② :Measures of Dispersion:-

Dispersion = Spreadness, difference b/w obs. of data set.

Aim = less dispersion b/w data's obs.

Ideal data set = where dispersion b/w obs. is less.

→ Measure of central tendency doesnot Tell neither the closeness b/w obs. nor dispersion b/w them but only & only central point.

Types:-

There are Two Types of measure of dispersion.

(i) Absolute measure of dispersion.

(ii) Relative measure of dispersion.

Absolute measure of dispersion:-

An Absolute measure of dispersion is one that measures the dispersion in terms of the same units or in the square of units, as the units of data.

e.g:- If the units of data are rupees, metres, kg, the unit of measure of dispersion will also be rupees, metres & kg.

③ Relative Measure of Dispersion:-

A relative measure of dispersion one that is expressed in the form of a ratio, co-efficient or percentage and it is independent of the units of measurement. They are also called unit free or unitless measures.

→ It is useful for comparison of data of different nature.

→ Types of Absolute measure of dispersion-

(i) Range (ii) Mean deviation

(iii) Variance (iv) Standard deviation

(v) The Semi-Interquartile range.

→ Types of Relative measure:-

(i) Co-efficient of range (ii) Co-efficient of mean deviation

(iii) Co-efficient of variation (C.V)

(i) Range:-

It is the difference b/w the maximum & minimum obs. of the given data set

$$\text{Range} = x_m - x_o$$

$$= 100km - 20km = 80\ km$$

unit hence absolute.

Co-efficient of Range:-

$$\text{Co-efficient of Range} = \frac{x_m - x_0}{x_m + x_0}$$

$$= \frac{100\,km - 20\,km}{100\,km + 20\,km}$$

$$= \frac{80\,km}{120\,km} = \underline{\underline{0.67}}$$

This is a pure number & is used for the purposes of comparison.

(2) The Semi-Interquartile Range or the Quartile Deviation:-

The difference b/w the third & first quartile, & half of this range is known as semi-interquartile range or quartile deviation.

$$Q.D = \frac{Q_3 - Q_1}{2}$$

$$\text{Co-efficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

Advantages:-

The Q.D is superior to range as it is not affected by extremely large or small obs.
It is simple to understand & easy to

calculate.

Disadvantages:-

It gives no information about the position of obs lying outside the two quartile.

(ii) **Mean Deviation:-**

The mean deviation of a set of data is defined as the arithematic mean of the deviations measured from the mean, all deviations being counted as positive.

$$M.D = \frac{\Sigma|x_i - \bar{x}|}{n}, \text{ for sample data.}$$

$$M.D = \frac{\Sigma|x_i - \mu|}{N}, \text{ for pop}^n \text{ data.}$$

Example:-

x_i	$(x_i - \bar{x})$	$\lvert x_i - \bar{x}\rvert$
84	4	4
91	11	11
72	-8	8
68	-12	12
87	7	7
78	-2	2
$\bar{x} = 80$	$\Sigma(x_i - \bar{x}) = 0$	44

$$M.D = \frac{\Sigma|x_i - \bar{x}|}{n} = \frac{44}{6} = 7.33$$

Co-efficient of M.D:-

Co-efficient of M.D = $\frac{M.D}{Mean}$ OR $\frac{M.D}{Median}$.

Variance:-

The mean of square of deviations of all the obs. from their mean is known as variance.

$$\sigma^2 = \frac{\sum(x_i - \mu)^2}{N}, \text{ for pop}^n \text{ data} \quad = \frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2$$

$$S^2 = \frac{\sum(x_i - \bar{x})^2}{n}, \text{ for sample data.}$$

Standard Deviation:-

The positive square root of the variance is called standard deviation.

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}, \text{ for pop}^n \text{ data}$$

$$S = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}, \text{ for sample data.}$$

Co-efficient of Standard deviation:-

Co-efficient of Standard deviation = $\frac{S.D}{Mean}$

Co-efficient of Variation:- (C.V)

It is used to compare the variation in two or more data sets or dist^n.

→ A large value of C.V indicates that the variability is great & a small value of C.V indicates less variability.

$$C.V = \frac{S}{\bar{x}} \times 100, \text{ for sample data}$$

$$= \frac{\sigma}{\mu} \times 100, \text{ for pop}^n \text{ data.}$$

Note:-

The C.V is also used to compare the performance of two candidates or of two players given their score in various papers or games, the smaller the co-efficient of variation (C.V) the more consistent is the performance of candidate or player.

Properties of Variance & Standard Deviation:-

1:- The variance of constant is equal to zero.

$$Var(a) = \frac{1}{N} \Sigma (a-a)^2 = 0$$

(∵ mean of constant is constant itself).

$$S.D(a) = 0$$

2:- The variance & S.D is independent of the origion. i.e it remains unchanged when a constant is added or subtracted from each obs. of variable X.

$$Var(X \pm a) = Var(X)$$

3:- The variance is multipied or divided by the square of the constant, when each obs. of the variable X is either multiplied or divided by a constant.

$$Var(aX) = a^2 Var(X).$$

4:- The variance of the sum or difference of the two independent variable variables is equal to the sum or difference of their respective variances.

$$Var(X \pm Y) = Var(X) \pm Var(Y)$$