

Exercise 9D

1.

Sol:

To find the mean let us put the data in the table given below:

Class	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
0 – 10	4	5	20
10 – 20	4	15	60
20 – 30	7	25	175
30 – 40	10	35	350
40 – 50	12	45	540
50 – 60	8	55	440
60 – 70	5	65	325
Total	$\Sigma f_i = 50$		$\Sigma f_i x_i = 1910$

$$\begin{aligned} \text{Mean} &= \frac{\sum f_i x_i}{\sum f_i} \\ &= \frac{1910}{50} \\ &= 38.2 \end{aligned}$$

Thus, the mean of the given data is 38.2.

Now, to find the median let us put the data in the table given below:

Class	Frequency (f_i)	Cumulative Frequency (cf)
0 – 10	4	4
10 – 20	4	8
20 – 30	7	15
30 – 40	10	25
40 – 50	12	37
50 – 60	8	45
60 – 70	5	50
Total	$N = \Sigma f_i = 50$	

$$\text{Now, } N = 50 \Rightarrow \frac{N}{2} = 25.$$

The cumulative frequency just greater than 25 is 37 and the corresponding class is 40 – 50.

Thus, the median class is 40 – 50.

$$\therefore l = 40, h = 10, N = 50, f = 12 \text{ and } cf = 25.$$

Now,

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

$$= 40 + \left(\frac{25 - 25}{12}\right) \times 10$$

$$= 40$$

Thus, the median is 40.

We know that,

$$\text{Mode} = 3(\text{median}) - 2(\text{mean})$$

$$= 3 \times 40 - 2 \times 38.2$$

$$= 120 - 76.4$$

$$= 43.6$$

Hence, Mean = 38.2, Median = 40 and Mode = 43.6

2.

Sol:

To find the mean let us put the data in the table given below:

Class	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
0 – 20	6	10	60
20 – 40	8	30	240
40 – 60	10	50	500
60 – 80	12	70	840
80 – 100	6	90	540
100 – 120	5	110	550
120 – 140	3	130	390
Total	$\Sigma f_i = 50$		$\Sigma f_i x_i = 3120$

$$\text{Mean} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

$$= \frac{3120}{50}$$

$$= 62.4$$

Thus, the mean of the given data is 62.4.

Now, to find the median let us put the data in the table given below:

Class	Frequency (f_i)	Cumulative Frequency (cf)
0 – 20	6	6
20 – 40	8	14
40 – 60	10	24
60 – 80	12	36
80 – 100	6	42
100 – 120	5	47
120 – 140	3	50
Total	$N = \Sigma f_i = 50$	

Now, $N = 50 \Rightarrow \frac{N}{2} = 25$.

The cumulative frequency just greater than 25 is 36 and the corresponding class is 60 – 80.
Thus, the median class is 60 – 80.

$\therefore l = 60, h = 20, N = 50, f = 12$ and $cf = 24$.

Now,

$$\begin{aligned}\text{Median} &= l + \left(\frac{\frac{N}{2} - cf}{f} \right) \times h \\ &= 60 + \left(\frac{25 - 24}{12} \right) \times 20 \\ &= 60 + 1.67 \\ &= 61.67\end{aligned}$$

Thus, the median is 61.67.

We know that,

$$\begin{aligned}\text{Mode} &= 3(\text{median}) - 2(\text{mean}) \\ &= 3 \times 61.67 - 2 \times 62.4 \\ &= 185.01 - 124.8 \\ &= 60.21\end{aligned}$$

Hence, Mean = 62.4, Median = 61.67 and Mode = 60.21

3.

Sol:

To find the mean let us put the data in the table given below:

Class	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
0 – 50	2	25	50
50 – 100	3	75	225
100 – 150	5	125	625
150 – 200	6	175	1050
200 – 250	5	225	1125
250 – 300	3	275	825
300 – 350	1	325	325
Total	$\sum f_i = 25$		$\sum f_i x_i = 4225$

$$\begin{aligned}\text{Mean} &= \frac{\sum f_i x_i}{\sum f_i} \\ &= \frac{4225}{25} \\ &= 169\end{aligned}$$

Thus, mean of the given data is 169.

Now, to find the median let us put the data in the table given below:

Class	Frequency (f_i)	Cumulative Frequency (cf)
0 – 50	2	2
50 – 100	3	5
100 – 150	5	10
150 – 200	6	16
200 – 250	5	21
250 – 300	3	24
300 – 350	1	25
Total	$N = \sum f_i = 25$	

Now, $N = 25 \Rightarrow \frac{N}{2} = 12.5$.

The cumulative frequency just greater than 12.5 is 16 and the corresponding class is 150 – 200.

Thus, the median class is 150 – 200.

$\therefore l = 150, h = 50, N = 25, f = 6$ and $cf = 10$.

Now,

$$\begin{aligned} \text{Median} &= l + \left(\frac{\frac{N}{2} - cf}{f} \right) \times h \\ &= 150 + \left(\frac{12.5 - 10}{6} \right) \times 50 \\ &= 150 + 20.83 \\ &= 170.83 \end{aligned}$$

Thus, the median is 170.83.

We know that,

$$\begin{aligned} \text{Mode} &= 3(\text{median}) - 2(\text{mean}) \\ &= 3 \times 170.83 - 2 \times 169 \\ &= 512.49 - 338 \\ &= 174.49 \end{aligned}$$

Hence, Mean = 169, Median = 170.83 and Mode = 174.49

4.

Sol:

To find the mean let us put the data in the table given below:

Marks obtained	Number of students (f_i)	Class mark (x_i)	$f_i x_i$
25 – 35	7	30	210
35 – 45	31	40	1240

45 – 55	33	50	1650
55 – 65	17	60	1020
65 – 75	11	70	770
75 – 85	1	80	80
Total	$\Sigma f_i = 100$		$\Sigma f_i x_i = 4970$

$$\begin{aligned} \text{Mean} &= \frac{\sum_i f_i x_i}{\sum_i f_i} \\ &= \frac{4970}{100} \\ &= 49.7 \end{aligned}$$

Thus, mean of the given data is 49.7.

Now, to find the median let us put the data in the table given below:

Class	Frequency (f_i)	Cumulative Frequency (cf)
25 – 35	7	7
35 – 45	31	38
45 – 55	33	71
55 – 65	17	88
65 – 75	11	99
75 – 85	1	100
Total	$N = \Sigma f_i = 100$	

$$\text{Now, } N = 100 \Rightarrow \frac{N}{2} = 50.$$

The cumulative frequency just greater than 50 is 71 and the corresponding class is 45 – 55.

Thus, the median class is 45 – 55.

$$\therefore l = 45, h = 10, N = 100, f = 33 \text{ and } cf = 38.$$

Now,

$$\begin{aligned} \text{Median} &= l + \left(\frac{\frac{N}{2} - cf}{f} \right) \times h \\ &= 45 + \left(\frac{50 - 38}{33} \right) \times 10 \\ &= 45 + 3.64 \\ &= 48.64 \end{aligned}$$

Thus, the median is 48.64.

We know that,

$$\begin{aligned} \text{Mode} &= 3(\text{median}) - 2(\text{mean}) \\ &= 3 \times 48.64 - 2 \times 49.70 \\ &= 145.92 - 99.4 \\ &= 46.52 \end{aligned}$$

Hence, Mean = 49.70, Median = 48.64 and Mode = 46.52

5.

Sol: We have the following

Height in cm	Mid value (x_i)	Frequency (f_i)	Cumulative frequency	($f_i \times x_i$)
120 – 130	125	2	2	250
130 – 140	135	8	10	1080
140 – 150	145	12	22	1740
150 – 160	155	20	42	3100
160 – 170	165	8	50	1320
		$\Sigma f_i = 50$		$\Sigma f_i \times x_i = 7490$

$$\text{Mean, } \bar{x} = \frac{\sum(f_i \times x_i)}{\sum f_i}$$

$$= \frac{7490}{50}$$
$$= 149.8$$

Now, $N = 50$

$$\Rightarrow \frac{N}{2} = 25.$$

The cumulative frequency just greater than 25 is 42 and the corresponding class is 150 – 160.

Thus, the median class is 150 – 160.

$\therefore l = 150, h = 10, f = 20, c = \text{cf of preceding class} = 22$ and $\frac{N}{2} = 25$

Now,

$$\text{Median, } M_e = l + \left\{ h \times \left(\frac{\frac{N}{2} - c}{f} \right) \right\}$$
$$= 150 + \left\{ 10 \times \left(\frac{25 - 22}{20} \right) \right\}$$
$$= \left(150 + 10 \times \frac{3}{20} \right)$$
$$= 151.5$$

Mode = 3(median) – 2(mean)

$$= 3 \times 151.5 - 2 \times 149.8$$
$$= 154.9$$

6.

Sol:

We have the following:

Daily income	Mid value (x_i)	Frequency (f_i)	Cumulative frequency	($f_i \times x_i$)
100 – 120	110	12	12	1320
120 – 140	130	14	26	1820
140 – 160	150	8	34	1200
160 – 180	170	6	40	1020
180 – 200	190	10	50	1900
		$\Sigma f_i = 50$		$\Sigma f_i \times x_i = 7260$

$$\begin{aligned} \text{Mean, } \bar{x} &= \frac{\Sigma f_i \times x_i}{\Sigma f_i} \\ &= \frac{7260}{50} \\ &= 145.2 \end{aligned}$$

Now, $N = 50$

$$\Rightarrow \frac{N}{2} = 25.$$

The cumulative frequency just greater than 25 is 26 and the corresponding class is 120 – 140.

Thus, the median class is 120 – 140.

$$\therefore l = 120, h = 20, f = 14, c = \text{cf of preceding class} = 12 \text{ and } \frac{N}{2} = 25$$

Now,

$$\begin{aligned} \text{Median, } M_e &= l + \left\{ h \times \left(\frac{\frac{N}{2} - c}{f} \right) \right\} \\ &= 120 + \left\{ 20 \times \left(\frac{25 - 12}{14} \right) \right\} \\ &= \left(120 + 20 \times \frac{13}{14} \right) \\ &= 138.57 \end{aligned}$$

Mode = 3(median) – 2(mean)

$$\begin{aligned} &= 3 \times 138.57 - 2 \times 145.2 \\ &= 125.31 \end{aligned}$$

7.

Sol:

We have the following:

Daily expenditure (in Rs)	Mid value (x_i)	Frequency (f_i)	Cumulative frequency	($f_i \times x_i$)
100 – 150	125	6	6	750
150 – 200	175	7	13	1225
200 – 250	225	12	25	2700
250 – 300	275	3	28	825
300 – 350	325	2	30	650
		$\Sigma f_i = 30$		$\Sigma f_i \times x_i = 6150$

$$\begin{aligned} \text{Mean, } \bar{x} &= \frac{\Sigma f_i \times x_i}{\Sigma f_i} \\ &= \frac{6150}{30} \\ &= 205 \end{aligned}$$

Now, $N = 30$

$$\Rightarrow \frac{N}{2} = 15.$$

The cumulative frequency just greater than 15 is 25 and the corresponding class is 200 – 250.

Thus, the median class is 200 – 250.

$$\therefore l = 200, h = 50, f = 12, c = \text{cf of preceding class} = 13 \text{ and } \frac{N}{2} = 15$$

Now,

$$\begin{aligned} \text{Median, } M_e &= l + \left\{ h \times \left(\frac{\frac{N}{2} - c}{f} \right) \right\} \\ &= 200 + \left\{ 50 \times \left(\frac{15 - 13}{12} \right) \right\} \\ &= \left(200 + 50 \times \frac{2}{12} \right) \\ &= 200 + 8.33 \\ &= 208.33 \end{aligned}$$