CHAPTER – 14
STATISTICS

Exercise 14.1

Question 1: A survey was conducted by a group of students as a part of their environment awareness program, 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:

The above given data can be represented in the form of table as below:

Class Interval	fi	xi	fixi
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
	$\sum$ fi = 20		$\sum$ fixi = 162

Mean can be calculated as follows:

$$\bar{x} = \frac{\sum \text{fixi}}{\sum \text{fi}}$$

where f_i = frequency of ith class and x_i = mid value of ith class

$= \frac{162}{20}$

= 8.1

We will use the direct method in this as the values of xi and fi are small. You can also use assumed mean method, but it's not necessary as the values are very small and assumed mean method is better for large values.

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

Daily wages (in Rs)	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.

Answer:

The above given data can be represented in the form of table as below:

let a = 150 [assumed mean]

Class Interval	fi	xi	di = xi –a	fidi	f_ix_i
100 -120	12	110	-40	-480	1320
120-140	14	130	-20	-280	1820
140 -160	8	150	0	0	1200
160-180	6	170	20	120	1020
180-200	10	190	40	400	1900
	$\sum fi = 50$			$\sum fidi = -240$	$\sum f_ix_i = 7260$

Now, mean of the deviation can be calculated as follows:

$\bar{d} = \frac{\sum fidi}{\sum fi}$

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

= -4.8

Mean can be calculated as follows:

x = d + a

x = -4.8 + 150

x = 145.20

Method 2:

Now we can also calculate mean by the formula:

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

Therefore, from the table, $\sum f_i x_i = 7260$

$\sum f_i = 50$

Therefore, Mean = 7260/50 **Mean = 145.20**

Question 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

Answer:

The above given data can be represented in the form of table as below:

Class Interval	fi	xi	fixi
11 – 13	7	12	84
13 – 15	6	14	84
15 – 17	9	16	144
17 – 19	13	18	234

19 – 21	f	20	20f
21 – 23	5	22	110
23 – 25	4	24	96
	$\sum$ fi = 44 + f		$\sum$ fixi = 752 + 20f

We can find the value of f as follows:

$\bar{x} = \frac{\sum \text{fixi}}{\sum \text{fi}}$

$18 = \frac{752+20f}{44+f}$

18 (44 + f) = 752 + 20f

792 + 18f = 752 + 20f

2f = 40

f = 20

Question 4: Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarized 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

Answer:

The above given data can be represented in the form of table as below:

Class Interval	fi	xi	di = xi –a	fidi
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	0	0
77-80	7	78.5	3	21

80-83	4	81.5	6	24
83-86	2	84.5	9	18
	$\sum$ fi = 30			$\sum$ fidi = 12

Let the assumed mean for the given data be, a = 75.5
Now, mean of the deviation can be calculated as follows:
$\bar{d} = \frac{\sum \text{fidi}}{\sum \text{fi}}$
where, f_i = frequency of the ith class
d_i = deviation from assumed mean of the ith class = x_i - a
deviation $= \frac{12}{30}$
= 0.4
Mean can be calculated as follows:
$\bar{x} = \bar{d} + a$
= 0.4 + 75.5
= 75.9
Mean heartbeat for women = 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?
Answer:
The above-given data can be represented in the form of a table as below:
Let a = 57

Class Interval	fi	Xi	di = xi –a	fidi
50-52	15	51	-6	-90
53-55	110	54	-3	-330
56-58	135	57	0	0
59-61	115	60	3	345
62-64	25	63	6	150
	$\sum$ fi = 400			$\sum$ fidi = 75

Now, the mean of the deviation can be calculated as follows:

$\bar{d} = \frac{\sum \text{fidi}}{\sum \text{fi}}$

where ,f_i = frequency of the ith class

$d_i = x_i$ - a

a = assumed mean of the data

$= \frac{75}{400}$

= 0.1875

Mean can be calculated as follows:

$= \bar{x} = \bar{d} + a$

where, a = assumed mean of the data

= 0.1875 + 57

Mean = 57.1875

≈ 57.19**Hence, the mean of the given data is 57.19.**

Question 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

Answer:

Solving by short-cut method:

The above given data can be represented in the form of table as below:

Class Interval (in Rs)	fi	xi (in Rs)	di = xi – a	ui = $\frac{di}{h}$(in Rs)	fiui (in Rs)
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
	$\sum$ fi = 25				$\sum$ fiui = -7

Formula of mean is given by

$\bar{x} = a + \frac{\sum \text{fiui}}{\sum \text{fi}} \times h$

where, a = assumed mean

f_i = frequency of the ith class

h = class width

$u_i = \frac{a - x_i}{h}$

$= 225 \pm \frac{7}{25} \times 50$

= Rs. 211

So, the mean of the data is Rs. 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

Class Interval	fi	xi	fixi
0.00 – 0.04	4	0.02	0.08
0.04 – 0.08	9	0.06	0.54
0.08 – 0.12	9	0.10	0.90
0.12 – 0.16	2	0.14	0.28
0.16 – 0.20	4	0.18	0.72
0.20 – 0.24	2	0.22	0.44
	$\sum$ fi = 30		$\sum$ fixi = 2.96

Mean can be calculated as follows:

$$\bar{x} = \frac{\sum \text{fixi}}{\sum \text{fi}}$$

where f_i = frequency of ith class

and x_i = middle point of ith class

$$= \frac{2.96}{30}$$

= 0.099 ppm

Therefore, Mean concentration of SO_2 in the air is 0.099 ppm

Assumed Mean method is not feasible for this question, because the values are too small and taking the steps will make the calculation tougher. Use Assumed mean or step deviation method when the values are larger and can be reduced with the help of steps.

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

Answer:

The above given data can be represented in the form of table as below:

Class Interval	fi	xi	fixi
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
	$\sum$ fi = 40		$\sum$ fixi = 499

Mean can be calculated as follows:

$$\bar{x} = \frac{\sum \text{fixi}}{\sum \text{fi}}$$

where, f_i = frequency of the ith class

and, x_i = midpoint of the ith class

$$= \frac{499}{40}$$

= 12.4 (approx.)

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

Answer:

The above-given data can be represented in the form of a table as below:

Class Interval	fi	xi	ui	fiui
45 – 55	3	50	-2	-6
55 – 65	10	60	-1	-10
65 – 75	11	70	0	0
75 – 85	8	80	1	8
85 – 95	3	90	2	6
	$\sum fi = 35$			$\sum fiui = -2$

The formula for mean is given by $\bar{x} = a + \frac{\sum fiui}{\sum fi} \times h$

where, a is the assumed mean, f_i is the frequency,

$u_i = (x_i - a) / h$

$= 70 + \frac{-2}{35} \times 10$

= 69.43

Therefore, the mean literacy rate is 69.43 %.

Exercise 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

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

Answer:

As per the question:

Modal class = 35 -45

l = 35

h = 10

f1 = 23

f0 = 21

f2 = 14

$Mode = l + \left(\frac{f1-f0}{2f1-f0-f2}\right)h$

$= 35 + \left(\frac{23-21}{2\times23-21-14}\right)10$

$= 35 + \frac{2}{11} \times 10$

= 36.8

The above given data can be represented in the form of table as below:

Class Interval	**fi**	**xi**	**fixi**
5 – 15	6	10	60
15 – 25	11	20	220
25 – 35	21	30	630
35 – 45	23	40	920
45 – 55	14	50	700
55 – 65	5	60	300
	$\sum$ f i = 80		**$\sum$ f i xi= 2830**

Mean can be calculated as follows:

$\bar{x} = \frac{\sum \text{fixi}}{\sum \text{fi}}$

$= \frac{2830}{80}$

= 35.37

The mode of the data shows that maximum number of patients in the age group of 36.8, whereas the average age of all the patients is 35.37.

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.

Answer:

As per the question:

Modal class = 60-80

l = 60

h = 20

$f_1 = 61$

$f_0 = 52$

$f_2 = 38$

$$Mode = l + \left(\frac{f1-f0}{2f1-f0-f2}\right)h$$

$$Mode = 60 + \left(\frac{61-52}{(2\times61)-52-38}\right)h$$

$$Mode = 60 + \frac{9\times20}{32}$$

Or Mode = 60 + 5.625

or Mode = 65.62

Thus, the modal lifetime of 225 electrical components is 65.62 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 Rs)	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

As per the question:
Modal class = 1500 – 2000
l = 1500
h = 500
f1 = 40
f0 = 24
f2 = 33
Formula for calculating mode is

$$Mode = l + \left(\frac{f1-f0}{2f1-f0-f2}\right)h$$

where, l = lower limit of modal classf_1 = frequency of the modal class
f_0 = frequency of the class before modal class
f_2 = frequency of the class after modal class
h = width of modal class
Therefore, Mode = $1500 + \frac{16}{23} \times 5000$
= 1500 + 347.82
= 1847.82
Mode of the data is Rs.1847.82
The above given data can be represented in the form of table as below:

Class Interval	**fi**	**xi**	**di = xi – a**	**ui**	**fiui**
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
	$\sum f_i = 200$				**$\sum f_i u_i = -35$**

Hence, the mean can be calculated as below:

$\bar{x} = a + \frac{\sum f_i u_i}{\sum f_i} \times h$

where, a = assumed mean

f_i = frequency of the ith class

h = class width

$u_i = \frac{a - x_i}{h}$

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

Mean = 2750 -87.5

Mean = Rs. 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

Answer:

As per the question:

Modal class = 30-35

l = 30

h = 5

f1 = 10

f0 = 9

f2 = 3

$Mode = l + \left(\frac{f1-f0}{2f1-f0-f2}\right)h$

$= 30 + \left(\frac{10-9}{2\times10-9-3}\right)5$

$= 30 + \frac{1}{8} \times 5$

= 30.625

Class Interval	**fi**	**xi**	**di = xi – a**	**ui**	**fiui**
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
	$\sum$ f i = 35				**$\sum$ f i ui= −23**

Hence, the mean can be calculated as below:

$\bar{x} = a + \frac{\sum \text{fiui}}{\sum \text{fi}} \times h$

$= 32.5 + \frac{-23}{35} \times h$

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

= 29.22

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

Answer:

As per the question:

Modal class = 4000-5000

l = 4000

h = 1000

f1 = 18

f0 = 4

f2 = 9

$Mode = l + \left(\frac{f1-f0}{2f1-f0-f2}\right)h$

$= 4000 + \left(\frac{18-4}{2\times18-4-9}\right)1000$

$= 4000 + \frac{14}{23} \times 1000$

= 4608.70s

Question 6: A student noted the number of cars passing through a spot on a road for 100periods each of 3 minutes and summarized 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

Answer:

For finding the mode, first we find the modal class i.e. class with maximum frequency.

In the given data, Modal class is 40 - 50and then we use the following formula for finding the mode $Mode = l + \left(\frac{f1-f0}{2f1-f0-f2}\right)h$

Where

l, lower limit of modal class = 40

h, width of modal class = 10

f1, frequency of modal class = 20

f0, frequency of class preceding modal class = 12

f2, frequency of class exceeding modal class = 11

Putting the values, we get

$= 40 + \left(\frac{20-12}{2\times20-12-11}\right)10$

$= 40 + \frac{8}{17} \times 10$

$= 44.70$

Exercise 14.3

Q.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

Answer:

Monthly consumption (in units)	Number of consumers	Cumulative frequency
65-85	4	4
85-105	5	9
105-125	13	22
125-145	20	42
145-165	14	56
165-185	8	64
185-205	4	68
	N = 68	

N= 68

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

where,l = lower limit of the median group
n = total frequencyc.
f = cumulative frequency of the group before median groupf = frequency of median group
W = Group Width
$\frac{N}{2} = 34$
Hence,
Median class = 125 - 145
Cumulative frequency = 42
Lower limit, l = 125

cf = 22
f = 20
h = 20
Hence,
Median can be calculated as:

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

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

$$= 125 + 12$$

$$= 137$$

Now, mode can be calculated as:

$$\text{Mode} = l + \left(\frac{f1-f0}{2f1-f0-f2}\right) h$$

where,
l = lower limit of the modal classf_1 = absolute frequency of the modal class
f_0 = absolute frequency of the class before modal class

f_2 = absolute frequency of the class after modal class
h = class width

Modal class = 125-145
l = 125
h = 20
f_1 = 20
f_0 = 13
f_2 = 14

$$\text{Mode} = l + \left(\frac{f1-f0}{2f1-f0-f2}\right) h$$

$= 125 + \left(\frac{20-13}{2\sim 20-13-14}\right)20$

$= 125 + \frac{7}{13} \times 20$

$= 125 + 10.76$

$= 135.76$

Now, mean of the following data can be calculated as:

Class interval	**fi**	**xi**	**di**	**ui**	**fiui**
065-085	4	75	-60	-3	-12
085-105	5	95	-40	-2	-10
105-125	13	115	-20	-1	-13
125-145	20	135	0	0	0
145-165	14	155	20	1	14
165-185	8	175	40	2	16
185-205	4	195	60	3	12
	$\Sigma fi = 68$				$\Sigma fi\ ui = 7$

$\bar{x} = a + \frac{\Sigma fi\ ui}{\Sigma fi} \times h$

where, a = assumed meanf$_i$ = frequency of ith term

$u_i = a - x_i / h$

h = class width

$= 32.5 + \frac{-23}{35} \times 5$

$= 137.05$

Hence,

Mean, Median and Mode are more or less equal in this distribution.

Q.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

Answer:

Let's make a cumulative frequency table for the above problem

Class interval	Frequency	Cumulative frequency
0-10	5	5
10-20	X	5+x
20-30	20	x+25
30-40	15	40+x
40-50	Y	40+x+y
50-60	5	45+x+y
Total	60	

Total frequency, N= 60

$\frac{N}{2} = 30$

Now,

Given median = 28.5, lies in 20 - 30

Median class = 20-30
frequency corresponding to median class, f = 20
cumulative frequency of the class preceding the median class, cf = 5 + x
Lower limit, l = 20
class height, h = 10
Now,
Median can be calculated as:

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

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

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

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

$$25 - x = 8.5 \times 2$$

$$\Rightarrow 25 - x = 17$$

$$\Rightarrow x = 25-17$$

$$\Rightarrow x = 8$$

Now,
From the cumulative frequency we can find the value of x + y as:

$$45 + x + y = 60$$

$$\Rightarrow x + y = 60 - 45$$

$$\Rightarrow x + y = 15$$

$$\Rightarrow y = 15 - x$$

as, x = 8

$$\Rightarrow y = 15 - 8$$

$$\Rightarrow y = 7$$

Hence,
Value of x = 8 and y = 7

Q.3 A life insurance agent found the following data for distribution of ages of 100 policyholders. Calculate the median age, if policies are given only to persons having age 18 years on wards but less than 60 year.

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

Answer :

In this case, we are given less than (or below) cumulative frequency distribution,we need to convert it into normal frequency distribution.

So, we need to find class intervals and corresponding frequency.Since, the difference between ages in each class is 5, we can take the first class interval as 15 - 20 and its frequency will be same as frequency of below 20 class.Also, for other class, class interval will can be found as following and corresponding frequency can be find by subtracting the previous frequency from the cumulative frequency.

Class intervals	**Frequency**	**Cumulative frequency**
15-20	2	2
20-25	4	6
25-30	18	24

30-35	21	45
35-40	33	78
40-45	11	89
45-50	3	92
50-55	6	98
55-60	2	100

As per the question,

N=100

$\frac{N}{2}$ =50

Hence,

Median class = 35-45

Cumulative frequency = 100

Lower limit, l = 35

cf = 45
f = 33
h = 5
Now,
Median can be calculated as:

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

where,
l = lower limit of median classn = total frequency of the datacf =

cumulative frequency of the class before median classf = frequency of the median class

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

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

Median $= 35.75$ years

Q.4 The lengths of 40 leaves of a plant are measured correct to the nearest milli meter, 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 to117.5 - 126.5, 126.5 - 135.5, . . ., 171.5 - 180.5)

Answer:

The cumulative frequency of the data can be calculated as:

Class interval	**frequency**	Cumulative frequency
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

As per the question,
N= 40

$\frac{N}{2} = 20$
Hence,

Median class =144.5-153.5

Lower limit, l = 144.5

cf = 17

f = 12

h = 9

Now,

Median can be calculated as:

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

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

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

= 146.75

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

Life time (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 life time of a lamp

Answer:

The cumulative frequency of the given data can be calculated as:

Life time (in hours)	**Number of lamps**	**Cumulative frequency**
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

As per the question,
N= 400

$\frac{N}{2} = 200$

Hence,
Median class = 3000-3500

Now,
Median class = 3000-3500
frequency corresponding to median class, f = 86
cumulative frequency of the class preceding the median class, cf =130
Lower limit, l = 3000
class height, h = 500
Now,

Median can be calculated as:

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

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

$$= 3000 + 406.97$$
$$= 3406.97$$

Q.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

Answer:

The cumulative frequency of the given data can be calculated as

Class interval	Frequency	cumulative frequency
1-4	6	6
4-7	30	36
7-10	40	76
10-13	16	92
13-16	4	96
16-19	4	100

As per the question,

N= 100

$\frac{N}{2} = 50$

Hence,

Median class = 7-10

Lower limit, l = 7

cf = 36

f = 40

h = 3

Now,

Median can be calculated as:

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

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

$$= 7 + \frac{14}{40} \times 3$$

$$= 8.05$$

Now, mode can be calculated as: class corresponding to maximum frequency.

Modal class = 7-10

l = 7

h = 3

f1 = 40

f0 = 30

f2 = 16

$$\text{Mode} = l + \left(\frac{f1-f0}{2f1-f0-f2}\right) h$$

$$= 7 + \left(\frac{40-30}{2\times40-30-16}\right) 3$$

$$= 7 + \left(\frac{10}{34}\right) \times 3$$

= 7.88

Now, mean of the following data can be calculated as:

Class interval	**fi**	**xi**	**fixi**
1-4	6	2.5	15
4-7	30	5.5	165
7-10	40	8.5	340
10-13	16	11.5	184
13-16	4	14.5	51
16-19	4	17.5	74
	$\Sigma fi = 100$		$\Sigma fi\ xi = 825$

$$\bar{x} = \frac{\Sigma fi\ xi}{\Sigma fi}$$

$$= \frac{825}{100}$$

= 8.25

Q.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

Answer:

The cumulative frequency of the given data can be calculated as:

Class interval	**frequency**	Cumulative frequency
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

As per the question,
N= 30

$\frac{N}{2}$ =15
Hence,
Median class = 55-60
Lower limit, l = 55
cf = 13
f = 6
h = 5
Now,
Median can be calculated as:

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

where, l = lower limit of median class
n = total frequency of distribution
c.f. = cumulative frequency of the class before median class
f = frequency og the median class
h = class width

$= 55 + \left(\frac{15-13}{6}\right) \times 6$
$= 55 + \frac{2}{6} \times 5$
$= 55 + 1.67$

Median = 56.67
Median weight is 56.57 kg

Exercise 14.4

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

Daily income (in Rs)	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

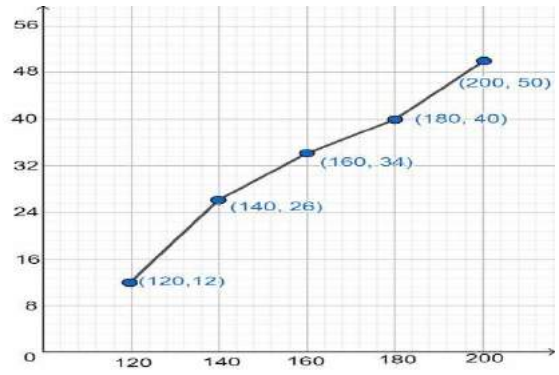
Answer:

The less than type cumulative frequency distribution of given data can be found as follows, Here previous cumulative frequencies are added to current frequency to find the cumulative frequency of any class.

Daily income (in Rs.) Upper class limits	Cumulative frequency
Less than 120	12
Less than 140	26
Less than 160	34
Less than 180	40
Less than 200	**50**

Now,

Taking upper class interval on x-axis and their respective frequencies on y-axis, ogive will be:



Q.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.

Answer:

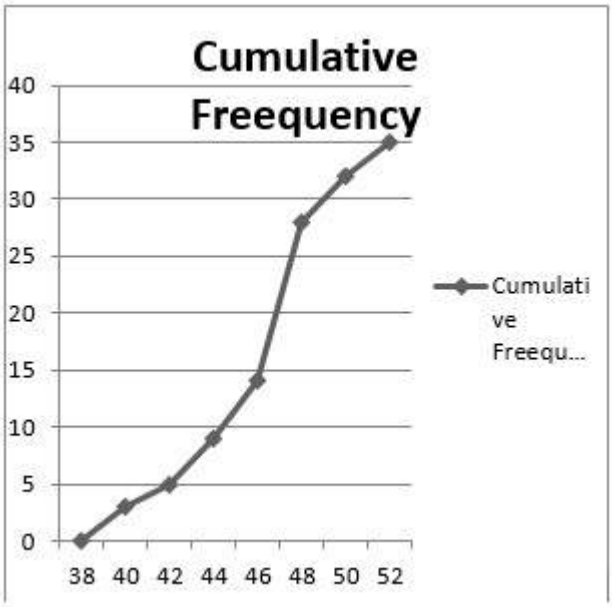
The frequency distribution table of less than type graph is as follows:

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 interval on x-axis and their respective frequencies on y-axis, ogive will be:



Here, N = 35

$\frac{N}{2}$ =17.5

Mark the point A whose ordinate is 17.5 and is x-ordinate is 46.5.

Hence,

Median of the data is 46.5

Now,

It can be observed that the difference between two consecutive upper class limits is 2

The class marks with respective frequencies are obtained below:

Weight (in kg)	Frequency	(Cumulative Frequency)
Less than 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	

We can see that the cumulative frequency is greater than n/2 and is 28 which belongs to the interval 46-48

Hence,

Median class = 46-48

Lower limit, l = 46

cf = 14

f = 14

h = 2

Now,

Median can be calculated as:

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

$$= 46 + \left(\frac{17.5 - 14}{14}\right) \times 2$$

$= 46 + \frac{.3.5}{7}$

$= 46.5$

Q.3 The following table gives production yield per hectare of wheat of 100 farms of a village

Production yield (in kh/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

Answer:

The frequency distribution table of more than type graph is as follows:

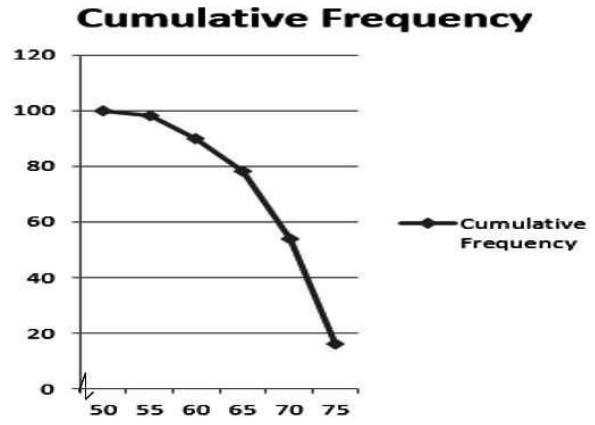
Production yield (lower class limits)	**Cumulative frequency**
More than or equal to 50	100
More than or equal to 55	98
More than or equal to 60	90
More than or equal to 65	78
More than or equal to 70	54
More than or equal to 75	16

Now,

Taking lower limit on x-axis,

Cumulative Frequencies on y- axis,

Its ogive can be drawn as:


Cumulative Frequency
120
100
80
60
40
20
0
50
55
60
65
70
75
Cumulative Frequency