1. **What do you understand by Dispersion?**

Ans. **Dispersion:**

Statistically, Dispersion means the spread or scatterness of observations in a data set.

The purpose of finding Dispersion is to study the behavior of each unit of population around the average value.

Important absolute measures of dispersion:

(i) **Range**
(ii) **Variance**
(iii) **Standard Deviation**

2. **How do you define measures of dispersion?**

Measures of dispersion:

The measures that are used to determine the degree or extent of variation in a data set or called Measures of Dispersion.

3. **Define Range, Standard deviation and Variance.**

Range:

Range measure the extent of variation between two extreme observations of a data set. It is given by the formula $Range = X_{max} - X_{min} = X_m - X_0$

Where= $X_{max} = X_m$: the maximum, highest or largest observation.

Where= $X_{min} = X_0$: the minimum, lowest or smallest observation.

Variance:

Variance is defined as the mean of the squared deviations of $X_i (i = 1, 2 \ldots \ldots, n)$ observations from their arithmetic mean. In symbols,

$$Variance\ of\ X = Var\ (X) = S^2 = \frac{\Sigma(X - \bar{X})^2}{n}$$

Standard Deviation

Standard deviation is defined as the positive square root of mean of the squared deviations of $X_i (i = 1, 2 \ldots \ldots, n)$ observations from their arithmetic mean. In symbols,

$$Standard\ Deviation\ of\ X = S.D(X) = S = \sqrt{\frac{\Sigma(X - \bar{X})^2}{n}}$$

4. **The salaries of five teachers in Rupees are as follows. 1150, 12400, 15000, 14500, 14800.**

Find Range and standard deviation.

Solution: $X = 11500, 12400, 15000, 14500, 14800$

Here, $X_{max} = 15000$

$X_{min} = 11500$

$Range = X_{max} - X_{min}$

$= 15000 - 11500$

$= 3500$

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

$$= \frac{11500 + 12400 + 15000 + 14500 + 14800}{5} = \frac{68200}{5} = 13640$$

Now

X	$X - \bar{X}$	$(X - \bar{X})^2$
11500	−2410	4579600
12400	−1240	1537600
15000	1360	1849600
14500	860	739600
14800	1160	1345600
$\sum X = 68200$		$\sum(X - \bar{X})^2$ $= 10052000$

Here

$n = 5, \quad \bar{X} = 13640$

$$S.D = S = \sqrt{\frac{\sum(X-\bar{X})^2}{n}} = \sqrt{\frac{10052000}{2}}$$

$$= \sqrt{2010400} \quad = 1417.88$$

5. a. **Find the standard deviation "S" of each set of numbers:**

(i) 12, 6, 7, 3, 15, 10, 18, 5

(ii) 9, 3, 8, 8, 9, 8, 9, 18.

Solution:

X	$X - \bar{X}$	$(X - \bar{X})^2$
12	2.5	6.25
6	−3.5	12.25
7	−2.5	6.25
3	−6.5	42.25
15	5.5	30.25
10	0.5	0.25
18	8.5	72.25
5	−4.5	20.25
$\sum x = 76$		$\sum(X - \bar{X})^2 = 190$

Here $\bar{X} = \frac{\sum x}{n}$

$n = 8, \quad \bar{X} = \frac{76}{8}, \quad \bar{X} = 9.5$

$$S.D = S = \sqrt{\frac{\sum(X-\bar{X})^2}{n}}$$

$$= \sqrt{\frac{190}{8}} \quad = \sqrt{23.75} \quad = 4.87$$

(ii) $9, 3, 8, 8, 9, 8, 9, 18$

$X = 9, 3, 8, 8, 9, 8, 9, 18$

X	$X - \bar{X}$	$(X - \bar{X})^2$
9	0	0
3	−6	36
8	−1	1
8	−1	1
9	0	0
8	−1	1
9	0	0
18	9	81
$\sum x = 72$		$\sum(X - \bar{X})^2 = 120$

Here $\bar{X} = \dfrac{\sum x}{n}, \quad n = 8$

$\bar{X} = \dfrac{72}{8}, \quad \bar{X} = 9 \qquad S.D = S = \sqrt{\dfrac{\sum(X - \bar{X})^2}{n}}$

$= \sqrt{\dfrac{120}{8}} = \sqrt{15} = 3.87$

b. **Calculate variance for the data: $10, 8, 9, 7, 5, 12, 8, 6, 8, 2$**

Solution: $X = 10, 8, 9, 7, 5, 12, 8, 6, 8, 2$

X	$X - \bar{X}$	$(X - \bar{X})^2$
9	0	0
3	−6	36
8	−1	1
8	−1	1
9	0	0
8	−1	1
9	0	0
18	9	81
$\sum X = 75$		$\sum(X - \bar{X})^2 = 68.5$

Here

$n = 10, \quad \bar{X} = \dfrac{\sum x}{n}$

$\bar{X} = \dfrac{75}{10}, \quad \bar{X} = 7.5$

$$Variance = S^2 = \frac{\sum(X-\bar{X})^2}{n}$$

$$= \frac{68.5}{10} = 6.85$$

6. **The length of 32 items are given below. Find the mean length and standard deviation of distribution.**

Length	20 − 22	23 − 25	26 − 28	29 − 31	32 − 34
Frequency	3	6	12	9	2

Solution:

C.I	f	Mid-points (x)	fx	X − X̄	$(X-\bar{X})^2$	$f(X-\bar{X})^2$
20 − 22	3	21	63	−6	36	108
23 − 25	6	24	144	−3	9	54
26 − 28	12	27	324	0	0	0
29 − 31	9	30	270	3	9	81
32 − 34	2	33	66	6	36	72
	32		$\sum fx = 867$		90	315

$$\bar{X} = \frac{\sum fx}{n} = \frac{867}{32} = 27.093 \approx 27 \, approx.$$

Now $\quad S.D = S = \sqrt{\dfrac{\sum(X-\bar{X})^2}{n}}$

$$= \sqrt{\frac{315}{32}}$$

$$= \sqrt{9.84375}$$
$$= 3.137$$

7. **For the following distribution of marks calculate Range.**

Marks in percentage	Frequency/ (No of students)
33 − 40	28
41 − 50	31
51 − 60	12
61 − 70	9
71 − 75	5

Solution:

C.I	Class Boundaries	f
33 − 40	32.5 − 40.5	28
41 − 20	40.5 − 50.5	31
51 − 60	50.5 − 60.5	12
61 − 70	60.5 − 70.5	9
71 − 75	70.5 − 75.5	5

Here, $X_{max} = 72.5$

$X_{min} = 32.5$

$Range = X_{max} - X_{min}$

$= 75.5 - 32.5$

$= 43$