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CENTRAL TENDENCY

- Central tendency is the tendency of a given set of observations to cluster around a single central or middle value
- The single value that represents the given set of observations is described as a measure of central tendency.

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Different Measures of Central Tendency

- Mean
  - Arithmetic Mean
  - Geometric Mean
  - Harmonic Mean
- Partition Values
  - Median
  - Quartiles
  - Deciles
  - Percentiles
- Mode

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ARITHMETIC MEAN

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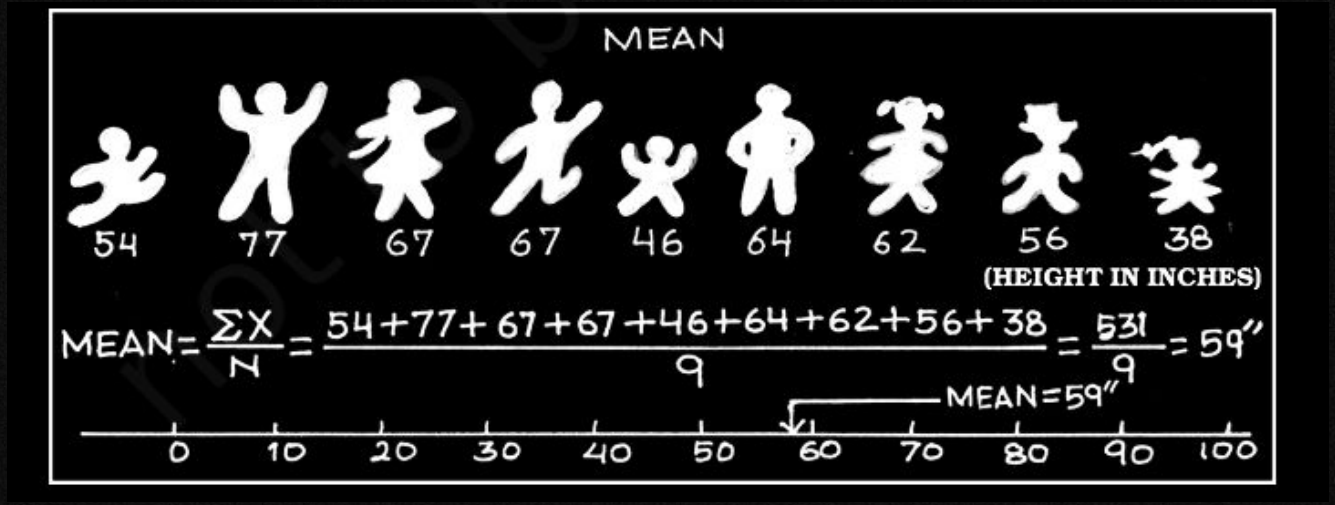

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ARITHMETIC MEAN

- AM is the sum of all the observations divided by the number of observations.

FOR DISCRETE OBSERVATIONS

$$\overline{X} = \frac{x_1 + x_2 + x_3 + \ldots\ldots\ldots\ldots + x_n}{n}$$

$$= \frac{\sum_{i=1}^{n} x_i}{n}$$

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ARITHMETIC MEAN

SIMPLE FREQUENCY DISTRIBUTION

$$\bar{x} = \frac{f_1x_1 + f_2x_2 + f_3x_3 + \ldots\ldots\ldots\ldots + f_nx_n}{f_1 + f_2 + f_3 + \ldots\ldots\ldots\ldots + f_n}$$

$$= \frac{\sum f_i x_i}{\sum f_i}$$

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

where , $N = \Sigma f_i$.

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ARITHMETIC MEAN

GROUPED FREQUENCY DISTRIBUTION

In case of grouped frequency distribution also we may use formula

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

with x_i as the mid value of the i-th class interval, on the assumption that all the values belonging to the i-th class interval are equal to x_i.

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ARITHMETIC MEAN

ASSUMED MEAN / STEP DEVIATION METHOD

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

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

A = Assumed Mean

C = Class Length

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Any mid value can be taken as A.

However, usually A is taken as the middle most mid-value for an odd number of class intervals

For an even number of class intervals any of the the two middle most mid-values can be taken.

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PROPERTIES OF ARITHMETIC MEAN

i. If all the observations are constants, say k, then the AM is also constant , k.

- For example , AM of 3 , 3 , 3 , 3 , 3 is _____

For example, if the height of every student in a group of 10 students is 170 cm, then the mean height is, of course, 170 cm.

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PROPERTIES OF ARITHMETIC MEAN

the algebraic sum of deviations of a set of observations from their AM is zero

i.e. for unclassified data , $\sum(x_i - \bar{x}) = 0$

and for grouped frequency distribution, $\sum f_i(x_i - \bar{x}) = 0$

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PROPERTIES OF ARITHMETIC MEAN

If there are two groups containing n_1 and n_2 observations and $\bar{x}_1$ and $\bar{x}_2$ as the respective arithmetic means, then the combined AM is given by

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

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CHANGE OF ORIGIN

The change of origin means that some value has been either added or subtracted to the observations.

CHANGE OF SCALE

The change of scale means that some value has been either multiplied or divided to the observations.

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PROPERTIES OF AM

- AM is affected both due to change of origin and scale.
- If y = a + b x then $\bar{y} = a + b\bar{x}$.

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MEDIAN

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MEDIAN – PARTITION VALUE

- Median is that positional value of the variable which divides the distribution into two equal parts, one part comprises all values greater than or equal to the median value and the other comprises all values less than or equal to it.
- The Median is the “middle” element when the data set is arranged in order of the magnitude.

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MEDIAN – PARTITION VALUE

FOR DISCRETE OBSERVATION

$$\text{Median} = \begin{cases} \left(\frac{n+1}{2}\right)\text{th observation, if } n \text{ is odd} \\ \dfrac{\left(\frac{n}{2}\right)\text{th observation} + \left(\frac{n}{2}+1\right)\text{th observation}}{2}, \text{ if } n \text{ is even} \end{cases}$$

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MEDIAN – PARTITION VALUE

FOR SIMPLE FREQUENCY DISTRIBUTION

- Arrange the series into ascending or descending order.
- Calculate cumulative frequency .
- Calculate $\frac{N+1}{2}$
- Check cumulative frequency which is greater than $\frac{N+1}{2}$
- The value of x corresponding to this cumulative frequency would be the median .

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FOR GROUPED FREQUENCY DISTRIBUTION

We proceed stepwise as follows:

Step 1. For the given frequency distribution and obtain $N = \Sigma f_i$.

Step 2. Find $\frac{N}{2}$.

Step 3. Look at the cumulative frequency just greater than $\frac{N}{2}$ and find the corresponding class, known as *median class* (as the middle-most observation lies in this class).

Make sure that series is exclusive .

Arrange the series in ascending order .

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FOR GROUPED FREQUENCY DISTRIBUTION

Step 4. Compute the median using the formula:

$$\text{Median, } M_e = l + \left\{ h \times \frac{\left(\frac{N}{2} - cf\right)}{f} \right\}, \text{ where}$$

l = lower limit of median class;
h = width of median class;
f = frequency of median class;
cf = cumulative frequency of the class preceding the median class;
$N = \Sigma f_i$.

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PROPERTIES OF MEDIAN

- If x and y are two variables, to be related by y = a + bx for any two constants a and b, then the median of y is given by

$$y_{me} = a + b\,x_{me}$$

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PROPERTIES OF MEDIAN

- For a set of observations, the sum of absolute deviations is minimum when the deviations are taken from the median.

  $\Sigma |x_i - A|$ is minimum if we choose A as the median.

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PARTITION VALUES

- These may be defined as values dividing a given set of observations into a number of equal parts.
- When we want to divide the given set of observations into two equal parts, we consider median .
- Similarly there are quartiles , deciles , percentiles .

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PARTITION VALUES

Name of PV	No . of equal parts	No. of PVs	Symbol
Median	2	1	Me
Quartile	4	3	Q_1 , Q_2 , Q_3
Decile	10	9	D_1, D_2 , ...D_9
Percentile	100	99	P_1 ,P_2 , P_3.....P_{99}

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PARTITION VALUE → **DISCRETE OBSERVATIONS**

$(n + 1)\, p^{th}$

- where n denotes the total number of observations.
- $p = 1/4, 2/4, 3/4$ for Q_1, Q_2 and Q_3 respectively.
- $p = 1/10, 2/10, \ldots\ldots\ldots\ldots 9/10$. For D_1, D_2, $\ldots\ldots$, D_9 respectively.
- $p = 1/100, 2/100, \ldots., 99/100$ for P_1, P_2, $P_3 \ldots . P_{99}$ respectively.

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MODE

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MODE

- For a given set of observations, mode may be defined as the value that occurs the maximum number of times.
- If two or more observations are having maximum frequency then there are multiple modes . { MULTIMODAL DISTRIBUTION }.
- If all observations are having same frequency then distribution has no mode .
- *MODE IS NOT RIGIDLY DEFINED .*

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MODE

DISCRETE OBSERVATION

- **Example** 5, 3, 8, 9, 5 ,6,

  Mode (Mo) = 5 *as it occurs twice and all the other observations occur just once.*

- **Example** 7 , 5 , 6 , 3 , 9 , 5 , 6

  Mode (Mo) = 5 , 6 *as it has two modes so the distribution is called Bimodal Distribution*

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MODE

DISCRETE OBSERVATION

- **Example** 1 , 2 , 6 , 9 , 13 , 17

  Mode (Mo) = No mode *as all observations are having same frequency .*

- **Example** 1 , 1 , 2 , 2 , 3 , 3 , 4 , 4

  Mode (Mo) = No mode *as all observations are having same frequency .*

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MODE

SIMPLE FREQUENCY DISTRIBUTION

Variable	10	20	30	40	50
Frequency	2	8	20	10	5

Mode = 30

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MODE

Grouped FREQUENCY DISTRIBUTION

STEPS

Find the class interval with the highest frequency .

This class interval is called MODAL CLASS

Make sure that series is exclusive

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MODE

Grouped FREQUENCY DISTRIBUTION

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

where l = lower limit of the modal class,

h = size of the class interval

f_1 = frequency of the modal class,

f_0 = frequency of the class preceding the modal class,

f_2 = frequency of the class succeeding the modal class.

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PROPERTIES OF MODE

- Mode is affected due to change in scale and due to change in origin .
- if y = a + bx , then

$$y_{mo} = a + bx_{mo}$$

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RELATIONSHIP BETWEEN MEAN , MODE AND MEDIAN

- For Symmetric Data

  Mean = Median = Mode

- Empirical Relationship between Mean, Median and Mode:

$$\text{Mean} - \text{Mode} = 3(\text{Mean} - \text{Median})$$

Or

Mode = 3 Median – 2 Mean

Moderately skewed Distribution

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GEOMETRIC MEAN

%%%%%%%
%%%%%%%
%%%%%%%
%%%%%%%
%%%%%%%
%

%%%%%%

%%%%%%

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GEOMETRIC MEAN

- For a given set of n positive observations, the geometric mean is defined as the n-th root of the product of the observations.

For DISCRETE OBSERVATION

- Thus if a variable x assumes n values $x_1, x_2, x_3, \ldots\ldots, x_n$, all the values being positive, then the GM of x is given by

$$G = (x_1 \times x_2 \times x_3 \ldots\ldots\ldots \times x_n)^{1/n}$$

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GEOMETRIC MEAN

SIMPLE / GROUPED FREQUENCY

$$G = (x_1^{f_1} \times x_2^{f_2} \times x_3^{f_3} \ldots\ldots\ldots\ldots\ldots \times x_n^{f_n})^{1/N}$$

Where $N = \Sigma f_i$

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PROPERTIES OF GEOMETRIC MEAN

if all the observations assumed by a variable are constants, say K > 0, then the GM of the observations is also K.

GM of the product of two variables is the product of their GM's i.e. if $z = xy$, then

GM of z = (GM of x) × (GM of y)

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PROPERTIES OF GEOMETRIC MEAN

GM of the ratio of two variables is the ratio of the GM's of the two variables i.e. if $z = x/y$ then

$$\text{GM of } z = \frac{\text{GM of } x}{\text{GM of } y}$$

Logarithm of G for a set of observations is the AM of the logarithm of the observations; i.e.

$$\log G = \frac{1}{n}\sum \log x$$

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PROPERTIES OF GEOMETRIC MEAN

Geometric Mean is used to calculate the average of percentages .

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HARMONIC MEAN

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HARMONIC MEAN

- For a given set of non-zero observations, harmonic mean is defined as the reciprocal of the AM of the reciprocals of the observation.

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HARMONIC MEAN

FOR DISCRETE OBSERVATIONS

- So, if a variable x assumes n non-zero values $x_1, x_2, x_3, \ldots\ldots\ldots\ldots, x_n$, then the HM of x is given by

$$H = \frac{n}{\sum(1/x_i)}$$

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SIMPLE / GROUPED FREQUENCY

For a grouped frequency distribution, we have

$$H = \frac{N}{\Sigma\left[\frac{f_i}{x_i}\right]}$$

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PROPERTIES OF HARMONIC MEAN

- If all the values assumed by a variable are constant , say k , then the Harmonic Mean is also k .

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PROPERTIES OF HARMONIC MEAN

- If there are two groups containing n_1 and n_2 observations with respective harmonic means as H_1 and H_2 , then combined Harmonic Mean is given by

$$\frac{n_1 + n_2}{\frac{n_1}{H_1} + \frac{n_2}{H_2}}$$

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PROPERTIES OF HARMONIC MEAN

- HM of 1,1/2, 1/3,.....1/n is given by

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

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PROPERTIES OF HARMONIC MEAN

- To calculate Average speed , use Harmonic Mean .

  The harmonic mean of two numbers x and y is given by

$$\frac{2xy}{x+y}$$

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RELATION BETWEEN AM ,GM ,HM

When all the observations are distinct → AM > GM > HM

When all the observations are same → AM = GM = HM

When nothing is mentioned → $AM \geq GM \geq HM$

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REMARK

$$A\,H = G^2$$

This result holds for only two positive observations

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WEIGHTED AVERAGE

- When the observations under consideration have a hierarchical order of importance, we take recourse to computing weighted average, which could be either weighted AM or weighted GM or weighted HM.

$$\text{Weighted AM} = \frac{\sum w_i x_i}{\sum w_i}$$

$$\text{Weighted HM} = \frac{\sum w_i}{\sum \left(\frac{w_i}{x_i} \right)}$$

$$G = (X_1^{w_1} \times X_2^{w_2} \times X_3^{w_3} \ldots\ldots\ldots\ldots \times X_n^{w_n})^{1/\Sigma w}$$

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Overview of Dispersion

- Absolute Measure of Dispersion
  - Range
  - Mean Deviation
  - Quartile Deviation
  - Standard Deviation
- Relative Measure of Dispersion
  - Coefficient of Range
  - Coefficient of Mean Deviation
  - Coefficient of Variation
  - Coefficient of Quartile Deviation

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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.

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CLASSIFICATION OF MEASURES OF DISPERSION

Absolute measures of dispersion.

Absolute measures of dispersion are classified into

(i) Range

(ii) Mean Deviation

(iii) Standard Deviation

(iv) Quartile Deviation

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CLASSIFICATION OF MEASURES OF DISPERSION

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2. Relative measures of dispersion.

(i) Coefficient of Range.

(ii) Coefficient of Mean Deviation

(iii) Coefficient of Variation

(iv) Coefficient of Quartile Deviation.

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Absolute Measures Of Dispersion	Relative Measures Of Dispersion
I. Absolute measures are with units	I. Relative measures of dispersion are unit free.
2. These are not useful for comparison of two variables with different units	2. These are useful for comparison of two variables with different units
Example :	**Example** :

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RANGE

FOR DISCRETE OBSERVATIONS

- For a given set of observations, range may be defined as the difference between the largest and smallest of observations.

Range = L – S

Where , L : largest observations

S : smallest observations

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COEFFICIENT OF RANGE

The corresponding Relative measure of dispersion of Range is known as coefficient of range .

FOR DISCRETE OBSERVATIONS

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

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RANGE

FOR GROUPED FREQUENCY DISTRIBUTION

- For a grouped frequency distribution, range is defined as the difference between the two extreme class boundaries.

Range = Uppermost Class Boundary – Lowermost Class Boundary

Make sure that the series is exclusive .

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COEFFICIENT OF RANGE

The corresponding Relative measure of dispersion of Range is known as coefficient of range .

FOR GROUPED FREQUENCY DISTRIBUTION

$$\frac{\text{Uppermost class boundary} - \text{Lowermost class boundary}}{\text{Uppermost class boundary} + \text{Lowermost class boundary}} \times 100$$

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Example: 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.

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Solution The largest and the smallest wages are L = ₹ 96 and S = ₹ 50

Thus range = ₹ 96 – ₹ 50 = ₹ 46

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

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Example: 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

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Solution The lowest class boundary is 49.50 kgs. and the highest class boundary is 74.50 kgs.

Thus we have

Range = 74.50 kgs. – 49.50 kgs.

= 25 kgs.

$$\text{Also, coefficient of range} = \frac{74.50 - 49.50}{74.50 + 49.50} \times 100$$

$$= \frac{25}{124} \times 100$$

$$= 20.16$$

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RESULT

- Range remains unaffected due to a change of origin but affected in the same ratio due to a change in scale .
- 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

  $R_y = |b| \times R_x$

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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.

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MEAN DEVIATION

- 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.
- This appropriate measure of central tendency could be , Mean , Median , or Mode .

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MEAN DEVIATION

FOR DISCRETE OBSERVATIONS

$$MD_A = \frac{1}{n}\Sigma|x_i - A|$$

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

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

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Solution The mean is given by

$$\overline{X} = \frac{5+8+10+10+12+9}{6} = 9$$

Table 14.2.1

Computation of MD about AM

x_i	$\lvert x_i - \overline{x} \rvert$
5	4
8	1
10	1
10	1
12	3
9	0
Total	10

Solution Thus mean deviation about mean is given by

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

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Example: 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.

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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.

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Solution

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Table 14.2.2

Computation of Mean deviation about median

x_i	$\lvert x_i - Me \rvert$
52	18
56	14
68	2
70	0
75	5
80	10
82	12
Total	61

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Solution

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

$$= (₹)\frac{61}{7}$$

$$= ₹\ 8714.28$$

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

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

$$= 12.45$$

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COEFFICIENT OF MEAN DEVIATION

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

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MEAN DEVIATION

FOR GROUPED FREQUENCY DISTRIBUTION

$$MD_A = \frac{1}{n}\Sigma|x_i - A|f_i$$

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

$N = \Sigma f_i$

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Example: 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.

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

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

$$= \frac{5\times1+8\times3+9\times5+2\times7+1\times9}{5+8+9+2+1} = 3.88$$

Table 14.2.3

Computation of MD about the AM

x (1)	f (2)	$\lvert x - \bar{x} \rvert$ (3)	$f\lvert x - \bar{x} \rvert$ (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

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Solution Thus, MD about AM is given by

$$\frac{\sum f|x-\bar{x}|}{N}$$

$$=\frac{42.88}{25}$$

$$=1.72$$

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

$$=\frac{1.72}{3.88}\times 100$$

$$=44.33$$

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PROPERTIES OF MEAN DEVIATION

- Mean Deviation takes its minimum value when deviations are taken from Median .

- Mean Deviation remains unaffected due to a change of origin but affected in the same ratio due to a change in scale

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Example: 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?

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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 furthermore, 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.

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STANDARD 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.

FOR DISCRETE OBSERVATIONS

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

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STANDARD DEVIATION

- FOR DISCRETE OBSERVATIONS

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

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STANDARD DEVIATION

- **FOR GROUPED FREQUENCY DISTRIBUTION**

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

OR

$$\sqrt{\frac{\sum f_i x_i^2}{N} - \bar{x}^2}$$

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VARIANCE

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

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

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

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COEFFICIENT OF VARIATION

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.

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

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

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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	$\sum x_i^2 = 210$

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Solution Applying (14.2.7), we get the standard deviation as

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

$$= \sqrt{\frac{210}{5} - \left(\frac{30}{5}\right)^2} \qquad \left(\text{since } \bar{x} = \frac{\sum x_i}{n}\right)$$

$$= \sqrt{42 - 36}$$

$$= \sqrt{6}$$

$$= 2.45$$

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Solution The coefficient of variation is

$$CV = 100 \times \frac{SD}{AM}$$

$$= 100 \times \frac{2.45}{6}$$

$$= 40.83$$

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Example: 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

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STANDARD DEVIATION

- **FOR ANY TWO NUMBERS**

$$S = \frac{\text{Range}}{2}$$

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SD for first n natural numbers

$$\sqrt{\frac{n^2-1}{12}}.$$

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PROPERTIES OF STANDARD DEVIATION

- *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.*

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PROPERTIES OF STANDARD DEVIATION

- *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

  - $S_y = |b| S_x$

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PROPERTIES OF STANDARD DEVIATION

- *If there are two groups containing n_1 and n_2 observations, x_1 and x_2 as respective AM's, s_1 and s_2 as respective SD's , then the combined SD is given by*

$$s = \sqrt{\frac{n_1 s_1^{\,2} + n_2 s_2^{\,2} + n_1 d_1^{\,2} + n_2 d_2^{\,2}}{n_1 + n_2}}$$

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

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

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

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

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

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Example: 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.

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Example: 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?

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Example: 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?

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QUARTILE DEVIATION

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

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

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COEFFICIENT QUARTILE DEVIATION

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

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

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QUARTILE DEVIATION

- 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.

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Example: 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.

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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

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

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

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

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

$$= 18.42$$

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

Que. 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.

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

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Solution $3x + 6y = 20$

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

Therefore, quartile deviation of

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

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

$$= 3.$$

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RELATIONSHIP BETWEEN SD, MD AND QD

4 SD = 5 MD = 6 QD

Or

SD : MD : QD = 15 : 12 : 10

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EXERCISE- Set (B)

CA FOUNDATION

CODE : SS12

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

Que. 1 What is the coefficient of range for the following wages of 8 workers?

₹ 80, ₹ 65, ₹ 90, ₹ 60, ₹ 75, ₹ 70, ₹ 72, ₹ 85.

(a) ₹ 30

(b) ₹ 20

(c) ₹ 30

(d) ₹ 20

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

Que. 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?

(a) $R_x = R_y$

(b) $2R_x = 3R_y$

(c) $3R_x = 2R_y$

(d) $R_x = 2R_y$

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

Que. 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	13

(a) 22

(b) 50

(c) 72.46

(d) 75.82

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

Que. 4 If the range of x is 2, what would be the range of −3x +50 ?

(a) 2

(b) 6

(c) −6

(d) 44

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

Que. 5 What is the value of mean deviation about mean for the following numbers?

5, 8, 6, 3, 4.

(a) 5.20

(b) 7.20

(c) 1.44

(d) 2.23

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

Que. 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.

(a) 5

(b) 7

(c) 35

(d) 10

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

Que. 7 The coefficient of mean deviation about mean for the first 9 natural numbers is

(a) 200/9

(b) 80

(c) 400/9

(d) 50

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 14 If the SD of x is 3, what us the variance of (5 – 2x)?

(a) 36

(b) 6

(c) 1

(d) 9

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 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

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

Que. 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

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EXERCISE- Set (A)

CA FOUNDATION

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

Que. 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).

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

Que. 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).

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

Que. 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).

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

Que. 4 Which one is easiest to compute?

(a) Relative measures of dispersion

(b) Absolute measures of dispersion

(c) Both (a) and (b)

(d) Range

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

Que. 5 Which one is an absolute measure of dispersion?

(a) Range

(b) Mean Deviation

(c) Standard Deviation

(d) All these measures

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

Que. 6 Which measure of dispersion is most useful ?

(a) Standard deviation

(b) Quartile deviation

(c) Mean deviation

(d) Range

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

Que. 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

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

Que. 8 Which measure of dispersion is based on the absolute deviations only?

(a) Standard deviation

(b) Mean deviation

(c) Quartile deviation

(d) Range

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

Que. 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

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

Que. 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)

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

Que. 11 The appropriate measure of dispersion for open-end classification is

(a) Standard deviation

(b) Mean deviation

(c) Quartile deviation

(d) All these measures.

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

Que. 12 The most commonly used measure of dispersion is

(a) Range

(b) Standard deviation

(c) Coefficient of variation

(d) Quartile deviation.

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

Que. 13 Which measure of dispersion has some desirable mathematical properties?

(a) Standard deviation

(b) Mean deviation

(c) Quartile deviation

(d) All these measures

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

Que. 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)

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

Que. 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

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

Que. 16 A shift of origin has no impact on

(a) Range

(b) Mean deviation

(c) Standard deviation

(d) All these and quartile deviation.

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

Que. 17 The range of 15, 12, 10, 9, 17, 20 is

(a) 5

(b) 12

(c) 13

(d) 11.

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

Que. 18 The standard deviation of 10, 16, 10, 16, 10, 10, 16, 16 is

(a) 4

(b) 6

(c) 3

(d) 0.

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

Que. 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.

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

Que. 20 If all the observations are increased by 10, then

(a) SD would be increased by 10

(b) Mean deviation would be increased by 10

(c) Quartile deviation would be increased by 10

(d) All these three remain unchanged.

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

Que. 21 If all the observations are multiplied by 2, then

(a) New SD would be also multiplied by 2

(b) New SD would be half of the previous SD

(c) New SD would be increased by 2

(d) New SD would be decreased by 2.

MATHS

PYQs

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

Que. 1 The average salary of 50 men was ₹ 80 but it was found that salary of 2 of them were ₹ 46 and ₹ 28 which was wrongly taken as ₹ 64 and ₹ 82 . The revised average salary is :

(a) ₹ 80

(b) ₹ 78.56

(c) ₹ 85.26

(d) ₹ 82.92

MATHS

PYQs

CA FOUNDATION

CODE : SS12

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

Que. 2 When mean is 3.57 and mode is 2.13 then the value of median is _____.

(a) 3.09

(b) 5.01

(c) 4.01

(d) None of these

MATHS

PYQs

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

Que3 If the mean of two numbers is 30 and geometric mean is 24 then what will be these two numbers?

(a) 36 and 24

(b) 30 and 30

(c) 48 and 12

(d) None of these

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PYQs

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

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Que4 If variance of x is 5, then find the variance of 2 – 3 x

(a) 10

(b) 45

(c) 5

(d) -13

MATHS

PYQs

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CODE : SS12

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

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Que5 A lady travel at a speed of 20 km/h and returned at quicker speed. If her average speed of the whole journey is 24 km/h, find the speed of return journey (in km/h)

(a) 25

(b) 30

(c) 35

(d) 38

MATHS

PYQs

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

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Que 6 Given the observations : 4, 9, 11 , 14 ,37 . The Mean deviation about the Median is

(a) 11

(b) 8.5

(c) 7.6

(d) 7.45

MATHS

PYQs

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

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Que 7 If the Arithmetic mean between two numbers is 64 and the Geometric mean between them is 16. The Harmonic Mean between them is _____.

(a) 64

(b) 4

(c) 16

(d) 40

MATHS

PYQs

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Sharma

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

Que 8 If all observations in a distribution are increased by 6, then the variance of the series will be _____.

(a) Increased

(b) Decreased

(c) Unchanged

(d) None of these

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PYQs

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

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Que 9 The average of 5 quantities is 6 and the average of 3 is 8. what is the average of the remaining two.

(a) 4

(b) 5

(c) 3

(d) 3.5

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PYQs

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

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Que 10 The standard deviation of the weights (in) of the students of a class of 50 students was calculated to be 4.5 kg . Later on it was found that due to some fault in weighing machine, the weight of each student was under measured by 0.5 kg . The Correct standard deviation of the weight will be:

(a) Less than 4.5

(b) Greater than 4.5

(c) Equal to 4.5

(d) Can not be determined

MATHS

PYQs

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CODE : SS12

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Sharma

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

Que 11 Geometric Mean of three observations 40,50 and X is 10. The value of X is

(a) 2

(b) 4

(c) 1/2

(d) None of the above.

MATHS

PYQs

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Sharma

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

Que 12 The third decile for the numbers 15, 10, 20, 25, 18, 11, 9, 12, is:

(a) 13

(b) 10.70

(c) 11

(d) 11.50

MATHS

PYQs

CA FOUNDATION

CODE : SS12

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

Que 13 If the first quartile is 142 and semi-inter quartile range is 18, then the value of median is:

(a) 151

(b) 160

(c) 178

(d) None of these

MATHS

PYQs

CA FOUNDATION

CODE : SS12

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

Shivani
Sharma

Que 14 Coefficient of quartile deviation is equal to

(a) Quartile deviation × 100/median

(b) Quartile deviation × 100/mean

(c) Quartile deviation × 100/mode

(d) None

MATHS

PYQs

CA FOUNDATION

CODE : SS12

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

Shivani
Sharma

Que 15 If a variance of a random variable 'x' is 23, then what is variance of 2x +10

(a) 56

(b) 33

(c) 46

(d) 92

MATHS