Exercise 13.1

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

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

Sol. Since the values of f_i and x_i are very small so we will use direct method to find the mean.

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

$\therefore$ Mean $= \frac{\Sigma f_i x_i}{\Sigma f_i}$

$= \frac{162}{20}$

$= 8.1$

$\therefore$ The mean number of plants per house is 8.1 Ans.

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

Daily wages (in Rs.)	500-520	520-540	540-560	560-580	580-600
Number of workers	12	14	8	6	10

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

Sol. Since the values of f_i and x_i are large so, we will use assumed mean method to find the mean.

Daily wages (In Rs.)	Number of workers (f_i)	x_i	$d_i = x_i - a$	$f_i\, d_i$
500-520	12	510	-40	-480
520-540	14	530	-20	-280
540-560	8	550 = a	0	0
560-580	6	570	20	120
580-600	10	590	40	400
Total	$\Sigma f_i = 50$			$\Sigma f_i d_i = -240$

$\therefore$ Mean = $a + \frac{\Sigma f_i d_i}{\Sigma f_i}$

$= 550 + \frac{-240}{50}$

$= 550 - 4.8$

$= 545.2$

$\therefore$ The daily wages of the workers of the factory are Rs. 545.20 Ans.

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

Daily pocket allowance (In Rs.)	11-13	13-15	15-17	17-19	19-21	21-23	23-25
Number of children	7	6	9	13	f	5	4

Sol. Since the values of f_i and x_i are very small so we will use direct method to find the mean.

Number of plants	Number of houses (f_i)	x_i	$f_i x_i$
11-13	7	12	84
13-15	6	14	84
15-17	9	16	144
17-19	13	18	234
19-21	f	20	20 f
21-23	5	22	110
23-25	4	24	96
Total	$\Sigma f_i = 44 + f$		$\Sigma f_i x_i = 20\ f + 752$

$\therefore$ Mean = $\frac{\sum f_i x_i}{\sum f_i}$

$18 = \frac{20\,f + 752}{44 + f}$ [$\because$ mean is given]

$\Rightarrow$ 18 (44 + f) = 20 f + 752

$\Rightarrow$ 792 + 18 f = 20 f + 752

$\Rightarrow$ 18 f - 20 f = 752 – 792

$\Rightarrow$ - 2 f = - 40

$\Rightarrow$ f = 20

$\therefore$ The missing frequency f is 20 Ans.

Alternate method using assumed mean

Number of plants	Number of houses (f_i)	x_i	$d_i = x_i$ - a	$f_i\, d_i$
11-13	7	12	-6	-42
13-15	6	14	-4	-24
15-17	9	16	-2	-18
17-19	13	18=a	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			$\sum f_i d_i$ = 2f - 40

$\therefore$ Mean = a + $\frac{\sum f_i d_i}{\sum f_i}$

$\Rightarrow 18 = 18 + \frac{2f - 40}{44 + f}$ [$\because$ mean is given]

$\Rightarrow 18 - 18 = \frac{2f - 40}{44 + f}$

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

$\Rightarrow$ 0 = 2f – 40

$\Rightarrow$ - 2 f = - 40

$\Rightarrow$ f = 20

$\therefore$ The missing frequency f is 20 Ans.

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 heartbeats per minute for these women, choosing a suitable method.

Number of heartbeats	65-68	68-71	71-74	74-77	77-80	80-83	83-86
Number of women	2	4	3	8	7	4	2

Sol. Since the values of f_i and x_i are large so, we will use assumed mean method to find the mean.

Number of heartbeats	Number of women (f_i)	x_i	$d_i = x_i - a$	$f_i d_i$
65-68	2	66.5	-9	-18
68-71	4	69.5	-6	-24
71-74	3	72.5	-3	-9
74-77	8	75.5=a	0	0
77-80	7	78.5	3	21
80-83	4	81.5	6	24
83-86	2	84.5	9	18
Total	$\Sigma f_i = 30$			$\Sigma f_i d_i = 12$

$$\therefore \text{Mean} = a + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

$$= 75.5 + \frac{12}{30}$$

$$= 75.5 + \frac{2}{5}$$

$$= 75.5 + 0.4$$

$$= 75.9$$

$\therefore$ the mean heartbeats per minute for these women is 75.9. Ans.

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?

Sol. Since the values of f_i and x_i are large so, we will use assumed mean method to find the mean.

Number of mangoes	C.I	Number of boxes (f_i)	x_i	$d_i = x_i$ - a	$f_i\, d_i$
50-52	49.5-52.5	15	51	-6	-90
53-55	52.5-55.5	110	54	-3	-330
56-58	55.5-58.5	135	57	0	0
59-61	58.5-61.5	115	60	3	345
62-64	61.5-64.5	25	63	6	150
Total		Σf_i = 400			$\Sigma f_i d_i$ = 75

$\therefore$ Mean = a + $\frac{\Sigma f_i d_i}{\Sigma f_i}$

= 57 + $\frac{75}{400}$

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

= 57 + 0.1875

= 57.1875

= 57 [$\because$ mangoes are natural]

$\therefore$ the mean number of mangoes kept in a packing box is 57 Ans.

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

Daily expenditure (In Rs.)	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.

Sol. Since the values of f_i and x_i are large so, we will use assumed mean method to find the mean.

Daily expenditure (In Rs.)	Number of households (f_i)	x_i	$d_i = x_i - a$	$f_i\, d_i$
100-150	4	125	-100	-400
150-200	5	175	-50	-250
200-250	12	225=a	0	0
250-300	2	275	50	100
300-350	2	325	100	200
Total	$\Sigma f_i = 25$			$\Sigma f_i d_i = -350$

$\therefore$ Mean = $a + \frac{\Sigma f_i d_i}{\Sigma f_i}$

$= 225 + \frac{-350}{25}$

$= 225 - 14$

$= 211$

$\therefore$ the mean daily expenditure on food of 25 households in a locality is 211 Ans.

7. To find out the concentration of SO_2 in the air (in parts per million, i.e., ppm), the data.

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

Find the mean concentration of SO_2 in the air

Sol. Since the values of f_i and x_i are large so, we will use assumed mean method to find the mean.

Daily expenditure (In Rs.)	Number of households (f_i)	x_i	$d_i = x_i - a$	$f_i\, d_i$
0.00-0.04	4	0.02	-0.08	-0.32
0.04-0.08	9	0.06	-0.04	-0.36
0.08-0.12	9	0.10= a	0	0
0.12-0.16	2	0.14	0.04	0.08
0.16-0.20	4	0.18	0.08	0.32
0.20-0.24	2	0.22	0.12	0.24
Total	$\Sigma f_i = 30$			$\Sigma f_i d_i = -0.04$

$\therefore$ Mean = a + $\frac{\sum f_i d_i}{\sum f_i}$

= 0.10 + $\frac{-0.04}{30}$

= 0.10 – 0.001

= 0.099

$\therefore$ the mean concentration of SO_2 in the air is 0.099 Ans.

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

Sol.

Number of days	Number of students (f_i)	x_i	$f_i\, x_i$
0-6	11	3	33
6-10	10	8	80
10-14	7	12	84
14-20	4	17	68
20-28	4	24	96
28-38	3	33	99
38-40	1	39	39
Total	$\sum f_i$ = 40		$\sum f_i x_i$ = 499

$\therefore$ Mean = $\frac{\sum f_i x_i}{\sum f_i}$

= $\frac{499}{40}$

= 12.475

= 12.48

$\therefore$ the mean number of days a student was absent is 12.48. Ans.

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

Sol.

Literacy rate (in %)	Number of cities (f_i)	x_i	$d_i = x_i - a$	$f_i d_i$
45-55	3	50	-20	-60
55-65	10	60	-10	-100
65-75	11	70=a	0	0
75-85	8	80	10	80
85-95	3	90	20	60
Total	$\Sigma f_i = 35$			$\Sigma f_i d_i = -20$

$$\therefore \text{Mean} = a + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

$$= 70 + \frac{-20}{35}$$

$$= 70 - \frac{4}{7}$$

$$= 70 - 0.57$$

$$= 69.43$$

$\therefore$ the mean literacy rate is 69.43% Ans.

Exercise 13.2

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.

Sol.

Age (in years)	Number of patients (f_i)	x_i	$d_i = x_i$ - a	$f_i\, d_i$
5-15	6	10	-30	-180
15-25	11	20	-20	-220
25-35	21 = f_0	30	-10	-210
35-45	23 = f_1	40= a	0	0
45-55	14 = f_2	50	10	140
55-65	5	60	20	100
Total	Σf_i = 80			$\Sigma f_i d_i$ = -370

(i) Here maximum frequency is 23

∴ Modal class is 35-45

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

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

= $35 + \left(\frac{23-21}{46-21-14}\right) \times 10$

= $35 + \left(\frac{2}{46-35}\right) \times 10$

= $35 + \frac{20}{11}$

= 35 + 1.8

= 36.8

(ii) Mean = a + $\frac{\Sigma f_i d_i}{\Sigma f_i}$

= 40 + $\frac{-370}{80}$

= 40 - $\frac{37}{8}$

= 40 - 4.625

= 35.375

∴ The mode of the given data is 36.8 and the mean is 35.375. Ans.

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.

Sol.

Lifetimes (in hours)	Frequency
0-20	10
20-40	35
40-60	52 = f_0
60-80	61 = f_1
80-100	38 = f_2
100-120	29

Here maximum frequency is 61

∴ Modal class is 60-80

l = 60, f_1 = 61, f_0 = 52, f_2 = 38 and h = 20

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

$$= 60 + \left(\frac{61-52}{122-52-38}\right) \times 20$$

$$= 60 + \left(\frac{9}{122-90}\right) \times 20$$

$$= 60 + \frac{180}{32}$$

$$= 60 + \frac{45}{8}$$

$$= 60 + 5.625$$

$$= 65.625$$

∴ The mode of the given data is 65.625 Ans.

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 Rs.)	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500	3500-4000	4000-4500	4500-5000
Number of families	24	40	33	28	30	22	16	7

Sol.

Expenditure (in Rs.)	Number of families (f_i)	x_i	$d_i = x_i - a$	$f_i d_i$
1000-1500	24 = f_0	1250	-1500	-36000
1500-2000	40 = f_1	1750	-1000	-40000
2000-2500	33 = f_2	2250	-500	-16500
2500-3000	28	2750= a	0	0
3000-3500	30	3250	500	15000
3500-4000	22	3750	1000	22000
4000-4500	16	4250	1500	24000
4500-5000	7	4750	2000	14000
Total	$\sum f_i$ = 200			$\sum f_i d_i$ = -17500

Here maximum frequency is 40

∴ Modal class is 1500-2000

l = 1500, f_1 = 40, f_0 = 24, f_2 = 33 and h = 500

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

= $1500 + \left(\frac{40-24}{80-24-33}\right) \times 500$

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

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

= 1500 + 347.83

= 1847.83

(i) Mean = $a + \frac{\sum f_i d_i}{\sum f_i}$

= $2750 + \frac{-17500}{200}$

= $2750 - \frac{175}{2}$

= 2750 – 87.5

= 2662.50

∴ the modal monthly expenditure of the families is Rs 1847.83 and the mean monthly expenditure is 2662.50 Ans.

Alternate method to find the mean (Step-deviation method)

Sol.

Expenditure (in Rs.)	Number of families (f_i)	x_i	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
1000-1500	24 = f_0	1250	-3	-72
1500-2000	40 = f_1	1750	-2	-80
2000-2500	33 = f_2	2250	-1	-33
2500-3000	28	2750 = a	0	0
3000-3500	30	3250	1	30
3500-4000	22	3750	2	44
4000-4500	16	4250	3	48
4500-5000	7	4750	4	28
Total	Σf_i = 200			$\Sigma f_i d_i$ = -35

∴ Mean = $a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$

= $2750 + \frac{-35}{200} \times 500$

= $2750 - \frac{35}{2} \times 5$

= $2750 - \frac{175}{2}$

= 2750 – 87.5

= 2662.50

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

Sol.

Number of students per teacher	Number of states / U.T.	x_i	$d_i = x_i$ - a	$f_i\, d_i$
15-20	3	17.5	-15	-45
20-25	8	22.5	-10	-80
25-30	9 = f_0	27.5	-5	-45
30-35	10 = f_1	32.5=a	0	0
35-40	3 = f_2	37.5	5	15
40-45	0	42.5	10	0
45-50	0	47.5	15	0
50-55	2	52.5	20	40
Total	Σf_i = 35			$\Sigma f_i d_i$ = -115

(i) Here maximum frequency is 10

∴ Modal class is 30-35

l = 35, f_1 = 10, f_0 = 9, f_2 = 3 and h = 5

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 + $\left(\frac{1}{8}\right) \times 5$

= 30 + $\frac{5}{8}$

= 30 + 0.625

= 30.625

(ii) Mean = a + $\frac{\Sigma f_i d_i}{\Sigma f_i}$

= 32.5 + $\frac{-115}{35}$

= 32.5 – 3.28

= 29.22

∴ the mode of this data is 30.625 and mean is 29.22 Ans.

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

Find the mode of the data.

Sol.

Runs scored	Number of batsmen
3000-4000	4 = f_0
4000-5000	18 = f_1
5000-6000	9 = f_2
6000-7000	7
7000-8000	6
8000-9000	3
9000-10000	1
10000-11000	1

Here maximum frequency is 18

∴ Modal class is 4000-5000

l = 4000, f_1 = 18, f_0 = 4, f_2 = 9 and h = 1000

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

$= 4000 + \left(\frac{18-4}{36-4-9}\right) \times 1000$

$= 4000 + \left(\frac{14}{36-13}\right) \times 1000$

$= 4000 + \frac{14000}{23}$

$= 4000 + 608.7$

$= 4608.7$

∴ the mode of the given data is 4608.7 Runs Ans.

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

Sol.

Number of cars	Frequency
0-10	7
10-20	14
20-30	13
30-40	12 = f_0
40-50	20 = f_1
50-60	11 = f_2
60-70	15
70-80	8

Here maximum frequency is 20

∴ Modal class is 40-50

l = 40, f_1 = 20, f_0 = 12, f_2 = 11 and h = 10

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

$= 40 + \left(\frac{20-12}{40-12-11}\right) \times 10$

$= 40 + \left(\frac{8}{40-23}\right) \times 10$

$= 40 + \frac{80}{17}$

$= 40 + 4.7$

$= 44.7$

∴ the mode of the given data is 44.7 cars Ans.

Exercise 13.3

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)	65-85	85-105	105-125	125-145	145-165	165-185	185-205
Number of consumers	4	5	13	20	14	8	4

Sol.

Monthly consumption (in units)	Number of consumers (f_i)	c.f.	x_i	$d_i = x_i - a$	$f_i d_i$
65-85	4	4	75	-60	-240
85-105	5	9	95	-40	-200
105-125	13 = f_0	22	115	-20	-260
125-145	20 = f_1	42	135=a	0	0
145-165	14 = f_2	56	155	20	280
165-185	8	64	175	40	320
185-205	4	68	195	60	240
Total	Σf_i = 68				$\Sigma f_i d_i$ = 140

(i) Here n = 68 and $\frac{n}{2}$ = 34

∴ Median class is 125-145

l = 125, $c.f.$ = 22, f = 20 and h = 20

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

$$= 125 + \left(\frac{34-22}{20}\right) \times 20$$

$$= 125 + \left(\frac{12}{20}\right) \times 20$$

$$= 125 + 12$$

$$= 137$$

(ii) $$\text{Mean} = a + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

$$= 135 + \frac{140}{68}$$

$= 135 + \frac{35}{17}$

$= 135 + 2.05$

$= 137.05$

(iii) Here maximum frequency is 20

∴ Modal class is 125-145

$l = 125$, $f_1 = 20$, $f_0 = 13$, $f_2 = 14$ and $h = 20$

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

$= 125 + \left(\frac{20-13}{40-13-14}\right) \times 20$

$= 125 + \left(\frac{7}{40-27}\right) \times 20$

$= 125 + \frac{140}{13}$

$= 125 + 10.76$

$= 135.76$

∴ the median = 137, mean = 137.05 and mode = 135.76 Ans.

Here the comparison is that **mean > median > mode** Ans.

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

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

Sol.

Class Interval	Frequency (f_i)	c.f.
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	

Here 45 + x + y = 60

Or, x + y = 15 ..... (i)

And the median is 28.5 so median class is 20-30

and n = 60 so $\frac{n}{2}$ = 30

l = 20, $c.f.$ = 5 + x, f = 20 and h = 10

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

$28.5 = 20 + \left(\frac{30-(5+x)}{20}\right) \times 10$

$28.5 - 20 = \left(\frac{30-5-x)}{20}\right) \times 10$

$8.5 = \frac{25-x}{2}$

$8.5 \times 2 = 25 - x$

$17 = 25 - x$

$x = 25 - 17$

$x = 8$

from (i) 8 + y = 15

y = 15 – 8

y = 7

∴ the values of x and y are 8 and 7 respectively.

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

Sol.

Age (in years)	Number of policy holders (f_i)	Age (in years)	f_i
Below 20	2	Below 20	2
Below 25	6	20-25	4
Below 30	24	25-30	18
Below 35	45	30-35	21
Below 40	78	35-40	33
Below 45	89	40-45	11
Below 50	92	45-50	3
Below 55	98	50-55	6
Below 60	100	55-60	2

(i) Here n = 100 and $\frac{n}{2}$ = 50

∴ Median class is 35-40

l = 35, $c.f.$ = 45, f = 33 and h = 5

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

= $35 + \left(\frac{50-45}{33}\right) \times 5$

= $35 + \left(\frac{5}{33}\right) \times 5$

= $35 + \frac{25}{33}$

= 35 + 0.76

= 35.76

∴ the median age is 35.76 years. Ans.

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

Length (in mm)	118-126	127-135	136-144	145-153	154-162	163-171	172-180
Number of leaves	3	5	9	12	5	1	2

Find the median length of the leaves.

Sol.

Length (in mm)	C. I	Number of leaves (f_i)	c.f.
118-126	117.5-126.5	3	3
127-135	126.5-135.5	5	8
136-144	135.5-144.5	9	17
145-153	144.5-153.5	12	29
154-162	153.5-162.5	5	34
163-171	162.5-171.5	4	38
172-180	171.5-180.5	2	40
Total			

(i) Here n = 40 and $\frac{n}{2}$ = 20

∴ Median class is 145-153

l = 145, $c.f.$ = 17, f = 12 and h = 9

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

= $144.5 + \left(\frac{20-17}{12}\right) \times 9$

= $144.5 + \left(\frac{3}{12}\right) \times 9$

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

= 144.5 + 2.25

= 146.75 mm

∴the median length of the leaves is 146.75 mm Ans.

5. The following table gives the distribution of the life time of 400 neon lamps:

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

Find the median life time of a lamp.

Sol.

Life time (in hours)	Number of lamps (f_i)	c.f.
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	

(i) Here n = 400 and $\frac{n}{2}$ = 200

∴ Median class is 3000-3500

l = 3000, $c.f.$ = 130, f = 86 and h = 500

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

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

= $3000 + \left(\frac{70}{43}\right) \times 250$

= $3000 + \frac{17500}{43}$

= 3000 + 406.98

= 3406.98 hours

∴ the median life time of a lamp is 3406.98hours Ans.

6. 100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabets 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.

Sol.

Number of letters	Number of surnames (f_i)	c.f.	x_i	$d_i = x_i$ - a	$f_i\, d_i$
1-4	6	6	2.5	-6	-36
4-7	30= f_0	36	5.5	-3	-90
7-10	40 = f_1	76	8.5=a	0	0
10-13	16 = f_2	92	11.5	3	48
13-16	4	96	14.5	6	24
16-19	4	100	17.5	9	36
Total	Σf_i = 100				$\Sigma f_i d_i$ = -18

(i) Here n = 100 and $\frac{n}{2}$ = 50

∴ Median class is 7-10

l = 7, $c.f.$ = 36, f = 40 and h = 3

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

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

= $7 + \left(\frac{14}{40}\right) \times 3$

= $7 + \left(\frac{7}{20}\right) \times 3$

= $7 + \frac{21}{20}$

= 7 + 1.05

= 8.05

(ii) Mean = a + $\frac{\Sigma f_i d_i}{\Sigma f_i}$

= 8.5 + $\frac{-18}{100}$

= 8.5 – 0.18

= 8.32

(iii) Here maximum frequency is 40

∴ Modal class is 7-10

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

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

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

= $7 + \left(\frac{10}{80-46}\right) \times 3$

= $7 + \frac{10}{34} \times 3$

= $7 + \frac{30}{34}$

= 7 + 0.88

= 7.88

∴ the median = 8.05, mean = 8.32 and mode = 7.88 Ans.

7. The distribution below gives the weights 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

Sol.

Weight (in kg)	Number of students (f_i)	c.f.
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	

(i) Here n = 30 and $\frac{n}{2}$ = 15

∴ Median class is 55-60

l = 55, $c.f.$ = 13, f = 6 and h = 50

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

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

= $55 + \left(\frac{2}{6}\right) \times 5$

= $55 + \frac{5}{3}$

= 55 + 1.67

= 56.67 kg

∴the median weight of the students is 56.67 kg Ans.