c) If a straight line supply curve passes through right side of point of origin and intersect X-axis, Es < 1.
56. **Change in Q.Supplied Vs change in Supply:**
    a) Change in Q.Supplied or Movement along supply curve
    **(i) Due to change in price of Commodity other factors remain constant**

Expansion of supply or Upward movement along with a supply curve  | Contraction of supply or Downward movement along with a supply curve
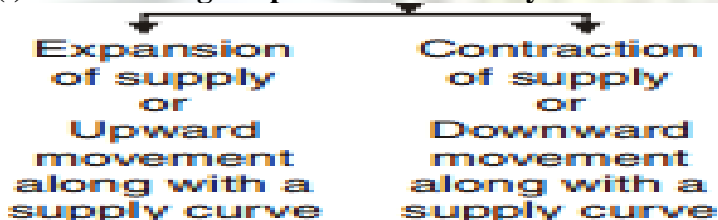
    b) Change in Supply or Shift in supply curve

**(i) Due to change in factors other than price of the commodity**

| Increase in supply or right ward shift insupply curve | Decrease in supply or leftward shift in supply curve |
|---|---|
| ↓ Causes | ↓ Cases |
| (i) fall in price of inputs | (i) Rise in price of inputs |
| (ii) fall in price of related goods | (ii) Rise in price of related goods |
| (iii) Improvement in tech. | (iii) Obsolete tech. |
| (iv) Increase in no. of firms | (iv) decrease in no. of firms |
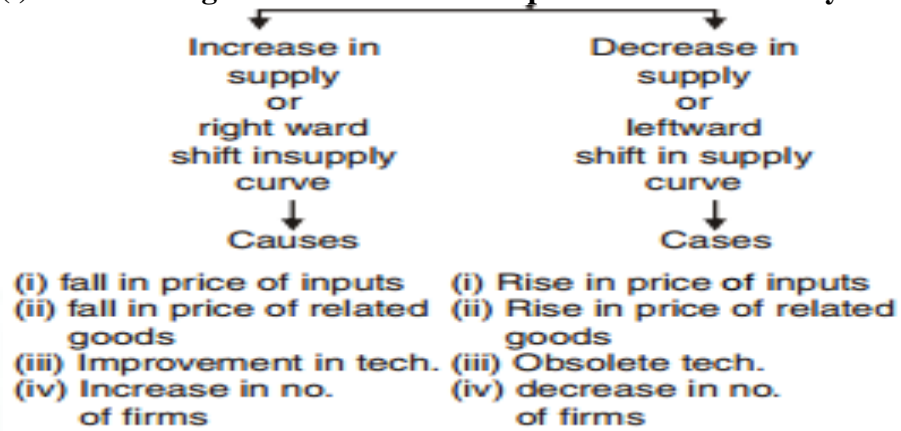
57. In simple words, Increase in supply--More supply at the same price or same supply at lower price. Decrease in supply-- Less supply at same price or same supply at a higher price.

# CH – 4 FORMS OF MARKET AND PRICE DETERMINATION

**Market** is a mechanism or arrangement through which the buyers and sellers of a commodity or service come into contact with one another and complete the act of sale and purchase of the commodity or service on mutually agreed prices.
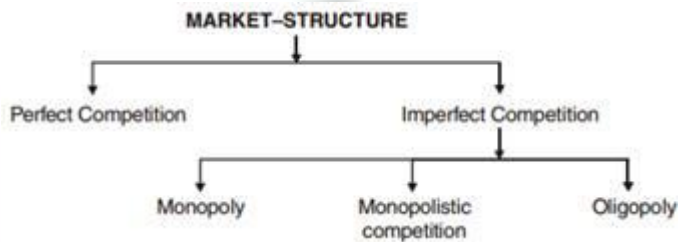


**Perfect competition-** It is a market structure where there are large number of buyers and sellers selling identical products at uniform price with free entry and exit of firms and absence of govt. control.

**Under perfect competition**, price remains constant therefore, average and marginal revenue curves coincide each other i.e., they become equal and parallel to x-axis.
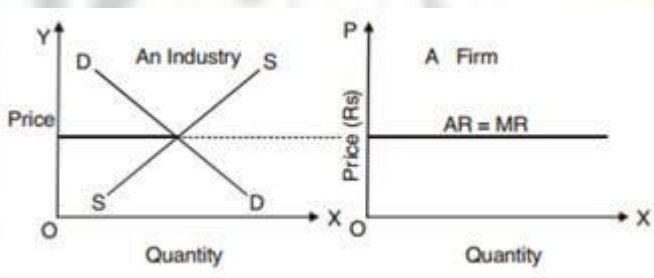


**Under perfect competition** price is determined by the industry on the basis of market forces of demand and supply. No individual firm can influence the price of the product. A firm can takes the decision regarding the output only. So industry is price maker and firm is price taker.

**Feature of perfect competition :**

(a) Very large no. of buyers and sellers.

(b) Homogeneous product.

(c) Free entry and exit of firms in the market.

(d) Perfect knowledge.

(e) Perfect Mobility.

(f) Perfectly elastic demand curve.

(g) No transportation cost.

## MONOPOLY MARKET

Monopoly is that type of market where there is a single seller and large number of buyers. There is absence of close substitutes to the products.

**Features :**(a) Single seller and large number of buyers.

(b) Restrictions on the entry of new firms.

(c) Absence of close substitutes.

(d) Full control over price

(e) Price discrimination.

(f) Price maker

(g) Downward sloping less elastic demand curve.

## AR or MR Curve in Monopoly market :

AR (Demand) Curve slopes downward from left to right and less elastic than that of monopolistic competition. It means that to increase demand, he has to reduce the price.

Given the demand for his product, the monopolist can increase his sales by lowering the price, the marginal revenue also falls but the rate of fall in marginal revenue is greater than that in average revenue.
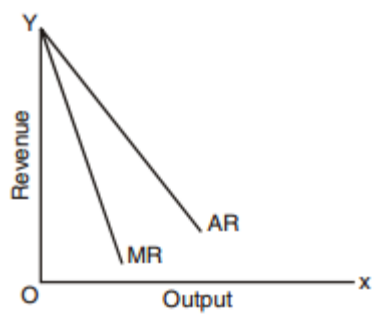


| Q | AR (=P) Rs | TR Rs | MR Rs |
|---|---|---|---|
| 1 | 20 | 20 | 20 |
| 2 | 18 | 36 | 16 |
| 3 | 16 | 48 | 12 |
| 4 | 14 | 56 | 8 |
| 5 | 12 | 60 | 4 |
| 6 | 10 | 60 | 0 |
| 7 | 8 | 56 | −4 |

A monopolist either decides price or output. He cannot decides both at a time.

## MONOPOLISTIC COMPETITION

It is that type of market in which there are large number of buyers and sellers. The Sellers sell differentiated product but not identical. The products are close substitutes of each other.

**Features** :(a) Large no. of buyers and sellers

(b) Product Differentiation: The products of each firm is differentiated from the other on the basis of colour, taste, packing, trademark, size and shape.

(c) Selling Cost: Cost on advertisement and sales promotion.

(d) Free entry or exit of firms.

(e) Lack of perfect knowledge.

(f) Partial control over price.

(g) Imperfect mobility: Factors of production and products are not perfectly mobile.

(h) Elastic and downward sloping demand curve.

### AR or MR in Monopolist Market:

AR (Demand) Curve is left to right downward sloping curve and more elastic / flatter than that of monopoly. It means that in response to change in price, the change in demand will be relatively more for a monopolistic competitive firm than a monopoly firm.
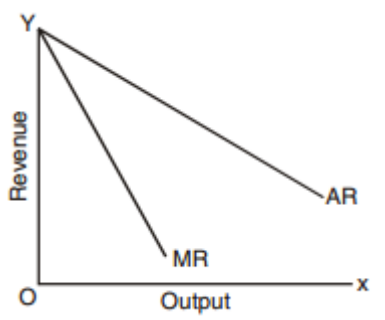


AR and MR curves are both downward sloping because more units can be sold only by lowering the price. MR lies below AR.

### OLIGOPOLY

Oligopoly is the form of market in which there are few sellers or few large firms, intensely competing against one another and recognising interdependence in their decision-making.

### Features of Oligopoly

(a) Few Sellers

(b) All the firms produce homogeneous or differentiated product.

(c) Under oligopoly demand curve cannot be determined. It has a kinked demand curve.

(d) All the firms are interdependent in respect of price determination.

(e) Price rigidity.

On the basis of production, **oligopoly** can be **categorised** in two categories:

(i) Collusive oligopoly is that form of oligopoly in which all the firms decide to avoid competition and determine the price and quantity of output on the basis of cooperative behaviour.

(ii) Non-collusive oligopoly is that form of oligopoly in which all the firms determine the price and quantity of output according to the action and reaction of the rival firms.

## FORMS OF MARKET STRUCTURE

### Perfect Competition

| Basis | Perfect Competition |
|---|---|
| 1. Number of sellers | Large |
| 2. Nature of product | Homogeneous |
| 3. Entry/Exit of firms | Free entry & exit of firm |
| 4. Firm's Demand Curve | ‖ to x-axis |
| 5. A R and MR curve | |
| 6. Selling cost | No required |
| 7. Degree of price control price | No. Control over price. |

Perfect

AR = MR

(Y-axis: Price, X-axis: Quantity, origin O)
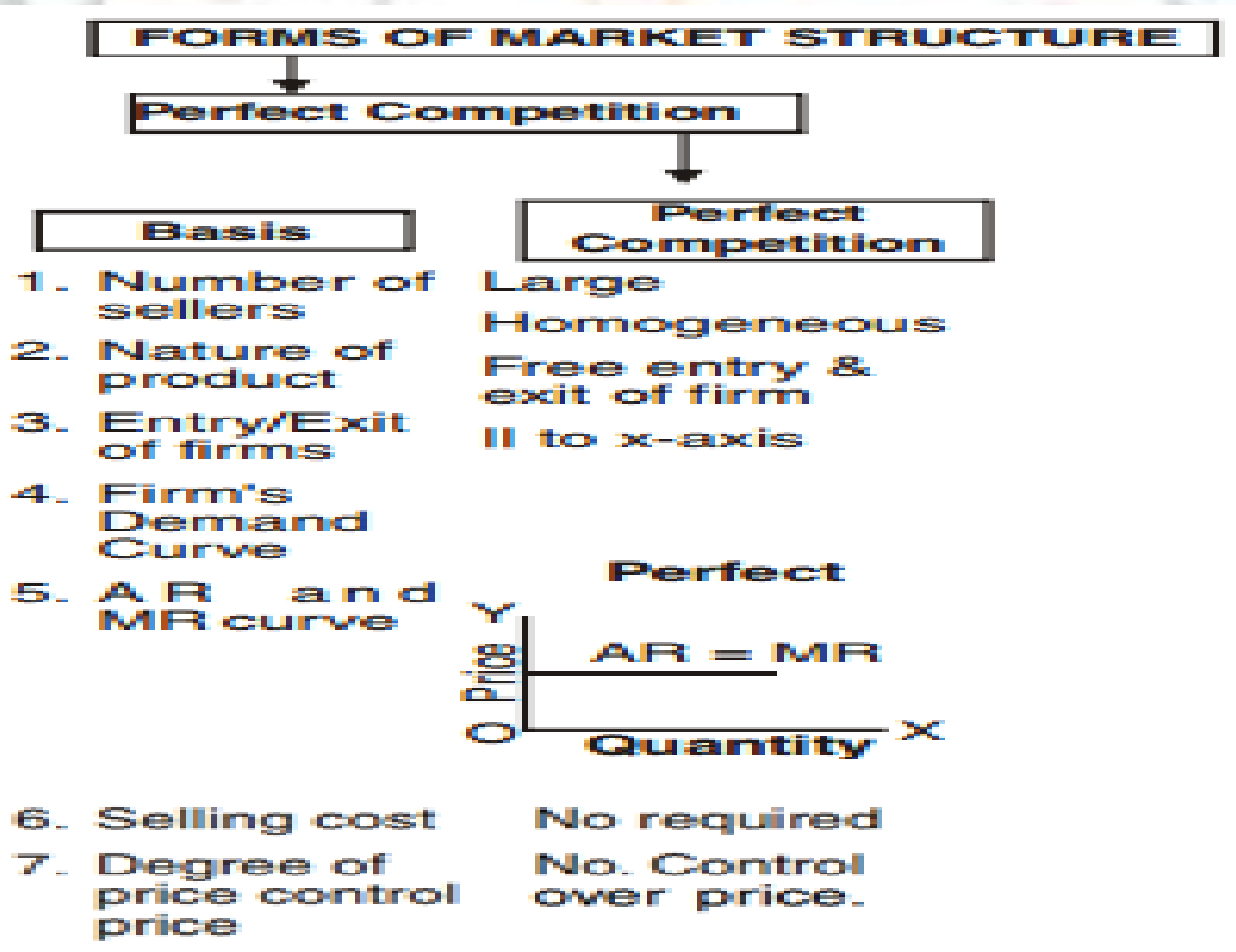
| Imperfect Competition | | |
| --- | --- | --- |
| **Monopoly** | **Monopolistic Competition** | **Oligopoly** |
| Single | Large | Few |
| No. Close substitute Product | Differentiated Product | Homogeneous & differentiated product |
| Restriction on entry of firm | Free entry and exit | Difficult entry of new firms |
| down ward sloping | down ward sloping | Undefined |
| | | Oligopoly Indeterminate |

**Monopoly**

AR > MR

MR AR

**Monopolistic Comp.**

AR > MR

AR

MR

| No required | Very significant | Very significant |
| --- | --- | --- |
| Full control overprice | Limited control | Price righdity |

on the basis of product differentiation,**Oligopoly**,can be **categorised** in two categories:

(i) Perfect Oligopoly: The Oligopoly is perfect or pure when the firms deal in the homogeneous products.
(ii) Imperfect Oligopoly: Whereas the Oligopoly is said to be imperfect, when the firms deal in heterogeneous products, i.e. products that are close but are not perfect substitutes.

**Equilibrium Price:** The price at which the quantity demanded and supplied are equal is known as equilibrium price.

**Equilibrium quantity:**The quantity demanded and supplied at an equilibrium price is known as equilibrium quantity.

**Market equilibrium** is a state in which market demand is equal to market supply. There is no excess demand and excess supply in the market.
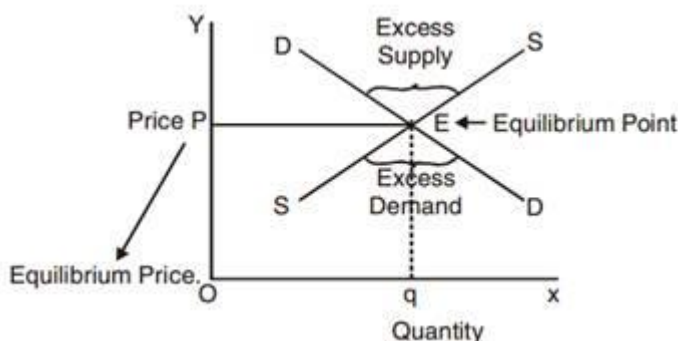


**Application of Demand of Supply**

**(a) Maximum Price Ceiling:** It means the maximum price the sellers are allowed to charge less than equilibrium market price. Government imposes such a ceiling when it finds that the demand for necessary goods exceeds its supply. That is, when consumers are facing shortages and equilibrium price is too high. Government does it in the interest of consumers.

Excess demand may be fulfilled by:(a) Rationing (b) Dual marketing
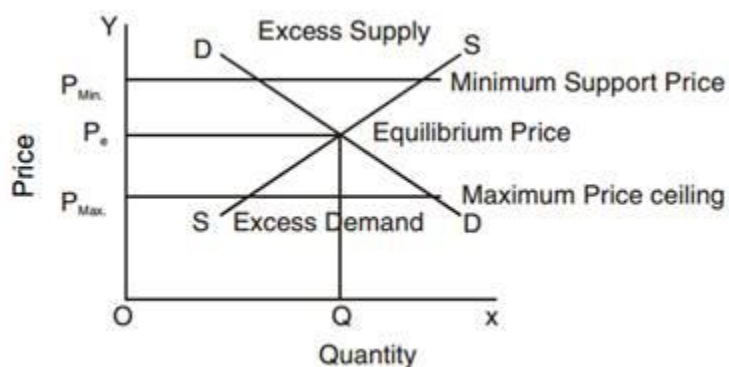


**(b) Minimum Price Ceiling:** It means that producer are not allowed to sell, the goods below the price fixed by Government, When government finds that equilibrium price is too low for the produce, then Govt. fixes a price ceiling higher than equilibrium price to prevent the possible loss to the producers. The price is also called floor price or minimum support price. Generally, government buys the excess supply at this price.

# UNIT - II

## 1. STATISTICS

**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.

**Scarcity definition given by Lionel Robbins(1932):-** Economics is a science that studies human behaviour as a relationship between ends and scarce means which have the alternative uses.

**Growth definition given by Paul A samuelson:-** Economics is the study of how man and the society chooses with or without the use of money, to employ scarce productive resources which could have the alternative uses to provide various commodities overtime and distribute them for consumption now and in future among various people and the groups of the society.

**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

**Stages of statistics in singular sense**
1. Collection of data
2. Organisation of data
3. Presentation of data
4. Analysis of data
5. Interpretation of data

**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 info 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
9. Without reference, results may prove to be wrong.

# 2. COLLECTION OF DATA

**Data is a collection of facts and measurement.**
Data is a tool which helps in reaching a sound conclusion by providing information therefore. For statistical investigation, collection of data is the first and foremost.

**Sources of Data**
1. Primary Source
2. Secondary Sources
a. Published sources
b. Un-published sources

**Primary Data–** Data originally collected in the process of investigation are known as primary data. This is original form of data which are collected for the first time.It is collected directly from its source of origin.

**Methods of collecting primary data**
There are three basic ways of collecting data :
(i) Personal interview OR Direct Personal Investigation
(ii) Mailing (questionnaire surveys)
(iii) Telephone interviews
(iv) Indirect verbal investigation
(v) Information from local sources
(vi) Enumerator method

**Secondary data** It refers to collection of data by some agency, which already collected the data and processed. The data thus collected is called secondary data.

**Point of difference between Primary and Secondary data :-**
1. Accuracy,
2. Originality,
3. Cost,
4. Need of modification

| BASIS FOR COMPARISON | PRIMARY DATA | SECONDARY DATA |
|---|---|---|
| Meaning | Primary data refer to the first hand data gathered by the researcher himself. | Secondary data means data collected by someone else earlier. |
| Data | Real time data | Past data |
| Process | Very involved | Quick and easy |
| Source | Surveys, observations, experiments, questionnaire, personal interview, etc. | Government publications, websites, books, journal articles, internal records etc. |
| Cost effectiveness | Expensive | Economical |
| Collection time | Long | Short |
| Specific | Always specific to the researcher's needs. | May or may not be specific to the researcher's need. |

| Accuracy and Reliability | More | Relatively less |
| --- | --- | --- |

## Sources of secondary data

### Published sources
1. Govt. publication
2. semi-Govt. Publication
3. Reports of committees & commissions
4. Private publications e.g., Journals and News papers research institute, publication of trade association.
5. International publications

### Unpublished Sources
The statistical data needn't always be published. There are various sources of unpublished statistical material such as the records maintained by private firms, business enterprises, scholars, research workers, etc. They may not like to release their data to any outside agency.

**Other source** : web-site

## Important points to be kept in mind while drafting the questionnaire
A. Introduction and purpose of investigation
B. Reasonable number questions.
C. Questions should be small & clear.
D. Questions should be arranged logically.
E. Instructions should be clear.
F. Proper space for answer.
G. Questions should be relevant to the investigation.
H. Personal questions should be avoided.
I. Avoid questions of calculations.
J. Cross Verification.
H. The question should not be ambiguous.
I. The question should not use double negative like "don't you".
J. The question should not indicate alternative answers.

**Pilot Survey:** Before sending the questionnaire to the information. It should be pretested. As a result of its short comings if any, can be removed. Such pretesting named as pilot survey.

A pilot survey is a preliminary survey used to gather information prior to conducting a survey on a larger scale. Pilot surveys, typically taken by smaller groups, help determine the efficiency of the future survey while also helping organizations smooth out difficulties before administering the main survey.

## Methods of sampling:
1. Random sampling
a. Simple or unrestricted random sampling
b. Restricted random sampling
i. Stratified
ii. systematic
iii. multistage or cluster sampling

2. Non-Random Sampling
a. Judgment sampling
b. Quota sampling
c. Convenience sampling

**Census survey :** In this method every element of population is included in the investigation.
**Sample survey :** In this method a group of units representing all the units of the population is investigated.

| BASIS FOR COMPARISON | CENSUS | SAMPLING |
|---|---|---|
| Meaning | A systematic method that collects and records the data about the members of the population is called Census. | Sampling refers to a portion of the population selected to represent the entire group, in all its characteristics. |
| Enumeration | Complete | Partial |
| Study of | Each and every unit of the population | Only a handful of units of the population. |
| Time required | It is a time consuming process. | It is a fast process. |
| Cost | Expensive method | Economical method |
| Results | Reliable and accurate | Less reliable and accurate, due to the margin of error in the data collected. |
| Error | Not present. | Depends on the size of the population |
| Appropriate for | Population of heterogeneous nature. | Population of homogeneous nature. |

**Population or universe**
In Statistics, population or universe simply refers to an aggregate of items to be studied for an investigation.

**Sample:** A group of items taken from the population for investigation and representative of all the items.
**Sampling Errors:** Sampling error is the difference between the result of studying a sample and the result of the census of the whole population.
**Non-Sampling Error:** Can occur in any type of survey whether it be a census or sample survey.

Sampling errors
1. Biased errors
2. Unbiased errors

Non sampling errors
1. Error in data acquisition
2. Non Response error
3. Sampling Bias

**Census of India and National Sample Survey Organization:**
The census of India provides the complete and continuous demographic record of population.

The NSSO was established by the Govt. of India to conduct nation wide survey on socio-economic issues like employment, literacy, maternity, child care, utilisation of public distribution system etc.

The data-collected by NSSO survey are released through reports and its quarterly journal ''Sarvekshana''.

Eg. Size, growth rate, distribution of population, density, population, projections, sex composition and literacy.

These data are used by govt. of India for planning purpose.

# 3. ORGANIZATION OF DATA

**Organization** of data refers to the systematic arrangement of collected figures (raw data), so that the data becomes easy to understand and more convenient for further statistical treatment .

**Classification** is the process of arranging data into sequences and groups according to their common characteristics of separating them in to different but related parts.

**Characteristics of classification:**
1. Homogeneity
2.Suitability
3. Clarity
4. Flexibility
5. Diversification

**A variable** is a characteristic which is capable of being measured and capable of change in its value from time to time.

**Basis of classification:**
**Raw data can be classified as:**
**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.
**2. Geographical/Spatial classification:** The data are classified with reference to geographical location/place such as countries, states , cities, districts, block etc.
**3. Qualitative classification:** Data are classified with reference to descriptive characteristics like sex, caste, religion literacy etc.
**4. Quantitative classification:** Data are classified on the basis of some measurable characteristics such as height, age, weight, income, marks of students.
**5. conditional classification:** When data are classified with respect to condition, the type of classification is called conditional classification.
A mass of data in its original form is called **raw data**. It is an unorganized mass of various items.
A characteristic which is capable of being measured and changes its value overtime is called a variable. It is of two types.
(a) Discrete
(b) Continuous

**Discrete:** Discrete variable are those variables that increase in jumps or in complete numbers and are not fractional. Ex.-number of student in a class could be 2, 4, 10, 15,, 20, 25, etc. It does not take any fractional value between them.

**Continuous variable:** Continuous variables are those variables that can takes any value i.e. integral value or fractional value in a specified interval.Ex- Wages of workers in a factory.

**A frequency distribution** is a comprehensive way to classify raw data of a quantitative variable. It shows how different values of a variable is distributed in different classes along with their corresponding class frequencies.

**The class mid-point or class mark** is the middle value of a class. It lies halfway between the lower class limit and the upper class limit of a class and can be ascertained in the following manner.

**Class mid-point = upper class limit + lower class limit / 2.**

**Class frequency:** It means the number of values in a particular class.
**Class width:-** It is the difference between the upper class limit and lower class limit

**Class width = upper class Limit - Lower class Limit**

**Class Limits:-** There are two ends of a class. The lowest value is called lower class limit and highest value is called upper class limit.

The classes, by the exclusive method is formed in such a way that the upper class limit of one class equals the lower class limit of the next class. eg 0-10, 10-20.

In comparison to the exclusive method, the inclusive method does not excludes the upper class limit in a class interval. It includes the upper class in a class. Thus both class limits are parts of the class intervals e.g., 0-9, 10-19.

The classification of data as a frequency distribution has an inherent short coming. While it summarizes the raw data making it concise and comprehensible. It does not show the details that are found in raw data. So there is a loss of information in classifying raw data.

Classification of data implies conversion of raw data in to statistical series.

**The difference between Univariate and Bivariate Frequency distribution**

| Basis | Univariate Frequency distribution | Bivariate Frequency distribution |
|---|---|---|
| Meaning | When data is classified on the basis of single variable,the distribution is known as univariate frequency distribution. | when data is classified on the basis of two variables, the distribution is known as bivariate frequency distribution. |
| Alternate Name | One-way frequency | Two-way frequency |
| Example | Height of students in a class | Height and weight of students in a class |

Broadly statistical series are of two types.
**Types of series**
1. Individual series
2. Frequency series
a. Discrete series Or frequency array
b. Frequency distribution or continuous series

**Individual series** are those series in which the items are listed singly. For example:

| Sr. No. of  workers | Daily wages(in Rs.) |
|---|---|
| 1 | 25 |
| 2 | 50 |
| 3 | 35 |
| 4 | 40 |
| 5 | 20 |

| | |
|---|---|
| 6 | 45 |

**A discrete series** or frequency array is that series in which data are prescribed in a way that exact measurements of items are clearly shown. The example in following table illustrates a frequency array.

**Frequency array of the size of household**

| Size of the household | Number of household (Frequency) |
|---|---|
| 1 | 5 |
| 2 | 15 |
| 3 | 25 |
| 4 | 35 |
| 5 | 10 |
| 6 | 5 |

**A continuous series:** It is that series in which items cannot be exactly measured. The items assume a range of values and are placed within the range of limits. In other words, data are classified into different classes with a range, the range is called class-intervals.

Frequency distribution or continuous series

| Marks | Frequency |
|---|---|
| 10-20 | 4 |
| 20-30 | 5 |
| 30-40 | 8 |
| 40-50 | 5 |
| 50-60 | 4 |
| 60-70 | 3 |

# 4. PRESENTATION OF DATA

The presentation of data means exhibition of data in such a clear and attractive manner that these can be easily understood and analysed.

**Forms of Presentation of data:**
1. Textual/Descriptive Presentation
2. Tabular Presentation
3. Diagrammatic Presentation
4. Graphical Presentation

**1. Textual/Descriptive Presentation of Data:-** In this, data is presented in the form of text. This is suitable when quantity of data is not too large.

**2. Tabulation**– It is the process of presenting data in the form of a table.
**Parts or components of Table:**
1. Table Number
2. Title
3. Caption Or Column Headings
4. Stubs Or Row Headings
5. Body of the Table
6. Unit of Measurement
7. Source
8. Head Note
9. Foot Note

**Features of a good table:**
(a) Compatible with the objective
(b) Helpful in comparison
(c) Ideal Size
(d) Stubs
(e) Headings
(f) Percentage and ratio
(g) Sources of Data
(h) Simplicity

**Kinds of Table:**
1. According to Purpose
2. According to originality
3. According to construction

**Classification of tabular presentation of data**
**1. Qualitative Classification:-** When classification is done according to attributes such as social status, nationality, etc. It is called qualitative classification.
**2. Quantitative Classification:-** In this, the data are classified on the basis of characteristics which are quantitative in nature. e.g., age, height, income, etc.

**3. Temporal classification:-** In this, time becomes the becomes the classifying variable and data are categorised according to time. Time may be in hours, weeks, years, etc.

**4. Spatial classification:-** When classification is done on the basis of place, it is called spatial classification. The place may be village, town, state, country, etc.

**Diagrammatic Presentation**: When data is presented in a simple and attractive manner in the form of diagrams is called diagrammatic presentation of data.

**Types of Diagrammatic Presentation**:
**1. Geometric Form**
a. Pie Diagram
b. Bar Diagram
i. Simple
ii. Multiple
iii. Sub Divided
iv. Percentage

**2. Frequency Diagram**
a. Histogram
b. Frequency Polygon
c. Frequency Curve
d. Ogive curve

**3. Arithmetic Line Graph or Time series graph**
**1. Bar diagram:-** Bar diagrams are those diagrams in which data are presented in the form of bars or rectangles.
**Simple bar diagram:-** They are those diagrams which are based on a single set of numerical data. Different items are represented by different bars.
**Multiple bar diagram:-** They are those diagrams which show two or more sets of data simultaneously. This type of diagram is, generally, used to make comparison between two sets of series.
**Sub divided bar diagram:-** These are those diagrams which present simultaneously, total values and parts there in a set of a data.
**Percentage bar diagram:-** They are those diagram which show simultaneously different parts off the values of a sets of data in terms of percentage.
**Deviation bar diagram:-** These are used to compare the net deviation of related variables with respect to time and location. Bars which represent positive deviation and which represent negative deviation are drawn above and below the base line respectively.
**Pie or circular diagram** is a circle divided into various segments showing the per cent values of a series.
**Histogram** is graphical presentations of a frequency distribution of a continuous series.It can never be drawn for a discrete series.
**Frequency polygon** is drawn by joining the mid points of the tops of rectangles in a histogram. It is constructed with the help of discrete as well as continuous series.
**Frequency curve** is obtained by joining the points of a frequency polygon through free hand smooth curve not by straight lines.
**Cumulative frequency curves or ogive curve is the curve** which is constructed by plotting cumulative frequency data on the graph paper in the form of a smooth curve.
**Arithmetic line Graphs or Time Series Graphs:-** In this graph, time(hour,day, date, week, month, year) is plotted along X-axis and the  corresponding value of variable along Y-axis.

# 5. MEASURES OF CENTRAL TENDENCY

**Points to Remember:** A **central tendency** is a single figure that represents the whole mass of data

**Arithmetic mean or mean i**s the number which is obtained by adding the values of all the items of a series and dividing the total by the number of items.
When all items of a series are given equal importance than it is called simple arithmetic mean and when different items of a series are given different weights according with their relative importance is known weighted arithmetic mean.

**Median** is the middle value of the series when arranged in order of the magnitude.
When a series is divided into more than two parts, the dividing values are called **Partition values**.
**Quartiles** are the measures which divide the data into four equal parts, each portion contains equal number of observation,

**There are three quartiles**
If a statistical series is divided into four equal parts, the end value of each part is called a quartile and denoted by 'Q'.

The **lower half** of a data set is the set of all values that are to the left of the median value when the data has been put into increasing order.

The **upper half** of a data set is the set of all values that are to the right of the median value when the data has been put into increasing order.

The **first quartile,** denoted by $Q_1$ , is the median of the *lower half* of the data set. This means that about 25% of the numbers in the data set lie below $Q_1$ and about 75% lie above $Q_1$ .

The **second quartile** also called median and denoted by $Q_2$, has 50% of the items below it and 50% of the items above it.

The **third quartile,** denoted by $Q_3$ , is the median of the *upper half* of the data set. This means that about 75% of the numbers in the data set lie below $Q_3$ and about 25% lie above $Q_3$ .

**Deciles** distribute the series into ten equal parts and generally expressed as D.

**Percentiles** divide the series into hundred equal parts and generally expressed as P.

**Mode** is the value which occurs most frequently in the series, that modal value has the highest frequency in the series.

**Main purposes and functions of averages.**

(i) To represent a brief picture of data.
(ii) Comparison.
(iii) Formulation of policies.

(iv) Basis of statistical analysis.
(v) One value for all the group or series.

**Essentials of a good average.**

(i) Easy to understand.
(ii) Easy to compute
(iii) Rigidly defined.
(iv) Based on all the items of series.
(v) Certain in character
(vi) Least effect of a change in the sample.
(vii) Capable of algebraic treatment.

**Merits of Arithmetic mean:**

(i) Simplicity
(ii) Certainty
(iii) Based on all values.
(iv) Algebraic treatment possible.
(v) Basis of comparison
(vi) Accuracy test possible.
(vii) No scope for estimated value.

**Demerits of Arithmetic mean:**

(i) Effect of extreme values.
(ii) Mean value may not figure in the series.
(iii) unsuitability.
(iv) Misleading conclusions.
(v) Can not be used in case of qualitative phenomenon.
(vi) Gets distorted by extreme value of the series.

**Merits of Median:**

(i) Simple measure of central tendency.
(ii) It is not affected by extreme observations.
(iii) Possible even when data is incomplete.
(iv) Median can be determined by graphic presentation of data.
(v) It has a definite value.
(vi) Simple to calculate and understand
(vii) It is a positional value not a calculated value.

**Demerits of median:**

(i) Not based on all the items in the series, as it indicates the value of middle items.
(ii) Not suitable for algebraic treatment.
(iii) Arranging the data in ascending order takes much time.

(iv) Affected by fluctuations of items.

(v) It cannot be computed exactly where the number of items in a series is even.

## Merits of mode:

(i) Simple and popular measure of central tendency.

(ii) It can be located graphically with the help of histogram.

(iii) Less effect of marginal values.

(iv) No need of knowing all the items of series.

(v) It is the most representative value in the given series.

(vi) It is less effected by extreme values.

## Demerits of mode:

(i) It is an uncertain measure.

(ii) It is not capable of algebraic treatment.

(iii) Procedure of grouping is complex.

(iv) It is not based on all observations.

(v) For bi- modal and tri-modal series, it is difficult to calculate.

(vi) Its value is not based on each and every item of the series.

(vii) If items are identical, it is difficult to identify the modal value.

Relation among mean, median and mode :

**Mode = 3 median - 2 mean**

## Location of median by graph:

(i) By 'Less than' or 'More than' ogives method a frequency distribution series is first converted into a less than or more than cumulative series as in the case of ogives, data are presented graphically to make a 'less than' or 'more than' ogive, N/2 item of the series is determined and from this point (on the y-axis of the graph) a perpendicular is drawn to the right to cut the cumulative frequency curve. The median value is the one where cumulative frequency curve cuts corresponding to x-axis.

(ii) Less than and more than ogive curve method present the data graphically in the form of 'less than' and 'more than' ogives simultaneously. The two ogives are superimposed upon each other to determine the median value. Mark the point where the ogive curve cut each other, draw a perpendicular from that point on x-axis, the corresponding value on the x-axis would be the median value.

## Graphic presentation of mode:

Prepare a histogram from the given data. Find out the rectangle whose height is the highest. This will be the modal class. Draw two lines-one joining the top right point of the rectangle preceding the modal class with top right point of the modal class. The other joining the top left point of the modal class with the top left point of the post modal class. From the point of intersection of these two diagonal lines, draw a perpendicular on horizontal axis i.e., x-axis the point where this perpendicular line meets x-axis, gives us the value of mode.

## Formulae of calculating arithmetic mean:

| Types of Series | Direct Method | Shortcut Methods | Step deviation Methods |
|---|---|---|---|
| Individual Series | $\overline{X} = \dfrac{\sum X}{N}$ | $\overline{X} = A + \dfrac{\sum d}{N}$ | $\overline{X} = A + \dfrac{\sum d'}{N} \times C$ |
| Discrete series | $\overline{X} = \dfrac{\sum fx}{N}$ | $\overline{X} = A + \dfrac{\sum fd}{N}$ | $\overline{X} = A + \dfrac{\sum fd'}{N} \times C$ |
| Continuous Series | $\overline{X} = \dfrac{\sum fm}{N}$ | $\overline{X} = A + \dfrac{\sum fd}{N}$ | $\overline{X} = A + \dfrac{\sum fd'}{N} \times C$ |

Combines Mean
$$\overline{X}_{12} = \dfrac{\overline{X}_1 N_1 + \overline{X}_2 N_2}{N_1 + N_2}$$

Weighted Mean
$$\overline{X} = \dfrac{\sum WX}{\sum W}$$

**Formulae of calculating median and partition values:**

| Measure | Individual Series Size of item | Discrete Series Size of item | Continuous Series Size of item | Formula |
|---|---|---|---|---|
| Median | $\left(\dfrac{N+1}{2}\right)$ th item | $\left(\dfrac{N+1}{2}\right)$ th item | $\dfrac{N}{2}$ | $I_1 + \left(\dfrac{\dfrac{N}{2} - cf}{f}\right) \times C$ |
| First Quartile $Q_1$ | $\left(\dfrac{N+1}{4}\right)$ th item | $\left(\dfrac{N+1}{4}\right)$ th item | $\dfrac{N}{4}$ | $I_1 + \left(\dfrac{\dfrac{N}{4} - cf}{f}\right) \times C$ |
| Third Quartile $Q_3$ | $\dfrac{3(N+1)}{4}$ th item | $\dfrac{3(N+1)}{4}$ th item | $\dfrac{3(N)}{4}$ | $I_1 + \left(\dfrac{\dfrac{3(N)}{4} - cf}{f}\right) \times C$ |

**Formula of calculating mode in continuous series:**

Mode = $L_1 + \dfrac{f_1 - f_0}{2f_1 - f_0 - f_2} \times C$

Where, $L_1$ = Lower limit of modal class

$f_0$ = Frequency of the group preceding the modal class

$f_1$ = Frequency of the modal class

$f_2$ = Frequency of the group succeeding the modal class

$C$ = Magnitude or class interval of the modal class

# 6. MEASURES OF DISPERSION

**Points to remember**

**Dispersion** is a measure of the variation of the items from central value.
The measures of dispersion is important to compare uniformity, consistency and reliability amongst variables / series.

**Absolute measures of dispersion** are expressed in terms of original unit of series.

**Relative measures** are expressed in ratios or percentage of average, also known as coefficients of dispersion.

**Measures of Dispersion:**
(i) Range
(ii) Inter quartile range
(iii) Quartile deviation or Semi-Inter-quartile range
(iv) Mean deviation
(v) Standard Deviation
(vi) Lorenz curve

**Range:** Range is defined as the difference between two extreme observations i.e. the largest and the smallest value.

Symbolically, R = L-S
Where R = Range
L = Largest Value
S = Smallest value

Coefficient of range = $\dfrac{L-S}{L+S}$

**Inter Quartile Range:**
Inter quartile range is the difference between upper quartile and lower quartile.

Inter-quartile range = $Q_3 - Q_1$

Where $Q_3$ = Third quartile or upper quartile.

$Q_1$ = First quartile or lower quartile

**Quartile Deviation:**

Quartile deviation is known as half of difference of third quartile ( $Q_3$ ) and first quartile ( $Q_1$ ). It is also known as semi inter quartile range.

$$Q.D. = \dfrac{Q_3 - Q_1}{2}$$

Where Q.D. = Quartile deviation

$Q_3$ = Third quartile or upper quartile.

$Q_1$ = First quartile of lower quartile.

Coefficient of quartile deviation= Q3−Q1Q3−Q1Q3−Q1Q3−Q1

## Mean Deviation:

Mean deviation/average deviation is the arithmetic mean of the deviations of various items from their average (mean, median or mode) generally from the median.

Calculation of mean deviation

Individual Series
$$M.D. = \frac{\Sigma |D|}{N}$$

Discrete Series
$$M.D. = \frac{\Sigma f |D|}{N}$$

Continuous Series
$$\frac{\Sigma f |D|}{N}$$

Where,

MD = Mean deviation

| D | = Deviations from mean or median ignoring + Signs

N = Number of item (Individual Series)

N = Total number of Frequencies (Discrete and continuous series)

F = Number of frequencies.

Coefficient of mean deviation

## Merit of Mean deviation:

1. As in case of X, every term is taken in account hence, it is certainly a better measure than other measures of dispersion i.e. Range, Percentile Range or Quartile Range.
2. Mean deviation is extensively used in other fields such as Economics, Business, Commerce or any other field of such type.
3. It has least sampling fluctuations as compared to Range, Percentile Range and Quartile Deviation.
4. When comparison is needed this is perhaps the best measure between two or more series.
5. This calculation has its base upon measurement than an estimate.
6. Mean Deviation is rigidly defined; one of the main focus point of any measure used for statistical Analysis.
7. It we calculate it from median it is less affected by extreme terms.
8. As it is based on the deviations about an average, it gives us better measure for comparison.

## Demerits of Mean Deviation:

1. If average is in fractions, it is difficult to compile M.D.
2. Main property is absent, It is not capable of further Algebraic Treatment.
3. Not so easy to calculate to calculate X, M or Z first and then to go for other measures.

4. If it is calculated from Z it is not much reliable as Mode (Z) is not the true representative of the series.
5. M.D. and its co-efficient taken from X, M and Z often differ.
6. As +,- signs are ignored which is not possible mathematically. Algebraically we have to proceed for Standard Deviation; or another measure of dispersion.
7. As for mean, open and series cannot be taken for the true result.
8. If Range increases in case the sample increases, Average deviation also increases but not in the same ratio.
9. For Sociological studies, it is almost not used.

**Standard Deviation:**

Standard deviation is the best and widely used measure of dispersion. Standard deviation is the square root of the arithmetic mean of the squares of deviation of its items from their arithmetic mean. Calculation of standard deviation in individual series.
Actual mean method.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

Where $\sigma$ = Standard Deviation

$\Sigma x^2$ = Sum total of square of Deviation taken from Mean

N = Number of items

**Shortcut Method or assumed mean method:**

$$\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

Where $d^2$ = Square of deviation taken from assumed mean.

**Calculation of standard deviation in discrete series:**
Actual mean method or direct method

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}}$$

Where $\sigma$ = S.D.

$\Sigma x^2$ = Sum total of the squared deviations multiplied by frequency

N = Number of pair of observations.

**Shortcut method or assumed method:**

$$\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

$\sigma$ = S.D.

$\Sigma fd^2$ = Sum total of the squared deviations Multiplied by frequency

$\Sigma fd^2$ = Sum total of deviations multiplied by frequency.

N = Number of pair of observations.

**Step deviation method:**

$$\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2} \ X\ C$$

$\sigma$ = Standard Deviation

$\Sigma fd^2$ = Sum total of the squared step deviations multiplied by frequency.

$\Sigma fd^2$ = Sum total of step deviations multiplied by frequency

C = Common factor

N = Number of pair of observation

**Individual Series:**
**1. Actual Mean Method**

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}}$$

$$x = X - \overline{X}$$

**2. Assumed Mean Method**

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

**Discrete/Continuous Series:**
**1. Actual Mean Method**

$$\sigma = \sqrt{\frac{\Sigma fx^2}{\Sigma f}}$$

$$x = X - \overline{X}$$

**2. Assumed Mean Method**

$$\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

**3. Step Deviation Method**

$$\sigma = \sqrt{\frac{\Sigma fd^{12}}{\Sigma f} - \left(\frac{\Sigma fd^1}{\Sigma f}\right)^2} \ X\ C$$

**Merits of standard donation:**
1. Based on all values

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2. Rigidly defined
3. Less effect of fluctuations
4. Capable of algebraic treatment

**Demerits of standard donation:**
1. Difficult to compute
2. More stress on extreme items
3. Dependent on unit of measurement.

**Coefficient of variation:**
When two or more groups of similar data are to be compared with respect to stability (or uniformly or consistency or homogeneity). Coefficient of variation is the most appropriate measures. It is the ratio of the standard deviation to the mean.

$$CV = \frac{\sigma}{\overline{X}} \times 100$$

Where C.V. = Coefficient of variation

$\sigma$ = Standard deviation

X = Arithmetic mean

**LORENZ CURVE:**
The Lorenz curve devised by Dr. Max O. Lorenz is a graphic method of studying dispersion.
The Lorenz curve always lies-below the line of equal distribution, unless the distribution is uniform.
The Area between the line of equal distribution and the plotted curve gives the extent of inequality in the items. The larger the area, more is the inequality.

**Application Lorenz Curve:**
(i) Distribution of income
(ii) Distribution of wealth
(iii) Distribution of wages
(iv) Distribution of production
(v) Distribution of population

**Construction of Lorenz Curve:**
1. Series is converted into a cumulative frequency series. The cumulative sum of items is assumed to be 100 and different items are converted into percentage of the cumulative sum.
2. Cumulative sum of frequency is assumed to be 100 and different Frequencies are converted into percentage of sum of frequency.
3. Cumulative frequencies are plotted on x-axis and cumulative items are plotted on y-axis of graph.
4. On both axis values are plotted from 0-100.
5. A diagonal line(0 on X-axis and 100 on Y-axis are joined by a line). It is called line of equal distribution.
6. Actual data are plotted by joining different points. This is Lorenz Curve.
7. Lesser distance between the line of equal distribution and line of actual distribution shows lesser dispersion and so on.

# 7. CORRELATION

**Points to remember**

**Meaning of correlation:** Correlation is a statistical tool which studies the relationship between two variables e.g. change 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.

**Type of Correlation**

Correlation is classified into positive and negative correlation. The correlation is said to be positive when the variables move together in the same direction. e.g. sale of lce cream and temperature move in same direction. The correlation is said to be negative when the variables move in opposite direction. e.g. When you spend more time in studying chances of your failure decline.

**Examples of positive correlation are:**
1. Price and supply of a commodity.
2. Increase in Height and Weight.
3. Age of husband and age of wife.
4. The family income and expenditure on luxury items.

**Examples of negative correlation are:**
1. Sale of woollen garments and day temperature.
2. Price and Demand of a commodity.
3. Yield of crops and price.

**Degree of Correlation:**

| Degree | Positive | Negative |
|--------|----------|----------|
| Perfect | +1 | -1 |
| High | Between +0.75 and +1 | Between -0.75 and -1 |
| Moderate | Between +0.25 and +0.75 | Between -0.25 and -0.75 |
| Low | Between 0 and +0.25 | Between 0 and -0.25 |
| Zero | 0 | 0 |

**Methods of estimating correlation:**
(a) Scatter diagram
(b) Karl person's coefficient of correlation.
(c) Spearman's rank correlation.

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.

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: $$r = \frac{\sum xy}{N\sigma x \times \sigma y}$$
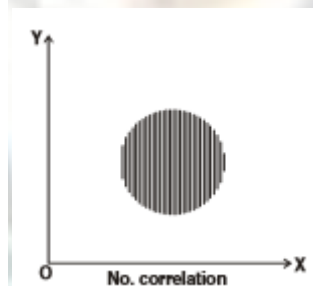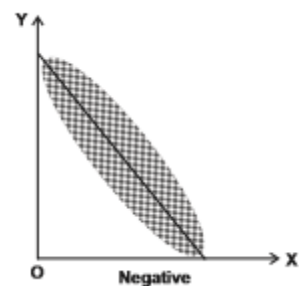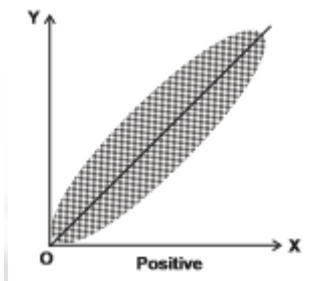
Here,

r = Coefficient of correlation

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

$y = (Y - Y)$

$\sigma x$ = Standard deviation of X-series.

$\sigma y$ = Standard deviation of Y-series.

N = Number of observations
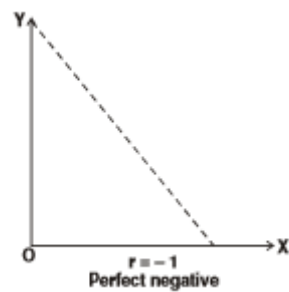


Karl Person's coefficient of correlation is calculated by following methods:

(a) Actual mean method: $$r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}}$$

Here,

r = Coeff. Of correlation

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

$y = (Y - Y)$

(b) Assumed Mean method:

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

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

Here,

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

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

$\sum dx\,dy$ = 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

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

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

$dy = \dfrac{dy}{C_2}$

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

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

$\sum dx\,dy$ = 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.

Given two variables x and y let us define two new variables

$$U = \frac{X-A}{B} \qquad V = \frac{Y-C}{D}$$

Here A and C are assumed means of X and V respectively. B and D are common factors. They rxy = ruv.

**Spearman's rank correlation method** 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.

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

Here,

$r_s$ = Coefficient of rank correlation.

D = Rank differences

N = Numbers of rank

When ranks are repeated the formula is:

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

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

# 8. INTRODUCTION TO INDEX NUMBER

**Introduction to index number:** An index number is a statistical device for measuring changes in the magnitude of a group of related variables.

**Features of Index Number**

1. Index numbers are expressed in terms of percentages. However, percentage sign (%) is never used.
2. Index numbers are relative measurement of group of data.
3. Index numbers offer a precise measurement of the quantitative change in the concerned variables over time.
4. Index number show changes in terms of averages.
5. They are expressed in numbers.
6. Index number facilitates the comparative study over different time period.

**Importance of Index number**

1. It serves as a barometer for measuring the value of money.
2. Gives knowledge about change in standard of living.
3. It helps the business community in planning their decision.
4. Helpful to determine the rate of premium.

**Limitation of Index Number**

1. Limited applicability
2. International comparison is not possible
3. Limited coverage
4. Difficulty in the construction of index number

**Types of Index numbers:**
(i) Wholesale price index (WPI)
(ii) Consumer price index (CPI) or Cost of living index
(iii) Index of industrial production (IIP)
(iv) Index of Agricultural production (IAP)
(v) Sensex

**Methods of constructing index numbers:**
1. Construction of Simple Index numbers
a. Simple Aggregative Method
b. Simple Average of Price Relatives Method
2. Construction of weighted Index numbers
a. weighted Average of Price Relative Method
b. Weighted Aggregative Method
**Simple aggregative method:**

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

Here, $P_{01}$ = Price index of the current year.

$\Sigma P_1$ = Sum of the prices of the commodities in the current year

$\Sigma P_0$ = Sum of the prices of the commodities in the base year

**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.

**Simple average of price Relatives method:**

$$P_{01} = \frac{\Sigma\left(\frac{P_1}{P_0} \times 100\right)}{N}$$

Here, $P_{01}$ = Price index of the current year

$\frac{P_1}{P_0} \times 100$ = Price relatives

N = Number of commodities

**Weighted average of price relative method:**

$$P_{01} = \frac{\Sigma RW}{\Sigma W}$$

Here, $P_{01}$ = Index number for the current year in relation to base year

W = Weight, R = Price relatives i.e. $\frac{P_1}{P_0} \times 100$

**Weighted Aggregative method:**
(i) Laspeyre's method :- P01 = ∑p1q0∑p0q0×100∑p1q0∑p0q0×100
(ii) Pasche's method :- P01 = ∑p1q1∑p0q1×100∑p1q1∑p0q1×100
(iii) Fisher's Method :- P01
= ∑p1q0∑p0q0×∑p1q1∑p0q1——————————√×100∑p1q0∑p0q0×∑p1q1∑p0q1×100

**Some Important index numbers:**
**(i) Consumer price index (CPI)**: CPI is also known as the cost of living index, measures the average change in retail prices.
**Methods of constructing CPI:**
Here,

$$CPI = \frac{\Sigma WR}{\Sigma W}$$

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

W = Weights

**(B) Aggregative expenditure method:** $P01 = \frac{\sum p1q0}{\sum p0q0} \times 100 \frac{\sum p1q0}{\sum p0q0} \times 100$

**(ii) Wholesale price index (WPI):** WPI Indicates the change in the general price level.

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

**IIP=** $\frac{\sum [q1q0 \times 100]W}{\sum W} \frac{\sum [q1q0 \times 100]W}{\sum W}$

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

$q_0$ = Level of production in the base year

W = Weight

**(iv) Index of agriculture production (IAP)**

IAP is used to study the rise and fall of the yield of principle crops from one period to other period.

**(v) Sensex:** Sensex is the short form of Bombay stock exchange sensitive index with 1978-79 as base. It is the benchmark index for the Indian stock market.

It consists or 30 stocks which represent 13 sectors of the economy and the companies are the leaders in their respective industries.

**Problems in construction of index numbers:**

(i) Purpose of index number.

(ii) Selection of base year.

(iii) Selection of items.

(iv) Selection of the prices of items.

(v) Selection of method of weighting

(vi) Selection of sources of data

(vii) Choice of an average.

(viii) Choice of method.

**Uses of index numbers:**

(i) To measure the purchasing power of money.

(ii) Knowledge of change in standard of living.

(iii) Adjustment in salaries and allowances.

(iv) Help in framing suitable policies.

(v) As economic barometers.

**Inflation and index numbers:**

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

Rate of inflation $\dfrac{A_2 - A_1}{A_1} \times 100$

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

$A_2$ = WPI for week second (2)