

Class XI : Maths  
Chapter 13 : Statistics

Questions and Solutions | Exercise 13.2 - NCERT Books

**Question 1:**

Find the mean and variance for the data 6, 7, 10, 12, 13, 4, 8, 12

Answer

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

$$\bar{x} = \frac{\sum_{i=1}^8 x_i}{n} = \frac{6+7+10+12+13+4+8+12}{8} = \frac{72}{8} = 9$$

Mean,

The following table is obtained.

$x_i$	$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
6	-3	9
7	-2	4
10	-1	1
12	3	9
13	4	16
4	-5	25
8	-1	1
12	3	9
		74

$$\text{Variance}(\sigma^2) = \frac{1}{n} \sum_{i=1}^8 (x_i - \bar{x})^2 = \frac{1}{8} \times 74 = 9.25$$

**Question 2:**

Find the mean and variance for the first  $n$  natural numbers

Answer

The mean of first  $n$  natural numbers is calculated as follows.

$$\text{Mean} = \frac{\text{Sum of all observations}}{\text{Number of observations}}$$

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

$$\begin{aligned} \text{Variance}(\sigma^2) &= \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \\ &= \frac{1}{n} \sum_{i=1}^n \left[ x_i - \left( \frac{n+1}{2} \right) \right]^2 \\ &= \frac{1}{n} \sum_{i=1}^n x_i^2 - \frac{1}{n} \sum_{i=1}^n 2 \left( \frac{n+1}{2} \right) x_i + \frac{1}{n} \sum_{i=1}^n \left( \frac{n+1}{2} \right)^2 \\ &= \frac{1}{n} \frac{n(n+1)(2n+1)}{6} - \left( \frac{n+1}{n} \right) \left[ \frac{n(n+1)}{2} \right] + \frac{(n+1)^2}{4n} \times n \\ &= \frac{(n+1)(2n+1)}{6} - \frac{(n+1)^2}{2} + \frac{(n+1)^2}{4} \\ &= \frac{(n+1)(2n+1)}{6} - \frac{(n+1)^2}{4} \\ &= (n+1) \left[ \frac{4n+2-3n-3}{12} \right] \\ &= \frac{(n+1)(n-1)}{12} \\ &= \frac{n^2-1}{12} \end{aligned}$$

**Question 3:**

Find the mean and variance for the first 10 multiples of 3

Answer

The first 10 multiples of 3 are

3, 6, 9, 12, 15, 18, 21, 24, 27, 30

Here, number of observations,  $n = 10$

$$\text{Mean, } \bar{x} = \frac{\sum_{i=1}^{10} x_i}{10} = \frac{165}{10} = 16.5$$

The following table is obtained.

$x_i$	$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
3	-13.5	182.25
6	-10.5	110.25
9	-7.5	56.25
12	-4.5	20.25
15	-1.5	2.25
18	1.5	2.25
21	4.5	20.25
24	7.5	56.25
27	10.5	110.25
30	13.5	182.25
		742.5

$$\text{Variance}(\sigma^2) = \frac{1}{n} \sum_{i=1}^{10} (x_i - \bar{x})^2 = \frac{1}{10} \times 742.5 = 74.25$$

**Question 4:**

Find the mean and variance for the data

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

Answer

The data is obtained in tabular form as follows.

$x_i$	$f_i$	$f_i x_i$	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$f_i (x_i - \bar{x})^2$
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

Here,  $N = 40$ ,  $\sum_{i=1}^7 f_i x_i = 760$

$$\therefore \bar{x} = \frac{\sum_{i=1}^7 f_i x_i}{N} = \frac{760}{40} = 19$$

$$\text{Variance} = (\sigma^2) = \frac{1}{N} \sum_{i=1}^7 f_i (x_i - \bar{x})^2 = \frac{1}{40} \times 1736 = 43.4$$

**Question 5:**

Find the mean and variance for the data

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

Answer

The data is obtained in tabular form as follows.

$x_i$	$f_i$	$f_i x_i$	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$f_i (x_i - \bar{x})^2$
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
	22	2200			640

Here,  $N = 22$ ,  $\sum_{i=1}^7 f_i x_i = 2200$

$$\therefore \bar{x} = \frac{1}{N} \sum_{i=1}^7 f_i x_i = \frac{1}{22} \times 2200 = 100$$

$$\text{Variance}(\sigma^2) = \frac{1}{N} \sum_{i=1}^7 f_i (x_i - \bar{x})^2 = \frac{1}{22} \times 640 = 29.09$$

### Question 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

Answer

The data is obtained in tabular form as follows.

$x_i$	$f_i$	$f_i = \frac{x_i - 64}{1}$	$y_i^2$	$f_i y_i$	$f_i y_i^2$
60	2	-4	16	-8	32
61	1	-3	9	-3	9
62	12	-2	4	-24	48
63	29	-1	1	-29	29
64	25	0	0	0	0
65	12	1	1	12	12
66	10	2	4	20	40
67	4	3	9	12	36
68	5	4	16	20	80
	100	220		0	286

$$\bar{x} = A + \frac{\sum_{i=1}^9 f_i y_i}{N} \times h = 64 + \frac{0}{100} \times 1 = 64 + 0 = 64$$

Mean,

$$\begin{aligned} \text{Variance, } \sigma^2 &= \frac{h^2}{N^2} \left[ N \sum_{i=1}^9 f_i y_i^2 - \left( \sum_{i=1}^9 f_i y_i \right)^2 \right] \\ &= \frac{1}{100^2} [100 \times 286 - 0] \\ &= 2.86 \end{aligned}$$

$$\therefore \text{Standard deviation } (\sigma) = \sqrt{2.86} = 1.69$$

### Question 7:

Find the mean and variance for the following frequency distribution.

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

Answer

Class	Frequency $f_i$	Mid-point $x_i$	$y_i = \frac{x_i - 105}{30}$	$y_i^2$	$f_i y_i$	$f_i y_i^2$
0-30	2	15	-3	9	-6	18
30-60	3	45	-2	4	-6	12
60-90	5	75	-1	1	-5	5
90-120	10	105	0	0	0	0
120-150	3	135	1	1	3	3
150-180	5	165	2	4	10	20
180-210	2	195	3	9	6	18
	30				2	76

$$\text{Mean, } \bar{x} = A + \frac{\sum_{i=1}^7 f_i y_i}{N} \times h = 105 + \frac{2}{30} \times 30 = 105 + 2 = 107$$

$$\begin{aligned} \text{Variance } (\sigma^2) &= \frac{h^2}{N^2} \left[ N \sum_{i=1}^7 f_i y_i^2 - \left( \sum_{i=1}^7 f_i y_i \right)^2 \right] \\ &= \frac{(30)^2}{(30)^2} [30 \times 76 - (2)^2] \\ &= 2280 - 4 \\ &= 2276 \end{aligned}$$

**Question 8:**

Find the mean and variance for the following frequency distribution.

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

Answer

Class	Frequency $f_i$	Mid-point $x_i$	$y_i = \frac{x_i - 25}{10}$	$y_i^2$	$f_i y_i$	$f_i y_i^2$
0-10	5	5	-2	4	-10	20
10-20	8	15	-1	1	-8	8
20-30	15	25	0	0	0	0
30-40	16	35	1	1	16	16
40-50	6	45	2	4	12	24
	50				10	68

$$\text{Mean, } \bar{x} = A + \frac{\sum_{i=1}^5 f_i y_i}{N} \times h = 25 + \frac{10}{50} \times 10 = 25 + 2 = 27$$

$$\begin{aligned} \text{Variance } (\sigma^2) &= \frac{h^2}{N^2} \left[ N \sum_{i=1}^5 f_i y_i^2 - \left( \sum_{i=1}^5 f_i y_i \right)^2 \right] \\ &= \frac{(10)^2}{(50)^2} [50 \times 68 - (10)^2] \\ &= \frac{1}{25} [3400 - 100] = \frac{3300}{25} \\ &= 132 \end{aligned}$$



**Question 9:**

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

Height in cms	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

Answer

Class Interval	Frequency $f_i$	Mid-point $x_i$	$y_i = \frac{x_i - 92.5}{5}$	$y_i^2$	$f_i y_i$	$f_i y_i^2$
70-75	3	72.5	-4	16	-12	48
75-80	4	77.5	-3	9	-12	36
80-85	7	82.5	-2	4	-14	28
85-90	7	87.5	-1	1	-7	7
90-95	15	92.5	0	0	0	0

95-100	9	97.5	1	1	9	9
100-105	6	102. 5	2	4	12	24
105-110	6	107. 5	3	9	18	54
110-115	3	112. 5	4	16	12	48
	60				6	25 4

$$\text{Mean, } \bar{x} = A + \frac{\sum_{i=1}^9 f_i y_i}{N} \times h = 92.5 + \frac{6}{60} \times 5 = 92.5 + 0.5 = 93$$

$$\begin{aligned} \text{Variance } (\sigma^2) &= \frac{h^2}{N^2} \left[ N \sum_{i=1}^9 f_i y_i^2 - \left( \sum_{i=1}^9 f_i y_i \right)^2 \right] \\ &= \frac{(5)^2}{(60)^2} [60 \times 254 - (6)^2] \\ &= \frac{25}{3600} (15204) = 105.58 \end{aligned}$$

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

**Question 10:**

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

Diameters	No. of children
33-36	15
37-40	17
41-44	21

45-48	22
49-52	25

Answer

Class Interval	Frequency $f_i$	Mid-point $x_i$	$y_i = \frac{x_i - 42.5}{4}$	$f_i^2$	$f_i y_i$	$f_i y_i^2$
32.5-36.5	15	34.5	-2	4	-30	60
36.5-40.5	17	38.5	-1	1	-17	17
40.5-44.5	21	42.5	0	0	0	0
44.5-48.5	22	46.5	1	1	22	22
48.5-52.5	25	50.5	2	4	50	100
	100				25	199

Here,  $N = 100$ ,  $h = 4$

Let the assumed mean,  $A$ , be 42.5.

$$\text{Mean, } \bar{x} = A + \frac{\sum_{i=1}^5 f_i y_i}{N} \times h = 42.5 + \frac{25}{100} \times 4 = 43.5$$

$$\begin{aligned} \text{Variance } (\sigma^2) &= \frac{h^2}{N^2} \left[ N \sum_{i=1}^5 f_i y_i^2 - \left( \sum_{i=1}^5 f_i y_i \right)^2 \right] \\ &= \frac{16}{10000} [100 \times 199 - (25)^2] \\ &= \frac{16}{10000} [19900 - 625] \\ &= \frac{16}{10000} \times 19275 \\ &= 30.84 \end{aligned}$$

$\therefore$  Standard deviation ( $\sigma$ ) = 5.55