Variance $= \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2$

$SD = +\sqrt{\text{variance}}$ $\qquad CV = \frac{\sigma}{\bar{x}} \times 100$

unit of measurement

different $\qquad$ same

same mean $\qquad$ diff mean

std dev $\qquad$ coeff of variation

Lesser the CV
higher the stability

Q) From the share prices of x and y given below, state which share is more stable in value
$\sigma_x = 3.25 \qquad \sigma_y = 2.87$ given

x	41	44	43	48	45	46	49	50	42	40
y	91	93	96	92	90	97	99	94	98	95

Sol^n

Share x

$\bar{x} = 448/10 = 44.8$

$\sigma = 3.25$

$CV = \frac{\sigma}{\bar{x}} \times 100$

$= \frac{3.25}{44.8} \times 100$

$= 7.25\%$

Share y

$\bar{x} = 945/10 = 94.5$

$\sigma_y = 2.87$

$CV = \frac{\sigma}{\bar{x}} \times 100$

$= \frac{2.87}{94.5} \times 100$

$= 3.03\%$

$CV_x < CV_y$ hence share x is more stable

Q) Goals scored by two teams A and B in a football session are as follows.

goals	0	1	2	3	4	
A	27	9	8	5	4	$\sigma_A = 1.309$
B	17	9	6	5	3	$\sigma_B = 1.307$

ans

team A

x	f_A	$f_A x$
0	27	0
1	9	9
2	8	16
3	5	15
4	4	16
	53	56

team B

x	f	fx
0	17	0
1	9	9
2	6	12
3	5	15
4	3	12
	40	48

$\bar{x}_A = 1.06$

$\sigma_A = 1.303$

$CV_A = \frac{1.303}{1.06} \times 100$

$= 123.49$

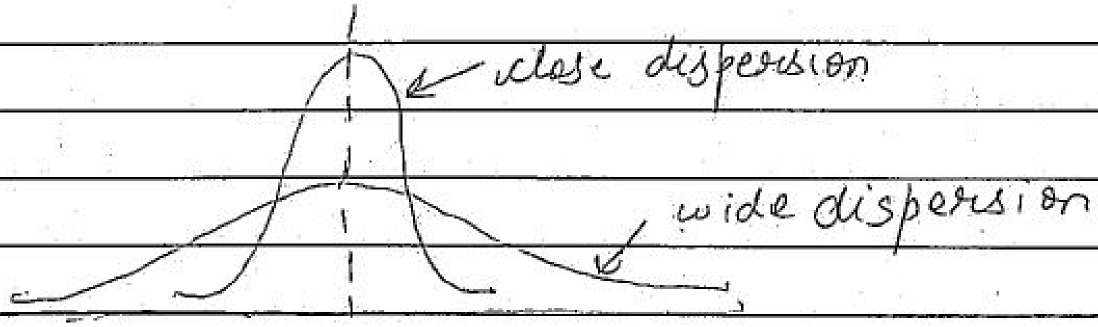
$\bar{x}_B = 1.2$

$\sigma_B = 1.307$

$CV_B = 108.9$

B is more stable

$CV_A > CV_B$



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Moments :- Moment of variable about some point and these pts are used to discribe the characteristics of frequency distribution.

↳ Moments about mean (central moment)

→ moment about origin or zero.

r^{th} moment about mean :-

$$u_r = \frac{\Sigma (x-\bar{x})^r}{N} \qquad \bar{x} = \frac{\Sigma x}{N}$$

$$u_1 = \frac{\Sigma (x-\bar{x})}{N} = 0$$

$$u_2 = \frac{\Sigma (x-\bar{x})^2}{N} \qquad u_3 = \frac{\Sigma (x-\bar{x})^3}{N}$$

$$u_4 = \frac{\Sigma (x-\bar{x})^4}{N}$$

First moment about mean is always 0

moment about origin or zero

$$u_r' = \frac{\Sigma (x-0)^r}{N} = \frac{\Sigma x^r}{N} \qquad r = 1, 2, 3, 4$$

$$u_1' = \frac{\Sigma x}{N} = \text{mean} \qquad u_2' = \frac{\Sigma x^2}{N} \qquad u_3' = \frac{\Sigma x^3}{N} \qquad u_4' = \frac{\Sigma x^4}{N}$$

Moments about mean ⇒

I.S

$$u_r = \frac{\Sigma (x-\bar{x})^r}{N} \quad r = 1, 2, 3, 4$$

$r = 1$

$u_1 = 0$

$$u_2 = \frac{\Sigma (x-\bar{x})^2}{N} = \text{Variance}$$

$$u_3 = \frac{\Sigma (x-\bar{x})^3}{N}$$

$$u_4 = \frac{\Sigma (x-\bar{x})^4}{N}$$

discrete Series :-

$$u_r = \frac{\Sigma f (x-\bar{x})^r}{N} \quad r = 1, 2, 3, 4$$

$$u_1 = \frac{\Sigma f (x-\bar{x})}{N} = 0$$

$$u_2 = \frac{\Sigma f (x-\bar{x})^2}{N} = \text{variance}$$

$$u_3 = \frac{\Sigma f (x-\bar{x})^3}{N} \quad u_4 = \frac{\Sigma f (x-\bar{x})^4}{N}$$

Continuous Series :-

$$u_r = \frac{\Sigma f (m-\bar{x})^r}{N}$$

$$u_1 = \frac{\Sigma f (m-\bar{x})}{N} = 0 \quad u_2 = \frac{\Sigma f (m-\bar{x})^2}{N}$$

$$u_3 = \frac{\Sigma f (m-\bar{x})^3}{N} \quad u_4 = \frac{\Sigma f (m-\bar{x})^4}{N}$$

Q] Find first 4 moment about mean

x	$(x-\bar{x})^2$	$(x-\bar{x})^3$	$(x-\bar{x})^4$
1	25	-125	625
3	9	-27	81
7	1	1	1
9	09	27	81
10	16	64	256
	60	-60	1044

$\bar{x} = 30/5 = 6$

$u_1 = 0$ $\quad u_4 = \frac{1044}{5} = 208.8$

$u_2 = \frac{60}{5} = 12$

$u_3 = \frac{-60}{5} = -12$

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moments About Origin

IS	DS	CS
$u_r' = \frac{\Sigma x^r}{N}$	$u_r' = \frac{\Sigma f x^r}{N}$	$u_r' = \frac{\Sigma f m^r}{N}$
$r = 1, 2, 3, 4$	$r = 1, 2, 3, 4$	$r = 1, 2, 3, 4$
$u_1' = \frac{\Sigma x}{N}$ = mean	$u_1' = \frac{\Sigma f x}{N}$ = mean	$u_1' = \frac{\Sigma f m}{N}$ = mean
$u_2' = \frac{\Sigma x^2}{N}$	$u_2' = \frac{\Sigma f x^2}{N}$	$u_2' = \frac{\Sigma f m^2}{N}$
$u_3' = \frac{\Sigma x^3}{N}$	$u_3' = \frac{\Sigma f x^3}{N}$	$u_3' = \frac{\Sigma f m^3}{N}$
$u_4' = \frac{\Sigma x^4}{N}$	$u_4' = \frac{\Sigma f x^4}{N}$	$u_4' = \frac{\Sigma f m^4}{N}$

Conversion of non-central moment to central moment

$u_1 = u_1' - (u_1')^1 = 0$

$u_2 = u_2' - (u_1')^2$ = variance

$u_3 = u_3' - 3u_2' u_1' + 2(u_1')^3$

$u_4 = u_4' - 4u_3' u_1' + 6u_2'(u_1')^2 - 3(u_1')^4$

Q) find first 4 moments about mean

step 1) calc. moments about origin
step 2) apply conversion formula

$\mu_r' = \frac{\sum f m^r}{N}$

x	f	m_i	fm	m^2	fm^2
0-5	2	2.5	5	6.25	12.5
5-10	5	7.5	37.5	56.25	281.25
10-15	7	12.5	87.5	156.25	1093.75
15-20	13	17.5	227.5	306.25	3981.25
20-25	21	22.5	472.5	506.25	10631.25
25-30	16	27.5	440.5	756.25	12100
30-35	8	32.5	260	1056.25	8450
35-40	3	37.5	112.5	1406.25	4218.75
	75		1642.5		40768.75

$\mu_1' = \frac{1642.5}{75} = 21.9$, $\mu_2' = \frac{40768.75}{75} = 543.58$

m^3	fm^3	m^4	fm^4
15.625	31.25	39.0625	78.125
421.875	2109.375	3164.0625	15820.3125
1953.125	13671.875	24414.0625	170898.4375
5359.375	69671.875	93789.0625	1219257.813
11390.625	239203.125	256289.0625	5382070.313
20796.875	332750	1115664.063	9150625
34328.125	274625	1977539.063	8925312.5
52734.375	158203.125	1977539.063	5932617.18
	1090265.625		30796729.69

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$u_3' = \frac{1090265.625}{75} = 14536.875$

$u_4' = \frac{30796679.69}{75} = 410622.3958$

$u_1 = 0$

$u_2 = u_2' - (u_1')^2$

$= 543.58 - (21.9)^2$

$= 63.97$

$u_3 = u_3' - 3u_2'u_1' + 2(u_1')^3$

$= 14536.875 - 3(543.58)(21.9) + 2(21.9)^3$

$= -21173.046 + 21006.918$

$= -166.128$