Statistic
Chapter no 1
Important Question.

1) **Statistic:-**

The word statistics is come from latin word status meaning a political state, originally mean information for a state.

⇒ The meaning of the statistic is commonly refer to the numerical facts. The number that represent the age of the student, income of the family.

⇒ The second meaning of the statistic is refer to the field or discipline of study etc.

⇒ (**Statistic** is a science of collecting, arranging, measuring and interpreting data as well as making decision based on such analysis.)

Type of statistic:-

Two type of statistic are

1) Descriptive statistics.
2) Inferential statistics.

* **Descriptive statistics:-**

Descriptive statistics consist of methods that is used for collecting, displaying and describing data by using tables, graph and summary measures.

* **Inferential statistics:-**
Inferential statistics consist of method that used to help in making decision or prediction about a population.

2/ **Variable:-**
A variable is a characteristic under study that assumes different values for different variables. In constant variable, value of variable is fixed.

Types of variable:-
Two major types of variable are.
1/ Quantative variable.
2/ Qualitative variable.

⇒* **Quantative variable:-**
A variable that can be assume and measure numerically is called Quantative variable.

Types of Quantative variable:-
Two major types of Quantative variable are:
1/ Discrete variable.
2/ Continuous variable.

* **Discrete variable:-**
A variable whose values can be counted numerically is called discrete variable.

* **Continuous variable:-**
A variable whose values can be assume numerically over a certain interval or intervals is called continuous variable.

⇒ **Qualitative variable:-**
A variable whose values cannot be assume numerically but it can be classified into two non-numeric values is called qualitative variable.

3/ **Data:-**
Data is recorded in a sequence that is collected before the processing.

Types of data:-
Two major types of data.
1/ Primary data
2/ Secondary data

* **Primary data:-**
A ~~original~~ collection of original data that cannot undergone to a sort of statistical treatment is called primary data.

* Secondary data:-
A collection of original data that can undergone to a sort of statistical treatment is called secondary data.

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Book ⇒ Population:-
Population consist of all elements individual, items or object that characteristic has being studied The population has being studied is called target population

Book ⇒ Sample:-
Sample is a portion of the population. Sample is also a subset of population. Generally it may consist of some of observation, in such situation it consist whole of the population.

* Qualitative data:-
A data that collected on qualitative variable is called Qualitative data.

* Quantative data:-
A data that collected on Quantative variable is called Quantative data.

* Discrete data
A data that collected

or consist of discrete variable is called discrete data.

* **Continous data:-**
A data that can be collected on continous variable is called Continous data.

End 1st Chapter

Statistics
Chapter no 2

1/ **Simple way classification:-**
When the data is sorted according to the only one criterion is called simple way classification or one-way classification.

2/ **Multiple way classification:-**
When the data is sorted according to the two criterion is called two-way classification or multiple way classification.

3/ **Grouped Frequency distribution:-**
The organization is a set of data that showing in a table is distributed into a groups or classes together with the number of observations

of the groups or classes is called frequency distribution or grouped frequency distribution.

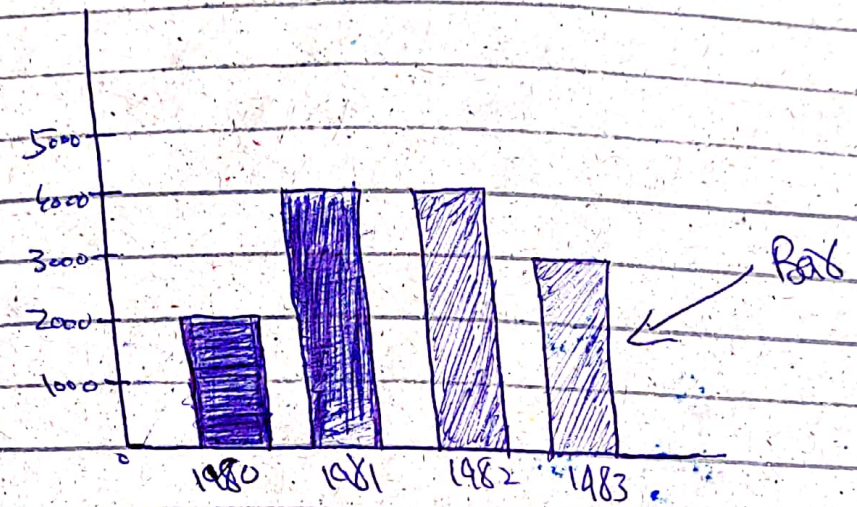
4/ **Cumulative frequency distribution:-** (also repeat below the same)
The total number of frequency in a variable from its end to the certain value is called Cummulative frequency, more than or less than a base variable. The distribution shaving the cummulative frequency is called cummulative frequency distribution.

5/ **Graphical Representation:-**
The visual displaying of data in statistics using a lines, bars, areas and symbol is known as graphical representation.

6/ **Class-limit:-**
The value of the variable described the class-limit The lower value represent the lower class-limit Higher value represent the upper-class limit Upper class--limit well defined and should no overlapping.

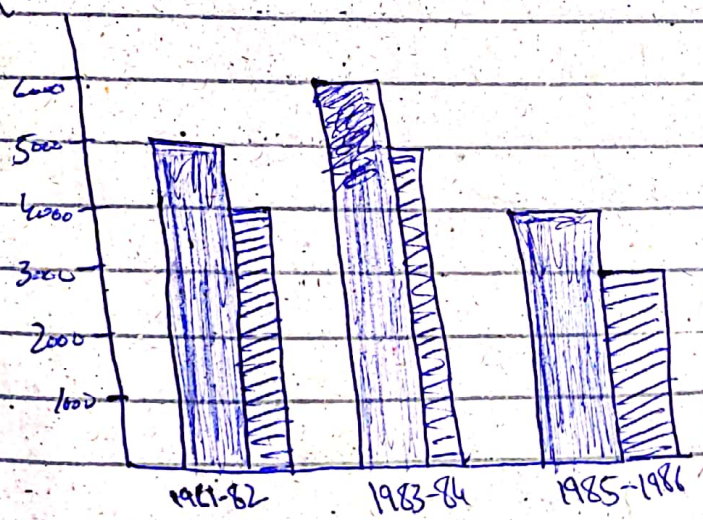
7/ **Bar graph:-**
A graph that is made-up of bars is called

bar graph. In bar graph whose height represent the frequency of respective categories.



Bar graph

8/ **Multiple bar chart:-** A chart showing two or more characteristics corresponding to the value of the variable in the form of groups whose height represent the value of the characteristic that is shaded or coloured for identification is called multiple bar chart



9/ Pie-chart:-

Pie-chart showing the frequencies or percentages. A circle that is divided into portion whose represent the frequencies or percentages of the population or samples that is belonging to the relative categories.

→ Pie-chart

10/ Component bar chart:-

A component bar chart is an effective technique in which a bar is divided into more section, proportional in size to the components parts of the total being displayed by each other.

Profit and Loss Graph:-

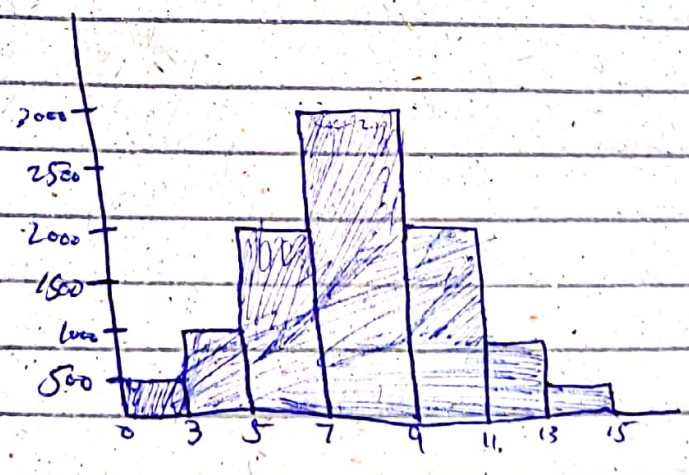
The graph is showing a percentages in component bar chart. Profit can be shown above the normal based line and loss can be shown below the normal based line.

Histogram or Time-series graph:-

The curve showing a value of one or more items from one period of time to the next is called time-series curve. This curve is also known as histogram.

Histogram:-

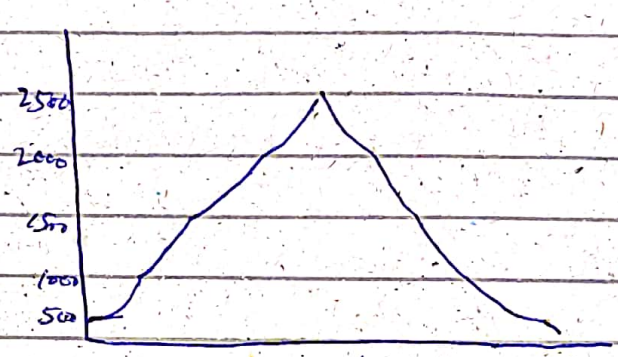
Histogram is consist of a set of two or more adjacent rectangle whose based are marked-off by class boundaries on x-axis. the length proportional to the frequency of respective classes.



Histogram.

Frequency polygon:-

Frequency polygon is a graphical representation device that understanding the shapes of distribution. It is similar to histogram but it especially used to compare two set of data. It most likely used for displaying cummulative frequency distribution.



Frequency polygon

Pictogram:-

Pictogram is a device that portraying the statistical data by means of picture or symbol. It said that one picture is worth ten thousand words.

(OR)

Pictogram is similar to the bar chart but it used picture instead of bars. Picture represent the frequency of respective classes.

Chapter no 3
Statistics

Average:-
The tendency of the observation to cluster is the central part of the data set is called central tendency and summary value is measure of central tendency. The measure of central tendency indicates the location of general position of distibution. It is also known as average.

Types of Average:-
Types of Average are
1. Arithematic Mean
2. Geomatric Mean
3. Harmonic Mean
4. Median
5. Mode.

*** Arithematic mean:-**
Arithematic mean is most familiar average. It is defined as the value obtained by dividing the sum of observation by their number.

$$A.M = \frac{\text{Sum of observation}}{\text{Num of observation}}$$

Sample Mean:-
If the given set of observation

represent the sample This mean is called sample Mean

$$\bar{x} = \frac{x_1 + x_2 + x_3 + x_4 + \cdots + x_n}{n} \quad (i = 1, 2, 3, \cdots n)$$

$$\bar{x} = \frac{\Sigma x_i}{n}$$

Population Mean:-

If the given set of observation represent the population. This mean is called population mean

$$\mu = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{N}$$

$$\mu = \frac{\Sigma x_i}{N} \quad (i = 1, 2, 3, \cdots N)$$

Weighted Aixthematic Mean:-

A set of number which express more or less adequately relative importance of observation ~~according~~ ~~to~~ in the data set technically is called weight. We assign weight $w_1, w_2, w_3, \cdots w_n$ to the observation according to the data given of relative importance So the weighted aithematic mean is define as

$$\bar{x}_w = \frac{x_1 w_1 + x_2 w_2 + x_3 w_3 + \cdots + x_n w_n}{w_1 + w_2 + w_3 + \cdots w_n}$$

$$\bar{x}_w = \frac{\Sigma w_i x_i}{\Sigma w_i}$$

For grouped data

$$\bar{x} = \frac{\sum f_i x_i}{N}$$

2/ Geometric mean:-

The Geometric mean G is a set of n positive value $(x_1, x_2, x_3, \ldots, x_n)$ it is defined as the nth square root of their positive product.

$$G = \sqrt[n]{x_1 x_2 x_3 \ldots x_n}$$

$$\log G = \frac{1}{n}\left[\log x_1 + \log x_2 + \ldots + \log x_n\right]$$

$$\log G = \frac{1}{n}\sum \log x_i$$

$$G = \text{Antilog}\left[\frac{1}{n}\sum \log x_i\right]$$

⇒ For grouped data

$$G = \text{Antilog}\left[\frac{1}{n}\sum f_i \log x_i\right]$$

⇒ For weighted data

$$G_w = \text{Antilog}\left[\frac{1}{\sum w_i}\sum w_i \log x_i\right]$$

3/ Harmonic mean:-

The harmonic mean H is a set of n values $(x_1, x_2, \ldots, x_n)$ is defined as the reciprocal of arithematic mean and reciprocal of its value

$$H = \frac{n}{\sum\left(\frac{1}{x_i}\right)}$$

⇒ For grouped data

$$H = \frac{n}{\Sigma f_i\left(\frac{1}{x_i}\right)}$$

⇒ For weighted data

$$H_w = \frac{\Sigma w_i}{\Sigma w_i\left(\frac{1}{x_i}\right)}$$

Properties of Airthematic Mean:-

1/ $\Sigma(x-\bar{x}) = 0$

2/ $\Sigma(x_i-\bar{x}) \leq \Sigma(x_i-a)$ where a is an arbitrary value other than mean.

3/ If $y_i = ax_i + b$ $(i=1,2,3,\ldots n)$ a and b are any two number, $a \neq 0$ then $\bar{y} = a\bar{x} + b$

Mode:-

The French word mode is come from fashion that is adopted to convey the "most frequent". It is define as the value is occurs frequently in the data set that is it indicates the most common value

$$\text{Mode} = l + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

OR

$$= l + \frac{f_2}{f_1 + f_2} \times h$$

Median:-

Median is defined as the value of data set in an ordered and divided in two equal parts One part is comparising greater than and the other part is smaller than it.

* Median:-

Median is define as the value which divides a data set that have been ordered, into two equal parts. One part comparising of observation is greater than and other part is smaller than it.

$$\text{Median} = \left(\frac{n+1}{2}\right) \text{ when observation is not integer}$$

$$\text{Median} = \left(\frac{n}{2}+1\right) \text{ when observation is an integer}$$

$$\text{Median} = l + \frac{h}{f}\left(\frac{n}{2} - c\right) \text{ for grouped data.}$$

Advantages of Airthematic mean, Geomatric mean and Harmonic mean:-

1. It is hardly defined by Mathematical formula.
2. It based on all dsecvation in a data set.
3. It is ammenabl to ammenable to mathematic

treatment.

⇒ **Disadvantages of Arithmetic mean:-**

1. It greatly effected by extreme value in data set.
2. It gives sometimes fallacious conculesion.

⇒ **Disadvantages of Geometric mean:-**

1. It neither easy to calculate nor to understand.
2. It cannot be calculated, if any observation is zero.

⇒ **Disadvantages of Harmonic mean:-**

1. It not be readily understand
2. It vanish all, if any one observation in a data set is zero.

⇒ **Disadvantages of Median:-**

1. It is not hardly defined mathematical formula.
2. It is not capable of lending itself to further statistical treatment

⇒ **Disadvantages of Mode:-**

1. It is not hardly defined
2. It is not capable of lending it self to further statistical treatment.

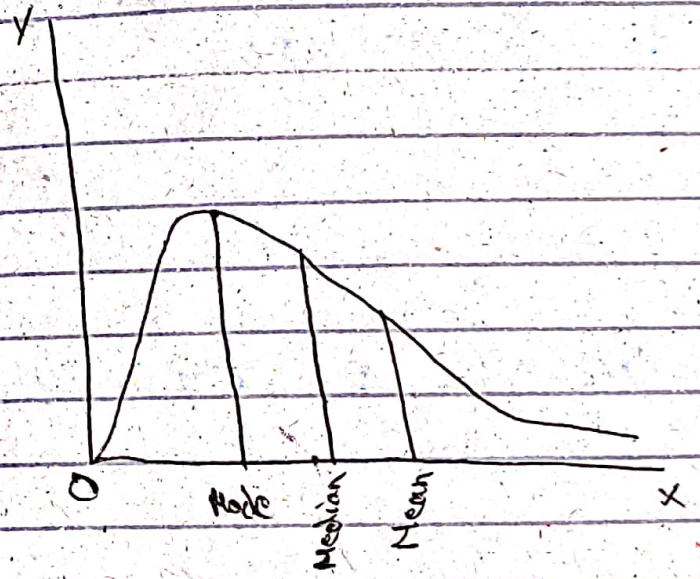
Advantages of Median:-

1. It is simply understood and easily calculated.
2. It is not affected by a extreme value.

Advantages of Mode:-

1. It is easily understand and calculated.
2. It is not be affected by normally large or small observation.

Relation b/w Mean, Median, Mode:-



Experience tell us that in unimodel curve of modeate skewness. the median is sandwitched b/w Mean and Mode. and between all of the following approximate relations holds good.

Mean - Mode = 3 (Mean - Median)

Mode = 3 Median - 2 Mean

Chapter # 3 End.

Chapter no 4
Statistics

Measure of dispersion:-

A quantity that measure characteristics, is called measure of dispersion.
characteristics are
1. is the same in unit of data
2. zero when all observations are equal.
3. independent origin.
4. Divided or Multiplied by constant.

It is also called scatter, variability.

Types of dispersion:-

Two types of measure of dispersion are
1. Absolute measure of dispersion
2. Relative measure of dispersion

Absolute measure of dispersion:-

Absolute measure of dispersion is one that measure the dispersion in term of same unit, as unit set of data. e.g Ruppee, Kilogram.
It is also called co-efficient of absolute dispersion.

Co-effient of absolute measure = $\frac{H_m - H_0}{H_m + H_0}$

Relative measure of dispersion:-

Relative measure of dispersion is one

measure of dispersion that is express in the form of ratios, co-efficient or percentages, independent of the unit of measurement.

Range:-

Range is define by different between the largest and the smallest value or observation in a set of data.

$$\text{Range} = x_m - x_0$$

x_m = largest value
x_0 = Smallest value

Semi-interquartile or quartile range:-

Semi-interquartile range is a measure of dispersion that is defined be the difference between the third and first quartile and half of the Range is called semi-interquartile range or quartile range.

$$\text{Quartile Range} = \frac{Q_3 - Q_1}{2}$$

Co-efficient of Quartile Range:-

Quartile Range is an absolute measure of dispersion. Its relative measure of dispersion called co-efficient of quartile.

Co-efficient of quartile $= \frac{Q_3 - Q_1}{Q_3 + Q_1}$

Mean deviation:-

Mean deviation of set of data is defined as Arithmatic mean of data either from mean or from median. all observation being counted as positive.

1/ $\sigma = \frac{\Sigma|x_i - \bar{x}|}{N}$ for population

2/ $S = \frac{\Sigma|x_i - \bar{x}|}{n}$ for sample

3/ For grouped data

$S = \frac{\Sigma f_i |x_i - \bar{x}|}{n}$

Co-efficient of mean deviation:-

Mean deviation is an absolute measure of dispersion. It relative measure of dispersion is called co-efficient of mean deviation.

Co-efficient of Mean deviation $= \frac{M.D}{\bar{x}}$ or

$= \frac{M.D}{\text{Median}}$

Variance:-

Variance is a set of observation is define as the mean of the square of the deviation of all the observation from their mean.

$$\sigma^2 = \frac{(\Sigma|x_i - \bar{x}|)^2}{N} \quad \text{for population}$$

$$S^2 = \frac{(\Sigma|x_i - \bar{x}|)^2}{n} \quad \text{for sample}$$

Standard deviation:-

The positive square root of the variance is called standard deviation.

$$S = \sqrt{\frac{(\Sigma|x_i - \bar{x}|)^2}{n}} \quad \text{for Sample}$$

$$\sigma = \sqrt{\frac{(\Sigma|x_i - \bar{x}|)^2}{N}} \quad \text{for grouped.}$$

Co-efficient of standard deviation:-

Standard deviation is absolute measure of dispersion. It relative measure of dispersion is called co-efficient of standard deviation.

Co-efficient of standard deviation $= \frac{S.D}{\text{Mean.}}$

Standardized variable:-

A variable is defined to the standardized if it is expressed in term of deviation from it mean and dividing by standard deviation.

$$z_i = \frac{x_i - \mu}{\sigma}$$ for population

$$z_i = \frac{x_i - \bar{x}}{s}$$ for sample

Moment:-

Moment designated the power in which deviation raised before the averag it. The quantity $\frac{1}{N}(x_i - \mu)$ is called First moment of population. The quantity $\frac{1}{N}(x_i - \mu)^2$ is called second moment of population.

Skewness:-

The distibution value is equidistant from the mean and are equal frequencies is defined as symmetrical and any appeduse from the symmetric is called skewness.

Kustosis:-

Properties of Variance & Standard deviation:-

1. The variance of a constant is equal to zero.
2. Independant origin
3. Divided or multiplied by the square of the constant
4. The sum or difference of relative variance is equal to the sum of respective variance.

Chapter no 4

End

Chapter no 6
Statistics.

1) **Term of Probability:-**
The word "Probability" has two meaning, a quantitative measure of uncertainty, a degree of measure of belief in a particular statement or problem.

2) **Set:-**
A set is a collection of distinct object i.e a group of student, The book in library, integer numbers between 1 and 100 etc. The object in a set is called set element or set members.
$A = \{1, 2, 3, 4, 5\}$

3) **Subset:-**
A set consist of object element of another set is called subset.
$A \subset B$
A is a subset of B. The element of set in A also containg in set B.

4) **Ven diagram:-**
A diagram understood to represent the circular region, parts of circular region with respect to rectangle representing the sample space S is called ven diagram.

5) **Algebric of set:-**
The Algebric of set

have laws that is used to solve the problems in the probability calculations.

6, **Operation of a set:-**

Let A and B are two set of universal set S. If both set are combine or to operated in a various ways to form a new set of the subset N. The operation on set are union, intersection, difference, compliment

7, **Experiment:-**

The word "Experiment" mean a planned activity. When the Experiment performe one time is called **trial.** The result of trial is called **an outcome.**

8, **Random experiment:-**

The experiment produced different result though even if it is repeated a large number of times under the essentially condition is called Random Experiment.

9, **Properties of Random experiment:-**

There are three properties of experiment.

1, The experiment is performed by practically or theoritically in number of times.

2/ The outcomes has two or more in random experiment. In experiment has only one outcome - This experiment is not a random experiment.

3/ The outcome of each repitation is unpredictable i-e it has some degree of uncertainly.

10/ **Sample space:-**

A set consisting of all possible outcomes that result from a random experiment is defined a sample space of a experiment. It is denoted by S.

11/ **Event:-**

An event is any number of outcomes from a random experiment. In set of terminology a subset of sample space of experiment is called an event.

⇒ An event occurs only one sample point is called **simple event.**

⇒ In **Compound event** contain more than one simple point and produced by union of simple event.

12/ **Mutual exclusive Event:-**

Two event A and B of a single experiment are said to be mutually exclusive event that occur only one event at a

time not both.
For example
throw a coin of head and tails
Only one head or tail is come at a time

13) **Non-Mutual exclusive:-**

If two event A and B of a single experiment is said to be non-mutually exclusive that occurs two or more event at a same time
For example
Draws a cards.

14) **Classification of probability:-**

If a random experiment n is mutualy exclusive and likely are equal outcomes, m of these outcomes considered most favorable occurences of the event A. The probability of event A is denoted by P(A) and is defined as the ration of $\frac{m}{n}$

$$P(A) = \frac{\text{Most favorable outcomes}}{\text{Numbers of outcomes}}$$

$$P(A) = \frac{m}{n}$$

15) Specialized probability:-

Specialized probability is define as the degree of measure of the strength of persons regarding to the outcomes of the event A.

16) Independent probability:-

Two event A and B are same sample space of are said to be independent if a probability of one event occurs not effected whenever other is called independent probability.

$$P(A \cap B) = P(A)\,P(B)$$

17) Dependent Probability:-

Two event A and B having same sample space of S to be dependent if the probability of one event some way of effecting the other event.

$$P(A \cap B) \neq P(A) \times P(B)$$

Chapter no 6 End

Chapter no 7
Statistics
Random Variable.

1/ **Random variable:-**

Such numerical quantity whose value is determined by the outcome of the random experiment is called random variable. Mathematically in a random variable we assigned a single real value of each outcome of the sample space S. It is also called chance variable. It is denoted by r.v.

2/ **Types of Random variable:-**

Two types of random variable are

* Discrete Random variable.
* Continous Random variable.

3/ **Discrete random variable:-**

The Random variable of X is define to be discrete, if it can assumed all possible values are finite or countable infinite.

$$F(x_i) = P(X = x_i) \quad \text{for } (i = 1, 2, \dots, n)$$
$$= 0 \quad x \neq x_i$$

This function is called probability of r.v For discrete r.v distribution function is given

$$F(x) = \sum_i f(x_i)$$

4/ Continous Random Variable:-

The Random Variable of x is define to be continous, if it can assume all possible values are in an interval $[a,b]$ $a>b$, where a and b may be $-\infty$ or $+\infty$ respectively.

This function

$f(x) \geq 0$ for all x.

$f(x) = \int_{-\infty}^{x} f(x)dx$

is called probability density function of r.v probability of r.v following properties.

1/ $f(x) \geq 0$ for all values x

2/ $\int_{-\infty}^{+\infty} f(x)dx = 1$

3/ The probability of X values take in interval $[c,d]$ $c \geq d$ is given

$f(c \geq d) = f(d) - f(c)$

$= \int_{-\infty}^{d} f(x)dx - \int_{-\infty}^{c} f(x)dx$

$= \int_{c}^{d} f(x)dx$

5/ Distribuition Function:-

The distribuition function of random variable is denoted by $f(x)$ is defined $f(x) = P(X \leq x)$ These function $f(x)$ probability of X values is less than or equal to the

specific value of x. It is also called cummulative density function.

$$F(-\infty) = F(\phi) = 0$$
$$F(+\infty) = F(S) = 1$$

$$f(b) - f(a) = F(X \geq a) - F(X \geq b)$$

A density function has the following properties.

1. $F(x) \geq 0$ For all values of x
2. $F(x)$ is non-decreasing values.
3. $F(x)$ is continuous at least one the right value of x.

It is called c.d.f

6/ Joint Distribution:-

The distribution function of two or more random variable which are observed when an experiment is performed This function is called joint distribution.

Types are

- Bivariate Distribution
- Trivariate Distribution
- Multivariate Distribution

7/ Bivariate Distribution Function:-

The Function of $F(x,y)$ is said to be bivariate. This function $F(x,y)$ is defined as $F(x,y) = P(X \leq x \text{ and } Y \leq y)$

This function $f(x,y)$ gives the probability of x values is less than or equal to

the value x and also Y is less than or equal to the value y at a same time.

$F(x, -\infty), (-\infty, y) = 0$

$F(+\infty, +\infty) = 1$

$F(x, y)$ is non-decreasing value

$F(x, y)$ is continous on right (x, y)

8/ Probability of bivariate distribution:-

The joint function is also called the probability of bivariate distribution. Function whose values at a point of $F(x_i, y_j)$ is given

$i = 1, 2, 3, \ldots, n$

$j = 1, 2, 3, \ldots, n$

$F(x, y)_{ij} = P(X = x_i, Y = y_j)$

The probabilities of bivariate distribution consist of all pairs of $f(x_i, y_j)$ and associated the probabilities of $f(x_i, y_j)$

↓

The joint Function is also called the probability of bivariate distribution, function whose values at a point $F(x_i, y_j)$ is given as

$$F(x_i, y_j) = P(X = x_i \text{ and } Y = y_j) \quad \text{for } (i = 1, 2, \ldots, n) \text{ for } (j = 1, 2, \ldots, n)$$

The probability of bivariate function consist of all pairs of values $f(x_i, y_j)$ and their associated probabilities of $f(x_i, y_j)$

9/ Continuous Bivariate distribution:-

The bivariate distribution of density function is continous of r.v x and y, function is integerable $f(x_i, y_i)$ is given following properties are

1) $f(x,y) \geq 0$ for all values of (x,y).
2) $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)\,dx\,dy = 1$
3) $f(a \leq X \leq b), (c \leq Y \leq d) = \int_a^b \int_c^d f(x,y)\,dx\,dy$

10/ Expected value of a random variable of a function:-

let function $H(X)$ is a random variable of x. Then $H(X)$ is a random variable and also an expected value so function is r.v and r.v also an expected value. if X is r.v with p.d.f $F(x)$ is defined $H(X)$ tobe the value $H(x_i)$ when $X = x_i$ expected value of the function $H(X)$ is.

$$E[H(X)] = H(x_1)F(x_1) + H(x_2)F(x_2) \cdots H(x_n)F(x_n)$$

$$= \sum H(x_i)F(x_i)$$

$$E[H(X)] = \int_{-\infty}^{\infty} H(x_i)F(x_i)$$

10- Properties of Expected values:-

Properties of expected values are

1) If a is constant then expected value is equal to constant

$$E(a) = a$$

2) X is discrete r.v if a and b are constn then expected value is

$$E(aX+b) = aE(X)+b$$

3) The expected value of sum of two Random variable is equal to the sum of two expected value

$$E(X+Y) = E(X)+E(Y)$$

4) The product of two Random variable is equal to the product of two expected value

$$E(XY) = E(X) \cdot E(Y).$$

11) Moment generating function:-

Moment generating function (mgf) is denoted by M_0t, random variable of X ~~data~~ the expn if it exist. is defined as the ~~function of~~ expected value of r.v e^{tx} - t is real variable is neighbourhood to zero then.

$$M_0t = E(e^{tx})$$

For discrete r.v

$$E(e^{tx}) = \sum_{i=1}^{\infty} (e^{tx_i}) f(x_i)$$

For continous

$$E(e^{tx}) = \int_{-\infty}^{\infty} e^{tx} f(x) \, dx$$

A.M

Arithematic mean

$$\frac{\text{Sum of observation}}{\text{Num of observation}}$$

Population mean

$$\bar{U} = \frac{\Sigma x_i}{N}$$

Simple mean

$$\bar{x} = \frac{\Sigma x_i}{n}$$

Grouped data

$$\bar{x} = \frac{\Sigma f_i x_i}{n}$$

Weighted Arithemetic mean.

$$\bar{x}_w = \frac{\Sigma w_i x_i}{w_i}$$

Hight Arithemetic mean

$$\bar{x}_h = \frac{\Sigma n_i x_i}{N}$$

Short weighted weight

$$x = a + hu$$

$$u_i = \frac{x_i + a}{h}$$

$$\bar{u} = \frac{\Sigma f_i u_i}{n}$$

G.M

$$G = \text{Antilog}\left(\frac{1}{n}\Sigma f_i \log x_i\right)$$

$$G_2 = \text{Antilog}\left(\frac{1}{\Sigma w_i}\Sigma w_i \log x_i\right)$$

H.M

$$H.M = \frac{n}{\Sigma\left(\frac{1}{x_i}\right)}$$

$$G.M = \frac{n}{\Sigma f\left(\frac{1}{x_i}\right)}$$

$$w = \frac{\Sigma w_i}{\Sigma w_i\left(\frac{1}{x_i}\right)}$$

Median

$$l + \left(\frac{h}{f}\left(\frac{n}{2} - c\right)\right)$$

$$\frac{n}{2}, \quad \frac{n}{2} + 1$$

Mode

$$= \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times$$

$$\Sigma f = n$$