NCERT Solutions for Class 10 Maths Chapter 14 - Statistics

Chapter 14 - Statistics Exercise Ex. 14.1

Solution 1

Let us find class marks (x_i) for each interval by using the relation.

$$\text{Class mark } (x_i) = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Now we may compute x_i and $f_i x_i$ as following

Number of plants	Number of houses (f_i)	x_i	$f_i x_i$
0 - 2	1	1	1 × 1 = 1
2 - 4	2	3	2 × 3 = 6
4 - 6	1	5	1 × 5 = 5
6 - 8	5	7	5 × 7 = 35
8 - 10	6	9	6 × 9 = 54

10 - 12	2	11	$2 \times 11 = 22$
12 - 14	3	13	$3 \times 13 = 39$
Total	20		162

From the table, we may observe that

$$\sum f_i = 20$$

$$\sum f_i x_i = 162$$

$$\text{Mean } \bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$= \frac{162}{20} = 8.1$$

So, the mean number of plants per house is 8.1.
We have used here direct method as values of class marks (x_i) and f_i are small.

Solution 2
Let us find class mark for each interval by using the relation.

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size (h) of this data = 20

Now taking 550 as assured mean (a) we may calculate di, u_i and $f_i u_i$ as following.

Daily wages (in Rs)	Number of workers (f_i)	x_i	$d_i = x_i - 550$	$u_i = \frac{x_i - 550}{h}$	$f_i u_i$
500 - 520	12	510	-40	-2	- 24

520 - 540	14	530	-20	-1	- 14
540 - 560	8	550	0	0	0
560 - 580	6	570	20	1	6
580 - 600	10	590	40	2	20
Total	50				-12

From the table we may observe that $\sum_i f = 50, \sum_i f_i u_i = -12$

$$\bar{x} = A + \frac{\sum_i f_i u_i}{\sum_i f} \times h = 550 + \frac{-12}{50} \times 20 = 545.2$$

So mean daily wages of the workers of the factory is Rs. 545.2.

Solution 3

We may find class mark (x_i) for each interval by using the relation.

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Given that mean pocket allowance $\bar{x}$ = Rs.18

Now taking 18 as assured mean (a) we may calculate d_i and $f_i d_i$ as following.

Daily pocket allowance (in Rs.)	Number of children f_i	Class mark x_i	$d_i = x_i - 18$	$f_i d_i$
11 - 13	7	12	- 6	-42
13 - 15	6	14	- 4	-

				24
15 - 17	9	16	- 2	- 18
17 - 19	13	18	0	0
19 - 21	f	20	2	2 f
21 - 23	5	22	4	20
23 - 25	4	24	6	24
Total	$\sum f_i = 44 + f$			2f - 40

From the table we may obtain

$$\sum f_i = 44 + f$$

$$\sum f_i u_i = 2f - 40$$

$$\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$$

$$18 = 18 + \left(\frac{2f - 40}{44 + f}\right)$$

$$0 = \left(\frac{2f - 40}{44 + f}\right)$$

$$2f - 40 = 0$$

$$2f = 40$$

$$f = 20$$

Hence the missing frequency f is 20.

Solution 4

We may find class mark of each interval (x_i) by using the relation.

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size h of this data = 3

Now taking 75.5 as assumed mean (a) we may calculate d_i, u_i, f_iu_i as following.

Number of heart beats per minute	Number of women f_i	x_i	$d_i = x_i - 75.5$	$u_i = \frac{x_i - 75.5}{h}$	f_iu_i
65 - 68	2	66.5	- 9	- 3	- 6
68 - 71	4	69.5	- 6	- 2	- 8
71 - 74	3	72.5	- 3	- 1	- 3

74 - 77	8	75.5	0	0	0
77 - 80	7	78.5	3	1	7
80 - 83	4	81.5	6	2	8
83 - 86	2	84.5	9	3	6
Total	30				4

Now we may observe from table that

$$\sum fi = 30$$

$$\sum f_i u_i = 4$$

$$\text{Mean } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) \times h$$

$$= 75.5 + \left(\frac{4}{30}\right) \times 3$$

$$= 75.5 + 0.4 = 75.9$$

So mean heart beats per minute for these women are 75.9 beats per minute.

Solution 5

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

We may observe that class intervals are not continuous. There is a gap of 1 between two class intervals. So we have to add $\frac{1}{2}$ to upper class limit and subtract $\frac{1}{2}$ from lower class limit of each interval.

And class mark (x_i) may be obtained by using the relation

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size (h) of this data = 3

Now taking 57 as assumed mean (a) we may calculate d_i, u_i, $f_i u_i$ as following -

Class interval	f_i	x_i	$d_i = x_i - 57$	$u_i = \frac{x_i - 57}{h}$	$f_i u_i$
49.5 - 52.5	15	51	-6	-2	-30

52.5 - 55.5	110	54	-3	-1	-110
55.5 - 58.5	135	57	0	0	0
58.5 - 61.5	115	60	3	1	115
61.5 - 64.5	25	63	6	2	50
Total	400				25

Now we may observe that

$$\Sigma f_i = 400$$

$$\Sigma f_i u_i = 25$$

$$\text{mean} \quad \bar{x} = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right) \times h$$

$$= 57 + \left(\frac{25}{400}\right) \times 3$$

$$= 57 + \frac{3}{16} = 57 + 0.1875$$

$$= 57.1875$$

$$= 57.19$$

Clearly, mean number of mangoes kept in a packing box is 57.19.
We have chosen step deviation method here as values of f_i, d_i are big and also there is a common multiple between all d_i.

Solution 6
We may calculate class mark (x_i) for each interval by using the relation

$$x_1 = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size = 50

Now taking 225 as assumed mean (a) we may calculate d_i, u_i, $f_i u_i$ as following

Daily expenditure (in Rs)	f_i	x_i	$d_i = x_i - 225$	$u_i = \frac{x_i - 225}{h}$	$f_i u_i$
100 - 150	4	125	-100	-2	-8
150 - 200	5	175	-50	-1	-5
200 - 250	12	225	0	0	0
250 - 300	2	275	50	1	2
300 - 350	2	325	100	2	4

Total	25				-7

Now we may observe that -

$\Sigma f_i = 25$

$\Sigma f_i u_i = -7$

$$\text{mean} \quad \bar{x} = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right) \times h$$
$$= 225 + \left(\frac{-7}{25}\right) \times (50)$$
$$= 225 - 14$$
$$= 211$$

So, mean daily expenditure on food is Rs. 211.

Solution 7

We may find class marks for each interval by using the relation

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size of this data = 0.04

Now, taking 0.14 as assumed mean (a) we may calculate d_i, u_i, $f_i u_i$ as following –

Concentration of SO_2 (in ppm)	Frequency	Class mark x_i	$d_i = x_i - 0.14$	$u_i = \frac{x_i - 0.14}{h}$	$f_i u_i$
0.00 - 0.04	4	0.02	-0.12	-3	-12
0.04 - 0.08	9	0.06	-0.08	-2	-18
0.08 - 0.12	9	0.10	-0.04	-1	-9
0.12 - 0.16	2	0.14	0	0	0
0.16 - 0.20	4	0.18	0.04	1	4
0.20 - 0.24	2	0.22	0.08	2	4
Total	30				-31

From the table we may observe that

$\Sigma f_i = 30$

$\Sigma f_i u_i = -31$

$$\text{mean } \bar{x} = a + \left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right) \times h$$

$$= 0.14 + \left(\frac{-31}{30}\right)(0.04)$$

$$= 0.14 - 0.04133$$

$$= 0.09867$$

$$\approx 0.099 \text{ ppm}$$

So, mean concentration of SO_2 in the air is 0.099 ppm.

Solution 8

We may find class mark of each interval by using the relation

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Now taking 16 as assumed mean (a) we may calculate di and fidi as following

Number of days	**Number of students f_i**	x_i	$d_i = x_i - 16$	$f_i d_i$
0 - 6	11	3	-13	-143
6 -10	10	8	-8	-80
10 - 14	7	12	-4	-28
14 - 20	4	16	0	0
20 - 28	4	24	8	32
28 - 38	3	33	17	51

38 - 40	1	39	23	23
Total	40			-145

Now we may observe that

$$\Sigma f_i = 40$$

$$\Sigma f_i d_i = -145$$

$$\text{mean} \quad \bar{x} = a + \left(\frac{\Sigma f_i d_i}{\Sigma f_i}\right)$$

$$= 16 + \left(\frac{-145}{40}\right)$$

$$= 16 - 3.625$$

$$= 12.375$$

$$= 12.38$$

So, mean number of days is 12.38 days, for which a student was absent.

Solution 9

We may find class marks by using the relation

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size (h) for this data = 10

Now taking 70 as assumed mean (a) we may calculate d_i, u_i, and $f_i u_i$ as following

Literacy rate (in %)	**Number of cities f_i**	x_i	$d_i = x_i - 70$	$u_i = \frac{x_i - 70}{h}$	$f_i u_i$
45 - 55	3	50	-20	-2	-6
55 - 65	10	60	-10	-1	-10
65 - 75	11	70	0	0	0
					8

75 - 85	8	80	10	1	
85 - 95	3	90	20	2	6
Total	35				-2

Now we may observe that

$\sum f_i = 35$

$\sum f_i u_i = -2$

$$\text{mean } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum u_i}\right) x h$$
$$= 70 + \left(\frac{-2}{35}\right) x(10)$$
$$= 70 - \frac{20}{35}$$
$$= 70 - \frac{4}{7}$$
$$= 70 - 0.57$$
$$= 69.43$$

So, the mean literacy rate is 69.43%.

Chapter 14 - Statistics Exercise Ex. 14.2

Solution 1

We may compute class marks (x_i) as per the relation

$$x_i = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Now taking 30 as assumed mean (a) we may calculate d_i and $f_i d_i$ as following.

Age (in years)	**Number of patients f_i**	**class mark x_i**	**$d_i = x_i - 30$**	**$f_i d_i$**
5 - 15	6	10	-20	-120

15 - 25	11	20	-10	-110
25 - 35	21	30	0	0
35 - 45	23	40	10	230
45 - 55	14	50	20	280
55 - 65	5	60	30	150
Total	80			430

From the table we may observe that

$$\sum f_i = 80$$
$$\sum f_i d_i = 430$$
$$\text{Mean } \bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$$
$$= 30 + \left(\frac{430}{80}\right)$$
$$= 30 + 5.375$$
$$= 35.375$$
$$\simeq 35.38$$

Clearly, mean of this data is 35.38. It represents that on an average the age of a patient admitted to hospital was 35.38 years.
As we may observe that maximum class frequency is 23 belonging to class interval 35 - 45.
So, modal class = 35 - 45
Lower limit (l) of modal class = 35
Frequency (f_1) of modal class = 23
Class size (h) = 10
Frequency (f_0) of class preceding the modal class = 21
Frequency (f_2) of class succeeding the modal class = 14

$$\text{Now mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$
$$= 35 + \left(\frac{23-21}{2(23)-21-14}\right) \times 10$$
$$= 35 + \left[\frac{2}{46-35}\right] \times 10$$
$$= 35 + \frac{20}{11}$$
$$= 35 + 1.81$$
$$= 36.8$$

Clearly mode is 36.8.It represents that maximum number of patients admitted in hospital were of 36.8 years.

Solution 2

From the data given as above we may observe that maximum class frequency is 61 belonging to class interval 60 - 80.

So, modal class = 60 - 80

Lower class limit (l) of modal class = 60

Frequency (f_1) of modal class = 61

Frequency (f_0) of class preceding the modal class = 52

Frequency (f_2) of class succeeding the modal class = 38

Class size (h) = 20

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$
$$= 60 + \left(\frac{61-52}{2(61)-52-38}\right)(20)$$
$$= 60 + \left(\frac{9}{122-90}\right)(20)$$
$$= 60 + \left(\frac{9 \times 20}{32}\right)$$
$$= 60 + \frac{90}{16} = 60 + 5.625$$
$$= 65.625$$

So, modal lifetime of electrical components is 65.625 hours.

Solution 3

We may observe from the given data that maximum class frequency is 40 belonging to 1500 - 2000 intervals.

So, modal class = 1500 - 2000

Lower limit (l) of modal class = 1500

Frequency (f_1) of modal class = 40

Frequency (f_0) of class preceding modal class = 24

Frequency (f_2) of class succeeding modal class = 33

Class size (h) = 500

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

$$= 1500 + \left(\frac{40 - 24}{2(40) - 24 - 33}\right) \times 500$$

$$= 1500 + \left(\frac{16}{80 - 57}\right) \times 500$$

$$= 1500 + \frac{8000}{23}$$

$$= 1500 + 347.826$$

$$= 1847.826 = 1847.83$$

So modal monthly expenditure was Rs.1847.83

Now we may find classmark as

$$\text{Class mark} = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Class size (h) of give data = 500

Now taking 2750 as assumed mean (a) we may calculate d_i, u_i and f_iu_i as following

Expenditure (in Rs)	**Number of families** f_i	x_i	$d_i = x_i - 2750$	$u_i = \frac{x_i - 2750}{h}$	f_iu_i
1000 - 1500	24	1250	-1500	-3	-72
1500 - 2000	40	1750	-1000	-2	-80
2000 - 2500	33	2250	-500	-1	-33
2500 - 3000	28	2750	0	0	0

3000 - 3500	30	3250	500	1	30
3500 - 4000	22	3750	1000	2	44
4000 - 4500	16	4250	1500	3	48
4500 - 5000	7	4750	2000	4	28
Total	200				-35

Now from the table, we may observe that

$$\sum f_i = 200$$
$$\sum f_i u_i = -35$$
$$\bar{x}\ (\text{mean}) = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) x h$$
$$\bar{x} = 2750 + \left(\frac{-35}{200}\right) x 500$$
$$= 2750 - 87.5$$
$$= 2662.5$$

So, mean monthly expenditure was Rs.2662.50.

Solution 4

We may observe from the given data that maximum class frequency is 10 belonging to class interval 30 - 35.

So, modal class = 30 - 35

Class size (h) = 5

Lower limit (l) of modal class = 30

Frequency (f_1) of modal class = 10

Frequency (f_0) of class preceding modal class = 9

Frequency (f_2) of class succeeding modal class = 3

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) x\ h$$
$$= 30 + \left(\frac{10 - 9}{2(10) - 9 - 3}\right) x(5)$$
$$= 30 + \left(\frac{1}{20 - 12}\right) 5$$
$$= 30 + \frac{5}{8} = 30.625$$
$$\text{Mode} = 30.6$$

It represents that most of states/U.T have a teacher student ratio as 30.6

Now we may find class marks by using the relation

$$\text{Class mark} = \frac{\text{upper class limit} + \text{lower class limit}}{2}$$

Now taking 32.5 as assumed mean (a) we may calculate d_i, u_i and f_iu_i as following.

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

Total	35				-23

$$\text{Now mean } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) h$$

$$= 32.5 + \left(\frac{-23}{35}\right) \times 5$$

$$= 32.5 - \frac{23}{7} = 32.5 - 3.28$$

$$= 29.22$$

So mean of data is 29.2
It represents that an average teacher-student ratio was 29.2.

Solution 5
From the given data we may observe that maximum class frequency is 18 belonging to class interval 4000 - 5000.
So, modal class = 4000 - 5000
Lower limit (l) of modal class = 4000
Frequency (f_1) of modal class = 18
Frequency (f_0) of class preceding modal class = 4
Frequency (f_2) of class succeeding modal class = 9
Class size (h) = 1000

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

$$= 4000 + \left(\frac{18 - 4}{2(18) - 4 - 9}\right) \times 1000$$

$$= 4000 + \left(\frac{14000}{23}\right)$$

$$= 4000 + 608.695$$

$$= 4608.695$$

So mode of given data is 4608.7 runs.

Solution 6
From the given data we may observe that maximum class frequency is 20 belonging to 40 - 50 class intervals.
So, modal class = 40 - 50
Lower limit (l) of modal class = 40
Frequency (f_1) of modal class = 20
Frequency (f_0) of class preceding modal class = 12
Frequency (f_2) of class succeeding modal class = 11
Class size = 10

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$
$$= 40 + \left[\frac{20 - 12}{2(20) - 12 - 11}\right] \times 10$$
$$= 40 + \left(\frac{80}{40 - 23}\right)$$
$$= 40 + \frac{80}{17}$$
$$= 40 + 4.7$$
$$= 44.7$$

So mode of this data is 44.7 cars.

Chapter 14 - Statistics Exercise Ex. 14.3

Solution 1

We may find class marks by using the relation

$$\text{Class mark} = \frac{\text{Upper class limit} + \text{lower class limit}}{2}$$

Taking 135 as assumed mean (a) we may find d_i, u_i, f_iu_i, according to step deviation method as following

Monthly consumption (in units)	**Number of consumers (f_i)**	**x_i class mark**	**$d_i = x_i$ - 135**	$u_i = \frac{d_i}{20}$	**f_iu_i**
65 - 85	4	75	- 60	- 3	- 12
85 - 105	5	95	- 40	- 2	- 10
105 - 125	13	115	- 20	- 1	- 13
125 - 145	20	135	0	0	0
				1	

145 - 165	14	155	20		14
165 - 185	8	175	40	2	16
185 - 205	4	195	60	3	12
Total	68				7

From the table we may observe that

$$\sum f_i u_i = 7$$
$$\sum f_i = 68$$
Class size (h) = 20

$$\text{Mean } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) \times h$$
$$= 135 + \frac{7}{68} \times 20$$
$$= 135 + \frac{140}{68}$$
$$= 137.058$$

Now from table it is clear that maximum class frequency is 20 belonging to class interval 125 - 145.
Modal class = 125 - 145
Lower limit (l) of modal class = 125
Class size (h) = 20
Frequency (f_1) of modal class = 20
Frequency (f_0) of class preceding modal class = 13
Frequency (f_2) of class succeeding the modal class = 14

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$
$$= 125 + \left[\frac{20 - 13}{2(20) - 13 - 14}\right] \times 20$$
$$= 125 + \frac{7}{13} \times 20$$
$$= 125 + \frac{140}{13} = 135.76$$

We know that
3 median = mode + 2 mean
= 135.76 + 2 (137.058)
= 135.76 + 274.116
= 409.876

Median = 136.625
So median, mode, mean of given data is 136.625, 135.76, 137.05 respectively.

Solution 2
We may find cumulative frequency for the given data as following

Class interval	**Frequency**	**Cumulative frequency**
0 - 10	5	5
10 - 20	x	$5 + x$
20 - 30	20	$25 + x$
30 - 40	15	$40 + x$
40 - 5	y	$40 + x + y$
50 - 60	5	$45 + x + y$
Total (n)	60	

It is clear that n = 60

45 + x + y = 60

x + y = 15 (1)
Median of data is given as 28.5 which lies in interval 20 - 30.
So, median class = 20 - 30
Lower limit (l) of median class = 20
Cumulative frequency (cf) of class preceding the median class = 5 + x
Frequency (f) of median class = 20
Class size (h) = 10

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

$$28.5 = 20 + \left[\frac{\frac{60}{2} - (5 + x)}{20}\right] \times 10$$

$$8.5 = \left(\frac{25 - x}{2}\right)$$

$$17 = 25 - x$$

$$x = 8$$

From equation (1)

$8 + y = 15$

$y = 7$

Hence values of x and y are 8 and 7 respectively.

Solution 3

Here the class width is not the same. There is no need to adjust the frequencies according to class intervals. Now given frequency table is of less than type represented with upper-class limits. As policies were given only to persons having age 18 years onwards but less than 60 years, we can define class intervals with their respective cumulative frequency as below

Age (in years)	**Number of policyholders (f_i)**	**Cumulative frequency (cf)**
18 - 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 (*n*)		

Now from the table we may observe that *n* = 100.

Cumulative frequency (*cf*) just greater than $\frac{n}{2}\left(\text{i.e., } \frac{100}{2}=50\right)$ is 78 belonging to interval 35 - 40
So, median class = 35 - 40
Lower limit (l) of median class = 35
Class size (h) = 5
Frequency (f) of median class = 33
Cumulative frequency (cf) of class preceding median class = 45

$$\begin{aligned}\text{meadian} &= l+\left(\frac{\frac{n}{2}-cf}{f}\right)\times h\\ &= 35+\left(\frac{50-45}{33}\right)\times 5\\ &= 35+\frac{25}{33}\\ &= 35.76\end{aligned}$$

So, the median age is 35.76 years.

Solution 4
The given data is not having continuous class intervals. We can observe that the difference between the two class intervals is 1. So, we have to add and subtract

$\frac{1}{2}=0.5$

to upper-class limits and lower class limits.
Now continuous class intervals with respective cumulative frequencies can be represented as below

Length (in mm)	**Number or leaves f_i**	**Cumulative frequency**
117.5 -	3	3

126.5		
126.5 - 135.5	5	3 + 5 = 8
135.5 - 144.5	9	8 + 9 = 17
144.5 - 153.5	12	17 + 12 = 29
153.5 - 162.5	5	29 + 5 = 34
162.5 - 171.5	4	34 + 4 = 38
171.5 - 180.5	2	38 + 2 = 40

From the table, we may observe that cumulative frequency just greater than $\frac{n}{2}\left(\text{i.e., } \frac{40}{2} = 20\right)$ is 29, belonging to class interval 144.5 - 153.5.

Median class = 144.5 - 153.5

Lower limit (l) of median class = 144.5

Class size (h) = 9

Frequency (f) of median class = 12

Cumulative frequency (cf) of class preceding median class = 17

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$$
$$= 144.5 + \left(\frac{20-17}{12}\right) \times 9$$
$$= 144.5 + \frac{9}{4} = 146.75$$

So, the median length of leaves is 146.75 mm.

Solution 5

We can find cumulative frequencies with their respective class intervals as below -

Life time	**Number of lamps (f_i)**	**Cumulative frequency**
1500 - 2000	14	14
2000 - 2500	56	14 + 56 = 70
2500 - 3000	60	70 + 60 = 130
3000 - 3500	86	130 + 86 = 216
3500 - 4000	74	216 + 74 = 290
4000 - 4500	62	290 + 62 = 352

4500 - 5000	48	352 + 48 = 400
Total (n)	400	

Now we may observe that cumulative frequency just greater than $\frac{n}{2}\left(\text{i.e., } \frac{400}{2}=200\right)$ is 216 belonging to class interval 3000 - 3500.
Median class = 3000 - 3500
Lower limit (l) of median class = 3000
Frequency (f) of median class = 86
Cumulative frequency (cf) of class preceding median class = 130
Class size (h) = 500

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

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

$$= 3000 + \frac{70 \times 500}{86}$$

So, the median lifetime of lamps is 3406.98 hours.

Solution 6

We can find cumulative frequencies with their respective class intervals as below

Number of letters	**Frequency (f_i)**	**Cumulative frequency**
1 - 4	6	6
4 - 7	30	30 + 6 = 36
7 - 10	40	36 + 40 = 76
10 - 13	16	76 + 16 = 92

13 - 16	4	92 + 4 = 96
16 - 19	4	96 + 4 = 100
Total (n)	100	

Now we may observe that cumulative frequency just greater than $\frac{n}{2}\left(\text{i.e., } \frac{100}{2} = 50\right)$ is 76 belonging to the class interval 7 - 10.

Median class = 7 - 10

Lower limit (l) of median class = 7

Cumulative frequency (cf) of class preceding median class = 36

Frequency (f) of median class = 40

Class size (h) = 3

$$\begin{aligned} \text{Median} &= l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h \\ &= 7 + \left(\frac{50-36}{40}\right) \times 3 \\ &= 7 + \frac{14 \times 3}{40} \\ &= 8.05 \end{aligned}$$

Now we can find class marks of given class intervals by using relation

$$\text{Class mark} = \frac{\text{Upper class limit} + \text{lower class limit}}{2}$$

Taking 11.5 as assumed mean (a) we can find d_i, u_i and $f_i u_i$ according to step deviation method as below.

Number of letters	**Number of surnames**	x_i	$x_i - a$	$u_i = \frac{x_i - a}{3}$	$f_i u_i$
1 - 4	6	2.5	-9	-3	-18
4 - 7	30	5.5	-6	-2	-60
7 - 10	40	8.5	-3	-1	-40

10 - 13	16	11.5	0	0	0
13 - 16	4	14.5	3	1	4
16 - 19	4	17.5	6	2	8
Total	100				-106

$\sum f_i u_i = -106$

$\sum f_i = 100$

$$\text{Mean } \bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right)$$

$$= 11.5 + \left(\frac{-106}{100}\right) \times 3$$

$$= 11.5 - 3.18 = 8.32$$

We know that
3 median = mode + 2 mean
3(8.05) = mode + 2(8.32)
24.15 - 16.64 = mode
7.51 = mode
So, median number and mean number of letters in surnames is 8.05 and 8.32 respectively while modal size of surnames is 7.51.

Solution 7
We may find cumulative frequencies with their respective class intervals as below

Weight (in kg)	No. of students	Cumulative frequency (c.f)
40 - 45	2	2
45 - 50	3	2+3=5
50 - 55	8	5+8=13
55 - 60	6	13+6=19
60 - 65	6	19+6=25

65 - 70	3	25+3=28
70 - 75	2	28+2=30
	Total = 30	

Cumulative frequency just greater than $\frac{n}{2}\left(\text{i.e., } \frac{30}{2}=15\right)$ is 19, belonging to class interval 55 - 60.
Median class = 55 - 60
Lower limit (l) of median class = 55
Frequency (f) of median class = 6
Cumulative frequency (cf) of class preceeding the median class = 13
Class size (h) = 5

$$\text{Median} = l+\left(\frac{\frac{n}{2}-cf}{f}\right)\times h$$
$$= 55+\left(\frac{15-13}{6}\right)\times 5$$
$$= 55+\frac{10}{6}$$
$$= 56.666$$

So, the median weight is 56.67 kg.

Chapter 14 - Statistics Exercise Ex. 14.4

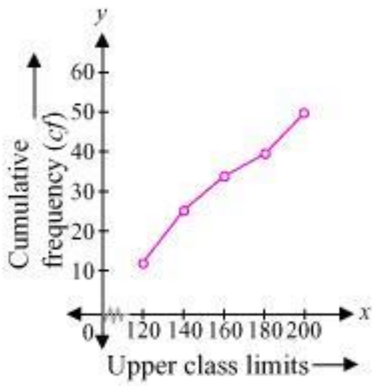
Solution 1

We can find frequency distribution table of less than type as following -

Daily income (in Rs) (upper class limits)	**Cumulative frequency**
Less than 120	12
Less than 140	12 + 14 = 26
Less than 160	26 + 8 = 34

Less than 180	34 + 6 = 40
Less than 200	40 + 10 = 50

Now taking upper class limits of class intervals on x-axis and their respective frequencies on y-axis we can draw its ogive as following -



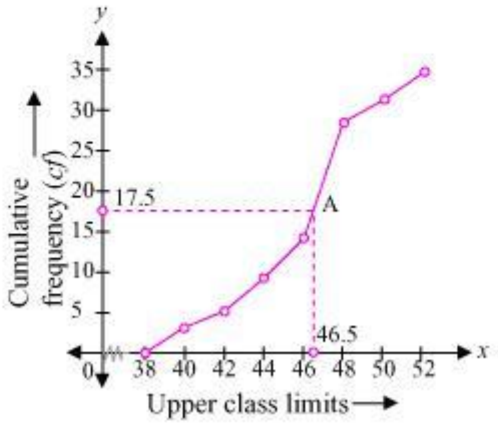
Solution 2

The given cumulative frequency distributions of less than type is -

Weight (in kg) upper class limits	**Number of students (cumulative frequency)**
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

Now taking upper class limits on x-axis and their respective cumulative frequency on y-axis we may draw its ogive as following -



>

Now mark the point A whose ordinate is 17.5 its x-coordinate is 46.5. So median of this data is 46.5.
We may observe that difference between two consecutive upper class limits is 2. Now we may obtain class marks with their respective frequencies as below

Weight (in kg)	**Frequency (*f*)**	**Cumulative frequency**
Less than 38	0	0
38 - 40	3 - 0 = 3	3
40 - 42	5 - 3 = 2	5
42 - 44	9 - 5 = 4	9
44 - 46	14 - 9 = 5	14

46 - 48	28 - 14 = 14	28
48 - 50	32 - 28 = 4	32
50 - 52	35 - 32 = 3	35
Total (*n*)	35	

Now the cumulative frequency just greater than $\frac{n}{2}\left(\text{i.e., } \frac{35}{2}=17.5\right)$ is 28 belonging to class interval 46 - 48

Median class = 46 - 48

Lower class limit (l) of median class = 46

Frequency (f) of median class = 14

Cumulative frequency (cf) of class preceding median class = 14

Class size (h) = 2

$$\text{Median} = l+\left(\frac{\frac{n}{2}-cf}{f}\right)\times h$$
$$=46+\left(\frac{17.5-14}{14}\right)\times 2$$
$$= 46+\frac{3.5}{7}$$
$$= 46.5$$

So median of this data is 46.5

Hence, value of median is verified.

Solution 3

We can obtain cumulative frequency distribution of more than type as following -

Production yield (lower class limits)	**Cumulative frequency**
more than or equal to 50	100

more than or equal to 55	100 - 2 = 98
more than or equal to 60	98 - 8 = 90
more than or equal to 65	90 - 12 = 78
more than or equal to 70	78 - 24 = 54
more than or equal to 75	54 - 38 = 16

Now taking lower class limits on x-axis and their respective cumulative frequencies on y-axis we can obtain its ogive as following.