The Shirpur Education Society's

R. C. Patel College of Engineering and Polytechnic, Shirpur

Department of Applied science and Humanities

NAME OF COURSE: - Basic Mathematics

Unit Name :- Statistics

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SEMESTER: - FIRST

SUBJECT TEACHER: - MS. Varsha S. Koli

* Statistics *

* Continuous and Discontinuous class Intervals.

- Continuous class Intervals :- If the distribution of classes like 0-10, 10-20, 20-30, 30-40, ... are said to be Continuous class Intervals.
- Discontinuous class Intervals :- If the distribution of classes like 1-10, 11-20, 21-30, 31-40, ... are said to be Discontinuous class Intervals.
- Correction Factor

$$= \frac{\text{Lower limit of upper class} - \text{Upper limit of lower class}}{2}$$

For example,

Discontinuous C.I.	Continuous C.I.
1 - 10	0.5 - 10.5
11 - 20	10.5 - 20.5
21 - 30	20.5 - 30.5
31 - 40	30.5 - 40.5

$$\text{correcting factor} = \frac{11-10}{2} = \frac{1}{2} = 0.5$$

Hence,

Lower class boundaries = lower limit - Correcting F.

Upper class boundaries = Upper limit + correcting F.

* Arithmetic Mean

1) Mean of Raw Data

If $x_1, x_2, x_3, \ldots, x_n$ are 'N' number of observations then the mean value is,

$$\bar{X} = \frac{x_1 + x_2 + x_3 + \ldots + x_n}{\text{Total number of observations}} = \frac{\sum x_i}{N}$$

For example

Ex. The Marks obtained by 5 students are : 20, 31, 40, 35, 25. Calculate arithmetic mean.

Soln. Total number of observations = N = 5

$$\bar{x} = \frac{\sum x_i}{N} = \frac{20 + 31 + 40 + 35 + 25}{5}$$

$$\bar{x} = \frac{151}{5} = 30.2$$

2) Mean of ungrouped Data :

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

For example

Ex. Calculate mean of following distribution.

x_i	1	3	5	7	9
f_i	14	23	27	21	15

Soln.

x_i	f_i	$f_i x_i$
1	14	14
3	23	69
5	27	135
7	21	147
9	15	135

$$\therefore \text{Mean } \bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{500}{100}$$

$$\therefore \bar{x} = 5$$

3) Mean of Grouped Data:

In this type, data is given by classes using class-intervals. We consider the centre value of class-intervals and calculate Mean.

The centre value

$$x_i = \frac{\text{Upper boundry} + \text{Lower boundry}}{2}$$

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

For example.

Ex. From the following data calculate arithmetic mean.

Marks	0-10	10-20	20-30	30-40	40-50
No. of Students.	6	15	25	20	4

Soln. For x_i

$$x_i = \frac{\text{Upper boundry} + \text{Lower boundry}}{2}$$

Marks	Mid Point x_i	No. of students f_i	$f_i x_i$
0-10	5	6	30
10-20	15	15	225
20-30	25	25	625
30-40	35	20	700
40-50	45	4	180
		$N = \sum f_i = 70$	$\sum f_i x_i = 1760$

$$\therefore \text{Mean } \bar{x} = \frac{\sum f_i x_i}{N} = \frac{1760}{70}$$

$$\bar{x} = 25.14$$

* Range:

Range is the difference between greatest and Smallest value in the data.

∴ Range = Largest value − Smallest value

i.e, Range = L − S

* Range for ungrouped data:

Example. Find the range of distribution 200, 210, 208, 160, 250, 290.

Soln. First arrange the data in ascending order.

160, 200, 208, 210, 250, 290

Smallest value (S) = 160

Largest value (L) = 290

∴ Range = L − S = 290 − 160 = 130

* Range for Grouped data:

Range = (Upper limit of highest class) − (lower limit of lowest class)

Example. From the following data, calculate range.

~~and~~ Mark	10-19	20-29	30-39	40-49
No. of students	6	10	16	14

Soln. Here class interval are not continuous making them continuous as

Class	Cont. class
10 - 19	9.5 - 19.5
20 - 29	19.5 - 29.5
30 - 39	29.5 - 39.5
40 - 49	39.5 - 49.5

Range = L − S = 49.5 − 9.5 = 40.

* Coefficient of Range

$$= \frac{\text{Range}}{\text{Sum of highest and lowest value}}$$

$$= \frac{L-S}{L+S}$$

Example Find Range and Co-efficient of range.
120, 100, 130, 50, 150

Soln. $C.\text{Range} = \frac{L-S}{L+S} = \frac{150-50}{150+50} = \frac{100}{200} = \frac{1}{2} = 1.5$

Coefficient of Range = 0.5

Example Find range and co-efficient of range

Mark	60-62	63-65	66-68	69-71	72-74
No. of Students.	5	18	42	27	8

Soln:

class	conti. class
60-62	59.5 - 62.5
63-65	62.5 - 65.5
66-68	65.5 - 68.5
69-71	68.5 - 71.5
72-74	71.5 - 74.5

Range = L-S = 74.5 - 59.5 = 15

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

$= \frac{74.5 - 59.5}{74.5 + 59.5} = \frac{15}{134}$

$= 0.1119$

* Mean Deviation

1) Mean Deviation for raw data

$$M.D. = \frac{\sum |x_i - \bar{x}|}{N} = \frac{\sum |d_i|}{N}$$ where $\bar{x}$ = mean.

Ex. Calculate the mean deviation about mean of the given data. 3, 6, 5, 7, 10, 12, 15, 18.

Soln. $$\text{Mean} = \bar{x} = \frac{\sum x_i}{N}$$

$$= \frac{3+6+5+7+10+12+15+18}{8} = \frac{76}{8}$$

$$\bar{x} = 9.5$$

x_i	$\lvert d_i \rvert = \lvert x_i - \bar{x} \rvert$
3	6.5
6	3.5
5	4.5
7	2.5
10	0.5
12	2.5
15	5.5
18	8.5
	$\sum \lvert d_i \rvert = 34$

$$M.D. = \frac{\sum |d_i|}{N}$$

$$= \frac{34}{8}$$

$$M.D. = 4.25$$

2) Mean Deviation for Discrete (ungrouped) data :

$$M.D. = \frac{\sum f_i |x_i - \bar{x}|}{\sum f_i} = \frac{\sum f_i |d_i|}{N}$$

Ex. Calculate mean deviation for the following data.

Mark	3	4	5	6	7	8
No. of Student	1	3	7	5	2	2

Soln. Table for M.D. about mean.

x_i	f_i	$f_i x_i$	$\|d_i\| = \|x_i - \bar{x}\|$	$f_i \|d_i\|$
3	1	3	2.5	2.5
4	3	12	1.5	4.5
5	7	35	0.5	3.5
6	5	30	0.5	2.5
7	2	14	1.5	3
8	2	16	2.5	5
	$N = 20$	$\sum f_i x_i = 110$		$\sum f_i \|d_i\| = 21$

$$\text{Mean} = \bar{x} = \frac{\sum f_i x_i}{N} = \frac{110}{20} = 5.5$$

$$M.D. = \frac{\sum f_i |d_i|}{N} = \frac{21}{20} = 1.05$$

3) Mean Deviation for grouped data.

$$M.D. = \frac{\sum f_i |x_i - \bar{x}|}{\sum f_i} = \frac{\sum f_i |d_i|}{N}$$

where, x_i = Mid value

$\bar{x}$ = mean

Ex. Find mean deviation of the following data.

Marks	0-10	10-20	20-30	30-40	40-50
No. of stud.	5	8	15	16	6

Soln. Table for M.D. about mean.

C.I.	f_i	x_i	$f_i x_i$	$\lvert d_i \rvert = \lvert x_i - \bar{x} \rvert$	$f_i \lvert d_i \rvert$
0-10	5	5	25	22	110
10-20	8	15	120	12	96
20-30	15	25	375	2	30
30-40	16	35	560	8	128
40-50	6	45	270	18	108
	$N=50$		$\Sigma f_i x_i = 1350$		$\Sigma f_i \lvert d_i \rvert = 472$

$$\text{Mean} = \bar{x} = \frac{\Sigma f_i x_i}{N} = \frac{1350}{50} = 27$$

$$\text{M.D.} = \frac{\Sigma f_i \lvert d_i \rvert}{N} = \frac{472}{50} = 9.44$$

3) Mean Deviation if class interval are not continuous.

Ex. Calculate the mean deviation for the following data:

class intervals	40-59	60-79	80-99	100-119	120-139
No. of fami	50	300	500	200	60

Soln. Here Data is group. class intervals are not continuous. Making them continuous.

class	continue class	x_i	f_i	$f_i x_i$	$\|d_i\| = \|x_i - \bar{x}\|$	$f_i\|d_i\|$
40-59	39.5 - 59.5	49.5	50	2475	38.558	1927.9
60-79	59.5 - 79.5	69.5	300	20850	18.558	5567.4
80-99	79.5 - 99.5	89.5	500	44750	1.442	721
100-119	99.5 - 119.5	109.5	200	21900	21.442	4288.4
120-139	119.5 - 139.5	129.5	60	7770	41.442	2486.86
			$N = 1110$	$\Sigma f_i x_i = 97745$		$\Sigma f_i\|d_i\| = 14991.16$

$$\text{Mean} = \bar{x} = \frac{\Sigma f_i x_i}{N} = \frac{97745}{1110} = 88.058$$

$$\text{M.D.} = \frac{\Sigma f_i|d_i|}{N} = \frac{14991.16}{1110} = 13.505$$

* Standard Deviation.

The square root of the mean of the squares of the deviations from mean is called standard deviation. It is denoted by 'σ'.

A] Standard Deviation for Raw data:

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

where, $d_i = x_i - \bar{x}$

$\bar{x}$ = Mean

N = Total number of observations.

Ex. Find standard deviation of the following
1, 2, 3, 4, 5, 6, 7, 8, 9.

Soln. Given data is raw data.

$$\bar{x} = \frac{\sum x_i}{N} = \frac{1+2+3+4+5+6+7+8+9}{9} = \frac{45}{9}$$

$$\bar{x} = 5$$

x_i	$d_i = (x_i - \bar{x})$	d_i^2
1	-4	16
2	-3	9
3	-2	4
4	-1	1
5	0	0
6	1	1
7	2	4
8	3	9
9	4	16
		$\sum d_i^2 = 60$

$$S.D. = \sqrt{\frac{\sum d_i^2}{N}} = \sqrt{\frac{60}{9}} = \sqrt{6.6666}$$

$$S.D. = 2.581$$

* Standard deviation for ungrouped data:

$$S.D. = \sigma = \sqrt{\frac{\sum f_i d_i^2}{N}}$$

where, $N = \sum f_i$

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

$d_i = (x_i - \bar{x})$

Ex. Find standard deviation for the distribution

x	5	10	15	20	25
F	12	17	22	19	16

Soln.

x_i	f_i	$f_i x_i$
5	12	60
10	17	170
15	22	330
20	19	380
25	16	400
	$N = 86$	$\Sigma f_i x_i = 1340$

$$\text{mean } \bar{x} = \frac{\Sigma f_i x_i}{N} = \frac{1340}{86}$$

$$\bar{x} = 15.58$$

$d_i = (x_i - \bar{x})$	d_i^2	$f_i d_i^2$
-10.58	111.936	1343.23
-5.58	31.136	529.312
-0.58	0.336	7.40
4.42	19.536	371.184
9.42	88.736	1419.78
		$\Sigma f_i d_i^2 = 3670.91$

$$S.D. = \sqrt{\frac{\Sigma f_i d_i^2}{N}} = \sqrt{\frac{3670.91}{86}}$$

$$S.D. = \sqrt{42.685}$$

$$S.D. = 6.533$$

* Standard Deviation for grouped data.

$$S.D. = \sigma = \sqrt{\frac{\sum f_i d_i^2}{N}}$$

where, $N = \sum f_i$

$d_i = |x_i - \bar{x}|$

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

x_i = mid value

Ex. Find S.D. for the following data.

C.I.	0-10	10-20	20-30	30-40	40-50
F	3	5	8	3	1

Soln.

C.I.	f_i	x_i	$f_i x_i$	d_i	d_i^2	$f_i d_i^2$
0-10	3	5	15	17	289	867
10-20	5	15	75	7	49	245
20-30	8	25	200	3	9	72
30-40	3	35	105	13	169	507
40-50	1	45	45	23	529	529
	$N=20$		$\sum f_i x_i = 440$			$\sum f_i d_i^2 = 2220$

$$\bar{x} = \frac{\sum f_i x_i}{N} = \frac{440}{20} = 22$$

$\bar{x} = 22$

$$S.D. = \sqrt{\frac{\sum f_i d_i^2}{N}} = \sqrt{\frac{2220}{20}} = \sqrt{111}$$

$S.D. = 10.53.$

* **Variance (σ^2):**

The square of standard deviation is called variance.

For any data e.g. Raw, grouped, ungrouped data we have to calculate first standard deviation then variance = σ^2.

$$\text{Variance} = (\text{S.D.})^2 = \sigma^2 = \frac{\sum (x_i - \bar{x})^2}{N}$$

* **Coefficient of variance:**

$$\text{C.O.V.} = \frac{\text{S.D.}}{\text{Mean}} \times 100$$

$$= \frac{\sigma}{\bar{x}} \times 100$$

Ex. Find variance and coefficient of variance of the following data.

49, 63, 46, 59, 65, 52, 60, 54.

Soln.

$$\bar{x} = \frac{\sum x_i}{N} = \frac{49+63+46+59+65+52+60+54}{8}$$

$$\bar{x} = \frac{448}{8} = 56.$$

x_i	d_i	d_i^2
49	-7	49
63	7	49
46	-10	100
59	3	9
65	9	81
52	-4	16
60	4	16
54	-2	4

$$\text{S.D.} = \sqrt{\frac{d_i^2}{N}} = \sqrt{\frac{324}{8}}$$

$$\text{S.D.} = \sigma = 6.6363$$

$$\text{Variance} = \sigma^2 = 40.487.$$

$$\text{C.O.V} = \frac{\text{S.D}}{\text{mean}} \times 100$$

$$= \frac{6.6363}{56} \times 100$$

$$\text{C.O.V.} = 11.362\ \%$$

* Comparision of Two sets of observations.

If there are two sets, set I and set II having their respective means and standard deviations and we want to know which set is more consistent then follow the procedure given below:

1. Calculate coefficient of variance for set I,

$$(C.V.)_{set\,I} = \frac{\sigma}{\bar{x}} \times 100$$

2. Calculate coefficient of variance for set II,

$$(C.V.)_{set\,II} = \frac{\sigma}{\bar{x}} \times 100$$

If $(C.V.)_{set\,II} < (C.V.)_{set\,I}$

then set II is more consistent.

Ex. The two sets of observation are given below:

Set - I	Set - II
$\bar{x} = 82.5$	$\bar{y} = 48.75$
$\sigma_x = 7.3$	$\sigma_y = 8.35$

which of the set is more consistent?

Soln.

$$C.O.V._{set\,I} = \frac{\sigma}{\bar{x}} \times 100 = \frac{7.3}{82.5} \times 100 = 8.848\%$$

$$C.O.V._{set\,II} = \frac{\sigma}{\bar{x}} \times 100 = \frac{8.35}{48.75} \times 100 = 17.12\%$$

$COV_{set\,I} < COV_{set\,II}$

$\therefore$ Set I is more consistent.

Ex. The runs scored by two batsmens A and B in 5 one day matches are given below:

A	48	50	39	46	37
B	50	52	60	55	53

Who is more consistent ? Why ?

Soln. For Batsman A.

x_i	$d_i = (x_i - \bar{x})$	d_i^2
48	4	16
50	6	36
39	-5	25
46	2	4
37	7	49
$\Sigma x_i = 220$		$\Sigma d_i^2 = 130$

$$\text{Mean} = \bar{x} = \frac{\Sigma x_i}{N} = \frac{220}{5} = 44$$

$$\text{S.D.} = 6 = \sqrt{\frac{\Sigma d_i^2}{N}} = \sqrt{\frac{130}{5}} = 5.1$$

$$\text{C.O.V. of batsman A} = \frac{6}{\bar{x}} \times 100$$

$$= \frac{5.1}{44} \times 100$$

$$= 11.59\ \%$$

For Batsman B.

x_i	$d_i = (x_i - \bar{x})$	d_i^2
50	-4	16
52	-2	4
60	6	36
55	1	1
53	-1	1
$\Sigma x_i = 270$		$\Sigma d_i^2 = 58$

$$\text{mean} = \bar{x} = \frac{\Sigma x_i}{N} = \frac{270}{5} = 54$$

$$S.D = \sigma = \sqrt{\frac{\Sigma d_i^2}{N}} = \sqrt{\frac{58}{5}} = 3.41$$

$$C.O.V \text{ of Batsman B} = \frac{\sigma}{\bar{x}} \times 100$$

$$= \frac{3.41}{54} \times 100$$

$$= 6.31\%$$

C.O.V. of Batsman B < C.O.V. of Batsman A.

∴ Batsmam B is more consistent.

Question Bank

2 Marks questions.

1) If mean is 34.5 and standard deviation is 5, find the co-efficient of variance. (Winter-2023)

2) Find range and co-efficient of range for the runs scored by cricket player in eight innings 45, 42, 39, 40, 48, 41, 45, 44. (Summer-2024)

3) If mean is 34.5 and S.D.(6) is 5, find (C.V.) coefficient of variance (Summer-2024)

4) Find the range and coefficient of the range of the following. (Winter-2024)
2, 3, 1, 10, 6, 31, 17, 20, 24

5) Find range and coefficient of range of data 45, 42, 39, 40, 48, 41, 45, 44 (Summer-2025)

6) If mean is 34.5 and Standard deviation is 5, find the coefficient of variance. (Winter-2025)

4 Marks questions.

1) Find the range and co-efficient of range for the following data: (Winter-2023)

class Interval	10-19	20-29	30-39	40-49	50-59
Frequency.	15	25	13	17	10

2) Calculate mean deviation about mean of the following data: 17, 15, 18, 23, 25, 22, 11, 5 (Winter-2023)

3) The following data Pertains to two workers doing the Same job in a factory. (Winter-2023)

Details	Worker A	Worker B
Mean	40	42
S.D.	8	6

4) Find mean deviation from mean for the data.
17, 15, 18, 23, 25, 22, 11, 5 (Summer - 2024)

5) Compute mean deviation for 15, 22, 27, 11, 9, 21, 14, 9 (winter - 2024)

6) Calculate mean and standard deviation (winter - 2024)

C.I.	0-10	10-20	20-30	30-40	40-50
F.	14	23	27	21	15

7) Find variance and coefficient of variance. (winter - 2024).

C. I.	10-20	20-30	30-40	40-50	50-60	60-70
F	4	6	10	18	9	3

8) calculate mean deviation about mean.
3, 6, 5, 7, 10, 12, 15, 18 (Summer - 2025)

9) Find range and coefficient of range. (Summer - 2025)

Marks	10-19	20-29	30-39	40-49	50-59	60-69
No. of stud	6	10	16	14	8	4

10) The data of run scored by two batsmen A and B in five one day matches is given. which batsman has greater variability? (Summer - 2025)

Batsmen	Average run	S.D.
A	44	5.1
B	54	6.31

6 Marks Questions.

1) Find mean, standard deviation and co-efficient of variance of the following data. (winter - 2023

class Interval	0-10	10-20	20-30	30-40	40-50
Frequency	14	23	27	21	15

2) i) Find mean of the following distribution.

Marks	0-10	10-20	20-30	30-40	40-50
No. of Stud.	5	8	15	16	6

ii) An analysis of monthly wages paid to the workers in two firms A and B belonging to the same industry gives,

	Firm-A	Firm-B
Avg monthly wages	186	175
variance of wages	81	100

(Summer - 2024)

3) The scores of two batsmen A and B in ten innings during a certain season as under.

(Winter - 2024)

A	32	28	47	63	71	39	10	60	96	14
B	19	31	48	53	67	90	10	62	40	80

4) Calculate the mean, S.D. and coefficient of variance of the following data.

(Summer - 2025)

C.I.	0-10	10-20	20-30	30-40	40-50
F	3	5	8	3	1

5) Find mean, standard deviation and coefficient of variance of the following data.

class interval	0-5	5-10	10-15	15-20	20-25
Frequency	6	10	12	10	8

(Winter - 2025)