Exercise 13.1

Q1 :

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?

Answer :

To find the class mark (x_i) for each interval, the following relation is used.

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

x_i and $f_i x_i$ can be calculated as follows.

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

From the table, it can be observed that

$$\sum f_i = 20$$

$$\sum f_i x_i = 162$$

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

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

Therefore, mean number of plants per house is 8.1.

Here, direct method has been used as the values of class marks (x_i) and f_i are small.

Q2 :

Consider the following distribution of daily wages of 50 worker of a factory.

Daily wages (in Rs)	100 - 120	120 - 140	140 - 1 60	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.

Answer :

To find the class mark for each interval, the following relation is used.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (h) of this data = 20

Taking 150 as assured mean (a), d_i, u_i, and $f_i u_i$ can be calculated as follows.

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

From the table, it can be observed that

$$\sum f_i = 50$$

$$\sum f_i u_i = -12$$

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

$$= 150 + \left(\frac{-12}{50}\right) 20$$

$$= 150 - \frac{24}{5}$$

$$= 150 - 4.8$$

$$= 145.2$$

Therefore, the mean daily wage of the workers of the factory is Rs 145.20.

Q3 :

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 workers	7	6	9	13	*f*	5	4

Answer :

To find the class mark (x_i) for each interval, the following relation is used.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

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

Taking 18 as assured mean (a), d_i and $f_i d_i$ are calculated as follows.

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	$2f$
21 - 23	5	22	4	20
23 - 25	4	24	6	24
Total	$\sum f_i = 44 + f$			$2f$ - 40

From the table, we 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.

Q4 :

Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarized as follows. Fine 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

Answer :

To find the class mark of each interval (x_i), the following relation is used.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size, h, of this data = 3

Taking 75.5 as assumed mean (a), d_i, u_i, $f_i u_i$ are calculated as follows.

Number of heart beats per minute	Number of women f_i	x_i	$d_i = x_i - 75.5$	$u_i = \frac{d_i}{3}$	$f_i u_i$
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

From the table, we obtain

$$\sum fi = 30$$

$$\sum f_i u_i = 4$$

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

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

$$= 75.5 + 0.4 = 75.9$$

Therefore, mean hear beats per minute for these women are 75.9 beats per minute.

Q5 :

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?

Answer :

Number of mangoes	Number of boxes f_i

50 - 52	15
53 - 55	110
56 - 58	135
59 - 61	115
62 - 64	25

It can be observed that class intervals are not continuous. There is a gap of 1 between two class intervals. Therefore, $\frac{1}{2}$ has to be added to the upper class limit and $\frac{1}{2}$ has to be subtracted from the lower class limit of each interval.

Class mark (x_i) can be obtained by using the following relation.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (h) of this data = 3

Taking 57 as assumed mean (a), d_i, u_i, f_iu_i are calculated as follows.

Class interval	f_i	x_i	$d_i = x_i - 57$	$u_i = \frac{d_i}{3}$	f_iu_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

It can be observed that

$$\sum f_i = 400$$
$$\sum f_iu_i = 25$$

$$\text{Mean, } \bar{x} = a + \left(\frac{\sum f_iu_i}{\sum f_i}\right) \times h$$
$$= 57 + \left(\frac{25}{400}\right) \times 3$$
$$= 57 + \frac{3}{16} = 57 + 0.1875$$
$$= 57.1875$$
$$= 57.19$$

Mean number of mangoes kept in a packing box is 57.19.

Step deviation method is used here as the values of f_i, d_i are big and also, there is a common

Q6 :

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.

Answer :

To find the class mark (x_i) for each interval, the following relation is used.

$$x_1 = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size = 50

Taking 225 as assumed mean (a), d_i, u_i, f_iu_i are calculated as follows.

Daily expenditure (in Rs)	f_i	x_i	$d_i = x_i - 225$	$u_i = \frac{d_i}{50}$	f_iu_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

From the table, we obtain

$\sum f_i = 25$

$\sum f_iu_i = -7$

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

$$= 225 + \left(\frac{-7}{25}\right) \times (50)$$

$$= 225 - 14$$

$$= 211$$

Therefore, mean daily expenditure on food is Rs 211.

Q7 :

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.

Answer :

To find the class marks for each interval, the following relation is used.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size of this data = 0.04

Taking 0.14 as assumed mean (a), d_i, u_i, $f_i u_i$ are calculated as follows.

Concentration of SO_2 (in ppm)	Frequency f_i	Class mark x_i	$d_i = x_i - 0.14$	$u_i = \frac{d_i}{0.04}$	$f_i u_i$
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 obtain

$$\sum f_i = 30$$

$$\sum f_i u_i = -31$$

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

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

$$= 0.14 - 0.04133$$

$$= 0.09867$$

$$\simeq 0.099 \text{ ppm}$$

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

Q8 :

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

Answer :

To find the class mark of each interval, the following relation is used.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Taking 17 as assumed mean (a), d_i and $f_i d_i$ are calculated as follows.

Number of days	**Number of students** f_i	x_i	$d_i = x_i - 17$	$f_i d_i$
0 - 6	11	3	- 14	- 154
6 - 10	10	8	- 9	- 90

10 - 14	7	12	- 5	- 35
14 - 20	4	17	0	0
20 - 28	4	24	7	28
28 - 38	3	33	16	48
38 - 40	1	39	22	22
Total	40			- 181

From the table, we obtain

$$\sum f_i = 40$$

$$\sum f_i d_i = -181$$

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

$$= 17 + \left(\frac{-181}{40}\right)$$

$$= 17 - 4.525$$

$$= 12.475$$

$$\simeq 12.48$$

Therefore, the mean number of days is 12.48 days for which a student was absent.

Q9 :

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

Answer :

To find the class marks, the following relation is used.

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (h) for this data = 10

Taking 70 as assumed mean (a), d_i, u_i, and $f_i u_i$ are calculated as follows.

Literacy rate (in %)	**Number of cities** f_i	x_i	$d_i = x_i - 70$	$u_i = \frac{d_i}{10}$	$f_i u_i$

45 - 55	3	50	- 20	- 2	- 6
55 - 65	10	60	- 10	- 1	- 10
65 - 75	11	70	0	0	0
75 - 85	8	80	10	1	8
85 - 95	3	90	20	2	6
Total	35				- 2

From the table, we obtain

$\sum f_i = 35$

$\sum f_i u_i = -2$

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

$$= 70 + \left(\frac{-2}{35}\right) \times (10)$$

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

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

$$= 70 - 0.57$$

$$= 69.43$$

Therefore, mean literacy rate is 69.43%.