

CBSE Class-11 Mathematics
NCERT Solutions
Chapter - 15 Statistics
Exercise 15.2

Find the mean and variance for each of the data in Exercises 1 to 5.

1. 6, 7, 10, 12, 13, 4, 8, 12

Ans. Given: $x = 6, 7, 10, 12, 13, 4, 8, 12$

$$\therefore \sum x = 6 + 7 + 10 + 12 + 13 + 4 + 8 + 12 = 72$$

And $n = 8 \therefore \bar{x} = \frac{72}{8} = 9$

Also $\sum x^2 = (6)^2 + (7)^2 + (10)^2 + (12)^2 + (13)^2 + (4)^2 + (8)^2 + (12)^2 = 722$

$$\therefore \text{Variance} = \sigma^2 = \frac{N \sum x^2 - (\sum x)^2}{N^2}$$

$$= \frac{8 \times 722 - (72)^2}{(8)^2}$$

$$= \frac{5776 - 5184}{64} = \frac{592}{64} = 9.25$$

2. First n natural numbers

Ans. Given: $x = 1, 2, 3, 4, \dots, n$

$$\therefore \sum x = 1 + 2 + 3 + 4 + \dots + n = \frac{n(n+1)}{2}$$

And $\sum x^2 = (1)^2 + (2)^2 + (3)^2 + (4)^2 + \dots (n)^2 = \frac{n(n+1)(2n+1)}{6}$

$\therefore \text{Mean } (\bar{x}) = \frac{n(n+1)}{2n} = \frac{n+1}{2}$

Now, Variance = $\sigma^2 = \frac{N\sum x^2 - (\sum x)^2}{N^2}$

$$= \frac{n \times \frac{n(n+1)(2n+1)}{6} - \left(\frac{n(n+1)}{2} \right)^2}{n^2}$$

$$= \frac{n(n+1)(2n+1)}{6n} - \left(\frac{(n+1)}{2} \right)^2$$

$$= \frac{(n+1)(n-1)}{12}$$

$$= \frac{n^2 - 1}{12}$$

3. First 10 multiples of 3

Ans. Given: $x = 3, 6, 9, 12, 15, 18, 21, 24, 27, 30$

$\therefore \sum x = 3 + 6 + 9 + 12 + \dots + 30 = 165$

And $\sum x^2 = 3^2 + 6^2 + 9^2 + 12^2 + 15^2 + \dots + 30^2 = 3465$

$\therefore \text{Mean } (\bar{x}) = \frac{165}{10} = 16.5$

Now, Variance = $\sigma^2 = \frac{N\sum x^2 - (\sum x)^2}{N^2}$

$$= \frac{10 \times 3465 - (165)^2}{(10)^2}$$

$$= \frac{34650 - 27225}{100}$$

$$= \frac{7425}{100} = 74.25$$

4.

x_i	6	10	14	18	24	28	30
f_i	2	4	7	12	8	4	3

Ans.

x_i	f_i	$f_i x_i$	$(x_i - 19)$	$(x_i - 19)^2$	$f_i (x_i - 19)^2$
6	2	12	-13	169	338
10	4	40	-9	81	324
14	7	98	-5	25	175
18	12	216	-1	1	12
24	8	192	5	25	200
28	4	112	9	81	324
30	3	90	11	121	363
	40	760			1736

$$\text{Mean } (\bar{x}) = \frac{1}{N} \sum f_i x_i = \frac{1}{40} \times 760 = 19$$

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

$$= \frac{1}{40} \times 1736 = 43.4$$

5.

x_i	92	93	97	98	102	104	109
f_i	3	2	3	2	6	3	3

Ans.

x_i	f_i	$f_i x_i$	$(x_i - 100)$	$(x_i - 100)^2$	$f_i (x_i - 100)^2$
92	3	276	-8	64	192
93	2	186	-7	49	98
97	3	291	-3	9	27
98	2	196	-2	4	8
102	6	612	2	4	24
104	3	312	4	16	48
109	3	327	9	81	243
Total	22	2200			640

$$\text{Mean } (\bar{x}) = \frac{1}{N} \sum f_i x_i = \frac{1}{22} \times 2200 = 100$$

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

$$= \frac{1}{22} \times 640 = 29.09$$

6. Find the mean and standard deviation using short cut method.

x_i	60	61	62	63	64	65	66	67	68
f_i	2	1	12	29	25	12	10	4	5

Ans.

x_i	f_i	$u = x - 64$	fu	fu^2
60	2	-4	-8	32
61	1	-3	-3	9
62	12	-2	-24	48
63	29	-1	-29	29
64	25	0	0	0
65	12	1	12	12
66	10	2	20	40
67	4	3	12	36
68	5	4	20	80
	100		0	286

$$\text{Mean } (\bar{x}) = A + \frac{\sum fu}{N} = 64 + \frac{0}{100} = 64$$

$$\text{Variance} = \sigma^2 = \frac{1}{N} \sqrt{N \sum fu^2 - (\sum fu)^2}$$

$$= \frac{1}{100} \times \sqrt{100 \times 286 - (0)^2}$$

$$= \frac{1}{100} \sqrt{28600} = \frac{1}{100} \times 169.1 = 1.69$$

Find the mean and variance for the following frequency distribution in Exercises 7 and 8.

7.

Class	0-30	30-60	60-90	90-120	120-150	150-180	180-210
Frequencies	2	3	5	10	3	5	2

Ans.

Classes	x_i	f_i	$u = \frac{x-105}{30}$	fu	fu^2
0 - 30	15	2	-3	-6	18
30 - 60	45	3	-2	-6	12
60 - 90	75	5	-1	-5	5
90 - 120	105	10	0	0	0
120 - 150	135	3	1	3	3
150 - 180	165	5	2	10	20
180 - 210	195	2	3	6	18
		30		2	76

$$\text{Mean } (\bar{x}) = A + \frac{\sum fu}{N} \times h = 105 + \frac{2}{30} \times 30 = 107$$

$$\text{Variance} = \sigma^2 = \frac{h^2}{N^2} \left[N \sum fu^2 - (\sum fu)^2 \right] = \frac{(30)^2}{(30)^2} \times [30 \times 76 - (2)^2] = 2280 - 4 = 2276$$

8.

Class	0-10	10-20	20-30	30-40	40-50
Frequencies	5	8	15	16	6

Ans.

Classes	x_i	f_i	$u = \frac{x-25}{10}$	fu	fu^2
0-10	5	5	-2	-10	20
10-20	15	8	-1	-8	8
20-30	25	15	0	0	0
30-40	35	16	1	16	16
40-50	45	6	2	12	27
Total		50		10	68

$$\text{Mean } (\bar{x}) = A + \frac{\sum fu}{N} \times h$$

$$= 25 + \frac{10}{50} \times 10 = 25 + 2 = 27$$

$$\text{Variance} = \sigma^2 = \frac{h^2}{N^2} \left[N \sum fu^2 - (\sum fu)^2 \right]$$

$$= \frac{(10)^2}{(50)^2} \times [50 \times 68 - (10)^2]$$

$$= \frac{1}{25} \times 3300 = 132$$

9. Find the mean, variance and standard deviation using short-cut method.

Height in cm.	No. of children
70 - 75	3
75 - 80	4
80 - 85	7
85 - 90	7
90 - 95	15
95 - 100	9
100 - 105	6
105 - 110	6
110 - 115	3

Ans.

Heights in cms.	x_i	f_i	$u = \frac{x - 92.5}{5}$	fu	fu^2
70 - 75	72.5	3	-4	-12	48
75 - 80	77.5	4	-3	-12	36
80 - 85	82.5	7	-2	-14	28
85 - 90	87.5	7	-1	-7	7
90 - 95	92.5	15	0	0	0
95 - 100	97.5	9	1	9	9
100 - 105	102.5	6	2	12	24
105 - 110	107.5	6	3	18	54
110 - 115	112.5	3	4	12	48
		60		6	254

$$\text{Mean } (\bar{x}) = A + \frac{\sum fu}{N} \times h$$

$$= 92.5 + \frac{6}{60} \times 5 = 92.5 + 0.5 = 93$$

$$\text{Variance} = \sigma^2 = \frac{h^2}{N^2} \left[N \sum fu^2 - (\sum fu)^2 \right]$$

$$= \frac{(5)^2}{(60)^2} \times [60 \times 254 - (6)^2]$$

$$= \frac{25}{3600} [15240 - 36]$$

$$= \frac{25}{3600} \times 15204 = 105.58$$

$$\text{Standard deviation } (\sigma) = \sqrt{105.58} = 10.27$$

10. The diameters of circles (in mm) drawn in a design are given below:

Diameters	33-36	37-40	41-44	45-48	49-52
No. of circles	15	17	21	22	25

Calculate the standard deviation and mean diameter of the circles.

[Hint: First make the data continuous by making the classes as 32.5-36.5, 36.5-40.5, 40.5-44.5, 44.5-48.5, 48.5-52.5 and then proceed]

Ans.

Diameters	Classes	x_i	f_i	$u = \frac{x - 42.5}{4}$	fu	fu^2
33 - 36	32.5-36.5	34.5	15	-2	-30	60
37 - 40	36.5-40.5	38.5	17	-1	-17	17
41 - 44	40.5-44.5	42.5	21	0	0	0
45 - 48	44.5-48.5	46.5	22	1	22	22
49 - 52	48.5-52.5	50.5	25	2	50	100
			100		25	199

$$\text{Mean } (\bar{x}) = A + \frac{\sum fu}{N} \times h$$

$$= 42.5 + \frac{25}{100} \times 4 = 42.5 + 1 = 43.5 \text{ mm}$$

$$\text{Standard deviation } (\sigma) = \frac{h}{N} \sqrt{N \sum fu^2 - (\sum fu)^2}$$

$$= \frac{4}{100} \sqrt{100 \times 199 - (25)^2}$$

$$= \frac{1}{25} \times 138.83 = 5.55$$