Standard Deviation

- Also known as Root mean square deviation, or mean error or mean square error
- Introduce by Karl Pearson
- Represented by sigma 'σ'
- It is defined as the positive square root of arithmetic mean of the squares of the deviation of the given variables (observation) from their arithmetic mean.

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

Where-

f = frequency

$\bar{x}$ = Mean

N = Total number

Calculation of Standard deviation

1) Direct method: Actual mean method :-

For Discrete series-

Formula

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

Process of calculation-

i. Steps- Mean is calculated.

ii. Deviations of various values (items) from the mean $(X - \bar{x})$ are calculated.

iii. Deviations are squared $(X - \bar{x})^2$

iv. Squared Deviations are multiplied with respective frequencies 'f' and then all the products are added $\sum f(X - \bar{x})^2$

v. The obtained value is then divided by total number of items 'N' or Σf and square rooted.

vi. Formula is applied.

For **Continuous series** 'X' is replaced with midX or 'm'

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

2. Assumed mean method

A) For Discrete series

Steps-

i. Any of the values in data is assumed as assumed mean 'A'

ii. Deviations 'd' of various values (items) from the assumed mean [d= $(X - A)$] are calculated.

iii. Deviations are squared $(X - A)^2$ or d^2

iv. Squared Deviations 'd^2' are multiplied with respective frequencies 'f' and then all the products are added $\sum fd^2$

v. The obtained value is then divided by total number of items 'N' or Σf and square rooted.

vi. Formula is applied.

$$S.D = \sqrt{\frac{\sum fd^2}{N} + \left[\frac{\sum fd}{N}\right]^2}$$

B) For Continuous series (step deviation method)

$$S.D = C\sqrt{\frac{\sum fD^2}{N} + \left[\frac{\sum fD}{N}\right]^2}$$

Where –

$D = \frac{m-A}{C}$

m = midX *or mid value of the class*

f = *frequency*

C = *class interval or common factor*

A = *assumed mean*

Calculation of S.D.,

Steps-

i. *Mid value* '**m**' *of each class is calculated*

ii. *Any one of the mid value in data is assumed as assumed mean* 'A'

iii. *Deviations* 'd' *of various mid values* (**m**) *from the assumed mean* [$d = (m - A)$] *are calculated.*

iv. *These deviations* '**d**' *are then divided by class interval* '**C**'

$$d = (m - A)$$

$$D = \frac{d}{C} = \frac{m-A}{C}$$

v. *All* 'D's *are squared ie for all classes* D^2 *are calculated.*

vi. *Squared* 'D' *ie* 'D^2' *are multiplied with respective frequencies* '**f**' *and then all the products are added* $\sum fD^2$

vii. *The obtained value is then divided by total number of items* 'N' *or* Σf

viii. *Formula applied.-*

$$S.D = C\sqrt{\frac{\sum fD^2}{N} + \left[\frac{\sum fD}{N}\right]^2}$$

Merits of Standard Deviation

i. It is widely used measures of dispersion

ii. It is clearly defined

iii. It is based on all the observations.

iv. . Further algebraic treatment may be done.

v. Sampling fluctuations are minimum.

vi. Squaring the deviations make all of them positive.

vii. .It provides the unit of measurement for the normal distribution.

Demerits

1. It is not easy to understand and it is difficult to calculate.
2. It is affected by the value of every item in the series
3. Therefore fluctuation in any single item may affect the result

Uses

It is the best measure of dispersion. It is widely used in statistics, sampling theory and biology.

Assignments

Calculate SD *from given data*

Size of item 'x'	6	7	8	9	10	11	12
Frequency	3	6	9	13	8	5	4

Ans – 1.6

Class	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	5	10	20	40	30	20	10	4

Ans –15.676

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