NCERT Solutions of Chapter 14 - Statistics

Ex 14.1

Question 1.
A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

Number of plants	0 – 2	2 – 4	4 – 6	6 – 8	8 – 10	10 – 12	12 – 14
Number of houses	1	2	1	5	6	2	3

Which method did you use for finding the mean, and why?
Solution:

Number of plants	Class mark (x_i)	Number of houses (f_i)	$f_i x_i$
0 – 2	1	1	01
2 – 4	3	2	06
4 – 6	5	1	05
6 – 8	7	5	35
8 – 10	9	6	54
10 – 12	11	2	22
12 – 14	13	3	39
Total		$\Sigma f_i = 20$	$\Sigma f_i x_i = 162$

We have, Mean $(\bar{x}) = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{162}{20} = 8.1$ plants. The mean of the data is 8.1.

Since the values of x_i and f_i are small, so we have used direct method to find the mean.

Question 2.
Consider the following distribution of daily wages of 50 workers of a factory.

Daily wages (in ₹)	100 – 120	120 – 140	140 – 160	160 – 180	180 – 200
Number of workers	12	14	8	6	10

Find the mean daily wages of the workers of the factory by using an appropriate method.
Solution:

Here h = 20

Daily wages (in ₹)	Class mark (x_i)	Number of workers (f_i)	$d_i = x_i - 150$	$u_i = \frac{d_i}{20}$	f_iu_i
100 – 120	110	12	–40	–2	–24
120 – 140	130	14	–20	–1	–14
140 – 160	150 = a (Let)	8	0	0	0
160 – 180	170	6	20	1	6
180 – 200	190	10	40	2	20
Total		$\Sigma f_i = 50$			$\Sigma f_iu_i = -12$

We have, Mean $= a + \frac{\Sigma f_iu_i}{\Sigma f_i} \times h$

$$= 150 + \frac{(-12)\times 20}{50} = \frac{150}{1} - \frac{24}{5} = \frac{750-24}{5} = \frac{726}{5} = ₹\ 145.20.$$

Question 3.
The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is ₹ 18. Find the missing frequency f.

Daily pocket allowance (in ₹)	11–13	13–15	15–17	17–19	19–21	21–23	23–25
Number of children	7	6	9	13	f	5	4

Solution:

Daily pocket allowance (in ₹)	Class mark (x_i)	Number of children (f_i)	$d_i = x_i - 18$	f_id_i
11 – 13	12	7	–6	–42
13 – 15	14	6	–4	–24
15 – 17	16	9	–2	–18
17 – 19	18 = a (Let)	13	0	0
19 – 21	20	f	2	2f
21 – 23	22	5	4	20
23 – 25	24	4	6	24
Total		$\Sigma f_i = 44 + f$		$\Sigma f_id_i = 2f - 40$

We have, Mean $= a + \frac{\Sigma f_id_i}{\Sigma f_i}$

$\Rightarrow$ $18 = 18 + \frac{2f-40}{44+f}$ [$\because$ Mean = 18 (given)]

$\Rightarrow$ $0 = \frac{2f-40}{44+f} \Rightarrow 2f - 40 = 0 \Rightarrow 2f = 40 \Rightarrow f = \frac{40}{2} = 20$

Question 4.
Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarised as follows. Find the mean heart beats per minute for these women, choosing a suitable method

Number of heart beats per minute	65–68	68–71	71–74	74–77	77–80	80–83	83–86
Number of women	2	4	3	8	7	4	2

Solution:

Number of heart beats per minute	Class mark (x_i)	Number of women (f_i)	$u_i = \frac{x_i - a}{3}$	$f_i u_i$
65 – 68	66.5	2	–3	–6
68 – 71	69.5	4	–2	–8
71 – 74	72.5	3	–1	–3
74 – 77	75.5 = a (Let)	8	0	0
77 – 80	78.5	7	1	7
80 – 83	81.5	4	2	8
83 – 86	84.5	2	3	6
Total		$\Sigma f_i = 30$		$\Sigma f_i u_i = 4$

We have, $$\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$$

$$= 75.5 + \frac{4 \times 3}{30} = 75.5 + 0.4 = 75.9$$

Question 5.
In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

Number of mangoes	50–52	53–55	56–58	59–61	62–64
Number of boxes	15	110	135	115	25

Find the mean number of mangoes kept in a packing box. Which method of finding the mean did you choose?
Solution:
Here h = 3

Number of mangoes	Class mark (x_i)	Number of boxes (f_i)	$u_i = \frac{x_i - 57}{3}$	$f_i u_i$
50 – 52	51	15	–2	–30
53 – 55	54	110	–1	–110
56 – 58	57 = a (Let)	135	0	0
59 – 61	60	115	1	115
62 – 64	63	25	2	50
Total		$\Sigma f_i = 400$		$\Sigma f_i u_i = 25$

We have, Mean $= a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h = 57 + \frac{25 \times 3}{400}$

$= 57 + 0.19 = 57.19$ mangoes.

Step deviation method.

Question 6.

The table below shows the daily expenditure on food of 25 households in a locality.

Daily expenditure (in ₹)	100–150	150–200	200–250	250–300	300–350
Number of households	4	5	12	2	2

Find the mean daily expenditure on food by a suitable method.

Solution:

Daily expenditure (in ₹)	Class mark (x_i)	Number of households (f_i)	$u_i = \frac{x_i - 225}{50}$	$f_i u_i$
100 – 150	125	4	–2	–8
150 – 200	175	5	–1	–5
200 – 250	225 = a (Let)	12	0	0
250 – 300	275	2	1	2
300 – 350	325	2	2	4
Total		$\Sigma f_i = 25$		$\Sigma f_i u_i = -7$

We have, Mean $= a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$

$= 225 + \frac{-7}{25} \times 50 = 225 - 14 =$ ₹ 211

Question 7.

To find out the concentration of SO_2 in the air (in parts per million, i.e. ppm), the data was collected for 30 localities in a certain city and is presented below:

Concentration of SO_2 (in ppm)	Frequency
0.00 – 0.04	4
0.04 – 0.08	9
0.08 – 0.12	9
0.12 – 0.16	2
0.16 – 0.20	4
0.20 – 0.24	2

Find the mean concentration of SO_2 in the air.

Solution:

Here h = 0.04

Concentration of SO_2 (in ppm)	Class mark (x_i)	Frequency (f_i)	$u_i = \frac{x_i - 0.10}{0.04}$	$f_i u_i$
0.00 – 0.04	0.02	4	–2	–8
0.04 – 0.08	0.06	9	–1	–9
0.08 – 0.12	0.10 = a (Let)	9	0	0
0.12 – 0.16	0.14	2	1	2
0.16 – 0.20	0.18	4	2	8
0.20 – 0.24	0.22	2	3	6
Total		$\Sigma f_i = 30$		$\Sigma f_i u_i = -1$

We have, $$\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$$

$$= 0.10 + \frac{(-1) \times 0.04}{30} = 0.10 - 0.001 = 0.099 \text{ ppm.}$$

Question 8.

A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

Number of days	0–6	6–10	10–14	14–20	20–28	28–38	38–40
Number of students	11	10	7	4	4	3	1

Solution:

Number of days	Class marks (x_i)	Number of students (f_i)	$d_i = x_i - 17$	$f_i d_i$
0 – 6	3	11	–14	–154
6 – 10	8	10	–9	–90
10 – 14	12	7	–5	–35
14 – 20	17 = a (Let)	4	0	0
20 – 28	24	4	7	28
28 – 38	33	3	16	48
38 – 40	39	1	22	22
Total		$\Sigma f_i = 40$		$\Sigma f_i d_i = -181$

We have, Mean $= a + \frac{\Sigma f_i d_i}{\Sigma f_i} = 17 + \frac{-181}{40} = 17 - 4.52 = 12.48$ days.

Question 9.
The following table gives the literacy rate (in percentage) of 35 cities. Find the mean literacy rate.

Literacy rate (in%)	45 – 55	55 – 65	65 – 75	75 – 85	85 – 95
Number of cities	3	10	11	8	3

Solution:
Here h = 10

Literacy rate (in%)	Class mark (x_i)	Number of cities (f_i)	$u_i = \frac{x_i - 70}{10}$	$f_i u_i$
45 – 55	50	3	– 2	– 6
55 – 65	60	10	– 1	– 10
65 – 75	70 = a (Let)	11	0	0
75 – 85	80	8	1	8
85 – 95	90	3	2	6
Total		$\Sigma f_i = 35$		$\Sigma f_i u_i = -2$

$$\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h = 70 + \frac{(-2) \times 10}{35} = 70 - 0.57 = 69.43\%$$

Ex 14.2

Question 1.
The following table shows the ages of the patients admitted in a hospital during a

year.

Age (in years)	5–15	15–25	25–35	35–45	45–55	55–65
Number of patients	6	11	21	23	14	5

Find the mode and the mean of the data given above. Compare and interpret the two measures of central tendency.

Solution:

For Mode:

Age (in years)	5–15	15–25	25–35	35–45	45–55	55–65
Number of patients	6	11	21	23	14	5

$\because$ Maximum frequency = 23

$\therefore$ Modal class = 35 – 45

Here, $l = 35, f_1 = 23, f_0 = 21, f_2 = 14, h = 10$

$$\text{Mode} = l + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h = 35 + \left[\frac{23-21}{46-21-14}\right] \times 10 = 35 + \frac{2}{11} \times 1($$

$$= 35 + \frac{20}{11} = 36.8 \text{ years}$$

For Mean:

Age (in years)	Class mark (x_i)	Number of patients (f_i)	$u_i = \frac{x_i - 30}{10}$	$f_i u_i$
5 – 15	10	6	–2	–12
15 – 25	20	11	–1	–11
25 – 35	30 = a (Let)	21	0	0
35 – 45	40	23	1	23
45 – 55	50	14	2	28
55 – 65	60	5	3	15
Total		$\Sigma f_i = 80$		$\Sigma f_i u_i = 43$

Here, $a = 30, \Sigma f_i u_i = 43, \Sigma f_i = 80, h = 10$

We have, $\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h = 30 + \frac{43 \times 10}{80} = 30 + 5.37 = 35.37$ years

We conclude that the maximum number of patients in the hospital are of the age 36.8 years. While on an average the age of patient admitted to the hospital is 35.37 years.

Question 2.

The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:

Lifetimes (in hours)	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	10	35	52	61	38	29

Determine the modal lifetimes of the components.
Solution:

Lifetimes (in hours)	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	10	35	52	61	38	29

Here, Maximum frequency = 61
$\therefore$ Modal class = 60 – 80
Here, $l = 60, f_0 = 52, f_1 = 61, f_2 = 38, h = 20$

We have, Mode $= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 60 + \left(\frac{61-52}{122-52-38}\right) \times 20 = 60 + \frac{9 \times 2}{32}$

$= 60 + \frac{45}{8} = 60 + 5.625 = 65.625$ hours

Question 3.
The following data gives the distribution of total monthly household expenditure of 200 families of a village. Find the modal monthly expenditure of the families. Also, find the mean monthly expenditure:

Expenditure (in ₹)	Number of families
1000 – 1500	24
1500 – 2000	40
2000 – 2500	33
2500 – 3000	28
3000 – 3500	30
3500 – 4000	22
4000 – 4500	16
4500 – 5000	7

Solution:

Here, Maximum frequency = 40

$\therefore$ Modal class = 1500 – 2000 and $l = 1500, f_0 = 24, f_1 = 40, f_2 = 33$

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 1500 + \left(\frac{40-24}{80-24-33}\right) \times 500$$

$$= 1500 + \frac{16}{23} \times 500 = 1500 + 347.83 = ₹\,1847.83$$

For Mean

Expenditure (in ₹)	Class mark (x_i)	Number of families (f_i)	$u_i = \frac{x_i - 2750}{500}$	$f_i u_i$
1000 – 1500	1250	24	–3	–72
1500 – 2000	1750	40	–2	–80
2000 – 2500	2250	33	–1	–33
2500 – 3000	2750 = a (Let)	28	0	0
3000 – 3500	3250	30	1	30
3500 – 4000	3750	22	2	44
4000 – 4500	4250	16	3	48
4500 – 5000	4750	7	4	28
Total		$\Sigma f_i = 200$		$\Sigma f_i u_i = -35$

Here, $a = 2750, \Sigma f_i = 200, \Sigma f_i u_i = -35, h = 500$

$$\therefore \quad \text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$$

$$= 2750 + \frac{(-35)}{200} \times 500 = 2750 - \frac{175}{2}$$

$$= 2750 - 87.50 = ₹\,2662.50$$

Question 4.

The following distribution gives the state-wise teacher- student ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two measures

Number of students per teacher	Number of states /U.T.
15 – 20	3
20 – 25	8
25 – 30	9
30 – 35	10
35 – 40	3
40 – 45	0
45 – 50	0
50 – 55	2

Solution:

Number of students per teacher	Number of states/U.T. (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 32.5}{5}$	$f_i u_i$
15 – 20	3	17.5	– 3	– 9
20 – 25	8	22.5	– 2	– 16
25 – 30	9	27.5	– 1	– 9
30 – 35	10	32.5 = a (Let)	0	0
35 – 40	3	37.5	1	3
40 – 45	0	42.5	2	0
45 – 50	0	47.5	3	0
50 – 55	2	52.5	4	8
Total	$\Sigma f_i = 35$			$\Sigma f_i u_i = -23$

Here, $a = 32.5, \Sigma f_i u_i = -23, h = 5, \Sigma f_i = 35$

We have, $\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h = 32.5 + \frac{(-23)}{35} \times 5 = 32.5 - \frac{23}{7} = 32.5 - 3.3 = 29.2$

Maximum frequency = 10

$\therefore$ Modal class = 30 – 35 Here, $l = 30,\ f_0 = 9,\ f_1 = 10,\ f_2 = 3$

Also we have, $\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 30 + \left(\frac{10-9}{20-9-3}\right) \times 5 = 30 + \frac{5}{8} = 30.6$

Hence, we conclude that most states/U.T. have a student teacher ratio of 30.6 and on an average this ratio is 29.2.

Question 5.

The given distribution shows the number of runs scored by some top batsmen of the world in one – day international cricket matches.

Runs scored	Number of batsmen
3000 – 4000	4
4000 – 5000	18
5000 – 6000	9
6000 – 7000	7
7000 – 8000	6
8000 – 9000	3
9000 – 10000	1
10000 – 11000	1

Find the mode of the data.

Solution:

Runs scored	Number of batsmen (f_i)
3000 – 4000	4
4000 – 5000	18
5000 – 6000	9
6000 – 7000	7
7000 – 8000	6
8000 – 9000	3
9000 – 10000	1
10000 – 11000	1

Maximum frequency = 18,

$\therefore$ Modal class = 4000 – 5000; Here, $l = 4000, f_0 = 4, f_1 = 18, f_2 = 9$

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 4000 + \left(\frac{18-4}{36-4-9}\right) \times 1000$$

$$= 4000 + \frac{14000}{23} = 4000 + 608.7 = 4608.7 \text{ runs}$$

Question 6.
A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below. Find the mode of the data:

Number of cars	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80
Frequency	7	14	13	12	20	11	15	8

Solution:

Number of cars	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80
Frequency (f_i)	7	14	13	12	20	11	15	8

Maximum frequency = 20

$\therefore$ Modal class = 40 – 50; Here, $l = 40, f_0 = 12, f_1 = 20, f_2 = 11$

$$\therefore \quad \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 40 + \left(\frac{20-12}{40-12-11}\right) \times 10 = 40 + 4.7 = 44.7 \text{ cars}$$

Ex 14.3

Question 1.
The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. Find the median, mean and mode of the data and compare them.

Monthly consumption (in units)	Number of consumers
65 – 85	4
85 – 105	5
105 – 125	13
125 – 145	20
145 – 165	14
165 – 185	8
185 – 205	4

Solution:

Monthly consumption (in units)	Number of consumers (f_i)	Cumulative frequency (cf)	Class mark (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
65 – 85	4	4	75	–3	–12
85 – 105	5	9	95	–2	–10
105 – 125	13	22	115	–1	–13
125 – 145	20	42	135 = a (Let)	0	0
145 – 165	14	56	155	1	14
165 – 185	8	64	175	2	16
185 – 205	4	68	195	3	12
Total	$\Sigma f_i = 68$				$\Sigma f_i u_i = 7$

We have, $\quad \text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h = 135 + \frac{7}{68} \times 20 = 135 + \frac{35}{17}$

$= 135 + 2.06 = 137.06$ units

Here, $\quad n = 68, \frac{n}{2} = \frac{68}{2} = 34,$

$\therefore$ Median class = 125 – 145

Here, $l = 125, n = 68, f = 20, cf = 22, h = 20$

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h = 125 + \left(\frac{34 - 22}{20}\right) \times 20$$

$= 125 + 12 = 137$ units

Maximum frequency = 20

Modal class = 125 – 145 Here, $l = 125, f_0 = 13, f_1 = 20, f_2 = 14$

$$\therefore \quad \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 125 + \left(\frac{20 - 13}{40 - 13 - 14}\right) \times 20$$

$$= 125 + \frac{7 \times 20}{13} = 125 + \frac{140}{13} = 125 + 10.76 = 135.76 \text{ units}$$

Mean > Median > Mode

Question 2.
If the median of the distribution given below is 28.5, find the values of x and y.

Class interval	Frequency
0 – 10	5
10 – 20	x
20 – 30	20
30 – 40	15
40 – 50	y
50 – 60	5
Total	60

Solution:
Given, Median = 28.5 which lies in the class (20 – 30).
Here, l = 20, f = 20, cf = 5 + x, h = 10, n = 60

Class interval	Frequency	Cumulative
0 – 10	5	5
10 – 20	x	$5 + x$
20 – 30	20	$25 + x$
30 – 40	15	$40 + x$
40 – 50	y	$40 + x + y$
50 – 60	5	$45 + x + y$
Total	60	

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h = 20 + \frac{30 - (5 + x)}{20} \times 10 = 20 + \frac{30 - 5 - x}{2}$$

$$\Rightarrow \quad 28.5 = 20 + \frac{25 - x}{2} \quad \Rightarrow \quad 28.5 - 20 = \frac{25 - x}{2}$$

$$\Rightarrow \quad 8.5 \times 2 = 25 - x \quad \Rightarrow \quad x = 25 - 17 \quad \Rightarrow \quad x = 8$$

Again $\quad 45 + x + y = 60 \quad \Rightarrow \quad x + y = 60 - 45 \quad \Rightarrow \quad x + y = 15$

$$8 + y = 15 \quad \Rightarrow y = 15 - 8 = 7$$

Question 3.
A life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are given only to persons having age 18 years onwards but less than 60 years.

Age (in years)	Number of policy holders
Below 20	2
Below 25	6
Below 30	24
Below 35	45
Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

Solution:

Age (in years)	Number of policy holders	Cumulative frequency
0 – 20	2	2
20 – 25	6 – 2 = 4	6
25 – 30	24 – 6 = 18	24
30 – 35	45 – 24 = 21	45
35 – 40	78 – 45 = 33	78
40 – 45	89 – 78 = 11	89
45 – 50	92 – 89 = 3	92
50 – 55	98 – 92 = 6	98
55 – 60	100 – 98 = 2	100
Total	100	

Here, $\frac{n}{2} = \frac{100}{2} = 50$

$\therefore$ Median class= 35 – 40, So, $l = 35$, $cf = 45$, $h = 5$, $f = 33$

We have, $$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h = 35 + \left(\frac{50-45}{33}\right) \times 5 = 35 + \frac{25}{33}$$

$$= 35 + 0.76 = 35.76 \text{ years}$$

Question 4.

The lengths of 40 leaves of a plant are measured correct to nearest millimetre, and the data obtained is represented in the following table:

Length (in mm)	Number of leaves
118 – 126	3
127 – 135	5
136 – 144	9
145 – 153	12
154 – 162	5
163 – 171	4
172 – 180	2

Find the median length of the leaves.
(Hint: The data needs to be converted to continuous classes for finding the median since the formula assumes continuous classes. The classes then change to 117.5 – 126.5,126.5 -135.5,…, 171.5 -180.5.)

Solution:

Length (in mm)	Number of leaves	*cf*
117.5 – 126.5	3	3
126.5 – 135.5	5	8
135.5 – 144.5	9	17
144.5 – 153.5	12	29
153.5 – 162.5	5	34
162.5 – 171.5	4	38
171.5 – 180.5	2	40
Total	40	

Here, $\frac{n}{2} = \frac{40}{2} = 20$

So, Median class $= 144.5 - 153.5$

Here, $l = 144.5, f = 12, cf = 17, h = 9$

We have, Median $= l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h = 144.5 + \left(\frac{20-17}{12}\right) \times 9$

$= 144.5 + \frac{9}{4} = 146.75$ mm

Question 5.
The following table gives the distribution of the lifetime of 400 neon lamps:

Lifetime (in hours)	Number of lamps
1500 – 2000	14
2000 – 2500	56
2500 – 3000	60
3000 – 3500	86
3500 – 4000	74
4000 – 4500	62
4500 – 5000	48

Find the median lifetime of a lamp.

Solution:

Lifetime (in hours)	Number of lamps	cf
1500 – 2000	14	14
2000 – 2500	56	70
2500 – 3000	60	130
3000 – 3500	86	216
3500 – 4000	74	290
4000 – 4500	62	352
4500 – 5000	48	400
Total	400	

Here, $\frac{n}{2} = \frac{400}{2} = 200$

$\therefore$ Median class = 3000 – 3500

So, $f = 86, cf = 130, h = 500$

We have, Median $= l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$

$= 3000 + \left(\frac{200 - 130}{86}\right) \times 500$

$= 3000 + \frac{35000}{86} = 3000 + 406.98 = 3406.98$ hours

Question 6.

100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabet in the surnames was obtained as follows:

Number of letters	1 – 4	4 – 7	7 – 10	10 – 13	13 – 16	16 – 19
Number of surnames	6	30	40	16	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames. Also, find the modal size of the surnames.

Solution:

Number of letters	Number of surnames	cf
1 – 4	6	6
4 – 7	30	36
7 – 10	40	76
10 – 13	16	92
13 – 16	4	96
16 – 19	4	100
Total	100	

Here, $\frac{n}{2} = \frac{100}{2} = 50$

∴ Median class $= 7 - 10$

So, $l = 7, f = 40, cf = 36, h = 3$

We have, $$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$$

$$= 7 + \left(\frac{50 - 36}{40}\right) \times 3$$

$$= 7 + \frac{42}{40} = 8.05$$

Here, Modal class $= 7 - 10$

So, $l = 7, f_0 = 30, f_1 = 40, f_2 = 16, h = 3$

∴ $$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$$= 7 + \left(\frac{40 - 30}{80 - 30 - 16}\right) \times 3 = 7 + \frac{30}{34} = 7.88$$

For mean

Number of letters	Frequency (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 8.5}{3}$	$f_i u_i$
1 – 4	6	2.5	–2	–12
4 – 7	30	5.5	–1	–30
7 – 10	40	8.5 = a (Let)	0	0
10 – 13	16	11.5	1	16
13 – 16	4	14.5	2	8
16 – 19	4	17.5	3	12
Total	$\Sigma f_i = 100$			$\Sigma f_i u_i = -6$

We have, $\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$

$$= 8.5 + \frac{(-6)}{100} \times 3 = 8.5 - 0.18 = 8.32$$

Question 7.

The distribution below gives the weight of 30 students of a class. Find the median weight of the students.

Weight (in kg)	40–45	45–50	50–55	55–60	60–65	65–70	70–75
Number of students	2	3	8	6	6	3	2

Solution:

Weight (in kg)	Number of students (f_i)	cf
40 – 45	2	2
45 – 50	3	5
50 – 55	8	13
55 – 60	6	19
60 – 65	6	25
65 – 70	3	28
70 – 75	2	30
Total	30	

Here, $\frac{n}{2} = \frac{30}{2} = 15,$

$\therefore$ Median class $= 55 - 60,$

So, $l = 55, f = 6, cf = 13, h = 5$

$$\text{Median weight} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$$

$$= 55 + \left(\frac{15 - 13}{6}\right) \times 5 = 55 + \frac{5}{3}$$

$$= 55 + 1.67 = 56.67 \text{ kg}$$

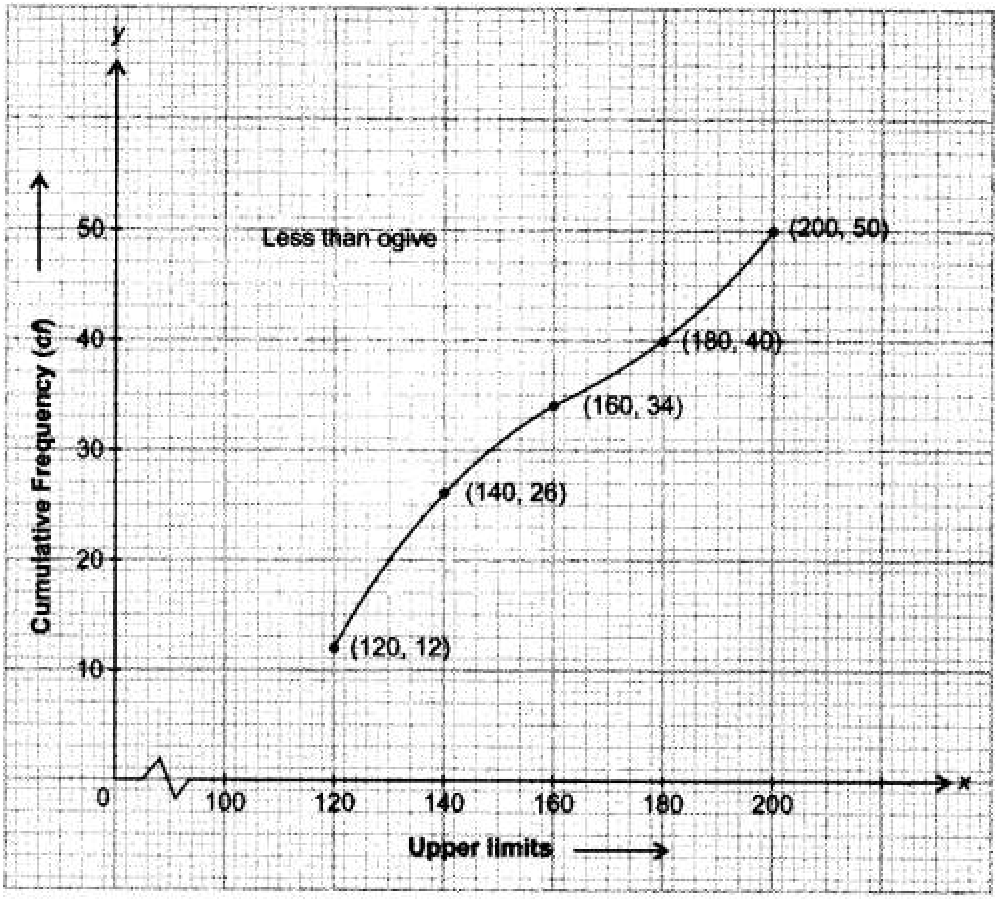
Ex 14.4

Question 1.
The following distribution gives the daily income of 50 workers of a factory.

Daily income (in ₹)	100–120	120–140	140–160	160–180	180–200
Number of workers	12	14	8	6	10

Convert the distribution above to a less than type cumulative frequency distribution, and draw its ogive.
Solution:

Daily income (In ₹)	Number of workers	Less than daily income in (₹)	cf
100 – 120	12	120	12
120 – 140	14	140	26
140 – 160	8	160	34
160 – 180	6	180	40
180 – 200	10	200	50



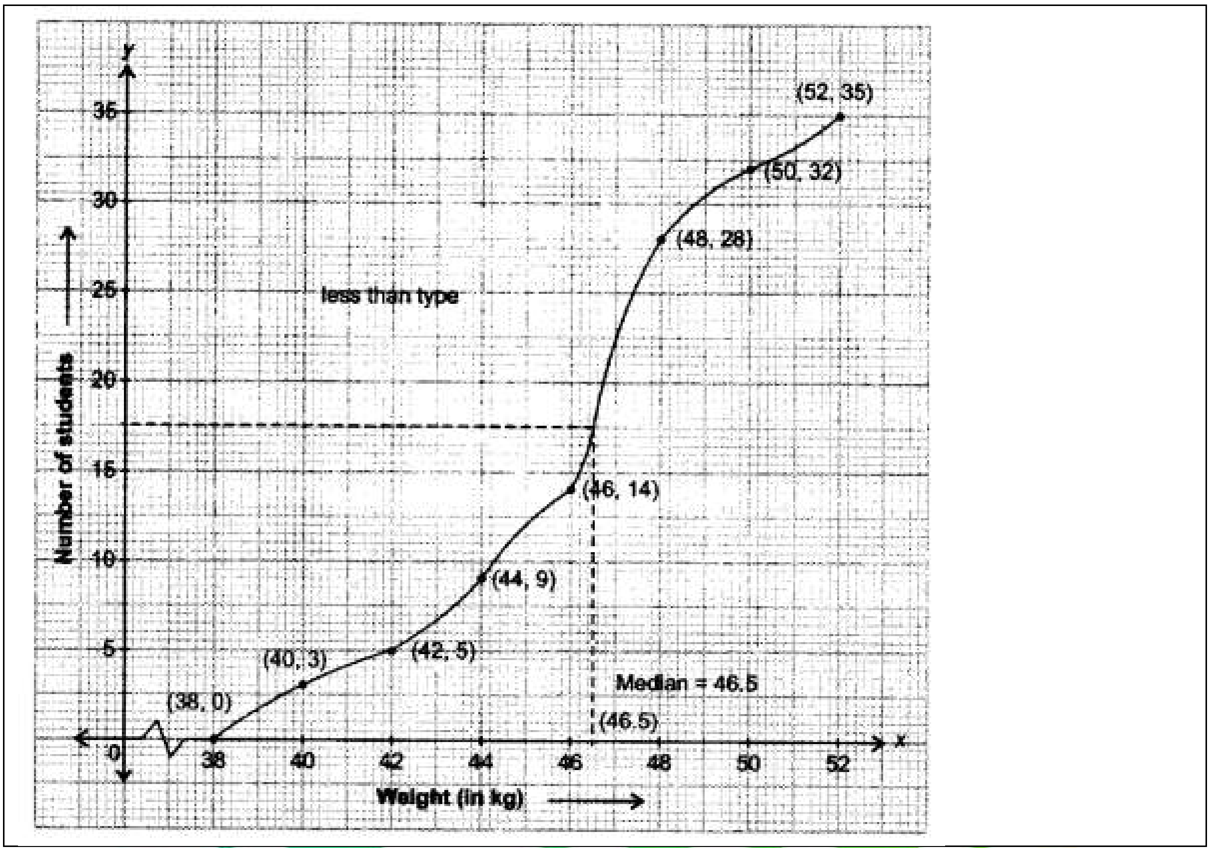
Question 2.
During the medical check-up of 35 students of a class, their weights were recorded as follows:

Weight (in kg)	Number of students
less than 38	0
less than 40	3
less than 42	5
less than 44	9
less than 46	14
less than 48	28
less than 50	32
less than 52	35

Draw a less than type ogive for the given data. Hence obtain the median weight from the graph and verify the result by using the formula.

Solution:

Weight in (kg)	Number of students
less than 38	0
less than 40	3
less than 42	5
less than 44	9
less than 46	14
less than 48	28
less than 50	32
less than 52	35



y
35
30
25
20
15
10
5
0
Number of students
less than type
(52, 35)
(50, 32)
(48, 28)
(46, 14)
(44, 9)
(42, 5)
(40, 3)
(38, 0)
Median = 46.5
(46.5)
38
40
42
44
46
48
50
52
x
Weight (in kg)

Median by formula:

Class interval	Frequency	cf
Below 38	0	0
38 – 40	3	3
40 – 42	2	5
42 – 44	4	9
44 – 46	5	14
46 – 48	14	28
48 – 50	4	32
50 – 52	3	35

$n = 35$ So, $\frac{n}{2} = \frac{35}{2} = 17.5$

Now, Median class is 46 – 48, so, $l = 46$, $cf = 14$, $f = 14$, $h = 2$.

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$$

l = Lower limit of class, n = number of observations.

cf = Cumulative frequency of class preceding the median class.

f = Frequency of median class.

h = Class size.

$$\text{Median} = 46 + \left(\frac{17.5 - 14}{14}\right) \times 2 = 46 + \frac{3.5}{14} \times 2 = 46 + \frac{35}{14} \times \frac{2}{10} = 46 + 0.5 = 46.5$$

Question 3.

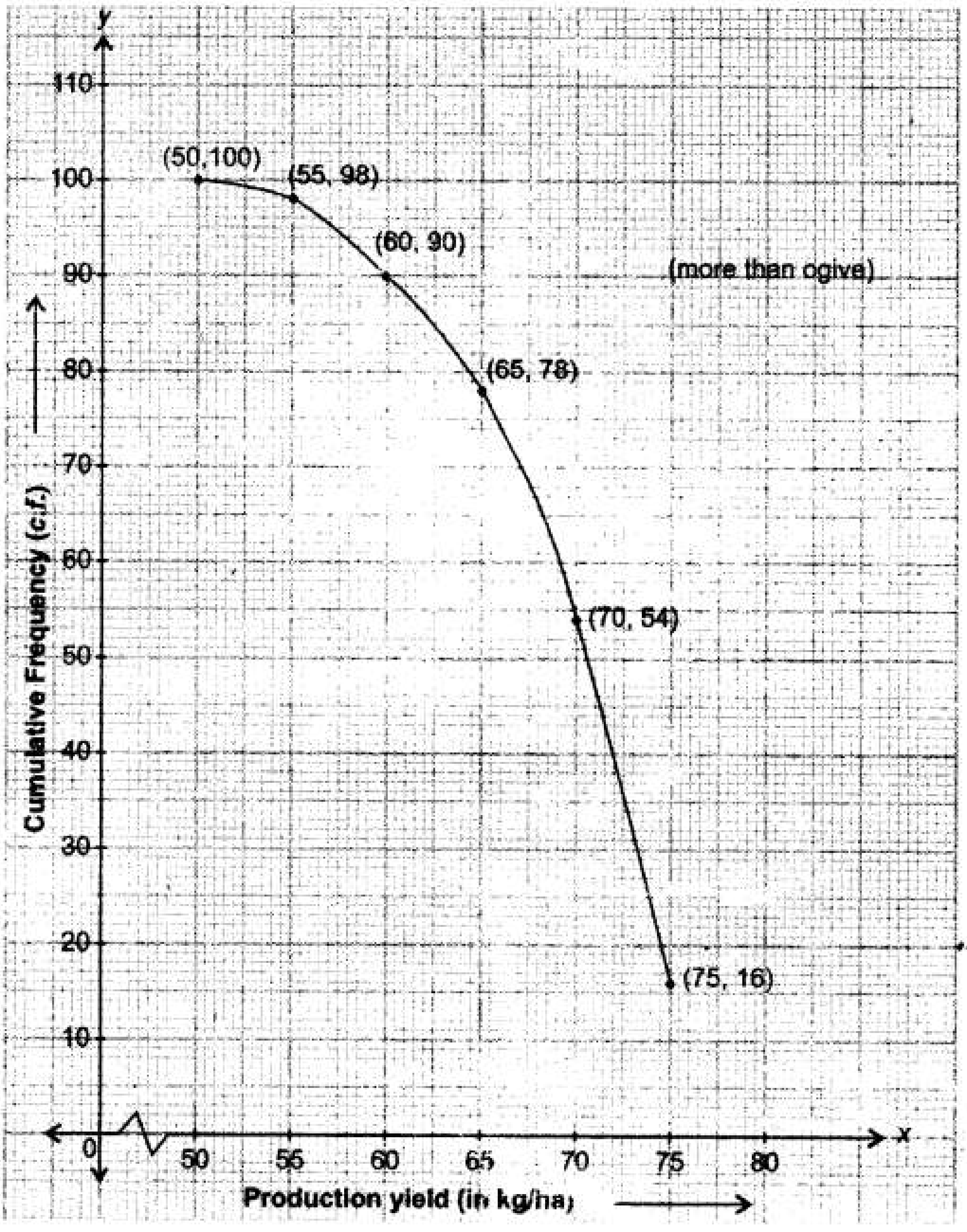
The following table gives production yield per hectare of wheat of 100 farms of a village.

Production yield (in kg/ha)	50 – 55	55 – 60	60 – 65	65 – 70	70 – 75	75 – 80
Number of farms	2	8	12	24	38	16

Change the distribution to a more than type distribution, and draw its ogive.

Solution:

Production yield (in kg/ha)	Number of farms	More than production yield in kg/ha	*c.f.*
50 –55	2	more than 50	100
55 – 60	8	more than 55	98
60 – 65	12	more than 60	90
65 – 70	24	more than 65	78
70 – 75	38	more than 70	54
75 – 80	16	more than 75	16



y
110
100
90
80
70
60
50
40
30
20
10
0
(50,100)
(55, 98)
(60, 90)
(65, 78)
(70, 54)
(75, 16)
(more than ogive)
Cumulative Frequency (c.f.)
50
55
60
65
70
75
80
x
Production yield (in kg/ha)

LBYH

LBYH