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STANDARD DEVIATION

Def – It is the square root of the arithmetic mean of the squares of all deviations, measured from arithmetic mean.

MERITS –

(I) Based on all values – The calculation is based on all the values of a series. It does not ignore any value.

(II) Certain measure – It is a clear and certain measure of dispersion. Therefore, it is used in all situations.

(III) Little effect of change in sample – Change in sample causes little effect on S.D. This is because deviation is based on all the values of a sample.

DEMERITS –

(1) ~~Difficult~~ – It is difficult to calculate.

(2) More importance to extreme values – Extreme value tend to get more importance in the calculation of Standard Deviation.

CALCULATION OF STANDARD DEVIATION IN INDIVIDUAL SERIES

STEPS –

(1) We take any value of the series as assumed average, generally written as A.

(2) Deviation of all the items are obtained from the assumed average. Sum total of these deviations is obtained as $\Sigma(X-A)$ or Σdx.

(3) Square up the deviations and obtain their sum total as $\Sigma(X-A)^2$ or Σdx^2.

(4) The following formula is applied to calculate the value of standard deviation —

$$\sigma = \sqrt{\frac{\Sigma dx^2}{N} - \left(\frac{\Sigma dx}{N}\right)^2}$$

8.1 Find out standard deviation, given the following data —

8, 10, 12, 14, 16, 18, 20, 22, 24, 26.

X	$dx = X - A$	dx^2
8	−10	100
10	−8	64
12	−6	36
14	−4	16
16	−2	4
18 (A)	0	0
20	2	4
22	4	16
24	6	36
26	8	64
	$\Sigma dx = -10$	$\Sigma dx^2 = 340$

$$\sigma = \sqrt{\frac{\Sigma dx^2}{N} - \left(\frac{\Sigma dx}{N}\right)^2}$$

$$= \sqrt{\frac{340}{10} - \left(\frac{-10}{10}\right)^2}$$

$$= \sqrt{34 - 1}$$

$$= \sqrt{33} = 5.74 \text{ Ans.}$$

CALCULATION IN DISCRETE SERIES

STEPS —

(1) Take any value of the series as assumed average written as A,

(2) Deviations of different items from assumed average are obtained as $dx = (X - A)$

(3) Deviations are multiplied by their corresponding frequencies and the sum total is obtained as Σfdx. The deviations are squared and multiplied by the corresponding frequencies to obtain Σfdx^2.

(4) The following formula is applied to calculate the value of standard deviation

$$\sigma = \sqrt{\frac{\Sigma f dx^2}{N} - \left(\frac{\Sigma f dx}{N}\right)^2}$$

Q. 2. Find out the standard deviation of the following data —

Size	frequency	$dx = x - A$	dx^2	fdx	fdx^2
1	5	−3	9	−15	45
2	10	−2	4	−20	40
3	15	−1	1	−15	15
4 (A)	20	0	0	0	0
5	15	1	1	15	15
6	10	2	4	20	40
7	10	3	9	30	90
8	15	4	16	60	240
	$\Sigma f = 100$ or $N = 100$			$\Sigma fdx = 75$	$\Sigma fdx^2 = 485$

$$\sigma = \sqrt{\frac{\Sigma f dx^2}{N} - \left(\frac{\Sigma f dx}{N}\right)^2}$$

$$= \sqrt{\frac{485}{100} - \left(\frac{75}{100}\right)^2}$$

$$= \sqrt{4.85 - 0.56}$$

$$= \sqrt{4.29} = 2.07 \text{ Ans.}$$

CALCULATION IN CONTINUOUS SERIES

STEPS –

(1) Find out mid-values of the class-intervals.
(2) Take any value as Assumed average A.
Rest of the steps are same as in case of discrete series.
The formula is also same.

Q. 3. Find out standard deviation of the following data –

C.I.	f	midvalue	$dx=(m-A)$	dx^2	fdx	fdx^2
0-10	5	5	-30	900	-150	4500
10-20	10	15	-20	400	-200	4000
20-30	20	25	-10	100	-200	2000
30-40	40	35(A)	0	0	0	0
40-50	30	45	10	100	300	3000
50-60	20	55	20	400	400	8000
60-70	10	65	30	900	300	9000
70-80	4	75	40	1600	160	6400
	Σf or $N=139$				$\Sigma fdx=610$	$\Sigma fdx^2=36900$

$$\sigma = \sqrt{\frac{\Sigma fdx^2}{N} - \left(\frac{\Sigma fdx}{N}\right)^2}$$

$$= \sqrt{\frac{36900}{139} - \left(\frac{610}{139}\right)^2}$$

$$= \sqrt{265.46 - 19.22}$$

$$= \sqrt{246.24}$$

$$= 15.69 \text{ Ans.}$$