Standard Deviation

It is the Square root of the A.M. of the Squares of deviation of the terms from their A.M.

There are four methods be used for measuring the S.D.

I Direct method II Square method

III Short cut method IV Summation method

I For Simple distribution :→ $\sigma = \sqrt{\frac{\Sigma (x-\bar{A})^2}{n}} = \sqrt{\frac{\Sigma d^2}{n}}$

Ex:→ Find the S.D. of 3000, 4000, 4200, 4400, 4600, 4800, 5800.

Sol:→ Here $n = 7$

So, A.M. $(\bar{A}) = \frac{\Sigma x}{n} = \frac{3000 + 4000 + 4200 + 4400 + 4600 + 4800 + 5800}{7} = \frac{30,800}{7} = 4400$ fr.

Table

x	$d = x - A$	d^2
3000	$3000 - 4400 = -1400$	1960000
4000	$4000 - 4400 = -400$	160000
4200	$4200 - 4400 = -200$	40000
4400	$4400 - 4400 = 0$	0
4600	$4600 - 4400 = 200$	40000
4800	$4800 - 4400 = 400$	160000
5800	$5800 - 4400 = 1400$	1960000
$n = 7$		$\Sigma d^2 = 4320000$

$\therefore$ S.D. $= \sqrt{\frac{\Sigma d^2}{n}} = \sqrt{\frac{4320000}{7}}$ fr.

S.D. in frequency distribution

$\sigma = \sqrt{\frac{\Sigma f (x-\bar{A})^2}{\Sigma f}} = \sqrt{\frac{\Sigma f d^2}{\Sigma f}}$

Ex:-

x	0	1	2	3	4	5	6	7
f	14	21	25	43	51	40	39	12

Σf → 200 (old)

Sol:→

First of all A.M. or $\bar{A}$

x	0	1	2	3	4	5	6	7	
f	14	21	25	43	51	40	39	12	$\Sigma f = 245$
xf	0	21	50	129	204	200	234	84	$\Sigma xf = 922$

$\bar{A} = \frac{\Sigma fx}{\Sigma f} = \frac{922}{295} = 3.76$ Table

x	f	$d = x - \bar{A}$	d^2	fd^2
0	14	$0 - 3.76 = -3.76$	14.14	196.96
1	21	$1 - 3.76 = -2.76$	7.62	160.02
2	25	$2 - 3.76 = -1.76$	3.10	77.50
3	43	$3 - 3.76 = -.76$	0.58	24.94
4	51	$4 - 3.76 = .24$	0.06	3.06
5	40	$5 - 3.76 = 1.24$	1.54	61.6
6	39	$6 - 3.76 = 2.24$	5.02	195.78
7	12	$7 - 3.76 = 3.24$	10.50	126.00
	$N = \Sigma f =$			$\Sigma fd^2 = 846.86$

$\therefore$ S.D $= \sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f}} = \sqrt{\frac{846.86}{245}} = 1.86$ Ans

III For classified data of S.D :→ अगर C.I के रूप में हो तो C.I. से x निकाल कर उपर कि जाती table बनाकर बनावें।

IV Short cut method for S.D :→ उपरोक्त विधि में काफी calculation करना पड़ता है। अतः इसे Simple करने के लिए Short cut method का use करते हैं।

formula :- $\sigma = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$

form of table

x	f	$d = x - a$	d^2	fd	fd^2

$\bar{A} = a + \frac{\Sigma fd}{\Sigma f}$

Ex:-

x	
f	

Sol :→ A

Assume

x
2
4
6
7
8
9

Ex:-

x	2	4	6	7	8	9
f	3	2	5	3	2	1

Sol:→ Assumed value 6 or 7 होगा 6 का frequ 7 से अधिक है अतः

Assumed value or Assumed mean $\boxed{a = 6}$

Table

x	f	$d = x - a$	d^2	fd	fd^2
2	3	$2-6 = -4$	16	$3\times-4 = -12$	48
4	2	$4-6 = -2$	4	$2\times-2 = -4$	8
6	5	$6-6 = 0$	0	$5\times0 = 0$	0
7	3	$7-6 = 1$	1	$3\times1 = 3$	3
8	2	$8-6 = 2$	4	$2\times2 = 4$	8
9	1	$9-6 = 3$	9	$1\times3 = 3$	9
	$\Sigma f = 16$		$\Sigma d^2 = 34$	$\Sigma fd = -6$	$\Sigma fd^2 = 76$

$$\therefore S.D. = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

$$= \sqrt{\frac{76}{16} - \left(\frac{-6}{16}\right)^2} \text{ fr.}$$

यह सभी A.M. के रूप में अर्थात् A.M. के रूप में S.D.

Step deviation method

Formula

$$\sigma = i\sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd'}{\Sigma f}\right)^2} \qquad d' = d/i$$

i = Length of interval.

This be used for in C.I. distribution.

P.T.O

Ex! →

C.I.	0–10	10–20	20–30	30–40
f	2	3	5	2

Sol^n

C.I.	x	f	$d = x - a$, $a = 25$	$d' = d/i$	fd'	fd'^2
0 – 10	5	2	$5 - 25 = -20$	$-20/10 = -2$	−4	8 (2×4)
10 – 20	15	3	$15 - 25 = -10$	$-10/10 = -1$	−3	3 (3×1)
20 – 30	(25)	5	$25 - 25 = 0$	0	0	0
30 – 40	35	2	$35 - 25 = 10$	$10/10 = 1$	2	2 (2×1)
		$\Sigma f = 12$			$\Sigma fd' = -5$	$\Sigma fd'^2 = 13$

$$\sigma = i\sqrt{\frac{\Sigma fd'^2}{\Sigma f} - \left(\frac{\Sigma fd'}{\Sigma f}\right)^2}$$

$$= 10\sqrt{\frac{13}{12} - \left(\frac{-5}{12}\right)^2} = 9.5377$$

Q 2015 Find the S.D. of the following distribution

x	0	1	2	3	4	5	6	7
f	14	21	25	48	51	40	39	12

Q. 2016 (a) Compute the S.D. for following frequency distribution by assumed mean method

(b) find M_o for following data.

Age (x)	0–6	6–12	12–18	18–24	24–30	30–36	36–42
f	6	11	25	35	18	12	6