STANDARD DEVIATION

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Introduction – Standard deviation is an important and popular measure of dispersion introduced by Karl Pearson. It satisfies most of the properties of measures of variability. It is expressed in terms of same units of measurement as that of mean. It is greater than mean deviation.

Definition: Square root of the arithmetic mean of the squares of the deviations measured from the arithmetic mean is known as standard deviation. It is represented by SD, S, σ or σ and is also known as RMS (= root mean square) deviation.

Facts:

1. SD always taken from mean only. Its square represents variance (σ^2 = variance)
2. Negative signs are not neglected. By taking squares of the deviations, positive signs are considered. Variance is regarded as second moment of dispersion.
3. The square of SD is called variance of the distribution.
4. The ratio of SD and mean is known as coefficient of SD. It is a relative measurement.

$$\text{Coefficient of SD} = \frac{\sigma}{\bar{x}}$$

5. Coefficient of variation is a percentage taken from coefficient of SD (Karl Pearson)

$$\text{Coefficient of variation} = \frac{\sigma}{\bar{x}} \times 100$$

6. The distribution for which the coefficient of variation is less categorises as more consistent. (= ideal)

Merits:

1. It is the best measure of variation because it is based on every item of the series and further algebraic treatment is possible. It is calculated from arithmetic mean only.
2. It is not much affected by fluctuations of sampling.
3. [illegible] the properties of [illegible]
4. It is the only measure of calculation of combined standard deviation of two or more groups. It is expressed in terms of the same units of measurement of mean.
5. It is rigidly defined and has wide range.
6. Its value is always definite and has special utility in statistics.
7. It is helpful in calculating standard error.
8. It gives a better idea about the distribution.
9. It is more useful for critical analysis due to its practical descriptive measure.

Demerits:

1. It is more complex in calculations, therefore, difficult to understand.
2. It gives more weight to extreme values and less to those which are nearer to mean.
3. $\bar{x} \pm \sigma$, $\bar{x} \pm 2\sigma$ and $\bar{x} \pm 3\sigma$ cover respectively 66%, 95% and 99% of total values.
4. The evaluation is longer.

Formula:

Types of series	Actual mean method	Assumed mean method	Step deviation method
1. Individual or Ungrouped data	$\sqrt{\frac{\Sigma x^2}{n}}$	$\sqrt{\frac{\Sigma d^2}{n} - \left(\frac{\Sigma d}{n}\right)^2}$	$\sqrt{\frac{\Sigma d'^2}{n} - \left(\frac{\Sigma d'}{n}\right)^2} \cdot c$
2. Grouped data			
(a) Discrete series	$\sqrt{\frac{\Sigma f x^2}{n}}$	$\sqrt{\frac{\Sigma f d^2}{n} - \left(\frac{\Sigma f d}{n}\right)^2}$	$\sqrt{\frac{\Sigma f d'^2}{n} - \left(\frac{\Sigma f d'}{n}\right)^2} \cdot c$
(b) Continuous series	"	"	"