

NCERT Solutions for Class-XI Maths

Chapter-15 Exercise-15.3

NCERT Math Class 11

1. From the data given below state which group is more variable, A or B?

Marks	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Group A	9	17	32	33	40	10	9
Group B	10	20	30	25	43	15	7

- 1.

the group having higher coefficient of variation will be more variable

So we will calculate

$$\text{Coefficient of variation (C.V.)} = \frac{\sigma}{\bar{x}} \times 100$$

Where σ is standard deviation

\bar{x} is mean

For group A

Marks	Group A f_i	Mid-point x_i	$y_i = \frac{x_i - A}{h}$	$(y_i)^2$	$f_i y_i$	$f_i(y_i)$
10-20	9	15	$\frac{15 - 45}{10} = -3$	$(-3)^2 = 9$	-27	81
20-30	17	25	$\frac{25 - 45}{10} = -2$	$(-2)^2 = 4$	-34	68
30-40	32	35	$\frac{35 - 45}{10} = -1$	$(-1)^2 = 1$	-32	32
40-50	33	45	$\frac{45 - 45}{10} = 0$	$0^2 = 0$	0	0
50-60	40	55	$\frac{55 - 45}{10} = 1$	$1^2 = 1$	40	40
60-70	10	65	$\frac{65 - 45}{10} = 2$	$2^2 = 4$	20	40

70-80	9	75	$\frac{75-45}{10} = -3$	$3^2 = 9$	27	81
Total	150				-6	342

$$\text{Mean } \bar{x} = A + \frac{\sum f_i y_i}{\sum f_i} \times h$$

Where A is assumed mean = 45

$$y_i = \frac{x_i - A}{h}$$

h = class size = 20 - 10 = 10

$$\text{Mean } \bar{x} = 45 + \frac{-6}{150} \times 10 = 44.6$$

$$\text{Variance } \sigma^2 = \frac{h^2}{N^2} [N \sum f_i y_i^2 - (\sum f_i y_i)^2]$$

$$= \frac{10^2}{150^2} [150 \times 342 - (-6)^2]$$

$$= \frac{100}{22500} \times 51264 = 227.84$$

$$\text{Standard deviation} = \sqrt{\text{variance}} = \sqrt{227.84} = 15.09$$

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

$$\text{C.V.}_A = \frac{15.09}{44.6} \times 100 = 33.83$$

For group B

Marks	Group B f_i	Mid-point x_i	$y_i (x_i - A)/h$	$(y_i)^2$	$f_i y_i$	$f_i (y_i)^2$
10-20	10	15	$\frac{15-45}{10} = -3$	9	-30	90
20-30	20	25	$\frac{25-45}{10} = -2$	4	-40	80

30-40	30	35	$\frac{35-45}{10} = -1$	1	-30	30
40-50	25	45	$\frac{45-45}{10} = 0$	0	0	0
50-60	43	55	$\frac{55-45}{10} = 1$	1	43	43
60-70	15	65	$\frac{65-45}{10} = 2$	4	30	160
70-80	7	75	$\frac{75-45}{10} = 3$	9	21	189
Total	150				-6	592

$$\text{Mean, } \bar{x} = 45 + \frac{-6}{150} \times 10 = 44.6$$

$$\text{Variance } \sigma^2 = \frac{h^2}{N^2} [N \sum f_i y_i^2 - (\sum f_i y_i)^2]$$

$$= \frac{10^2}{150^2} [150 \times 592 - (-6)^2]$$

$$= \frac{100}{22500} \times 88764 = 394.50$$

$$\text{Standard deviation} = \sqrt{\text{variance}} = \sqrt{394.50} = 19.86$$

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

$$C.V.A = \frac{19.86}{44.6} \times 100 = 44.53$$

Since the coefficient of variance of group B > coefficient of Group A

∴ Group B is more variable

2. From the prices of shares X and Y below, find out which is more stable in value:

X	35	54	52	53	56	58	52	50	51	49
Y	108	107	105	105	106	107	104	103	104	101

- 2.

The prices of the shares X are
35, 54, 52, 53, 56, 58, 52, 50, 51, 49

Here, the number of observations, $N = 10$

$$\therefore \text{Mean, } \bar{x} = \frac{1}{N} \sum_{i=1}^{10} x_i = \frac{1}{10} \times 510 = 51$$

The following table is obtained corresponding to shares X .

x_i	$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
35	-16	256
54	3	9
52	1	1
53	2	4
56	5	25
58	7	49
52	1	1
50	-1	1
51	0	0
49	-2	4
	350	

$$\text{Variance}(\sigma_1^2) = \frac{1}{N} \sum_{i=1}^{10} (x_i - \bar{x})^2 = \frac{1}{10} \times 350 = 35$$

$$\therefore \text{Standard deviation } (\sigma_1) = \sqrt{35} = 5.91$$

$$\text{C.V. (Shares } X) = \frac{\sigma_1}{\bar{x}} \times 100 = \frac{5.91}{51} \times 100 = 11.58$$

The prices of share Y are

108, 107, 105, 105, 106, 107, 104, 103, 104, 101

$$\therefore \text{Mean, } \bar{y} = \frac{1}{N} \sum_{i=1}^{10} y_i = \frac{1}{10} \times 1050 = 105$$

The following table is obtained corresponding to shares Y .

y_i	$(y_i - \bar{y})$	$(y_i - \bar{y})^2$
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108	3	9
107	2	4
105	0	0
105	0	0
106	1	1
107	2	4
104	-1	1
103	-2	4
104	-1	1
101	-4	16
	40	

$$\text{Variance}(\sigma_2^2) = \frac{1}{N} \sum_{i=1}^{10} (y_i - \bar{y})^2 = \frac{1}{10} \times 40 = 4$$

$$\therefore \text{Standard deviation} (\sigma_2) = \sqrt{4} = 2$$

$$\therefore \text{C.V. (Shares Y)} = \frac{\sigma_2}{\bar{y}} \times 100 = \frac{2}{105} \times 100 = 1.9 = 11.58$$

C. V. of prices of shares X is greater than the C.V. of prices of shares Y.
Thus, the prices of shares Y are more stable than the prices of shares X.

3. An analysis of monthly wages paid to workers in two firms A and B, belonging to the same industry, gives the following results:

	Firm A	Firm B
No. of wage earners	586	648
Mean of monthly wages	Rs 5253	Rs 5253

Variance of the distribution of wages	100	121
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(i) Which firm A or B pays larger amount as monthly wages?

(ii) Which firm, A or B, shows greater variability in individual wages?

3. Here Mean monthly wages of firm A = 5253

No. of wage earners = 586

Total amount paid = $586 \times 5253 = 3078258$

Mean monthly wages of firm B = 5253

No. of wage earners = 648

Total amount paid = $648 \times 5253 = 3403944$

(i) Hence the firm B pays larger amount as monthly wages.

(ii) Variance of firm A = 100

\Rightarrow standard deviation (σ) = $\sqrt{100} = 10$

Variance of firm B = 121

\Rightarrow Standard deviation (σ) = $\sqrt{121} = 11$

Since the standard deviation is more in case of Firm B that means in firm B there is greater variability in individual wages.

4. The following is the record of goals scored by team A in a football session:

No. of goals scored	0	1	2	3	4
No. of matches	1	9	7	5	3

For the team B, mean number of goals scored per match was 2 with a standard deviation 1.25 goals. Find which team may be considered more consistent?

4. The mean and the standard deviation of goals scored by team A are calculated as follows.

No. of goals scored	No. of matches	$f_i x_i$	x_i^2	$f_i x_i^2$
0	1	0	0	0
1	9	9	1	9
2	7	14	4	28
3	5	15	9	45
4	3	12	16	48

$$\text{Mean} = \frac{\sum_{i=1}^5 f_i x_i}{\sum_{i=1}^5 f_i} = \frac{50}{25} = 2$$

Thus, the mean of both the teams is same.

$$\sigma = \frac{1}{N} \sqrt{N \sum f_i x_i^2 - (\sum f_i x_i)^2}$$

$$= \frac{1}{25} \sqrt{25 \times 130 - (50)^2}$$

$$= \frac{1}{25} \sqrt{750}$$

$$= \frac{1}{25} \times 27.38$$

$$= 1.09$$

The standard deviation of team B is 1.25 goals.

The average number of goals scored by both the teams is same i.e., 2. Therefore, the team with lower standard deviation will be more consistent.

Thus, team A is more consistent than team B.

5. The sum and sum of squares corresponding to length x (in cm) and weight y (in gm) of 50 plant products are given below:

$$\sum_{i=1}^{50} x_i = 212, \sum_{i=1}^{50} x_i^2 = 902.8,$$

$$\sum_{i=1}^{50} y_i = 261, \sum_{i=1}^{50} y_i^2 = 1457.6$$

Which is more varying, the length or weight?

5.

For length x :

$$\text{Mean, } \bar{x} = \frac{\sum x_i}{n} = \frac{212}{50} = 4.24$$

$$\text{Variance} = \frac{1}{N^2} [N \sum f_i x_i^2 - (\sum f_i x_i)^2]$$

$$= \frac{1}{50^2} [50 \times 902.8 - 212^2] = \frac{1}{2500} (45140 - 44944) = \frac{196}{2500} = 0.0784$$

Standard deviation $\sigma = \sqrt{\text{variance}} = \sqrt{0.0784} = 0.28$

$$C.V._x = \frac{\sigma}{x} \times 100 = \frac{0.28}{4.24} \times 100 = 6.603$$

For Weight Y

$$\text{Mean, } \bar{y} = \frac{\sum y_i}{n} = \frac{261}{50} = 5.22$$

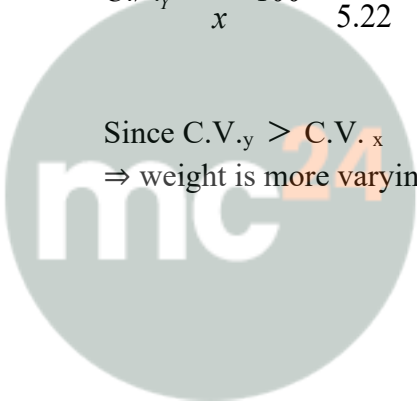
$$\text{Variance} = \frac{1}{N^2} \left[N \sum f_i x_i^2 - (\sum f_i x_i)^2 \right]$$

$$= \frac{1}{50^2} \left[50 \times 1457.6 - 261^2 \right] = \frac{1}{2500} (72880 - 68121) = \frac{4759}{2500} = 1.9036$$

Standard deviation (σ) = $\sqrt{\text{variance}} = \sqrt{1.9036} = 1.37$

$$C.V._y = \frac{\sigma}{x} \times 100 = \frac{1.37}{5.22} \times 100 = 26.24$$

Since $C.V._y > C.V._x$
 \Rightarrow weight is more varying.



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