

## EXERCISE 6.3

### Q.1 What do you understand by Dispersion?

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

### Q.2 How do you define measures of dispersion?

#### Measures of Dispersion:

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

For example Range, Variance and Standard Deviation etc.

### Q.3 Define range, standard deviation and variance?

#### Definitions:

##### Range:

Range measures the extent of variation between two extreme observations of a data set. It is given by the formula.

Range =  $X_{\max} - X_{\min} = X_m - X_o$  Where,

$X_{\max} = X_m$  : the maximum, observation.

$X_{\min} = X_o$  : the minimum observation.

##### Variance:

Variance is defined as the mean of the squared deviation of  $X_i, (i=1, 2, 3, \dots, n)$  observations from their arithmetic mean.

#### Variance from Ungrouped Data

- **Definitional Formula**

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

- **Computational formula:**

$$\text{Var}(x) = S^2 = \frac{\sum x^2}{n} - \left( \frac{\sum x}{n} \right)^2$$

#### Variance from Grouped Data

- **Definitional Formula**

$$\text{Var}(x) = S^2 = \frac{\sum f(x - \bar{x})^2}{\sum f}$$

- **Computational Formula**

$$\text{Var}(x) = S^2 = \frac{\sum fx^2}{\sum f} - \left( \frac{\sum fx}{\sum f} \right)^2$$

### Standard Deviation:

Standard deviation is defined as the positive square root of mean of the squared deviations of  $X_i$ , ( $i= 1,2,3,\dots, n$ ) observations from their arithmetic mean.

#### Standard Deviation from Un-Grouped Data

- Definitional Formula

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

- Computational Formula

$$S. D (x) = S = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}$$

#### Standard Deviation from Grouped Data

- Definitional Formula

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

- Computational Formula

$$S.D (x) = S = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

**Q.4** The salaries of five teachers in Rupees are as follows. 11500, 12400, 15000, 14500, 14800

Find range and standard deviation

#### Solution

Maximum value =  $X_{\max}$  = Rs. 15000

Minimum value =  $X_{\min}$  = Rs. 11500

Range (R) = ?

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

$$R = 15000 - 11500$$

Range = Rs. 3500

#### Standard Deviation:

Let  $X = 11500, 12400, 15000, 14500, 14800$

We know that  $\bar{X} = \frac{\sum X}{n} = \frac{68200}{5} = 13640$

X	$x - \bar{x}$	$(x - \bar{x})^2$
11500	$11500 - 13640 = -2140$	4579600
12400	$12400 - 13640 = -1240$	1537600
15000	$15000 - 13640 = 1360$	1849600
14500	$14500 - 13640 = 860$	739600
14800	$14800 - 13640 = 1160$	1345600
$\sum x = 68200$	$\sum (x - \bar{x})^2 = 10052000$	

### Standard Deviation:

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

$$S = \sqrt{\frac{10052000}{5}}$$

$$S = \sqrt{2010400}$$

$$S = 1417.88575$$

### Q. 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

b. Calculate variance for the data:

10, 8, 9, 7, 5, 12, 8, 6, 8, 2

(i) Solution:

$X = 12, 6, 7, 3, 15, 10, 18, 5$

Number of observations =  $n = 8$

X	$X^2$
3	9
5	25
6	36
7	49
10	100
12	144
15	225
18	324
$\sum x = 76$	$\sum x^2 = 912$

$$S = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}$$

$$S = \sqrt{\frac{912}{8} - \left(\frac{76}{8}\right)^2}$$

$$S = \sqrt{114 - 90.25}$$

$$S = \sqrt{23.75}$$

$$S = 4.87$$

(ii) **Solution:**

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

Number of observations =  $n = 8$

X	$X^2$
3	9
8	64
8	64
8	64
9	81
9	81
9	81
18	324
$\sum x = 72$	$\sum x^2 = 768$

We know that,

$$S = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}$$

$$S = \sqrt{\frac{768}{8} - \left(\frac{72}{8}\right)^2}$$

$$S = \sqrt{96 - 81}$$

$$S = \sqrt{15} \Rightarrow S = 3.87$$

(b). Calculate variance for the data

10, 8, 9, 7, 5, 12, 8, 6, 8, 2

**Solution:**

Number of Observations =  $n = 10$

X	$X^2$
10	100
8	64
9	81
7	49
5	25
12	144
8	64
6	36
8	64
2	4
$\sum x = 75$	$\sum x^2 = 631$

We know that,

$$S^2 = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2$$

$$S^2 = \frac{631}{10} - \left(\frac{75}{10}\right)^2$$

$$S^2 = 63.1 - (7.5)^2$$

$$S^2 = 63.1 - 56.25 \Rightarrow S^2 = 6.85$$

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

Length	20-22	23-25	26-28	29-31	32-34
$f$	3	6	12	9	2

**Solution:**

Length	( $f$ )	Class Marks (x)	$fx$	$x^2$	$fx^2$
20-22	3	21	63	441	1323
23-25	6	24	144	576	3456
26-28	12	27	324	729	8748
29-31	9	30	270	900	8100
32-34	2	33	66	1089	2178
$\sum f = 32$		$\sum fx = 867$		$\sum fx^2 = 23805$	

(i) **Arithmetic Mean**

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{867}{32} = 27.093$$

(ii) **Standard Deviation**

$$S = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

$$S = \sqrt{\frac{23805}{32} - \left(\frac{867}{32}\right)^2}$$

$$S = \sqrt{743.90 - (27.093)^2}$$

$$S = \sqrt{743.90 - 734.03065}$$

$$S = \sqrt{9.86935}$$

$$S = 3.1415$$

Q. 7 For the following distribution of marks calculate range.

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

**Solution:**

Marks in percentage	Class Boundaries	Frequency / No of students
31 – 40	30.5 – 40.5	28
41 – 50	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

Upper class boundary of last class = 75.5

Lower class boundary of 1<sup>st</sup> class = 30.5

Range = ?

Range (R) = 75.5 – 30.5

R = 45