Chapter - 1

* Meaning of statistics :-

It is the branch of science dealing with collecting, organising, comprising, analysing and making decision from data.

"Statistics as the science of counting"

This definition covers clearly the aspects of statistics:

1.) Collection of data :- The result of the analysis and its interpretation depends upon the data collected.

2) Organization :- Data obtained from the published source, it generally be in organised form.

3.) Presentation :- After this, data need to be present systematically in different forms like table, diagrammatic & graphical form

4) Analysis :- To analyze statistical tools like average, dispersion, correlation, test of significance to analysis of data.

5.) Interpretation :- To interpret means to drawn the valid conclusion from data, high degree of skill and experience is necessary.

It is divided into areas :-

1) Descriptive Statistics :- It deals with method for collecting, organizing and describing data by using tables, graphs and summary measures.

2.) Inferential :- It deals with method that use sample result to help in estimation and make decision about population.

- population It is the set of all elements (observation items or object. Parameters :- S.D & variance.
- Sample It is the subset of the population selected for study.

* Variables and types of data :- In this unit important tools in stat problem such terms are :-

1) An element :- (All members of sample or a population) is a specific subject, about which the information is selected. Eg :- The following table gives the number of Snake bite reported in the hostipal in the cities (A, B, C)

city	no. of Snake bites
A	17
B	20
C	23

2) Variable :- It is a characteristic under study that takes different values for different elements.
Eg :- If we collect info about income of households
∴ Income is variable that can be represented.
x, y, z $x(A) = 17$, $x(B) = 20$, $x(C) = 23$

3.) Measurement :- The value of variable for an element. (observation).

→ types of variable :-
1) Quantitative variable It gives us numbers representing counts or measurement. (Counting)
2) Qualitative variable gives us names or tables that are not representing observations. (categorisation)

Quantitive (mean, median)	Qualitative (mode)
• height, • temp, • no. of goals, • no of students (20, 40, 30)	- gender (Male, female)
- age of people 25, 36, 76	- tosing of coin (tail, head)
- no. of children (3, 4, 1)	- Religion (Hindu, jain, ---)
Discrete variable (exact result) ← ↓ Continous variable	- Category, hair colour
	nominal, interval, ratio, odinal

* Discrete :- Assumes values that can be counted. For e.g:- Dice ; $X = \{2, 4, 6, 8\}$
* Continous :- It assumes all values between any two specific values i.e. they take values in an individual (intervals).
Eg :- height , IP address and odinal.
* Nominals :- The nominal level of measurement classified data into exclusive categories in which mutually in order or ranking can be imposed on data.
Eg: grade i.e A, A+, B; rating scale i.e good, bad, V.G, faculty i.e Director, HOD, teacher.
* Interval :- The interval level of measurement orders data with precised difference b/w units of measure.
Eg: Ilets (0-9 bond), time (0-24)

Examples
(i) no. less than 5, $X = \{1, 2, 3, 4\}$ $\{x : x \in N ; x < 5\}$
(ii) first 10 prime no. ; $X = \{2, 3, 5, 7, 11, 13, 17, 19, 23, 29\}$
(iii) $X = \{A^+, B, C, E, B\}$ (Blood group)
(iv) $X = \{A^+, A, B^+, B, C, E\}$ (Post) (Nirf Ranking)
pH scale (0-14), SAT

Data :- statistical data are a numerical statement of aggregates. Information represented in numbers.
Sources :-
Internal :- Collected from Internal source of an organisation. E.g:- total profit, total sales, production, salary.
External :- Collected from outside agencies. From primary as well as secondary sources. such as from census or sample method survey & investigation.

Type of Data.

Primary	Secondary
- collected for the first time even by the person itself.	- data that have already been collected by some other person.
- It is original because collected by investigator for first time	- Not original as someone collected for own purpose.
- It is in the form of raw material (ungrouped).	- finished form (grouped)
- most reliable as collected personally.	less reliable and less suitable as someone else collected.
- Collection is expensive in time & money terms.	Req less time & mony.
→ Collection method:- oral, person interaction, phone	Collection:- published (magazines) unpublished (government survey RTI)

1) Ungrouped Data :- Arranged in systematic order are called raw data or U.D

2) Grouped Data :- presented in form of frequency distribution.

Data:- The set of all information that obtained from each element of sample or population are recored in sequence in which it become available.

Suppose collect information of scores of 20 student. The data in order collected are recorded in variable.

$v(x)$ value.

10, 20, 30, 40, 50, 60, 70,

* Frequency table :- Method to organise a qualitative data or variable is called frequency table.

Assume selected 50 studens asked about high interest, m-interest, low interest in degree & reported.

where, h → high interest
m → mid interest
l → low interest

l l l h m l l l h h
h m
h m
h m m
l m

type of Interest	no of student (f)	R.f
h (high)	20	0.4
m (mid)	12	0.24
l (low)	18	0.36

element
→ measurement

(B) Relative frequency :- $\frac{\text{frequency of particular category}}{\text{sum of all frequency}}$

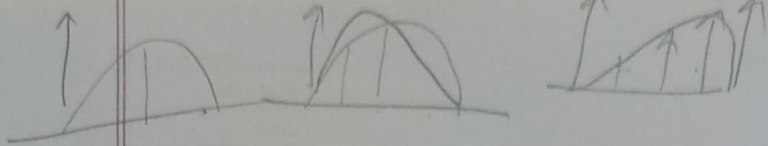
% of a category ⇒ R.F × 100%

Population :- Type

(a) Finite :- countable population, finite :- individuals are Consumer in market
(b) Infinite :- uncountable, infinite :- germs, stars.
(c) Existent :- population of concrete individuals. Books, students.
(d) Hypothetical :- unit Not available in solid form. rolling dice, tossing coin.

Sample :- one or more observations drawn from the population. Its parameter is statistics. process of selecting sample sampling.

1. Probability :- units Cannot be selected at discretion
2. Non-Probability " can " " " "



Population & Sample e.g.:-

⇒ All the people
Student having ID card & group of people have Pan card.

Population	Sample
- All elements or units of common characteristic	Subgroup member of population
- include every group element	handful units
Parameter. S.D, v	Statistics
- Data collection census	- Sample Survey.

Univariate	Bivariate
⇒ This type of data contain only one variable (Individual Series)	⇒ Data involves two different variable - (Discrete, continous Series)
⇒ Analysis of univariate data is simplest form analyses because single quantity changes	⇒ Analysis deals with causes, relationship and is done to find out realation b/w two variable.
⇒ e.g:- height cm (110, 174.5, 170)	⇒ temp : 20 30 35 40 Ice cream sales 180 500 350 750 80
⇒ To can find $\bar{x}$, m, z, σ^2, σ, range	⇒ We can find relationship b/w two variable, comparison co-relation, regression, student distribution.

Classification:- Analyse & Interpretation and organising in sequence of common characteristics.

Methods:-

(a) **Discriptive**:- Not measured directly but counted on basis of presence & absence.

(b) **Numerical**:- (e.g:- height, weight, profit) Numerical facts are those which can be measured.

Classification type :-

Qualitative

on basis of attribute

(a) Two-fold :- classification of attribute within the classification.
For eg:- Sex → male, females.

(b) Manifold :- Two & more attributes considered and several classes are formed.
For eg:- Sex → male, female
(i) male employed, unemployed
(ii) female employed, unemployed.

Quantitative

basis of variable

(a) Geographical :- geographic location

USA	India	Canada
59	60	50

(b) Chronological :- (Year, hour, day, week, month) time.

Year	1951	1961
Pop	36.1	

(c) Variable :-

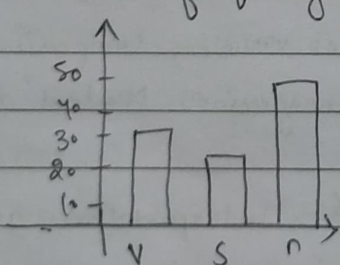
Continous — variable take values in a given specified range.

Discrete. — Those variable which cannot take value in a range.

Graphical representation :- (qualitative) :-

graphically representation of qualitative data

(i) Bar graph : Representing category on horizontal axis
- Mark frequency on vertical axis.



∴ a graph made of bars whose height represent the frequency of respective categories.

2.) pie chart :- A circle divided into portions that represent the relative frequencies or % of a population or sample of different categories is called pie chart.

- Construction (a) Draw a circle
(b) Find central angle of each category

measure of central angle = R.F × 360°

3.) Draw sectors corresponding to angles -

Sr.no	Category	no. of each(f)	R.f	%	Central angle
1	A	8	$\frac{8}{40} = 0.20$	20%	$0.20 \times 360 = 72°$
2	B	11	$\frac{11}{40} = 0.27$	27%	$0.27 \times 360 = 97.2$
3	C	13	$\frac{13}{40} = 0.33$	33%	$0.33 \times 360 = 118.8°$
4	D	8	$\frac{8}{40} = 0.20$	20%	$0.20 \times 360 = 72°$

Country	(f)
Finland	7
Poland	1
USSR	2
C	2
US	1

B.G	(f)
O	19
A	13
B	5
AB	3

→ Organising & graphing :- (Quantitative data)

A) Frequency Distribution : Data presented in form of frequency distribution table is grouped.
(for grouped data)

For eg:-

Class Interval	f
2 - 5	7
6 - 9	5
10 - 13	2
14 - 17	6
18 - 21	3

variable

fourth class

→ continuous

lower limit

upper limit

For ungrouped data :- 8, 9, 9, 8, 5, 6, 1, 5, 3, 9
(discrete)

x	f
1	1
3	1
5	2
6	1
8	2
9	3

— Find class boundary :- (i) 40 - 44

Lower boundary limit = $40 - 0.5 = 39.5$

upper " " = $44 + 0.5 = 44.5$

Now, class width = upper limit - lower limit

= $44.5 - 39.5 = 5$

→ Class mid point = (i) 40-44 ⇒ $\frac{44+40}{2} = \frac{84}{2} = 42$

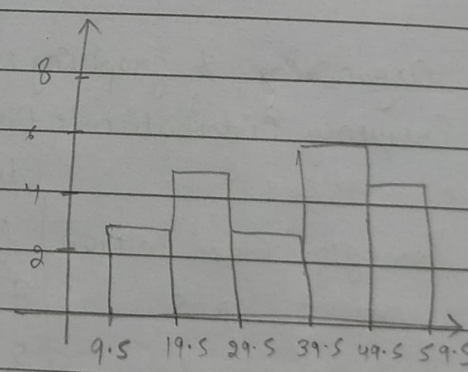
with class boundary

⇒ $\frac{39.5+44.5}{2} = \frac{84}{2} = 42$

Graphing :-

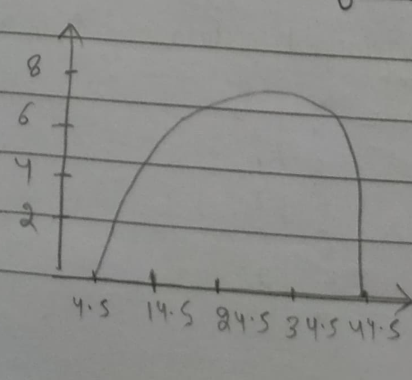
Histogram for groupeddata in a frequency distribution table with equal class width is a graph in which class boundaries are marked on the horizontal axis and the frequency, relative frequency or percentage are marked on vertical frequency.

CB	Class Interval	f
9.5-19.5	10 - 19	3
19.5-29.5	20 - 29	6
29.5-39.5	30 - 39	8
39.5-49.5	40 - 49	8
49.5-59.5	50 - 59	5



Polygons :- A frequency polygen is a graph that displays the data by using line segments that commect points plotted for the frequencies at the mid point of classes.

Mid Point	Class Interval
14.5	10-19
24.5	20-29
34.5	30-39
44.5	40-49



ch-3 Numerical descriptive measure

Mean:-

(1) Individual series → (ungrouped data).
(2) Discrete series → (grouped data) (table variable with freq.)
(3) Continuous series → (grouped data) (given in table form with class interval)

(I) Individual Series (only variable are given)

$$\bar{x} = \frac{\Sigma x}{N} = \frac{(x_1 + x_2 + x_3 + \cdots x_n)}{N}$$

Sample mean $\bar{x}$ $= \frac{\sum_{i=1}^{i=n} x}{N}$

population mean (μ)

eg:- (1) Find mean score of 10 students in a mid term exam in a class if their scores are.

25, 27, 30, 23, 27, 29, 14, 28, 20, 16

x = series of students in a class

$x_1 = 25$, $x_2 = 27$, $x_3 = 30$, $x_4 = 23$, $x_5 = 27$, $x_6 = 29$, $x_7 = 14$, $x_8 = 28$, $x_9 = 20$, $x_{10} = 16$

$\Sigma x = 239$, $N = 10$

$$\bar{x} = \frac{\Sigma x}{N} = \frac{239}{10} = 23.9$$

(2) Data of exports of a continuous form for year 13 to 14 are mentioned.

Freq.	1	2	3	4	5	6	7	8	9
Value of export	10	20	30	40	50	60	70	80	90

$$\bar{x} = \frac{450}{9} = 50$$

Discrete Series $\bar{x} = \frac{\Sigma f x}{\Sigma f}$

eg:- The following data gives the weekly wages (in ₹) of 20 workers is a factory.

Weekly earning (variable) (in ₹)	no. of workers	fx
100	5	500
140	2	280
170	6	1020
200	4	800
250	3	750
	20	3350

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{3350}{20} = 167.5$$

→ From the following data of the marks obtained by 60 students in a class.

marks	no. of student	fx
20	8	160
30	12	360
40	20	800
50	10	500
60	6	360
70	4	280
	60	2460

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{2460}{60} = 41$$

* Continous Series :- $\bar{x} = \frac{\Sigma fm}{\Sigma f}$ → mid point of the class

Marks	No. of student	mid point	fm
0-10	12	5	60
10-20	18	15	270
20-30	27	25	675
30-40	20	35	700
40-50	17	45	765
50-60	6	55	330
	100		2800

$$\bar{x} = \frac{\Sigma fm}{\Sigma f} = \frac{2800}{100} = 28$$

* Properties of Arithmatic Mean :-

1) The product of A.M and no. of items, gives total no. of items.
2) The sum of deviation of all the values of x from their A.M is zero.
3) The sum of squares of deviation of the item taken from A.M is minimum.
4) If a constant is added or subtracted to all the variable then mean increasing or decreasing by that constant.
5) If all the variables are multiply or divided by a constant then mean also gets multiply or divided by the constant.

→

x	6	7	8	9	10	11	12
f	3	6	9	13	8	5	4
fx	18	42	72	117	80	55	48

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{432}{48} = 9$$

Demerits	Merits
1) Gives value which is not present in given data.	1) Easy & Fast
2) Can't locate graphically	2) No. order needed of data
3) Can be distributed by one max. and min value.	3) No item is ignored.

* Central Tendency :- (Median)

It is defined as the measure of central item when they are arranged in ascending or descending order of their magnitude.

(a) Individual Series :- When total no. of items is odd and equal to say n then the value of $\left(\frac{n+1}{2}\right)$th item gives the median.

- Find the median of the following data
13, 6, 10, 8, 12, 9, 11, 6, 8, 9, 10, 11, 12, 13

$$m = \left(\frac{n+1}{2}\right)\text{th item} = \left(\frac{7+1}{2}\right)\text{th item}$$

$$= \frac{8}{2}\text{th item} = 4\text{th item}$$

i.e $\Rightarrow$ 10

→ The following data related to no of patients examined per hour in the hospital.
10, 12, 15, 20, 13, 24, 17, 18, 10, 12, 13, 15, 17, 18, 20, 24.

$\Rightarrow$ $$m = \left(\frac{n+1}{2}\right)\text{th item}$$

$$= \frac{9}{2} = 4.5\text{th item}$$

$$= \frac{15+17}{2} = 16$$

* **Discrete Series**

In case of discrete series the position of median i.e $\left(\frac{N+1}{2}\right)$th item located from c.f.

Step-1 Managed arranged data in ascending order or descending order of magnitude.

2.) Find c.f

3.) Find out median = Size of $\left(\frac{n+1}{2}\right)$th item.

4.) Look at c.f column, and find that total which is either equal to $\left(\frac{n+1}{2}\right)$th or $\left(\frac{n}{2}\right)$th then determine value of variable.

Continuous Series

Step 1 Calculate c.f

Step 2 Size of median = size of $\left(\frac{n}{2}\right)$th term or size of $\left(\frac{n+1}{2}\right)$th term

Step 3 Find out c.f which include $\left(\frac{n}{2}\right)$th term or $\left(\frac{n+1}{2}\right)$th term and is corresponding class frequency.

Step 4 $$m = L_1 + \frac{\frac{N}{2} - cf}{f} \times i$$

Calculate median

0-10	14	14
10-20	23	37
20-30	27	64
30-40	21	85
40-50	15	100

$N = 100 \quad \Sigma f = 100$

$\frac{N}{2} = \frac{100}{2} = 50$

$$m = L_1 + \frac{\frac{N}{2} - cf}{f} \times i$$

$$= 20 + \frac{50 - 37}{27} \times 10$$

$$= 20 + \frac{13}{27} \times 10$$

$$= 20 + \frac{130}{27} = 24.815$$

Age (year)	no of person	cf
20-25	70	70
25-30	80	150
30-35	180	330
35-40	150	480
40-45	20	500
	500	

$\frac{N}{2} = \frac{500}{2} = 250$

$$m = L_1 + \frac{\frac{N}{2} - cf}{f} \times i$$

$$= 30 + \frac{250 - 150}{180} \times 5$$

$$= 30 + \frac{10\cancel{0}}{18\cancel{0}} \times 5$$

$$= 32.78$$

Mode: (Modal)

(I) Individual Series: The number which occurs most often is the mode.

Find mode: 15, 21, 26, 25, 21, 23, 28, 21

Mode: 21 [Reason most frequent value]

- Find mode 12, 15, 56, 12, 15, 18, 9, 27, 12

mode : 12

(II) Discrete Series : The modal value is the value of the variable against which frequency is largest.

- Find mode

Age	No. of person
5	4
7	6
10	9
12	7
15	5
10	0

Mode is 10

(III) Continuous Series : Find largest frequency

Ages	f
20-25	50
25-30	70
30-35	80
35-40	150
40-45	180
45-50	120
50-55	70
55-60	50

$$Z = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times i$$

$$Z = 40 + \frac{180-150}{2 \times 180 - 150 - 120} \times 5$$

$$= 40 + \frac{30}{360-150-120} \times 5$$

$$= 40 + \frac{30}{90} \times 5$$

$$= 40 + \frac{150}{90} = 41.67$$

* Dispersion (variability)

(I) Range :- Range = largest value - Smallest value

40, 10, 20, 30, 35, 40, 50, 60

$R = 60 - 10 = 50$

Find Range :-

Staff	Salary
owner	4,00,000
Manager	160,000
Sales R	1,20,000
W I	1,00,000
W II	60,000
W III	72,000

$R = 40,0000 - 60000$

$= 340000$

Range = Highest value - lowest value

(II) Variance (σ^2) and standard deviation (σ)

→ for Individual series

$$\sigma^2 = \frac{\Sigma(x-\bar{x})^2}{N}$$

variable, (mean), number of item

- Find the relation b/w (σ^2) and (σ)
- Difference

Eg:- Rolling dice, find (σ^2) & (σ)

x	$(x-\bar{x})$	$(x-\bar{x})^2$
1	-2	4
2	-1	1
3	0	0
4	1	1
5	2	4
6	3	9
		19

$$\bar{x} = \frac{1+2+3+4+5+6}{6}$$

$$= \frac{21}{6} = 3.5 \sim 3$$

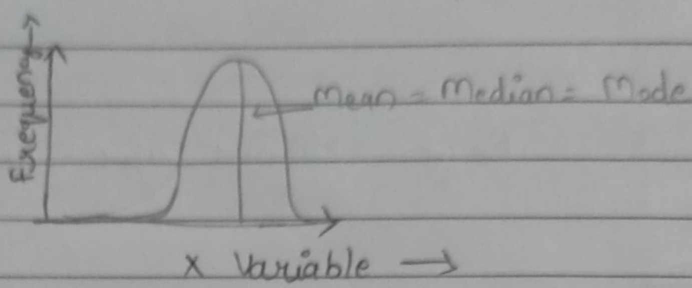
$$\sigma = \frac{19}{6} = 3.16$$

$$\sigma = \sqrt{3.16} = 1.77$$

3 median = Mode + 2 Mean → bimodal

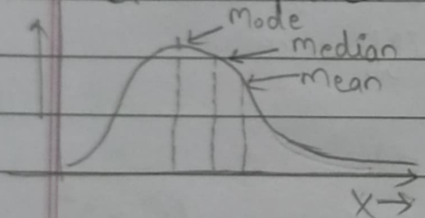
* Relationship b/w mean, median & mode. (unimodal)

(1) Symmetrical:- when mean, median, mode are same

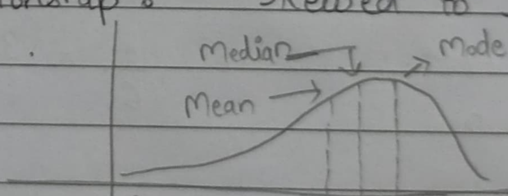


(2) Assymetrical:- when mean, median, mode are not same
divided Two types:-

(a) Positive Relationship : If distribution is skewed to the left, then mode > median > mean. Because here mean is pulled down the median by low values.



(b) Negative Relationship : Skewed to right, then median > mode.



(distribution of negative)

what is meaning of Reliability.

Relation / Difference b/w Probability & Reliability. (on which step we use reliability.)

(due to probability failure)

Unit - 2

Chapter ① **Probability**:- concept of experiments, Sample Space, Event, Conditional probability, Bayes Theorem.

Chapter - ② **Probability Distribution**:- Discrete and Continuous Distribution

Discrete :- Binomial, Poisson, Geometric Distribution
(Tossing a coin until 500 times not more than that) (countable infinite)

V.V.I important.

uniform, Experimental, Normal distribution, Chi-Square $(\chi)^2$

Continuous :- t-test, f-test distribution.

Expected values and moments:- Mathematic ~~equation~~ expectation and its properties, Moment (including σ^2) and interpretation

* Basic terminology:-

1) Random Experiment :- If its result cannot be predicted although the conditions under which it is performed remain homogeneous.
For e.g:- Tossing a coin, throwing dice, playing card.

2) Trial & Events :- Performing of Random experiment is called trial and its result is called Event.
Trial e.g:- Tossing a coin
Event eg:- Result of Tossing (Suppose Head or Tail)

3) Exhaustive Events (or Sample Space):-
The total possible outcomes of a random experiment are called exhaustive event or Sample Space.

Furthermore, The set of exhaustive event is also known as Sample Space. It is always denoted as (S).

For eg:- 3 coins are tossed

$2^n = 2^3 = 8$

$S = \{(HHH), (TTT), (HHT), (TTH), (HTT), (THH), (HTH), (THT)\}$

Total possible outcomes.

* Favourable events :- The number of outcomes of a random experiment which results in the happening of a event are called favourable events.

For e.g:- If two dices are thrown, the no. of favourable events that the sum on the faces is five.

$$S \Rightarrow \left\{ \begin{array}{l} (1,1)\,(1,2)\,(1,3)\,(1,4)\,(1,5)\,(1,6) \\ (2,1)\,(2,2)\,-\,-\,- \\ (3,1)\,(3,2)\,-\,-\,- \\ (4,1)\,(4,2)\,-\,-\,- \\ (5,1)\,(5,2)\,-\,-\,- \\ (6,1)\,(6,2)\,(6,3)\,(6,4)\,(6,5)\,(6,6) \end{array} \right\}$$

Total possible outcomes

$= (6)^2 = 36$

Here, Sum of 5

have $(3,2)\,(2,3)\,(1,4)\,(4,1)$

No. of favourable outcomes $= 4$

Mutualy Exclusive :- Two or more events are said to be mutually exclusive event if these events cannot occur simultaneously.

For eg:- Two dice are thrown

Event A : Sum on the faces is odd

B : Sum on the faces is even

In case of $A \cap B = \phi$

Also called as disjoint event

(iii) $P(2W, 1G) = \dfrac{{}^5C_2 \cdot {}^7C_1 \cdot {}^6C_0}{{}^{18}C_3} = \dfrac{70}{816}$

(ii) $P(\text{All 3 are white}) = \dfrac{{}^5C_3 \cdot {}^6C_0 \cdot {}^7C_0}{{}^{18}C_3}$

$= \dfrac{\frac{\lfloor 5}{\lfloor 3 \lfloor 2} \cdot \frac{\lfloor 6}{\lfloor 6} \cdot \frac{\lfloor 7}{\lfloor 7}}{\frac{\lfloor 18}{\lfloor 3 \lfloor 15}}$

$\Rightarrow \dfrac{\frac{5\times 4}{2} \times \ldots}{\frac{18 \times 17 \times 16}{3 \times 2 \times 1}}$

$\Rightarrow \dfrac{10 \times \ldots}{816} = \dfrac{70}{816}$

Axioms of Probability:-

(1) The probability of immposible event is zero
i.e $P(\phi) = 0$

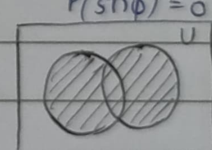
Prove that $P(\phi) = 0$

- Null set ϕ is also a subset of Sample space S and contains no sample point.

$S \cap \phi = \phi$

$\therefore$ S and ϕ are disjoint

$P(S \cap \phi) = 0$



$S \cup \phi = S$

$P(S \cup \phi) = P(S)$

$P(S)$ or $P(\phi)$ or $P(S \cap \phi) = P(S)$

$\Rightarrow P(S) + P(\phi) + P(S \cap \phi) = P(S)$

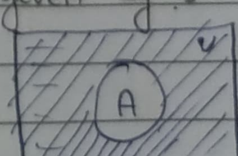
$\cancel{P(S)} + P(\phi) + 0 = \cancel{P(S)}$

$P(\phi) = 0$

$\therefore$ probability of immposit event is zero.

(2) The probability of A^c of event is given by:-

$P(A^c) = 1 - P(A)$



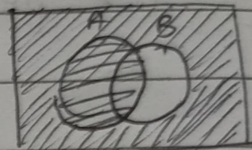
A^c is also a subset of Sample Space S and contains elements which are

$P(A^c) = 1 - P(A)$ Sample Space is 1

Hence Proved

* If A & B are two events then

$$P(A \cup B^c) = P(A) - P(A \cap B)$$

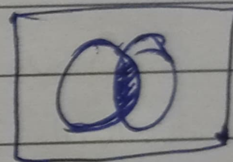


e.g:- $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$A = \{1, 2, 3, 4\}$

$B = \{5, 6, 7, 8\}$ Since $A \cup B^c$ & $A \cap B$

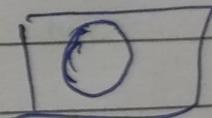
$B^c = \{1, 2, 3, 4, 9, 10\}$ are disjoint events



$A \cup B^c = \{1, 2, 3, 4, 9, 10\}$

$A \cap B = \phi$ $P((A \cup B^c) \cup (A \cap B)) = P(A)$

$(A \cup B^c \cap (A \cap B)) = \phi$ $P(A \cup B^c) + P(A \cap B) = P(A)$



$$P(A \cup B^c) = P(A) - P(A \cap B)$$

For any two event A & B the probability of occurence of atleast 1 of two events A & B are given by :-

Probability

1. Measure of the likelihood of a specific event occuring. expressed b/w 0 to 1
2. $P(A) = \frac{\text{No. of Fav. outcomes}}{\text{Total no. of outcomes}}$
3. Used in statistics & decision-making.
4. For e.g:- A die is rolled and probability of coming 4 is $\frac{1}{6}$.

Reliability

1. It refers to the consistency and dependability to perfom specific function over period of time.
2. $R = 1 - P$
   Where P is probability of failure.
3. Used in engineering industry, aerospace, electrical
4. For e.g:- A company make a systems and probability of its failure is 0.1. So
   Reliability $= 1 - 0.1$
   $= 0.9$

Q-1 If A & B are two events such that $P(A) = 0$ $P(B) = k$ $P(A \cup B) = 0.8$. Find the value of k

(i) If A & B are disjoint events.
(ii) If A & B are Independent events

(i) For disjoint $A \cap B = \phi$
$\Rightarrow P(A \cap B) = 0$

Now, formula

$$P(A \cup B) = P(A) + P(B)$$
$$0.8 = 0.5 + k$$
$$k = 0.3$$

(ii)
$$P(A \cap B) = P(A).P(B)$$
$$= 0.5 \times 0.3 = 0.15$$