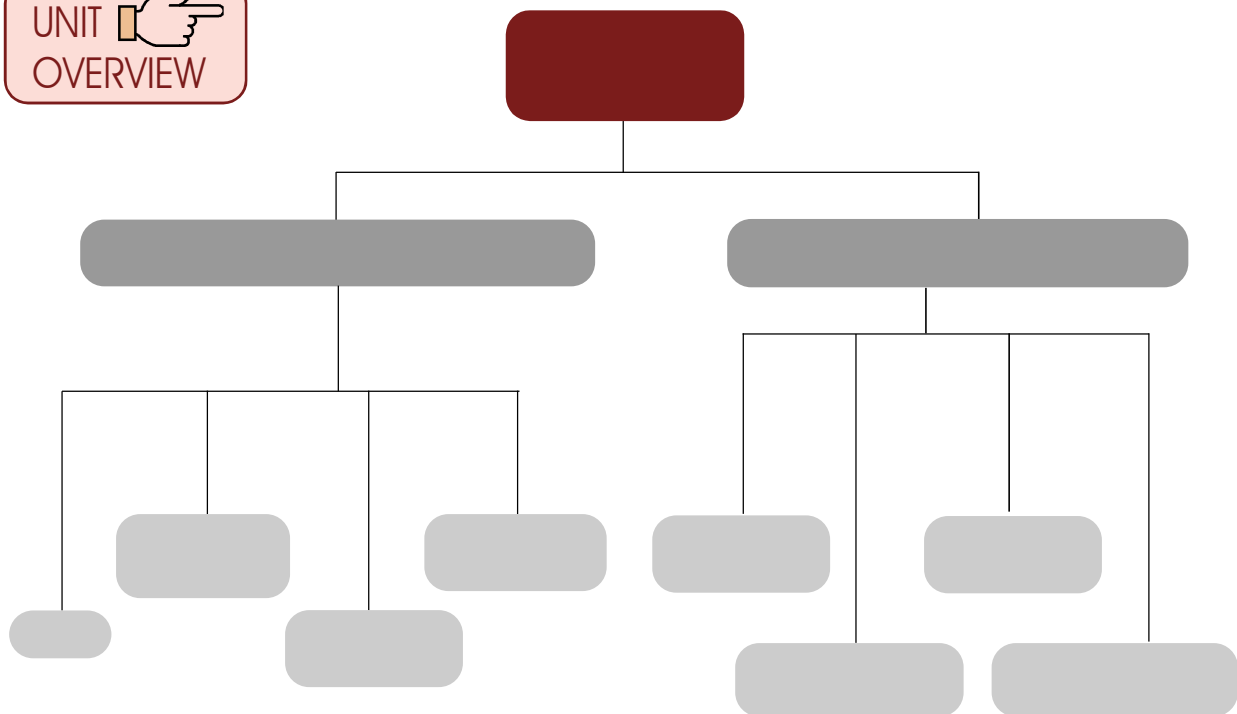


UNIT II: DISPERSION

LEARNING OBJECTIVES

After reading this chapter, students will be able to understand:

- ◆ To understand different measures of Dispersion i.e Range, Quartile Deviation, Mean Deviation and Standard Deviation and computational techniques of these measures.
- ◆ To learn comparative advantages and disadvantages of these measures and therefore, which measures to use in which circumstance.
- ◆ To understand a set of observation, it is equally important to have knowledge of dispersion which indicates the volatility. In advanced stage of chartered accountancy course, volatility measures will be useful in understanding risk involved in financial decision making.



14.2.1 DEFINITION OF DISPERSION

The second important characteristic of a distribution is given by dispersion. Two distributions may be identical in respect of its first important characteristic i.e. central tendency and yet they may differ on account of scatterness. The following figure shows a number of distributions having identical measure of central tendency and yet varying measure of scatterness. Obviously, distribution is having the maximum amount of dispersion.

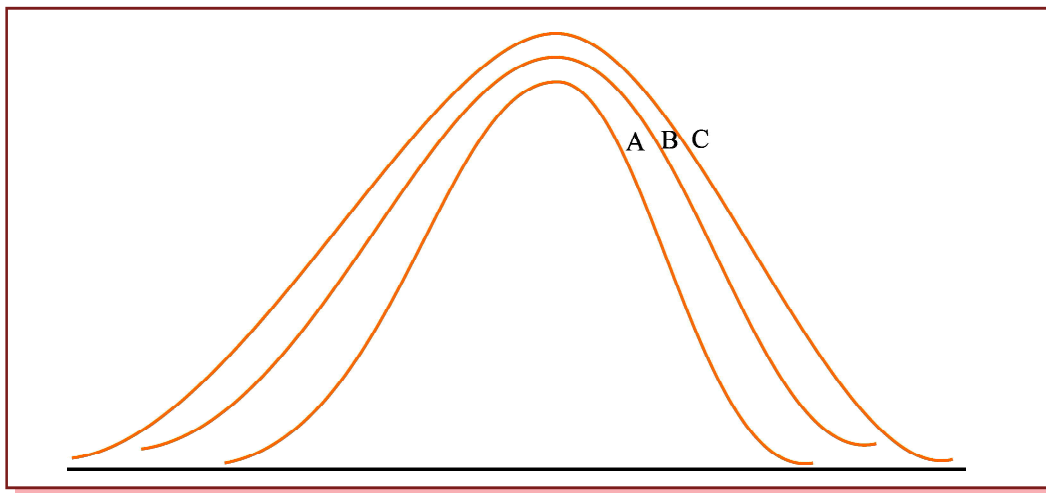


Figure 14.2.1

Showing distributions with identical measure of central tendency and varying amount of dispersion.

Dispersion for a given set of observations may be defined as the amount of deviation of the observations, usually, from an appropriate measure of central tendency. Measures of dispersion may be broadly classified into

1. Absolute measures of dispersion.

2. Relative measures of dispersion.

Absolute measures of dispersion are classified into

- | | |
|--------------------------|-------------------------|
| (i) Range | (ii) Mean Deviation |
| (iii) Standard Deviation | (iv) Quartile Deviation |

Likewise, we have the following relative measures of dispersion :

- | | |
|--------------------------------|---|
| (i) Coefficient of Range. | (ii) Coefficient of Mean Deviation |
| (iii) Coefficient of Variation | (iv) Coefficient of Quartile Deviation. |

We may note the following points of distinction between the absolute and relative measures of dispersion :

- I Absolute measures are dependent on the unit of the variable under consideration whereas the relative measures of dispersion are unit free.
- II For comparing two or more distributions, relative measures and not absolute measures of dispersion are considered.
- III Compared to absolute measures of dispersion, relative measures of dispersion are difficult to compute and comprehend.

Characteristics for an ideal measure of dispersion

As discussed in section 14.2.1 an ideal measure of dispersion should be properly defined, easy to comprehend, simple to compute, based on all the observations, unaffected by sampling fluctuations and amenable to some desirable mathematical treatment.

14.2.2 RANGE

For a given set of observations, range may be defined as the difference between the largest and smallest of observations. Thus if L and S denote the largest and smallest observations respectively then we have

$$\text{Range} = L - S$$

The corresponding relative measure of dispersion, known as coefficient of range, is given by

$$\text{Coefficient of range} = \frac{L - S}{L + S} \times 100$$

For a grouped frequency distribution, range is defined as the difference between the two extreme class boundaries. The corresponding relative measure of dispersion is given by the ratio of the difference between the two extreme class boundaries to the total of these class boundaries, expressed as a percentage.

We may note the following important result in connection with range:

Result:

Range remains unaffected due to a change of origin but affected in the same ratio due to a change in scale i.e., if for any two constants a and b, two variables x and y are related by $y = a + bx$,

Then the range of y is given by

$$R_y = |b| \times R_x \dots\dots\dots (14.2.1)$$

Example 14.2.1: Following are the wages of 8 workers expressed in Rupees. 82, 96, 52, 75, 70, 65, 50, 70. Find the range and also its coefficient.

Solution: The largest and the smallest wages are $L = ₹ 96$ and $S = ₹ 50$
Thus range = $₹ 96 - ₹ 50 = ₹ 46$

$$\begin{aligned} \text{Coefficient of range} &= \frac{96 - 50}{96 + 50} \times 100 \\ &= 31.51 \end{aligned}$$

Example 14.2.2: What is the range and its coefficient for the following distribution of weights?

Weights in kgs. :	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74
No. of Students :	12	18	23	10	3

Solution: The lowest class boundary is 49.50 kgs. and the highest class boundary is 74.50 kgs. Thus we have

$$\begin{aligned} \text{Range} &= 74.50 \text{ kgs.} - 49.50 \text{ kgs.} \\ &= 25 \text{ kgs.} \end{aligned}$$

$$\begin{aligned}\text{Also, coefficient of range} &= \frac{74.50 - 49.50}{74.50 + 49.50} \times 100 \\ &= \frac{25}{124} \times 100 \\ &= 20.16\end{aligned}$$

Example 14.2.3 : If the relationship between x and y is given by $2x+3y=10$ and the range of x is ₹ 15, what would be the range of y?

Solution: Since $2x+3y=10$

$$\text{Therefore, } y = \frac{10}{3} - \frac{2}{3}x$$

Applying (14.2.1), the range of y is given by

$$\begin{aligned}R_y &= |b| \times R_x = 2/3 \times ₹ 15 \\ &= ₹ 10.\end{aligned}$$

14.2.3 MEAN DEVIATION

Since range is based on only two observations, it is not regarded as an ideal measure of dispersion. A better measure of dispersion is provided by mean deviation which, unlike range, is based on all the observations. For a given set of observation, mean deviation is defined as the arithmetic mean of the absolute deviations of the observations from an appropriate measure of central tendency. Hence if a variable x assumes n values $x_1, x_2, x_3, \dots, x_n$, then the mean deviation of x about an average A is given by

$$MD_A = \frac{1}{n} \sum |x_i - A| \dots \dots \dots (14.2.2)$$

For a grouped frequency distribution, mean deviation about A is given by

$$MD_A = \frac{1}{n} \sum |x_i - A| f_i \dots \dots \dots (14.2.2)$$

Where x_i and f_i denote the mid value and frequency of the i-th class interval and

$$N = \sum f_i$$

In most cases we take A as mean or median and accordingly, we get mean deviation about mean or mean deviation about median.

A relative measure of dispersion applying mean deviation is given by

$$\text{Coefficient of mean deviation} = \frac{\text{Mean deviation about } A}{A} \times 100 \dots\dots\dots(14.2.3)$$

Mean deviation takes its minimum value when the deviations are taken from the median. Also mean deviation remains unchanged due to a change of origin but changes in the same ratio due to a change in scale i.e. if $y = a + bx$, a and b being constants,

$$\text{then MD of } y = |b| \times \text{MD of } x \dots\dots\dots(14.2.4)$$

Example 14.2.4: What is the mean deviation about mean for the following numbers?

5, 8, 10, 10, 12, 9.

Solution:

The mean is given by

$$\bar{x} = \frac{5+8+10+10+12+9}{6} = 9$$

Table 14.2.1

Computation of MD about AM	
x_i	$ x_i - \bar{x} $
5	4
8	1
10	1
10	1
12	3
9	0
Total	10

Thus mean deviation about mean is given by

$$\frac{\sum |x_i - \bar{x}|}{n} = \frac{10}{6} = 1.67$$

Example. 14.2.5: Find mean deviations about median and also the corresponding coefficient for the following profits ('000 ₹) of a firm during a week.

82, 56, 75, 70, 52, 80, 68.

Solution:

The profits in thousand rupees is denoted by x . Arranging the values of x in an ascending order, we get

52, 56, 68, 70, 75, 80, 82.

Therefore, Me = 70. Thus, Median profit = ₹ 70,000.

Table 14.2.2

Computation of Mean deviation about median	
x_i	$ x_i - \text{Me} $
52	18
56	14
68	2
70	0
75	5
80	10
82	12
Total	61

$$\text{Thus mean deviation about median} = \frac{\sum |x_i - \text{Median}|}{n}$$

$$= (\text{₹}) \frac{61}{7}$$

$$= \text{₹ } 8714.28$$

$$\text{Coefficient of mean deviation} = \frac{\text{MD about median}}{\text{Median}} \times 100$$

$$= \frac{8714.28}{70000} \times 100$$

$$= 12.45$$

Example 14.2.6 : Compute the mean deviation about the arithmetic mean for the following data:

x : 1 3 5 7 9

f : 5 8 9 2 1

Also find the coefficient of the mean deviation about the AM.

Solution: We are to apply formula (14.1.2) as these data refer to a grouped frequency distribution the AM is given by

$$\begin{aligned}\bar{x} &= \frac{\sum f_i x_i}{N} \\ &= \frac{5 \times 1 + 8 \times 3 + 9 \times 5 + 2 \times 7 + 1 \times 9}{5 + 8 + 9 + 2 + 1} = 3.88\end{aligned}$$

Table 14.2.3

Computation of MD about the AM

x	f	$ x - \bar{x} $	$f x - \bar{x} $
(1)	(2)	(3)	(4) = (2) × (3)
1	5	2.88	14.40
3	8	0.88	7.04
5	9	1.12	10.08
7	2	3.12	6.24
9	1	5.12	5.12
Total	25	–	42.88

Thus, MD about AM is given by

$$\begin{aligned}\frac{\sum f|x - \bar{x}|}{N} \\ &= \frac{42.88}{25} \\ &= 1.72\end{aligned}$$

$$\text{Coefficient of MD about its AM} = \frac{\text{MD about AM}}{\text{AM}} \times 100$$

$$\begin{aligned}&= \frac{1.72}{3.88} \times 100 \\ &= 44.33\end{aligned}$$

Example 14.2.7: Compute the coefficient of mean deviation about median for the following distribution:

Weight in kgs.	:	40-50	50-60	60-70	70-80
No. of persons	:	8	12	20	10

Solution: We need to compute the median weight in the first stage

Table 14.2.4

Computation of median weight

Weight in kg (CB)	No. of Persons (Cumulative Frequency)
40	0
50	8
60	20
70	40
80	50

Hence,
$$M = l_1 + \left(\frac{\frac{N}{2} - N_l}{N_u - N_l} \right) \times C$$

$$= \left[60 + \frac{25 - 20}{40 - 20} \times 10 \right] \text{kg.} = 62.50 \text{kg.}$$

Table 14.2.5

Computation of mean deviation of weight about median

weight (kgs.) (1)	mid-value (x_i) kgs. (2)	No. of persons (f_i) (3)	$ x_i - \text{Me} $ (kgs.) (4)	$f_i x_i - \text{Me} $ (kgs.) (5)=(3)×(4)
40-50	45	8	17.50	140
50-60	55	12	7.50	90
60-70	65	20	2.50	50
70-80	75	10	12.50	125
Total	—	50	—	405

$$\begin{aligned}\text{Mean deviation about median} &= \frac{\sum f_i |x_i - \text{Median}|}{N} \\ &= \frac{405}{50} \text{ kg.} \\ &= 8.10 \text{ kg.}\end{aligned}$$

$$\begin{aligned}\text{Coefficient of mean deviation about median} &= \frac{\text{Mean deviation about median}}{\text{Median}} \times 100 \\ &= \frac{8.10}{62.50} \times 100 \\ &= 12.96\end{aligned}$$

Example 14.2.8: If x and y are related as $4x+3y+11=0$ and mean deviation of x is 5.40, what is the mean deviation of y ?

Solution: Since $4x + 3y + 11 = 0$

$$\text{Therefore, } y = \left(\frac{-11}{3}\right) + \left(\frac{-4}{3}\right)x$$

Hence MD of $y = |b| \times \text{MD of } x$

$$\begin{aligned}&= \frac{4}{3} \times 5.40 \\ &= 7.20\end{aligned}$$

14.2.4 STANDARD DEVIATION

Although mean deviation is an improvement over range so far as a measure of dispersion is concerned, mean deviation is difficult to compute and further more, it cannot be treated mathematically. The best measure of dispersion is, usually, standard deviation which does not possess the demerits of range and mean deviation.

Standard deviation for a given set of observations is defined as the root mean square deviation when the deviations are taken from the AM of the observations. If a variable x assumes n values $x_1, x_2, x_3, \dots, x_n$ then its standard deviation(s) is given by

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}} \quad \dots \dots \dots (14.2.5)$$

For a grouped frequency distribution, the standard deviation is given by

$$s = \sqrt{\frac{\sum f_i (x_i - \bar{x})^2}{N}} \quad \dots \dots \dots (14.2.6)$$

(14.2.5) and (14.2.6) can be simplified to the following forms

$$s = \sqrt{\frac{\sum x_i^2}{n} - \bar{x}^2} \text{ for unclassified data}$$

$$= \sqrt{\frac{\sum f_i x_i^2}{N} - \bar{x}^2} \text{ for a grouped frequency distribution.} \quad \dots (14.2.7)$$

Sometimes the square of standard deviation, known as variance, is regarded as a measure of dispersion. We have, then,

$$\text{Variance} = s^2 = \frac{\sum (x_i - \bar{x})^2}{n} \text{ for unclassified data}$$

$$= \frac{\sum f_i (x_i - \bar{x})^2}{N} \text{ for a grouped frequency distribution} \dots\dots\dots(14.2.8)$$

A relative measure of dispersion using standard deviation is given by coefficient of variation (cv) which is defined as the ratio of standard deviation to the corresponding arithmetic mean, expressed as a percentage.

$$\text{Coefficient of Variation (CV)} = \frac{SD}{AM} \times 100 \dots\dots\dots (14.2.9)$$



ILLUSTRATIONS:

Example 14.2.9: Find the standard deviation and the coefficient of variation for the following numbers: 5, 8, 9, 2, 6

Solution: We present the computation in the following table.

Table 14.2.6
Computation of standard deviation

x_i	x_i^2
5	25
8	64
9	81
2	4
6	36
30	$\sum x_i^2 = 210$

Applying (14.2.7), we get the standard deviation as

$$s = \sqrt{\frac{\sum x_i^2}{n} - \bar{x}^2}$$

$$\begin{aligned}
 &= \sqrt{\frac{210}{5} - \left(\frac{30}{5}\right)^2} \quad \left(\text{since } \bar{x} = \frac{\sum x_i}{n}\right) \\
 &= \sqrt{42 - 36} \\
 &= \sqrt{6} \\
 &= 2.45
 \end{aligned}$$

The coefficient of variation is

$$\begin{aligned}
 CV &= 100 \times \frac{SD}{AM} \\
 &= 100 \times \frac{2.45}{6} \\
 &= 40.83
 \end{aligned}$$

Example 14.2.10: Show that for any two numbers a and b, standard deviation is given

$$\text{by } \frac{|a-b|}{2}.$$

Solution: For two numbers a and b, AM is given by $\bar{x} = \frac{a+b}{2}$

The variance is

$$\begin{aligned}
 s^2 &= \frac{\sum (x_i - \bar{x})^2}{2} \\
 &= \frac{\left(a - \frac{a+b}{2}\right)^2 + \left(b - \frac{a+b}{2}\right)^2}{2} \\
 &= \frac{\frac{(a-b)^2}{4} + \frac{(a-b)^2}{4}}{2} \\
 &= \frac{(a-b)^2}{4}
 \end{aligned}$$

$$\Rightarrow s = \frac{|a-b|}{2}$$

(The absolute sign is taken, as SD cannot be negative).

Example 14.2.11: Prove that for the first n natural numbers, SD is $\sqrt{\frac{n^2-1}{12}}$.

Solution: for the first n natural numbers AM is given by

$$\bar{x} = \frac{1+2+3+\dots\dots\dots+n}{n}$$

$$= \frac{n(n+1)}{2n}$$

$$= \frac{n+1}{2}$$

$$\therefore \text{SD} = \sqrt{\frac{\sum x_i^2}{n} - \bar{x}^2}$$

$$= \sqrt{\frac{1^2+2^2+3^2\dots\dots\dots+n^2}{n} - \left(\frac{n+1}{2}\right)^2}$$

$$= \sqrt{\frac{n(n+1)(2n+1)}{6n} - \frac{(n+1)^2}{4}}$$

$$= \sqrt{\frac{(n+1)(4n+2-3n-3)}{12}} = \sqrt{\frac{n^2-1}{12}}$$

Thus, SD of first n natural numbers is $\text{SD} = \sqrt{\frac{n^2-1}{12}}$

We consider the following formula for computing standard deviation from grouped frequency distribution with a view to saving time and computational labour:

$$S = \sqrt{\frac{\sum f_i d_i^2}{N} - \left(\frac{\sum f_i d_i}{N}\right)^2} \dots\dots\dots(14.2.10)$$

Where $d_i = \frac{x_i - A}{C}$

Example 14.2.12: Find the SD of the following distribution:

Weight (kgs.)	:	50-52	52-54	54-56	56-58	58-60
No. of Students	:	17	35	28	15	5

Solution:

Table 14.2.7
Computation of SD

Weight (kgs.) (1)	No. of Students (f_i) (2)	Mid-value (x_i) (3)	$d_i = x_i - 55$ 2 (4)	$f_i d_i$ (5)=(2)×(4)	$f_i d_i^2$ (6)=(5)×(4)
50-52	17	51	-2	-34	68
52-54	35	53	-1	-35	35
54-56	28	55	0	0	0
56-58	15	57	1	15	15
58-60	5	59	2	10	20
Total	100	-	-	-44	138

Applying (14.2.7), we get the SD of weight as

$$\begin{aligned}
 &= \sqrt{\frac{\sum f_i d_i^2}{N} - \left(\frac{\sum f_i d_i}{N}\right)^2} \times C \\
 &= \sqrt{\frac{138}{100} - \frac{(-44)^2}{100}} \times 2 \text{ kgs.} \\
 &= \sqrt{1.38 - 0.1936} \times 2 \text{ kgs.} \\
 &= 2.18 \text{ kgs.}
 \end{aligned}$$

Properties of standard deviation

- I. If all the observations assumed by a variable are constant i.e. equal, then the SD is zero. This means that if all the values taken by a variable x is k , say, then $s = 0$. This result applies to range as well as mean deviation.
- II. SD remains unaffected due to a change of origin but is affected in the same ratio due to a change of scale i.e., if there are two variables x and y related as $y = a + bx$ for any two constants a and b , then SD of y is given by

$$s_y = |b| s_x \quad \dots\dots\dots(14.2.11)$$
- III. If there are two groups containing n_1 and n_2 observations, \bar{x}_1 and \bar{x}_2 as respective AM's, s_1 and s_2 as respective SD's, then the combined SD is given by

$$s = \sqrt{\frac{n_1 s_1^2 + n_2 s_2^2 + n_1 d_1^2 + n_2 d_2^2}{n_1 + n_2}} \quad \dots\dots\dots(14.2.12)$$

where, $d_1 = \bar{x}_1 - \bar{x}$

$d_2 = \bar{x}_2 - \bar{x}$

and $\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$ = combined AM

This result can be extended to more than 2 groups. For $x \geq 2$ groups, we have

$$s = \sqrt{\frac{\sum n_i s_i^2 + \sum n_i d_i^2}{\sum n_i}} \dots\dots\dots (14.2.13)$$

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

and $\bar{x} = \frac{\sum n_i \bar{x}_i}{\sum n_i}$

Where $\bar{x}_1 = \bar{x}_2$ (14.2.13) is reduced to

$$s = \sqrt{\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2}}$$

Example 14.2.13: If AM and coefficient of variation of x are 10 and 40 respectively, what is the variance of (15-2x)?

Solution: let $y = 15 - 2x$

Then applying (14.2.4), we get,

$$s_y = 2 \times s_x \dots\dots\dots (1)$$

As given $cv_x =$ coefficient of variation of $x = 40$ and $\bar{x} = 10$

This $cv_x = \frac{S_x}{\bar{x}} \times 100$

$$\Rightarrow 40 = \frac{S_x}{10} \times 100$$

$$\Rightarrow S_x = 4$$

From (1), $S_y = 2 \times 4 = 8$

Therefore, variance of $(15 - 2x) = S_y^2 = 64$

Example 14.2.14: Compute the SD of 9, 5, 8, 6, 2.

Without any more computation, obtain the SD of

Sample I	-1,	-5,	-2,	-4,	-8,
Sample II	90,	50,	80,	60,	20,
Sample III	23,	15,	21,	17,	9.

Solution:

Table 14.2.7
Computation of SD

x_i	x_i^2
9	81
5	25
8	64
6	36
2	4
30	210

The SD of the original set of observations is given by

$$\begin{aligned}
 s &= \sqrt{\frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2} \\
 &= \sqrt{\frac{210}{5} - \left(\frac{30}{5}\right)^2} \\
 &= \sqrt{42 - 36} \\
 &= \sqrt{6} \\
 &= 2.45
 \end{aligned}$$

If we denote the original observations by x and the observations of sample I by y , then we have

$$\begin{aligned}
 y &= -10 + x \\
 y &= (-10) + (1)x \\
 \therefore S_y &= |1| \times S_x \\
 &= 1 \times 2.45 \\
 &= 2.45
 \end{aligned}$$

In case of sample II, x and y are related as

$$\begin{aligned}
 Y &= 10x \\
 &= 0 + (15)x
 \end{aligned}$$

$$\begin{aligned}\therefore s_y &= |10| \times s_x \\ &= 10 \times 2.45 \\ &= 24.50\end{aligned}$$

And lastly, $y = (5) + (2) \times$

$$\begin{aligned}\Rightarrow s_y &= 2 \times 2.45 \\ &= 4.90\end{aligned}$$

Example 14.2.15: For a group of 60 boy students, the mean and SD of stats. marks are 45 and 2 respectively. The same figures for a group of 40 girl students are 55 and 3 respectively. What is the mean and SD of marks if the two groups are pooled together?

Solution: As given $n_1 = 60$, $\bar{x}_1 = 45$, $s_1 = 2$, $n_2 = 40$, $\bar{x}_2 = 55$, $s_2 = 3$

Thus the combined mean is given by

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

$$\begin{aligned}&= \frac{60 \times 45 + 40 \times 55}{60 + 40} \\ &= 49\end{aligned}$$

Thus $d_1 = \bar{x}_1 - \bar{x} = 45 - 49 = -4$

$$d_2 = \bar{x}_2 - \bar{x} = 55 - 49 = 6$$

Applying (14.2.13), we get the combined SD as

$$s = \sqrt{\frac{n_1s_1^2 + n_2s_2^2 + n_1d_1^2 + n_2d_2^2}{n_1 + n_2}}$$

$$\begin{aligned}s &= \sqrt{\frac{60 \times 2^2 + 40 \times 3^2 + 60 \times (-4)^2 + 40 \times 6^2}{60 + 40}} \\ &= \sqrt{30} \\ &= 5.48\end{aligned}$$

Example 14.2.16: The mean and standard deviation of the salaries of the two factories are provided below :

Factory	No. of Employees	Mean Salary	SD of Salary
A	30	₹ 4800	₹ 10
B	20	₹ 5000	₹ 12

- Find the combined mean salary and standard deviation of salary.
- Examine which factory has more consistent structure so far as satisfying its employees are concerned.

Solution: Here we are given

$$n_1 = 30, \bar{x}_1 = ₹ 4800, s_1 = ₹ 10,$$

$$n_2 = 20, \bar{x}_2 = ₹ 5000, s_2 = ₹ 12$$

$$i) \quad \frac{30 \times ₹ 4800 + 20 \times ₹ 5000}{30 + 20} = ₹ 4880$$

$$d_1 = \bar{x}_1 - \bar{x} = ₹ 4,800 - ₹ 4880 = - ₹ 80$$

$$d_2 = \bar{x}_2 - \bar{x} = ₹ 5,000 - ₹ 4880 = ₹ 120$$

hence, the combined SD in rupees is given by

$$\begin{aligned} s &= \sqrt{\frac{30 \times 10^2 + 20 \times 12^2 + 30 \times (-80)^2 + 20 \times 120^2}{30 + 20}} \\ &= \sqrt{9717.60} \\ &= 98.58 \end{aligned}$$

thus the combined mean salary and the combined standard deviation of salary are ₹ 4880 and ₹ 98.58 respectively.

ii) In order to find the more consistent structure, we compare the coefficients of variation of the

two factories. Letting $CV_A = 100 \times \frac{S_A}{\bar{X}_A}$ and $CV_B = 100 \times \frac{S_B}{\bar{X}_B}$

We would say factory A is more consistent

if $CV_A < CV_B$. Otherwise factory B would be more consistent.

$$\text{Now } CV_A = 100 \times \frac{S_A}{\bar{X}_A} = 100 \times \frac{s_1}{\bar{x}_1} = \frac{100 \times 10}{4800} = 0.21$$

$$\text{and } CV_B = 100 \times \frac{S_B}{\bar{X}_B} = 100 \times \frac{s_2}{\bar{x}_2} = \frac{100 \times 12}{5000} = 0.24$$

Thus we conclude that factory A has more consistent structure.

Example 14.2.17: A student computes the AM and SD for a set of 100 observations as 50 and 5 respectively. Later on, she discovers that she has made a mistake in taking one observation as 60 instead of 50. What would be the correct mean and SD if

i) The wrong observation is left out?

ii) The wrong observation is replaced by the correct observation?

Solution: As given, $n = 100$, $\bar{x} = 50$, $S = 5$

Wrong observation = 60, correct observation = 50

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

$$\Rightarrow \sum x_i = n\bar{x} = 100 \times 50 = 5000$$

$$\text{and } s^2 = \frac{\sum x_i^2}{n} - \bar{x}^2$$

$$\Rightarrow \sum x_i^2 = n(\bar{x}^2 + s^2) = 100(50^2 + 5^2) = 252500$$

i) Sum of the 99 observations = 5000 – 60 = 4940

AM after leaving the wrong observation = 4940/99 = 49.90

Sum of squares of the observation after leaving the wrong observation

$$= 252500 - 60^2 = 248900$$

Variance of the 99 observations = 248900/99 – (49.90)²

$$= 2514.14 - 2490.01$$

$$= 24.13$$

∴ SD of 99 observations = 4.91

ii) Sum of the 100 observations after replacing the wrong observation by the correct observation

$$= 5000 - 60 + 50 = 4990$$

$$\text{AM} = \frac{4990}{100} = 49.90$$

$$\text{Corrected sum of squares} = 252500 + 50^2 - 60^2 = 251400$$

$$\text{Corrected SD} = \sqrt{\frac{251400}{100} - (49.90)^2}$$

$$= \sqrt{23.94} = 4.90$$



14.2.5 QUARTILE DEVIATION

Another measure of dispersion is provided by **quartile deviation** or **semi-inter-quartile** range which is given by

$$Q_d = \frac{Q_3 - Q_1}{2} \dots\dots\dots(14.2.14)$$

A relative measure of dispersion using quartiles is given by coefficient of quartile deviation which is

$$\text{Coefficient of quartile deviation} = \frac{Q_3 - Q_1}{Q_3 + Q_1} \times 100 \dots\dots\dots(14.2.15)$$

Quartile deviation provides the best measure of dispersion for open-end classification. It is also less affected due to extreme observations or sampling fluctuations. Like other measures of dispersion, quartile deviation remains unaffected due to a change of origin but is affected in the same ratio due to change in scale.

Example 14.2.18 : Following are the marks of the 10 students : 56, 48, 65, 35, 42, 75, 82, 60, 55, 50. Find quartile deviation and also its coefficient.

Solution:

After arranging the marks in an ascending order of magnitude, we get 35, 42, 48, 50, 55, 56, 60, 65, 75, 82

$$\text{First quartile } (Q_1) = \frac{(n+1)}{4} \text{th observation}$$

$$= \frac{(10+1)}{4} \text{th observation}$$

$$= 2.75^{\text{th}} \text{ observation}$$

$$= 2^{\text{nd}} \text{ observation} + 0.75 \times \text{difference between the third and the } 2^{\text{nd}} \text{ observation.}$$

$$= 42 + 0.75 \times (48 - 42)$$

$$= 46.50$$

$$\text{Third quartile } (Q_3) = \frac{3(n+1)}{4} \text{th observation}$$

$$= 8.25^{\text{th}} \text{ observation}$$

$$= 65 + 0.25 \times 10$$

$$= 67.50$$

Thus applying (14.2.14), we get the quartile deviation as

$$\frac{Q_3 - Q_1}{2} = \frac{67.50 - 46.50}{2} = 10.50$$

Also, using (14.2.15), the coefficient of quartile deviation

$$= \frac{Q_3 - Q_1}{Q_3 + Q_1} \times 100$$

$$= \frac{67.50 - 46.50}{67.50 + 46.50} \times 100$$

$$= 18.42$$

Example 14.2.19 : If the quartile deviation of x is 6 and $3x + 6y = 20$, what is the quartile deviation of y?

Solution: $3x + 6y = 20$

$$\Rightarrow y = \left(\frac{20}{6}\right) + \left(\frac{-3}{6}\right)x$$

Therefore, quartile deviation of $y = \frac{|-3|}{6} \times \text{quartile deviation of } x$

$$= \frac{1}{2} \times 6$$

$$= 3.$$

Example 14.2.20: Find an appropriate measures of dispersion from the following data:

Daily wages (₹)	:	upto 20	20-40	40-60	60-80	80-100
No. of workers (₹)	:	5	11	14	7	3

Solution: Since this is an open-end classification, the appropriate measure of dispersion would be quartile deviation as quartile deviation does not taken into account the first twenty five percent and the last twenty five per cent of the observations.

Table 14.2.8
Computation of Quartile

Daily wages in (₹) (Class boundary)	No. of workers (less than cumulative frequency)
a	0
20	5
40	16
60	30
80	37
100	40

Here a denotes the first Class Boundary

$$Q_1 = ₹ \left[20 + \frac{10 - 5}{16 - 5} \times 20 \right] = ₹ 29.09$$

$$Q_3 = ₹ \left[40 + \frac{30 - 16}{30 - 16} \times 20 \right] = ₹ 60$$

$$Q_3 = ₹ 60$$

Thus quartile deviation of wages is given by

$$\frac{Q_3 - Q_1}{2}$$

$$= \frac{₹ 60 - ₹ 29.09}{2}$$

$$= ₹ 15.46$$

Example 14.2.21: The mean and variance of 5 observations are 4.80 and 6.16 respectively. If three of the observations are 2, 3 and 6, what are the remaining observations?

Solution: Let the remaining two observations be a and b, then as given

$$\frac{2+3+6+a+b}{5} = 4.80$$

$$\Rightarrow 11+a+b = 24$$

$$\Rightarrow a+b = 13 \quad \dots\dots\dots(1)$$

$$\text{and } \frac{2^2+a^2+b^2+3^2+6^2}{5} - (4.80)^2$$

$$\Rightarrow \frac{49+a^2+b^2}{5} - 23.04 = 6.16$$

$$\Rightarrow 49 + a^2 + b^2 = 146$$

$$\Rightarrow a^2 + b^2 = 97 \quad \dots\dots\dots(2)$$

$$\text{From (1), we get } a = 13 - b \quad \dots\dots\dots(3)$$

Eliminating a from (2) and (3), we get

$$(13 - b)^2 + b^2 = 97$$

$$\Rightarrow 169 - 26b + 2b^2 = 97$$

$$\Rightarrow b^2 - 13b + 36 = 0$$

$$\Rightarrow (b-4)(b-9) = 0$$

$$\Rightarrow b = 4 \text{ or } 9$$

$$\text{From (3), } a = 9 \text{ or } 4$$

Thus the remaining observations are 4 and 9.

Example 14.2.22: After shift of origin and change of scale, a frequency distribution of a continuous variable with equal class length takes the following form of the changed variable (d):

d	:	-2	-1	0	1	2
Frequency	:	17	35	28	15	5

If the mean and standard deviation of the original frequency distribution are 54.12 and 2.1784 respectively, find the original frequency distribution.

Solution: We need find out the origin A and scale C from the given conditions.

$$\text{Since } d_i = \frac{x_i - A}{C}$$

$$\Rightarrow x_i = A + Cd_i$$

Once A and C are known, the mid-values x_i 's would be known. Finally, we convert the mid-values to the corresponding class boundaries by using the formula:

$$LCB = x_i - C/2$$

and $UCB = x_i + C/2$

On the basis of the given data, we find that

$$\sum f_i d_i = -44, \sum f_i d_i^2 = 138 \text{ and } N = 100$$

$$\text{Hence } s = \sqrt{\frac{\sum f_i d_i^2}{N} - \left(\frac{\sum f_i d_i}{N}\right)^2} \times C$$

$$\Rightarrow 2.1784 = \sqrt{\frac{138}{100} - \left(\frac{-44}{100}\right)^2} \times C$$

$$\Rightarrow 2.1784 = \sqrt{1.38 - 0.1936} \times C$$

$$\Rightarrow 2.1784 = 1.0892 \times C$$

$$\Rightarrow C = 2$$

Further, $\bar{x} = A + \frac{\sum f_i d_i}{N} \times C$

$$\Rightarrow 54.12 = A + \frac{-44}{100} \times 2$$

$$\Rightarrow 54.12 = A - 0.88$$

$$\Rightarrow A = 55$$

Thus $x_i = A + C d_i$

$$\Rightarrow x_i = 55 + 2d_i$$

Table 14.2.9

Computation of the Original Frequency Distribution

d_i	f_i	$x_i =$ $55 + 2d_i$	Class interval $x_i \pm \frac{C}{2}$
-2	17	51	50-52
-1	35	53	52-54
0	28	55	54-56
1	15	57	56-58
2	5	59	58-60

Example 14.2.23: Compute coefficient of variation from the following data:

Age	:	under 10	under 20	under 30	under 40	under 50	under 60
No. of persons							
Dying	:	10	18	30	45	60	80

Solution: What is given in this problem is less than cumulative frequency distribution. We need first convert it to a frequency distribution and then compute the coefficient of variation.

Table 14.2.10

Computation of coefficient of variation

Age in years class Interval	No. of persons dying (f_i)	Mid-value (x_i)	$d_i = \frac{x_i - 25}{10}$	$f_i d_i$	$f_i d_i^2$
0-10	10	5	-2	-20	40
10-20	18-10=8	15	-1	-8	8
20-30	30-18=12	25	0	0	0
30-40	45-30=15	35	1	15	15
40-50	60-45=15	45	2	30	60
50-60	80-60=20	55	3	60	180
Total	80	-	-	77	303

The AM is given by:

$$\begin{aligned}\bar{x} &= A + \frac{\sum f_i d_i}{N} \times C \\ &= \left(25 + \frac{77}{80} \times 10 \right) \text{ years} \\ &= 34.63 \text{ years}\end{aligned}$$

The standard deviation is

$$\begin{aligned}s &= \sqrt{\frac{\sum f_i d_i^2}{N} - \left(\frac{\sum f_i d_i}{N} \right)^2} \times C \\ &= \sqrt{\frac{303}{80} - \left(\frac{77}{80} \right)^2} \times 10 \text{ years}\end{aligned}$$

$$= \sqrt{3.79 - 0.93} \times 10 \text{ years}$$

$$= 16.91 \text{ years}$$

Thus the coefficient of variation is given by

$$CV = \frac{S}{\bar{X}} \times 100$$

$$= \frac{16.91}{34.63} \times 100$$

$$= 48.83$$

Example 14.2.24: You are given the distribution of wages in two factors A and B

Wages in ₹	:	100-200	200-300	300-400	400-500	500-600	600-700
No. of workers in A	:	8	12	17	10	2	1
No. of workers in B	:	6	18	25	12	2	2

State in which factory, the wages are more variable.

Solution:

As explained in example 14.2.3, we need compare the coefficient of variation of A (i.e. v_A) and of B (i.e. v_B).

If $v_A > v_B$, then the wages of factory A would be more variable. Otherwise, the wages of factory B would be more variable where

$$V_A = 100 \times \frac{S_A}{\bar{X}_A} \quad \text{and} \quad V_B = 100 \times \frac{S_B}{\bar{X}_B}$$

Table 14.2.11

Computation of coefficient of variation of wages of Two Factories A and B

Wages in rupees	Mid-value x	d=	No. of workers of A f_A	No. of workers of B f_B	$f_A d$	$f_A d^2$	$f_B d$	$f_B d^2$
(1)	(2)	(3)	(4)	(5)	(6)=(3)×(4)	(7)=(3)×(6)	(8)=(3)×(5)	(9)=(3)×(8)
100-200	150	-2	8	6	-16	32	-12	24
200-300	250	-1	12	18	-12	12	-18	18
300-400	350	0	17	25	0	0	0	0
400-500	450	1	10	12	10	10	12	12
500-600	550	2	2	2	4	8	4	8
600-700	650	3	1	2	3	9	6	18
Total	-	-	50	65	-11	71	-8	80

For Factory A

$$\bar{x}_A = ₹ \left(350 + \frac{-11}{50} \times 100 \right) = ₹ 328$$

$$S_A = ₹ \sqrt{\frac{71}{50} - \left(\frac{-11}{50} \right)^2} \times 100 = ₹ 117.12$$

$$\therefore V_A = \frac{S_A}{\bar{x}_A} \times 100 = 35.71$$

For Factory B

$$\bar{x}_B = ₹ \left(350 + \frac{-8}{65} \times 100 \right) = ₹ 337.69$$

$$S_B = ₹ \sqrt{\frac{80}{65} - \left(\frac{-8}{65} \right)^2} \times 100$$

$$= ₹ 110.25$$

$$\therefore V_B = \frac{110.25}{337.69} \times 100 = 32.65$$

As $V_A > V_B$, the wages for factory A is more variable.



SUMMARY

- ◆ Standard deviation is the most widely and commonly used measure of dispersion
- ◆ Range is the quickest to compute and as such, has its application in statistical quality control. However, range is based on only two observations and affected too much by the presence of extreme observation(s).
- ◆ Mean deviation is rigidly defined, based on all the observations and not much affected by sampling fluctuations. However, mean deviation is difficult to comprehend and its computation is also time consuming and laborious. Furthermore, unlike SD, mean deviation does not possess mathematical properties.
- ◆ Quartile deviation is also rigidly defined, easy to compute and not much affected by sampling fluctuations. The presence of extreme observations has no impact on quartile deviation since quartile deviation is based on the central fifty-percent of the observations. However, quartile deviation is not based on all the observations and it has no desirable mathematical properties. Nevertheless, quartile deviation is the best measure of dispersion for open-end classifications.

 **EXERCISE — UNIT-II****Set A**

Write down the correct answers. Each question carries one mark.

1. Which of the following statements is correct?
 - (a) Two distributions may have identical measures of central tendency and dispersion.
 - (b) Two distributions may have the identical measures of central tendency but different measures of dispersion.
 - (c) Two distributions may have the different measures of central tendency but identical measures of dispersion.
 - (d) All the statements (a), (b) and (c).
2. Dispersion measures
 - (a) The scatterness of a set of observations
 - (b) The concentration of a set of observations
 - (c) Both (a) and (b)
 - (d) Neither (a) and (b).
3. When it comes to comparing two or more distributions we consider
 - (a) Absolute measures of dispersion
 - (b) Relative measures of dispersion
 - (c) Both (a) and (b)
 - (d) Either (a) or (b).
4. Which one is easiest to compute?
 - (a) Relative measures of dispersion
 - (b) Absolute measures of dispersion
 - (c) Both (a) and (b)
 - (d) Range
5. Which one is an absolute measure of dispersion?
 - (a) Range
 - (b) Mean Deviation
 - (c) Standard Deviation
 - (d) All these measures
6. Which measure of dispersion is most usefull?
 - (a) Standard deviation
 - (b) Quartile deviation
 - (c) Mean deviation
 - (d) Range
7. Which measures of dispersions is not affected by the presence of extreme observations?
 - (a) Range
 - (b) Mean deviation
 - (c) Standard deviation
 - (d) Quartile deviation
8. Which measure of dispersion is based on the absolute deviations only?
 - (a) Standard deviation
 - (b) Mean deviation
 - (c) Quartile deviation
 - (d) Range

9. Which measure is based on only the central fifty percent of the observations?
- (a) Standard deviation (b) Quartile deviation
(c) Mean deviation (d) All these measures
10. Which measure of dispersion is based on all the observations?
- (a) Mean deviation (b) Standard deviation
(c) Quartile deviation (d) (a) and (b) but not (c)
11. The appropriate measure of dispersion for open-end classification is
- (a) Standard deviation (b) Mean deviation
(c) Quartile deviation (d) All these measures.
12. The most commonly used measure of dispersion is
- (a) Range (b) Standard deviation
(c) Coefficient of variation (d) Quartile deviation.
13. Which measure of dispersion has some desirable mathematical properties?
- (a) Standard deviation (b) Mean deviation
(c) Quartile deviation (d) All these measures
14. If the profits of a company remains the same for the last ten months, then the standard deviation of profits for these ten months would be ?
- (a) Positive (b) Negative (c) Zero (d) (a) or (c)
15. Which measure of dispersion is considered for finding a pooled measure of dispersion after combining several groups?
- (a) Mean deviation (b) Standard deviation
(c) Quartile deviation (d) Any of these
16. A shift of origin has no impact on
- (a) Range (b) Mean deviation
(c) Standard deviation (d) All these and quartile deviation.
17. The range of 15, 12, 10, 9, 17, 20 is
- (a) 5 (b) 12 (c) 13 (d) 11.
18. The standard deviation of 10, 16, 10, 16, 10, 10, 16, 16 is
- (a) 4 (b) 6 (c) 3 (d) 0.
19. For any two numbers SD is always
- (a) Twice the range (b) Half of the range
(c) Square of the range (d) None of these.

20. If all the observations are increased by 10, then
- SD would be increased by 10
 - Mean deviation would be increased by 10
 - Quartile deviation would be increased by 10
 - All these three remain unchanged.
21. If all the observations are multiplied by 2, then
- New SD would be also multiplied by 2
 - New SD would be half of the previous SD
 - New SD would be increased by 2
 - New SD would be decreased by 2.

Set B

Write down the correct answers. Each question carries two marks.

1. What is the coefficient of range for the following wages of 8 workers?
₹ 80, ₹ 65, ₹ 90, ₹ 60, ₹ 75, ₹ 70, ₹ 72, ₹ 85.
- ₹ 30
 - ₹ 20
 - 30
 - 20
2. If R_x and R_y denote ranges of x and y respectively where x and y are related by $3x+2y+10=0$, what would be the relation between x and y ?
- $R_x = R_y$
 - $2 R_x = 3 R_y$
 - $3 R_x = 2 R_y$
 - $R_x = 2 R_y$
3. What is the coefficient of range for the following distribution?
- | Class Interval : | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 |
|------------------|-------|-------|-------|-------|-------|
| Frequency: | 11 | 25 | 16 | 7 | 3 |
- 22
 - 50
 - 72.46
 - 75.82
4. If the range of x is 2, what would be the range of $-3x + 50$?
- 2
 - 6
 - 6
 - 44
5. What is the value of mean deviation about mean for the following numbers?
5, 8, 6, 3, 4.
- 5.20
 - 7.20
 - 1.44
 - 2.23
6. What is the value of mean deviation about mean for the following observations?
50, 60, 50, 50, 60, 60, 60, 50, 50, 50, 60, 60, 60, 50.
- 5
 - 7
 - 35
 - 10
7. The coefficient of mean deviation about mean for the first 9 natural numbers is
- 200/9
 - 80
 - 400/9
 - 50.

8. If the relation between x and y is $5y - 3x = 10$ and the mean deviation about mean for x is 12, then the mean deviation of y about mean is
- (a) 7.20 (b) 6.80 (c) 20 (d) 18.80.
9. If two variables x and y are related by $2x + 3y - 7 = 0$ and the mean and mean deviation about mean of x are 1 and 0.3 respectively, then the coefficient of mean deviation of y about its mean is
- (a) -5 (b) 12 (c) 50 (d) 4.
10. The mean deviation about mode for the numbers $4/11, 6/11, 8/11, 9/11, 12/11, 8/11$ is
- (a) $1/6$ (b) $1/11$ (c) $6/11$ (d) $5/11$.
11. What is the standard deviation of 5, 5, 9, 9, 9, 10, 5, 10, 10?
- (a) $\sqrt{14}$ (b) $\frac{\sqrt{42}}{3}$ (c) 4.50 (d) 8
12. If the mean and SD of x are a and b respectively, then the SD of $\frac{x-a}{b}$ is
- (a) -1 (b) 1 (c) ab (d) a/b .
13. What is the coefficient of variation of the following numbers?
53, 52, 61, 60, 64.
- (a) 8.09 (b) 18.08 (c) 20.23 (d) 20.45
14. If the SD of x is 3, what is the variance of $(5-2x)$?
- (a) 36 (b) 6 (c) 1 (d) 9
15. If x and y are related by $2x+3y+4 = 0$ and SD of x is 6, then SD of y is
- (a) 22 (b) 4 (c) $\sqrt{5}$ (d) 9.
16. The quartiles of a variable are 45, 52 and 65 respectively. Its quartile deviation is
- (a) 10 (b) 20 (c) 25 (d) 8.30.
17. If x and y are related as $3x+4y = 20$ and the quartile deviation of x is 12, then the quartile deviation of y is
- (a) 16 (b) 14 (c) 10 (d) 9.
18. If the SD of the 1st n natural numbers is 2, then the value of n must be
- (a) 2 (b) 7 (c) 6 (d) 5.
19. If x and y are related by $y = 2x + 5$ and the SD and AM of x are known to be 5 and 10 respectively, then the coefficient of variation of y is
- (a) 25 (b) 30 (c) 40 (d) 20.

20. The mean and SD for a, b and 2 are 3 and $\frac{2}{\sqrt{3}}$ respectively, The value of ab would be
 (a) 5 (b) 6 (c) 11 (d) 3.

Set C

Write down the correct answer. Each question carries 5 marks.

1. What is the mean deviation about mean for the following distribution?

Variable:	5	10	15	20	25	30
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Frequency:	3	4	6	5	3	2
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(a) 6.00 (b) 5.93 (c) 6.07 (d) 7.20

2. What is the mean deviation about median for the following data?

X :	3	5	7	9	11	13	15
-----	---	---	---	---	----	----	----

F :	2	8	9	16	14	7	4
-----	---	---	---	----	----	---	---

(a) 2.50 (b) 2.46 (c) 2.43 (d) 2.37

3. What is the coefficient of mean deviation for the following distribution of heights? Take deviation from AM.

Height in inches:	60-62	63-65	66-68	69-71	72-74
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No. of students:	5	22	28	17	3
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(a) 2.31 inches (b) 3.45 inches (c) 3.82 inches (d) 2.48 inches

4. The mean deviation of weights about median for the following data:

Weight (lb) :	131-140	141-150	151-160	161-170	171-180	181-190
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No. of persons :	3	8	13	15	6	5
------------------	---	---	----	----	---	---

Is given by

(a) 10.97 (b) 8.23 (c) 9.63 (d) 11.45.

5. What is the standard deviation from the following data relating to the age distribution of 200 persons?

Age (year) :	20	30	40	50	60	70	80
--------------	----	----	----	----	----	----	----

No. of people:	13	28	31	46	39	23	20
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(a) 15.29 (b) 16.87 (c) 18.00 (d) 17.52

6. What is the coefficient of variation for the following distribution of wages?

Daily Wages (₹):	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80	80 – 90
------------------	---------	---------	---------	---------	---------	---------

No. of workers	17	28	21	15	13	6
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(a) ₹ 14.73 (b) 14.73 (c) 26.93 (d) 20.82

7. Which of the following companies A and B is more consistent so far as the payment of dividend is concerned ?

Dividend paid by A : 5 9 6 12 15 10 8 10

Dividend paid by B : 4 8 7 15 18 9 6 6

(a) A (b) B (c) Both (a) and (b) (d) Neither (a) nor (b)

8. The mean and SD for a group of 100 observations are 65 and 7.03 respectively. If 60 of these observations have mean and SD as 70 and 3 respectively, what is the SD for the group comprising 40 observations?

(a) 16 (b) 25 (c) 4 (d) 2

9. If two samples of sizes 30 and 20 have means as 55 and 60 and variances as 16 and 25 respectively, then what would be the SD of the combined sample of size 50?

(a) 5.00 (b) 5.06 (c) 5.23 (d) 5.35

10. The mean and SD of a sample of 100 observations were calculated as 40 and 5.1 respectively by a CA student who took one of the observations as 50 instead of 40 by mistake. The current value of SD would be

(a) 4.90 (b) 5.00 (c) 4.88 (d) 4.85.

11. The value of appropriate measure of dispersion for the following distribution of daily wages

Wages (₹):	Below 30	30-39	40-49	50-59	60-79	Above 80
No. of workers	5	7	18	32	28	10

is given by

(a) ₹ 11.03 (b) ₹ 10.50 (c) 11.68 (d) ₹ 11.68.

UNIT-II: ANSWERS

Set A

1. (d) 2. (a) 3. (b) 4. (d) 5. (d) 6. (a)
 7. (d) 8. (b) 9. (b) 10. (d) 11. (c) 12. (b)
 13. (a) 14. (c) 15. (b) 16. (d) 17. (d) 18. (c)
 19. (b) 20. (d) 21. (a)

Set B

1. (d) 2. (c) 3. (c) 4. (b) 5. (c) 6. (a)
 7. (c) 8. (a) 9. (b) 10. (a) 11. (b) 12. (b)
 13. (a) 14. (a) 15. (b) 16. (a) 17. (d) 18. (b)
 19. (c) 20. (c)

Set C

1. (c) 2. (d) 3. (a) 4. (a) 5. (b) 6. (c)
 7. (a) 8. (c) 9. (b) 10. (b) 11. (a)

ADDITIONAL QUESTION BANK

1. The number of measures of central tendency is
(a) two (b) three (c) four (d) five
2. The words "mean" or "average" only refer to
(a) A.M (b) G.M (c) H.M (d) none
3. _____ is the most stable of all the measures of central tendency.
(a) G.M (b) H.M (c) A.M (d) none.
4. Mean is of _____ types.
(a) 3 (b) 4 (c) 8 (d) 5
5. Weighted A.M is related to
(a) G.M (b) frequency (c) H.M (d) none.
6. Frequencies are also called as weights.
(a) True (b) false (c) both (d) none
7. The algebraic sum of deviations of observations from their A.M is
(a) 2 (b) -1 (c) 1 (d) 0
8. G.M of a set of n observations is the _____ root of their product.
(a) $n/2$ th (b) $(n+1)$ th (c) n th (d) $(n-1)$ th
9. The algebraic sum of deviations of 8, 1, 6 from the A.M viz.5 is
(a) -1 (b) 0 (c) 1 (d) none
10. G.M of 8, 4, 2 is
(a) 4 (b) 2 (c) 8 (d) none
11. _____ is the reciprocal of the A.M of reciprocal of observations.
(a) H.M (b) G.M (c) both (d) none
12. A.M is never less than G.M
(a) True (b) false (c) both (d) none
13. G.M is less than H.M
(a) true (b) false (c) both (d) none
14. The value of the middlemost item when they are arranged in order of magnitude is called
(a) standard deviation (b) mean (c) mode (d) median
15. Median is unaffected by extreme values.
(a) true (b) false (c) both (d) none

16. Median of 2, 5, 8, 4, 9, 6, 71 is
(a) 9 (b) 8 (c) 5 (d) 6
17. The value which occurs with the maximum frequency is called
(a) median (b) mode (c) mean (d) none
18. In the formula $\text{Mode} = L_1 + (d_1 \times c) / (d_1 + d_2)$
 d_1 is the difference of frequencies in the modal class & the _____ class.
(a) preceding (b) following (c) both (d) none
19. In the formula $\text{Mode} = L_1 + (d_1 \times c) / (d_1 + d_2)$
 d_2 is the difference of frequencies in the modal class & the _____ class.
(a) preceding (b) succeeding (c) both (d) none
20. In formula of median for grouped frequency distribution N is
(a) total frequency (b) frequency density
(c) frequency (d) cumulative frequency
21. When all observations occur with equal frequency _____ does not exist.
(a) median (b) mode (c) mean (d) none
22. Mode of the observations 2, 5, 8, 4, 3, 4, 4, 5, 2, 4, 4 is
(a) 3 (b) 2 (c) 5 (d) 4
23. For the observations 5, 3, 6, 3, 5, 10, 7, 2 there are _____ modes.
(a) 2 (b) 3 (c) 4 (d) 5
24. _____ of a set of observations is defined to be their sum, divided by the no. of observations.
(a) H.M (b) G.M (c) A.M (d) none
25. Simple average is sometimes called
(a) weighted average (b) unweighted average
(c) relative average (d) none
26. When a frequency distribution is given, the frequencies themselves treated as weights.
(a) True (b) false (c) both (d) none
27. Each value is considered only once for
(a) simple average (b) weighted average
(c) both (d) none
28. Each value is considered as many times as it occurs for
(a) simple average (b) weighted average
(c) both (d) none

29. Multiplying the values of the variable by the corresponding weights and then dividing the sum of products by the sum of weights is
- (a) simple average (b) weighted average
(c) both (d) none
30. Simple & weighted average are equal only when all the weights are equal.
- (a) True (b) false (c) both (d) none
31. The word "average " used in "simple average" and "weighted average" generally refers to
- (a) median (b) mode (c) A.M , G.M or H.M (d) none
32. _____ average is obtained on dividing the total of a set of observations by their number
- (a) simple (b) weighted (c) both (d) none
33. Frequencies are generally used as
- (a) range (b) weights (c) mean (d) none
34. The total of a set of observations is equal to the product of their number of observations and the
- (a) A.M (b) G.M (c) H.M (d) none
35. The total of the deviations of a set of observations from their A.M is always
- (a) 0 (b) 1 (c) -1 (d) none
36. Deviation may be positive or negative or zero
- (a) true (b) false (c) both (d) none
37. The sum of the squares of deviations of a set of observations has the smallest value, when the deviations are taken from their
- (a) A.M (b) H.M (c) G.M (d) none
38. For a given set of positive observations H.M is less than G.M
- (a) true (b) false (c) both (d) none
39. For a given set of positive observations A.M is greater than G.M
- (a) true (b) false (c) both (d) none
40. Calculation of G.M is more difficult than
- (a) A.M (b) H.M (c) median (d) none
41. _____ has a limited use
- (a) A.M (b) G.M (c) H.M (d) (b) and (c)
42. A.M of 8, 1, 6 is
- (a) 5 (b) 6 (c) 4 (d) none

43. _____ can be calculated from a frequency distribution with open end intervals
(a) Median (b) Mean (c) Mode (d) none
44. The values of all items are taken into consideration in the calculation of
(a) median (b) mean (c) mode (d) none
45. The values of extreme items do not influence the average in case of
(a) median (b) mean (c) mode (d) none
46. In a distribution with a single peak and moderate skewness to the right, it is closer to the concentration of the distribution in case of
(a) mean (b) median (c) both (d) none
47. If the variables x & z are so related that $z = ax + b$ for each $x = x_i$ where a & b are constants, then $\bar{z} = a\bar{x} + b$
(a) true (b) false (c) both (d) none
48. G.M is defined only when
(a) all observations have the same sign and none is zero
(b) all observations have the different sign and none is zero
(c) all observations have the same sign and one is zero
(d) all observations have the different sign and one is zero
49. _____ is useful in averaging ratios, rates and percentages.
(a) A.M (b) G.M (c) H.M (d) Both (b) and (c)
50. G.M is useful in construction of index number.
(a) true (b) false (c) both (d) none
51. More laborious numerical calculations involves in G.M than A.M
(a) True (b) false (c) both (d) none
52. H.M is defined when no observation is
(a) 3 (b) 2 (c) 1 (d) 0
53. When all values occur with equal frequency, there is no
(a) mode (b) mean (c) median (d) none
54. _____ cannot be treated algebraically
(a) mode (b) mean (c) median (d) Both (a) and (c)
55. For the calculation of _____, the data must be arranged in the form of a frequency distribution.
(a) median (b) mode (c) mean (d) none

56. _____ is equal to the value corresponding to cumulative frequency
(a) mode (b) mean (c) median (d) none
57. _____ is the value of the variable corresponding to the highest frequency
(a) mode (b) mean (c) median (d) none
58. The class in which mode belongs is known as
(a) median class (b) mean class (c) modal class (d) none
59. The formula of mode is applicable if classes are of _____ width.
(a) equal (b) unequal (c) both (d) none
60. For calculation of _____ we have to construct cumulative frequency distribution
(a) mode (b) median (c) mean (d) none
61. For calculation of _____ we have to construct a grouped frequency distribution
(a) median (b) mode (c) mean (d) none
62. Relation between mean, median & mode is
(a) mean - mode = 2 (mean - median) (b) mean - median = 3 (mean - mode)
(c) mean - median = 2 (mean - mode) (d) mean - mode = 3 (mean - median)
63. When the distribution is symmetrical, mean, median and mode
(a) coincide (b) do not coincide (c) both (d) none
64. Mean, median & mode are equal for the
(a) Binomial distribution (b) Normal distribution
(c) both (d) none
65. In most frequency distributions, it has been observed that the three measures of central tendency viz. mean, median & mode, obey the approximate relation, provided the distribution is
(a) very skew (b) not very skew (c) both (d) none
66. _____ divides the total number of observations into two equal parts.
(a) mode (b) mean (c) median (d) none
67. Measures which are used to divide or partition the observations into a fixed number of parts are collectively known as
(a) partition values (b) quartiles (c) both (d) none
68. The middle most value of a set of observations is
(a) median (b) mode (c) mean (d) none
69. The number of observations smaller than _____ is the same as the number larger than it.
(a) median (b) mode (c) mean (d) none

* Question no. 64 is based on theoretical distribution.

70. _____ is the value of the variable corresponding to cumulative frequency $N/2$
(a) mode (b) mean (c) median (d) none
71. _____ divide the total no. observations into 4 equal parts.
(a) median (b) deciles (c) quartiles (d) percentiles
72. _____ quartile is known as Upper quartile
(a) First (b) Second (c) Third (d) none
73. Lower quartile is
(a) first quartile (b) second quartile (c) upper quartile (d) none
74. The number of observations smaller than lower quartile is the same as the no. lying between lower and middle quartile.
(a) true (b) false (c) both (d) none
75. _____ are used for measuring central tendency, dispersion & skewness.
(a) Median (b) Deciles (c) Percentiles (d) Quartiles.
76. The second quartile is known as
(a) median (b) lower quartile (c) upper quartile (d) none
77. The lower & upper quartiles are used to define
(a) standard deviation (b) quartile deviation
(c) both (d) none
78. Three quartiles are used in
(a) Pearson's formula (b) Bowley's formula
(c) both (d) none
79. Less than First quartile, the frequency is equal to
(a) $N/4$ (b) $3N/4$ (c) $N/2$ (d) none
80. Between first & second quartile, the frequency is equal to
(a) $3N/4$ (b) $N/2$ (c) $N/4$ (d) none
81. Between second & upper quartile, the frequency is equal to
(a) $3N/4$ (b) $N/4$ (c) $N/2$ (d) none
82. Above upper quartile, the frequency is equal to
(a) $N/4$ (b) $N/2$ (c) $3N/4$ (d) none
83. Corresponding to first quartile, the cumulative frequency is
(a) $N/2$ (b) $N/4$ (c) $3N/4$ (d) none

* Question no. 78 is based on skewness, which is not in syllabus.

84. Corresponding to second quartile, the cumulative frequency is
(a) $N/4$ (b) $2N/4$ (c) $3N/4$ (d) none
85. Corresponding to upper quartile, the cumulative frequency is
(a) $3N/4$ (b) $N/4$ (c) $2N/4$ (d) none
86. The values which divide the total number of observations into 10 equal parts are
(a) quartiles (b) percentiles (c) deciles (d) none
87. There are _____ deciles.
(a) 7 (b) 8 (c) 9 (d) 10
88. Corresponding to first decile, the cumulative frequency is
(a) $N/10$ (b) $2N/10$ (c) $9N/10$ (d) none
89. Fifth decile is equal to
(a) mode (b) median (c) mean (d) none
90. The values which divide the total number of observations into 100 equal parts is
(a) percentiles (b) quartiles (c) deciles (d) none
91. Corresponding to second decile, the cumulative frequency is
(a) $N/10$ (b) $2N/10$ (c) $5N/10$ (d) none
92. There are _____ percentiles.
(a) 100 (b) 98 (c) 97 (d) 99
93. 10th percentile is equal to
(a) 1st decile (b) 10th decile (c) 9th decile (d) none
94. 50th percentile is known as
(a) 50th decile (b) 50th quartile (c) mode (d) median
95. 20th percentile is equal to
(a) 19th decile (b) 20th decile (c) 2nd decile (d) none
96. $(3^{\text{rd}} \text{ quartile} - 1^{\text{st}} \text{ quartile})/2$ is
(a) skewness (b) median (c) quartile deviation (d) none
97. 1st percentile is less than 2nd percentile.
(a) true (b) false (c) both (d) none
98. 25th percentile is equal to
(a) 1st quartile (b) 25th quartile (c) 24th quartile (d) none
99. 90th percentile is equal to
(a) 9th quartile (b) 90th decile (c) 9th decile (d) none

100. 1st decile is greater than 2nd decile
(a) True (b) false (c) both (d) none
101. Quartile deviation is a measure of dispersion.
(a) true (b) false (c) both (d) none
102. To define quartile deviation we use
(a) lower & middle quartiles (b) lower & upper quartiles
(c) upper & middle quartiles (d) none
103. Calculation of quartiles, deciles, percentiles may be obtained graphically from
(a) Frequency Polygon (b) Histogram (c) Ogive (d) none
104. 7th decile is the abscissa of that point on the Ogive whose ordinate is
(a) $7N/10$ (b) $8N/10$ (c) $6N/10$ (d) none
105. Rank of median is
(a) $(n+1)/2$ (b) $(n+1)/4$ (c) $3(n+1)/4$ (d) none
106. Rank of 1st quartile is
(a) $(n+1)/2$ (b) $(n+1)/4$ (c) $3(n+1)/4$ (d) none
107. Rank of 3rd quartile is
(a) $3(n+1)/4$ (b) $(n+1)/4$ (c) $(n+1)/2$ (d) none
108. Rank of kth decile is
(a) $(n+1)/2$ (b) $(n+1)/4$ (c) $(n+1)/10$ (d) $k(n+1)/10$
109. Rank of kth percentile is
(a) $(n+1)/100$ (b) $k(n+1)/10$ (c) $k(n+1)/100$ (d) none
110. _____ is equal to value corresponding to cumulative frequency $(N+1)/2$ from simple frequency distribution
(a) Median (b) 1st quartile (c) 3rd quartile (d) 4th quartile
111. _____ is equal to the value corresponding to cumulative frequency $(N+1)/4$ from simple frequency distribution
(a) Median (b) 1st quartile (c) 3rd quartile (d) 1st decile
112. _____ is equal to the value corresponding to cumulative frequency $3(N+1)/4$ from simple frequency distribution
(a) Median (b) 1st quartile (c) 3rd quartile (d) 1st decile
113. _____ is equal to the value corresponding to cumulative frequency $k(N+1)/10$ from simple frequency distribution
(a) Median (b) kth decile (c) kth percentile (d) none

114. _____ is equal to the value corresponding to cumulative frequency $k(N + 1)/100$ from simple frequency distribution
(a) k^{th} decile (b) k^{th} percentile (c) both (d) none
115. For grouped frequency distribution _____ is equal to the value corresponding to cumulative frequency $N/2$
(a) median (b) 1st quartile (c) 3rd quartile (d) none
116. For grouped frequency distribution _____ is equal to the value corresponding to cumulative frequency $N/4$
(a) median (b) 1st quartile (c) 3rd quartile (d) none
117. For grouped frequency distribution _____ is equal to the value corresponding to cumulative frequency $3N/4$
(a) median (b) 1st quartile (c) 3rd quartile (d) none
118. For grouped frequency distribution _____ is equal to the value corresponding to cumulative frequency $kN/10$
(a) median (b) k^{th} percentile (c) k^{th} decile (d) none
119. For grouped frequency distribution _____ is equal to the value corresponding to cumulative frequency $kN/100$
(a) k^{th} quartile (b) k^{th} percentile (c) k^{th} decile (d) none
120. In Ogive, abscissa corresponding to ordinate $N/2$ is
(a) median (b) 1st quartile (c) 3rd quartile (d) none
121. In Ogive, abscissa corresponding to ordinate $N/4$ is
(a) median (b) 1st quartile (c) 3rd quartile (d) none
122. In Ogive, abscissa corresponding to ordinate $3N/4$ is
(a) median (b) 3rd quartile (c) 1st quartile (d) none
123. In Ogive, abscissa corresponding to ordinate _____ is k^{th} decile.
(a) $kN/10$ (b) $kN/100$ (c) $kN/50$ (d) none
124. In Ogive, abscissa corresponding to ordinate _____ is k^{th} percentile.
(a) $kN/10$ (b) $kN/100$ (c) $kN/50$ (d) none
125. For 899, 999, 391, 384, 590, 480, 485, 760, 111, 240
Rank of median is
(a) 2.75 (b) 5.5 (c) 8.25 (d) none
126. For 333, 999, 888, 777, 666, 555, 444
Rank of 1st quartile is
(a) 3 (b) 1 (c) 2 (d) 7

127. For 333, 999, 888, 777, 1000, 321, 133
Rank of 3rd quartile is
(a) 7 (b) 4 (c) 5 (d) 6
128. Price per kg.(₹) : 45 50 35; Kgs.Purchased : 100 40 60 Total frequency is
(a) 300 (b) 100 (c) 150 (d) 200
129. The length of a rod is measured by a tape 10 times. You are to estimate the length of the rod by averaging these 10 determinations.
What is the suitable form of average in this case?
(a) A.M (b) G.M (c) H.M (d) none
130. A person purchases 5 rupees worth of eggs from 10 different markets.You are to find the average no. of eggs per rupee for all the markets taken together. What is the suitable form of average in this case?
(a) A.M (b) G.M (c) H.M (d) none
131. You are given the population of India for the courses of 1981 & 1991. You are to find the population of India at the middle of the period by averaging these population figures, assuming a constant rate of increase of population.
What is the suitable form of average in this case?
(a) A.M (b) G.M (c) H.M (d) none
132. _____ is least affected by sampling fluctuations.
(a) Standard deviation (b) Quartile deviation
(c) both (d) none
133. “Root –Mean Square Deviation from Mean“ is
(a) Standard deviation (b) Quartile deviation
(c) both (d) none
134. Standard Deviation is
(a) absolute measure (b) relative measure (c) both (d) none
135. Coefficient of variation is
(a) absolute measure (b) relative measure (c) both (d) none
136. _____ deviation is called semi-interquartile range.
(a) Percentile (b) Standard (c) Quartile (d) none
137. _____ Deviation is defined as half the difference between the lower & upper quartiles.
(a) Quartile (b) Standard (c) both (d) none

138. Quartile Deviation for the data 1, 3, 4, 5, 6, 6, 10 is
(a) 3 (b) 1 (c) 6 (d) 1.5
139. Coefficient of Quartile Deviation is
(a) $(\text{Quartile Deviation} \times 100) / \text{Median}$ (b) $(\text{Quartile Deviation} \times 100) / \text{Mean}$
(c) $(\text{Quartile Deviation} \times 100) / \text{Mode}$ (d) none
140. Mean for the data 6, 4, 1, 6, 5, 10, 3 is
(a) 7 (b) 5 (c) 6 (d) none
141. Coefficient of variation = $(\text{Standard Deviation} \times 100) / \text{Mean}$
(a) true (b) false (c) both (d) none
142. If mean = 5, Standard deviation = 2.6 then the coefficient of variation is
(a) 49 (b) 51 (c) 50 (d) 52
143. If median = 5, Quartile deviation = 1.5 then the coefficient of quartile deviation is
(a) 33 (b) 35 (c) 30 (d) 20
144. A.M of 2, 6, 4, 1, 8, 5, 2 is
(a) 4 (b) 3 (c) 4 (d) none
145. Most useful among all measures of dispersion is
(a) S.D (b) Q.D (c) Mean deviation (d) none
146. For the observations 6, 4, 1, 6, 5, 10, 4, 8 Range is
(a) 10 (b) 9 (c) 8 (d) none
147. A measure of central tendency tries to estimate the
(a) central value (b) lower value (c) upper value (d) none
148. Measures of central tendency are known as
(a) differences (b) averages (c) both (d) none
149. Mean is influenced by extreme values.
(a) true (b) false (c) both (d) none
150. Mean of 6, 7, 11, 8 is
(a) 11 (b) 6 (c) 7 (d) 8
151. The sum of differences between the actual values and the arithmetic mean is
(a) 2 (b) -1 (c) 0 (d) 1
152. When the algebraic sum of deviations from the arithmetic mean is not equal to zero, the figure of arithmetic mean _____ correct.
(a) is (b) is not (c) both (d) none

153. In the problem

No. of shirts:	30–32	33–35	36–38	39–41	42–44
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No. of persons:	15	14	42	27	18
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The assumed mean is

(a) 34 (b) 37 (c) 40 (d) 43

154. In the problem

Size of items:	1–3	3–8	8–15	15–26
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Frequency:	5	10	16	15
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The assumed mean is

(a) 20.5 (b) 2 (c) 11.5 (d) 5.5

155. The average of a series of overlapping averages, each of which is based on a certain number of item within a series is known as

(a) moving average (b) weighted average
(c) simple average (d) none

156. _____ averages is used for smoothening a time series.

(a) moving average (b) weighted average
(c) simple average (d) none

157. Pooled Mean is also called

(a) Mean (b) Geometric Mean (c) Grouped Mean (d) none

158. Half of the numbers in an ordered set have values less than the _____ and half will have values greater than the _____.

(a) mean, median (b) median, median (c) mode, mean (d) none.

159. The median of 27, 30, 26, 44, 42, 51, 37 is

(a) 30 (b) 42 (c) 44 (d) 37

160. For an even number of values the median is the

(a) average of two middle values (b) middle value
(c) both (d) none

161. In the case of a continuous frequency distribution, the size of the _____ item indicates class interval in which the median lies.

(a) $(n-1)/2^{\text{th}}$ (b) $(n+1)/2^{\text{th}}$ (c) $n/2^{\text{th}}$ (d) none

162. The deviations from median are _____ if negative signs are ignored as compared to other measures of central tendency.

(a) minimum (b) maximum (c) same (d) none

* Question no. 155 and 156 is based on moving averages, which is not in foundation syllabus.

163. Ninth Decile lies in the class interval of the item
 (a) $n/9$ (b) $9n/10$ (c) $9n/20$ (d) none item.
164. Ninety Ninth Percentile lies in the class interval of the item
 (a) $99n/100$ (b) $99n/10$ (c) $99n/200$ (d) none item.
165. _____ is the value of the variable at which the concentration of observation is the densest.
 (a) mean (b) median (c) mode (d) none
166. Height in cms: 60–62 63–65 66–68 69–71 72–74
 No. of students: 15 118 142 127 18
 Modal group is
 (a) 66–68 (b) 69–71 (c) 63–65 (d) none
167. A distribution is said to be symmetrical when the frequency rises & falls from the highest value in the _____ proportion.
 (a) unequal (b) equal (c) both (d) none
168. _____ always lies in between the arithmetic mean & mode.
 (a) G.M (b) H.M (c) Median (d) none
169. Logarithm of G.M is the _____ of logarithms of the different values.
 (a) weighted mean (b) simple mean (c) both (d) none
170. _____ is not much affected by fluctuations of sampling.
 (a) A.M (b) G.M (c) H.M (d) none
171. The data 1, 2, 4, 8, 16 are in
 (a) Arithmetic progression (b) Geometric progression
 (c) Harmonic progression (d) none
172. _____ & _____ can not be calculated if any observation is zero.
 (a) G.M & A.M (b) H.M & A.M (c) H.M & G. M (d) None.
173. _____ & _____ are called ratio averages.
 (a) H.M & G.M (b) H. M & A.M (c) A.M & G.M (d) none
174. _____ is a good substitute to a weighted average.
 (a) A.M (b) G.M (c) H.M (d) none
175. For ordering shoes of various sizes for resale, a _____ size will be more appropriate.
 (a) median (b) modal (c) mean (d) none
176. _____ is called a positional measure.
 (a) mean (b) mode (c) median (d) none

* Question no. 174 is not in foundation syllabus.

177. 50% of actual values will be below & 50% of will be above _____
(a) mode (b) median (c) mean (d) none
178. Extreme values have _____ effect on mode.
(a) high (b) low (c) no (d) none
179. Extreme values have _____ effect on median.
(a) high (b) low (c) no (d) none
180. Extreme values have _____ effect on A.M.
(a) greatest (b) least (c) some (d) none
181. Extreme values have _____ effect on H.M.
(a) least (b) greatest (c) medium (d) none
182. _____ is used when representation value is required & distribution is asymmetric.
(a) mode (b) mean (c) median (d) none
183. _____ is used when most frequently occurring value is required (discrete variables).
(a) mode (b) mean (c) median (d) none
184. _____ is used when rate of growth or decline required.
(a) mode (b) A.M (c) G.M (d) none
185. In finding _____, the distribution has open-end classes.
(a) median (b) mean (c) standard deviation (d) none
186. The cumulative frequency distribution is used for
(a) median (b) mode (c) mean (d) none
187. In _____ the quantities are in ratios.
(a) A.M (b) G.M (c) H.M (d) none
188. _____ is used when variability has also to be calculated.
(a) A.M (b) G.M (c) H.M (d) none
189. _____ is used when the sum of absolute deviations from the average should be least.
(a) Mean (b) Mode (c) Median (d) None
190. _____ is used when sampling variability should be least.
(a) Mode (b) Median (c) Mean (d) none
191. _____ is used when distribution pattern has to be studied at varying levels.
(a) A.M (b) Median (c) G.M (d) none

192. The average discovers
(a) uniformity in variability (b) variability in uniformity of distribution
(c) both (d) none
193. The average has relevance for
(a) homogeneous population (b) heterogeneous population
(c) both (d) none
194. The correction factor is applied in
(a) inclusive type of distribution (b) exclusive type of distribution
(c) both (d) none
195. "Mean has the least sampling variability" prove the mathematical property of mean
(a) True (b) false (c) both (d) none
196. "The sum of deviations from the mean is zero" — is the mathematical property of mean
(a) True (b) false (c) both (d) none
197. "The mean of the two samples can be combined" — is the mathematical property of mean
(a) True (b) false (c) both (d) none
198. "Choices of assumed mean does not affect the actual mean"— prove the mathematical property of mean
(a) True (b) false (c) both (d) none
199. "In a moderately asymmetric distribution mean can be found out from the given values of median & mode"— is the mathematical property of mean
(a) True (b) false (c) both (d) none
200. The mean wages of two companies are equal. It signifies that the workers of both the companies are equally well-off.
(a) True (b) false (c) both (d) none
201. The mean wage in factory A is ₹ 6,000 whereas in factory B it is ₹ 5,500. It signifies that factory A pays more to all its workers than factory B.
(a) True (b) false (c) both (d) none
202. Mean of 0, 3, 5, 6, 7, 9, 12, 0, 2 is
(a) 4.9 (b) 5.7 (c) 5.6 (d) none
203. Median of 15, 12, 6, 13, 12, 15, 8, 9 is
(a) 13 (b) 8 (c) 12 (d) 9
204. Median of 0.3, 5, 6, 7, 9, 12, 0, 2 is
(a) 7 (b) 6 (c) 3 (d) 5

205. Mode of 0, 3, 5, 6, 7, 9, 12, 0, 2 is
(a) 6 (b) 0 (c) 3 (d) 5
206. Mode of 15, 12, 5, 13, 12, 15, 8, 8, 9, 9, 10, 15 is
(a) 15 (b) 12 (c) 8 (d) 9
207. Median of 40, 50, 30, 20, 25, 35, 30, 30, 20, 30 is
(a) 25 (b) 30 (c) 35 (d) none
208. Mode of 40, 50, 30, 20, 25, 35, 30, 30, 20, 30 is
(a) 25 (b) 30 (c) 35 (d) none
209. _____ in particular helps in finding out the variability of the data.
(a) Dispersion (b) Median (c) Mode (d) None
210. Measures of central tendency are called averages of the _____ order.
(a) 1st (b) 2nd (c) 3rd (d) none
211. Measures of dispersion are called averages of the _____ order.
(a) 1st (b) 2nd (c) 3rd (d) none
212. In measuring dispersion, it is necessary to know the amount of _____ & the degree of _____.
(a) variation, variation (b) variation, median
(c) median, variation (d) none
213. The amount of variation is designated as _____ measure of dispersion.
(a) relative (b) absolute (c) both (d) none
214. The degree of variation is designated as _____ measure of dispersion.
(a) relative (b) absolute (c) both (d) none
215. For purposes of comparison between two or more series with varying size or no. of items, varying central values or units of calculation, only _____ measures can be used.
(a) absolute (b) relative (c) both (d) none
216. The relation $\text{Relative range} = \text{Absolute range} / \text{Sum of the two extremes}$ is
(a) True (b) false (c) both (d) none
217. The relation $\text{Absolute range} = \text{Relative range} / \text{Sum of the two extremes}$ is
(a) True (b) false (c) both (d) none
218. In quality control _____ is used as a substitute for standard deviation.
(a) mean deviation (b) median (c) range (d) none
219. _____ factor helps to know the value of standard deviation.
(a) Correction (b) Range (c) both (d) none

220. _____ is extremely sensitive to the size of the sample
 (a) Range (b) Mean (c) Median (d) Mode
221. As the sample size increases, _____ also tends to increase.
 (a) Range (b) Mean (c) Median (d) Mode
222. As the sample size increases, range also tends to increase though not proportionately.
 (a) true (b) false (c) both (d) none.
223. As the sample size increases, range also tends to
 (a) decrease (b) increase (c) same (d) none
224. The dependence of range on extreme items can be avoided by adopting
 (a) standard deviation (b) mean deviation (c) quartile deviation (d) none
225. Quartile deviation is called
 (a) semi inter quartile range (b) quartile range (c) both (d) none
226. When 1st quartile = 20, 3rd quartile = 30, the value of quartile deviation is
 (a) 7 (b) 4 (c) -5 (d) 5
227. $(Q_3 - Q_1)/(Q_3 + Q_1)$ is
 (a) coefficient of Quartile Deviation (b) coefficient of Mean Deviation
 (c) coefficient of Standard deviation (d) none
228. Standard deviation is denoted by
 (a) σ^2 (b) σ (c) $\sqrt{\sigma}$ (d) none
229. The square of standard deviation is known as
 (a) variance (b) standard deviation
 (c) mean deviation (d) none
230. Mean of 25, 32, 43, 53, 62, 59, 48, 31, 24, 33 is
 (a) 44 (b) 43 (c) 42 (d) 41
231. For the following frequency distribution
- | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|
| Class interval: | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 |
| Frequency: | 20 | 9 | 31 | 18 | 10 | 9 |
- assumed mean can be taken as
 (a) 55 (b) 45 (c) 35 (d) none
232. The value of the standard deviation does not depend upon the choice of the origin.
 (a) True (b) false (c) both (d) none
233. Coefficient of standard deviation is
 (a) S.D/Median (b) S.D/Mean (c) S.D/Mode (d) none

234. The value of the standard deviation will change if any one of the observations is changed.
(a). True (b) false (c) both (d) none
235. When all the values are equal then variance & standard deviation would be
(a) 2 (b) -1 (c) 1 (d) 0
236. For values lie close to the mean, the standard deviations are
(a) big (b) small (c) moderate (d) none
237. If the same amount is added to or subtracted from all the values, variance & standard deviation shall
(a) changed (b) unchanged (c) both (d) none
238. If the same amount is added to or subtracted from all the values, the mean shall increase or decrease by the _____ amount
(a) big (b) small (c) same (d) none
239. If all the values are multiplied by the same quantity, the _____ & _____ also would be multiple of the same quantity.
(a) mean, standard deviation (b) mean , median
(c) mean, mode (d) median , deviations
240. For a moderately non-symmetrical distribution, Mean deviation = $4/5$ of standard deviation
(a) true (b) false (c) both (d) none
241. For a moderately non-symmetrical distribution, Quartile deviation = Standard deviation/ 3
(a) true (b) false (c) both (d) none
242. For a moderately non-symmetrical distribution, probable error of standard deviation = Standard deviation/ 3
(a) true (b) false (c) both (d) none
243. Quartile deviation = Probable error of Standard deviation.
(a) true (b) false (c) both (d) none
244. Coefficient of Mean Deviation is
(a) Mean deviation $\times 100$ /Mean or mode (b) Standard deviation $\times 100$ /Mean or median
(c) Mean deviation $\times 100$ /Mean or median (d) none
245. Coefficient of Quartile Deviation = Quartile Deviation $\times 100$ /Median
(a) true (b) false (c) both (d) none
246. Karl Pearson's measure gives
(a) coefficient of Mean Variation (b) coefficient of Standard deviation
(c) coefficient of variation (d) none

247. In ——— range has the greatest use.
(a) Time series (b) quality control (c) both (d) none
248. Mean is an absolute measure & standard deviation is based upon it. Therefore standard deviation is a relative measure.
(a) true (b) false (c) both (d) none
249. Semi-quartile range is one-fourth of the range in a normal symmetrical distribution.
(a) Yes (b) No (c) both (d) none
250. Whole frequency table is needed for the calculation of
(a) range (b) variance (c) both (d) none
251. Relative measures of dispersion make deviations in similar units comparable.
(a) true (b) false (c) both (d) none
252. Quartile deviation is based on the
(a) highest 50% (b) lowest 25%
(c) highest 25% (d) middle 50% of the item.
253. S.D is less than Mean deviation
(a) true (b) false (c) both (d) none
254. Coefficient of variation is independent of the unit of measurement.
(a) true (b) false (c) both (d) none
255. Coefficient of variation is a relative measure of
(a) mean (b) deviation (c) range (d) dispersion.
256. Coefficient of variation is equal to
(a) Standard deviation \times 100 / median (b) Standard deviation \times 100 / mode
(c) Standard deviation \times 100 / mean (d) none
257. Coefficient of Quartile Deviation is equal to
(a) Quartile deviation \times 100 / median (b) Quartile deviation \times 100 / mean
(c) Quartile deviation \times 100 / mode (d) none
258. If each item is reduced by 15 A.M is
(a) reduced by 15 (b) increased by 15 (c) reduced by 10 (d) none
259. If each item is reduced by 10, the range is
(a) increased by 10 (b) decreased by 10 (c) unchanged (d) none
260. If each item is reduced by 20, the standard deviation
(a) increased (b) decreased (c) unchanged (d) none

261. If the variables are increased or decreased by the same amount the standard deviation is
 (a) decreased (b) increased (c) unchanged (d) none
262. If the variables are increased or decreased by the same proportion, the standard deviation changes by
 (a) same proportion (b) different proportion (c) both (d) none
263. The mean of the 1st n natural no. is
 (a) $n/2$ (b) $(n-1)/2$ (c) $(n+1)/2$ (d) none
264. If the class interval is open-end then it is difficult to find
 (a) frequency (b) A.M (c) both (d) none
265. Which one is true—
 (a) A.M = assumed mean + arithmetic mean of deviations of terms
 (b) G.M = assumed mean + arithmetic mean of deviations of terms
 (c) Both (d) none
266. If the A.M of any distribution be 25 & one term is 18. Then the deviation of 18 from A.M is
 (a) 7 (b) -7 (c) 43 (d) none
267. For finding A.M in Step-deviation method, the class intervals should be of
 (a) equal lengths (b) unequal lengths (c) maximum lengths (d) none
268. The sum of the squares of the deviations of the variable is ————— when taken about A.M
 (a) maximum (b) zero (c) minimum (d) none
269. The A.M of 1, 3, 5, 6, x, 10 is 6. The value of x is
 (a) 10 (b) 11 (c) 12 (d) none
270. The G.M of 2 & 8 is
 (a) 2 (b) 4 (c) 8 (d) none
271. $(n+1)/2$ th term is median if n is
 (a) odd (b) even (c) both (d) none
272. For the values of a variable 5, 2, 8, 3, 7, 4, the median is
 (a) 4 (b) 4.5 (c) 5 (d) none
273. The abscissa of the maximum frequency in the frequency curve is the
 (a) mean (b) median (c) mode (d) none
274. Variable: 2 3 4 5 6 7
 No. of men: 5 6 8 13 7 4
 Mode is
 (a) 6 (b) 4 (c) 5 (d) none

275. The class having maximum frequency is called
(a) modal class (b) median class (c) mean class (d) none
276. For determination of mode, the class intervals should be
(a) overlapping (b) maximum (c) minimum (d) none
277. First Quartile lies in the class interval of the
(a) $n/2^{\text{th}}$ item (b) $n/4^{\text{th}}$ item (c) $3n/4^{\text{th}}$ item (d) $n/10^{\text{th}}$ item
278. The value of a variate that occur most often is called
(a) median (b) mean (c) mode (d) none
279. For the values of a variable 3, 1, 5, 2, 6, 8, 4 the median is
(a) 3 (b) 5 (c) 4 (d) none
280. If $y = 5x - 20$ & $\bar{x} = 30$ then the value of \bar{y} is
(a) 130 (b) 140 (c) 30 (d) none
281. If $y = 3x - 100$ and $\bar{x} = 50$ then the value of \bar{y} is
(a) 60 (b) 30 (c) 100 (d) 50
282. The median of the numbers 11, 10, 12, 13, 9 is
(a) 12.5 (b) 12 (c) 10.5 (d) 11
283. The mode of the numbers 7, 7, 7, 9, 10, 11, 11, 11, 12 is
(a) 11 (b) 12 (c) 7 (d) 7 & 11
284. In a symmetrical distribution when the 3rd quartile plus 1st quartile is halved, the value would give
(a) mean (b) mode (c) median (d) none
285. In Zoology _____ is used.
(a) median (b) mean (c) mode (d) none
286. For calculation of Speed & Velocity
(a) G.M (b) A.M (c) H.M (d) none is used.
287. The S.D is always taken from
(a) median (b) mode (c) mean (d) none
288. Coefficient of Standard deviation is equal to
(a) S.D/A.M (b) A.M/S.D (c) S.D/GM (d) none
289. The distribution, for which the coefficient of variation is less, is _____ consistent.
(a) less (b) more (c) moderate (d) none

ANSWERS

- | | | | | |
|----------|----------|----------|----------|----------|
| 1. (b) | 2. (a) | 3. (c) | 4. (a) | 5. (b) |
| 6. (a) | 7. (d) | 8. (c) | 9. (b) | 10. (a) |
| 11. (a) | 12. (a) | 13. (b) | 14. (d) | 15. (a) |
| 16. (d) | 17. (b) | 18. (a) | 19. (b) | 20. (a) |
| 21. (b) | 22. (d) | 23. (a) | 24. (c) | 25. (b) |
| 26. (a) | 27. (a) | 28. (b) | 29. (b) | 30. (a) |
| 31. (c) | 32. (a) | 33. (b) | 34. (a) | 35. (a) |
| 36. (a) | 37. (a) | 38. (a) | 39. (a) | 40. (a) |
| 41. (d) | 42. (a) | 43. (a) | 44. (b) | 45. (a) |
| 46. (b) | 47. (a) | 48. (a) | 49. (d) | 50. (a) |
| 51. (a) | 52. (d) | 53. (a) | 54. (d) | 55. (b) |
| 56. (c) | 57. (a) | 58. (c) | 59. (a) | 60. (b) |
| 61. (b) | 62. (d) | 63. (a) | 64. (b) | 65. (b) |
| 66. (c) | 67. (a) | 68. (a) | 69. (a) | 70. (c) |
| 71. (c) | 72. (c) | 73. (a) | 74. (a) | 75. (d) |
| 76. (a) | 77. (b) | 78. (b) | 79. (a) | 80. (c) |
| 81. (b) | 82. (a) | 83. (b) | 84. (b) | 85. (a) |
| 86. (c) | 87. (c) | 88. (a) | 89. (b) | 90. (a) |
| 91. (b) | 92. (d) | 93. (a) | 94. (d) | 95. (c) |
| 96. (c) | 97. (a) | 98. (a) | 99. (c) | 100. (b) |
| 101. (a) | 102. (b) | 103. (c) | 104. (a) | 105. (a) |
| 106. (b) | 107. (a) | 108. (d) | 109. (c) | 110. (a) |
| 111. (b) | 112. (c) | 113. (b) | 114. (b) | 115. (a) |
| 116. (b) | 117. (c) | 118. (c) | 119. (b) | 120. (a) |
| 121. (b) | 122. (b) | 123. (a) | 124. (b) | 125. (b) |
| 126. (c) | 127. (d) | 128. (d) | 129. (a) | 130. (c) |
| 131. (b) | 132. (a) | 133. (a) | 134. (a) | 135. (b) |
| 136. (c) | 137. (a) | 138. (d) | 139. (a) | 140. (b) |
| 141. (a) | 142. (d) | 143. (c) | 144. (c) | 145. (a) |
| 146. (b) | 147. (a) | 148. (b) | 149. (a) | 150. (d) |
| 151. (c) | 152. (b) | 153. (b) | 154. (c) | 155. (a) |

- | | | | | |
|----------|----------|----------|----------|----------|
| 156. (a) | 157. (c) | 158. (b) | 159. (d) | 160. (a) |
| 161. (c) | 162. (a) | 163. (b) | 164. (a) | 165. (c) |
| 166. (a) | 167. (b) | 168. (c) | 169. (a) | 170. (b) |
| 171. (b) | 172. (c) | 173. (c) | 174. (c) | 175. (b) |
| 176. (c) | 177. (b) | 178. (c) | 179. (c) | 180. (a) |
| 181. (a) | 182. (b) | 183. (b) | 184. (c) | 185. (a) |
| 186. (a) | 187. (b) | 188. (a) | 189. (c) | 190. (c) |
| 191. (b) | 192. (a) | 193. (b) | 194. (a) | 195. (b) |
| 196. (a) | 197. (a) | 198. (a) | 199. (b) | 200. (b) |
| 201. (b) | 202. (a) | 203. (c) | 204. (d) | 205. (b) |
| 206. (a) | 207. (b) | 208. (b) | 209. (a) | 210. (a) |
| 211. (b) | 212. (a) | 213. (b) | 214. (a) | 215. (b) |
| 216. (a) | 217. (b) | 218. (c) | 219. (a) | 220. (a) |
| 221. (a) | 222. (a) | 223. (b) | 224. (c) | 225. (a) |
| 226. (d) | 227. (a) | 228. (b) | 229. (a) | 230. (d) |
| 231. (c) | 232. (a) | 233. (b) | 234. (a) | 235. (d) |
| 236. (b) | 237. (b) | 238. (c) | 239. (a) | 240. (a) |
| 241. (b) | 242. (b) | 243. (a) | 244. (d) | 245. (a) |
| 246. (c) | 247. (b) | 248. (b) | 249. (a) | 250. (c) |
| 251. (a) | 252. (d) | 253. (b) | 254. (a) | 255. (d) |
| 256. (c) | 257. (a) | 258. (a) | 259. (c) | 260. (c) |
| 261. (c) | 262. (a) | 263. (c) | 264. (b) | 265. (a) |
| 266. (b) | 267. (a) | 268. (c) | 269. (b) | 270. (b) |
| 271. (a) | 272. (b) | 273. (c) | 274. (c) | 275. (a) |
| 276. (a) | 277. (b) | 278. (c) | 279. (c) | 280. (a) |
| 281. (d) | 282. (d) | 283. (d) | 284. (c) | 285. (c) |
| 286. (c) | 287. (c) | 288. (a) | 289. (b) | |

