

6. Statistics

Exercise 6.1

1. Question

The mean of 11 results is 30. If the mean of the first 6 results is 28 and that of last 6 results is 32, find the 6th result.

Answer

Let the 6th number be x

Given that mean of 11 results = 30

$$\therefore \text{sum of 11 numbers} = 11 \times 30 = 330$$

Mean of the first 6 results = 28

$$\text{Sum of first 6 numbers} = 6 \times 28 = 168$$

Mean of the last 6 results = 32

$$\text{Sum of the last 6 results} = 6 \times 32 = 192$$

Therefore,

Sum of first 6 numbers + sum of last 6 numbers – 6th number = sum of 11 numbers

$$168 + 192 - x = 330$$

$$\Rightarrow 360 - x = 330$$

$$\Rightarrow x = 30$$

2. Question

The mean of 17 observations is 20. If the mean of the first 9 observation is 23 and that of last 9 observations is 18, find the 9th observation.

Answer

Let the 9th observation be x

Given that mean of 17 observations = 20

$$\therefore \text{sum of 17 observations} = 17 \times 20 = 340$$

Mean of the first 9 observations = 23

Sum of first 9 observations = $9 \times 23 = 207$

Mean of the last 9 observations = 18

Sum of the last 9 observations = $9 \times 18 = 162$

Therefore,

Sum of first 9 observations + sum of last 9 observations – 9th observation
= sum of 17 observations

$$207 + 162 - x = 340$$

$$\Rightarrow 369 - x = 340$$

$$\Rightarrow x = 29$$

3. Question

The mean weight of 21 students of a class is 52 kg. If the mean weight of the first 11 students of the class is 50 kg and that of the last 11 students is 54 kg, find the weight of the 11th student.

Answer

Let the weight of 11th student be x

Given that mean weight of 21 students = 52kg

$$\therefore \text{sum of 21 students weight} = 21 \times 52 = 1092\text{kg}$$

Mean weight of the first 11 students = 50kg

$$\text{Sum of first 11 students weight} = 11 \times 50 = 550\text{kg}$$

Mean weight of the last 11 students = 54kg

$$\text{Sum of the last 11 students weight} = 11 \times 54 = 594\text{kg}$$

Therefore,

Sum of first 11 students weight + sum of last 11 students weight – weight
of the 11th student = sum of 21 students weight

$$550 + 594 - x = 1092$$

$$\Rightarrow 1144 - x = 1092$$

$$\Rightarrow x = 52$$

Hence, weight of 11th student is 52kg

4. Question

The mean weight of 25 students of a class is 60 kg. If the mean weight of the first 13 students of the class is 57 kg and that of the last 13 students is 63 kg, find the weight of the 13th student.

Answer

Let the weight of 13th student be x

Given that mean weight of 25 students = 60kg

\therefore sum of 25 students weight = $25 \times 60 = 1500\text{kg}$

Mean weight of the first 13 students = 57kg

Sum of first 13 students weight = $13 \times 57 = 741\text{kg}$

Mean weight of the last 13 students = 63kg

Sum of the last 13 students weight = $13 \times 63 = 819\text{kg}$

Therefore,

Sum of first 13 students weight + sum of last 13 students weight – weight of the 13th student = sum of 25 students weight

$$741 + 819 - x = 1500$$

$$\Rightarrow 1560 - x = 1500$$

$$\Rightarrow x = 60$$

Hence, weight of 13th student is 60kg

5. Question

The mean of 23 observations is 34. If the mean of the first 12 observations is 32 and that of the last 12 observations is 38, find the 12th observation.

Answer

Let the 12th observation be x

Given that mean of 23 observations = 34

\therefore sum of 23 observations = $23 \times 34 = 782$

Mean of the first 12 observations = 32

Sum of first 12 observations = $12 \times 32 = 384$

Mean of the last 12 observations = 38

Sum of the last 12 observations = $12 \times 38 = 456$

Therefore,

Sum of first 12 observations + sum of last 12 observations – 12th observation = sum of 23 observations

$$384 + 456 - x = 782$$

$$\Rightarrow 840 - x = 782$$

$$\Rightarrow x = 58$$

6. Question

The mean of 11 numbers is 35. If the mean of first 6 numbers is 32 and that of last 6 numbers is 37, find the 6th number.

Answer

Let the 6th number be x

Given that mean of 11 results = 35

$$\therefore \text{sum of 11 numbers} = 11 \times 35 = 385$$

Mean of the first 6 results = 32

$$\text{Sum of first 6 numbers} = 6 \times 32 = 192$$

Mean of the last 6 results = 37

$$\text{Sum of the last 6 results} = 6 \times 37 = 222$$

Therefore,

Sum of first 6 numbers + sum of last 6 numbers – 6th number = sum of 11 numbers

$$192 + 222 - x = 385$$

$$\Rightarrow 414 - x = 385$$

$$\Rightarrow x = 29$$

7. Question

The mean of 25 observations is 36. If the mean of the first 13 observations is 32 and that of the last 13 observations is 39, find the 13th observation.

Answer

Let the 13th observation be x

Given that mean of 25 observations = 36

\therefore sum of 25 observations = $25 \times 36 = 900$

Mean of the first 13 observations = 32

Sum of first 13 observations = $13 \times 32 = 416$

Mean of the last 13 observations = 39

Sum of the last 13 observations = $13 \times 39 = 507$

Therefore,

Sum of first 13 observations + sum of last 13 observations - 13th observation = sum of 25 observations

$$416 + 507 - x = 900$$

$$\Rightarrow 923 - x = 900$$

$$\Rightarrow x = 23$$

8. Question

If the mean of the following data is 25, find the value of k.

x	5	15	25	35	45
f	3	k	3	6	2

Answer

x_i	f_i	$x_i f_i$
5	3	15
15	K	15k
25	3	75
35	6	210
45	2	90
Total	$\Sigma f_i = 14+k$	$\Sigma f_i x_i = 390+15k$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 25 = \frac{390 + 15k}{14 + k}$$

$$\Rightarrow 25(14+k) = 390 + 15k$$

$$\Rightarrow 350 + 25k = 390 + 15k$$

$$\Rightarrow 25k - 15k = 390 - 350$$

$$\Rightarrow 10k = 40$$

$$\Rightarrow k = 4$$

9. Question

Find the arithmetic mean of the following distribution:

Marks obtained	10	15	20	25	30
No. of students	2	4	6	8	10

Answer

Marks obtained (x_i)	No. of students (f_i)	$x_i f_i$
10	2	20
15	4	60
20	6	120
25	8	200
30	10	300
Total	$\Sigma f_i = 30$	$\Sigma f_i x_i = 700$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{700}{30} = 23.33$$

10. Question

The mean of the following frequency distribution is 62.8. Find the missing frequency x:

Class	0-20	20-40	40-60	60-80	80-100	100-120
Frequency	5	8	x	12	7	8

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
0 - 20	5	10	50
20 - 40	8	30	240
40 - 60	x	50	50x
60 - 80	12	70	840
80-100	7	90	630
100-120	8	110	880
Total	$\Sigma f_i = 40+x$		$\Sigma f_i x_i = 2640+50x$

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

$$\Rightarrow 62.8 = \frac{2640 + 50x}{40 + x}$$

$$\Rightarrow 62.8 (40 + x) = 2640 + 50x$$

$$\Rightarrow 2512 + 62.8x = 2640 + 50x$$

$$\Rightarrow 62.8x - 50x = 2640 - 2512$$

$$\Rightarrow 12.8x = 128$$

$$\Rightarrow x = 10$$

11. Question

The arithmetic mean of the following data is 14. Find the value of p:

x	5	10	15	20	25
f	7	p	8	4	5

Answer

x_i	f_i	$x_i f_i$
5	7	35
10	p	10p
15	8	120
20	4	80
25	5	125
Total	$\sum f_i = 24 + p$	$\sum f_i x_i = 360 + 10p$

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

$$\Rightarrow 14 = \frac{360 + 10p}{24 + p}$$

$$\Rightarrow 14 (24 + p) = 360 + 10p$$

$$\Rightarrow 336 + 14p = 360 + 10p$$

$$\Rightarrow 14p - 10p = 360 - 336$$

$$\Rightarrow 4p = 24$$

$$\Rightarrow p = 6$$

12. Question

If the mean of the following data is 18, find the missing frequency p:

x	10	15	20	25
f	5	10	p	8

Answer

x_i	f_i	$x_i f_i$
10	5	50
15	10	150
20	p	20p
25	8	200
Total	$\Sigma f_i = 23 + p$	$\Sigma f_i x_i = 400 + 20p$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 18 = \frac{400 + 20p}{23 + p}$$

$$\Rightarrow 18(23 + p) = 400 + 20p$$

$$\Rightarrow 414 + 18p = 400 + 20p$$

$$\Rightarrow 18p - 20p = 400 - 414$$

$$\Rightarrow -2p = -14$$

$$\Rightarrow p = 7$$

13. Question

Find the value of p if the mean of the following distribution is 7.5:

x	3	5	7	9	11	13
f	6	8	15	p	8	4

Answer

x_i	f_i	$x_i f_i$
3	6	18
5	8	40
7	15	105
9	p	9p
11	8	88
13	4	52
Total	$\Sigma f_i = 41 + p$	$\Sigma f_i x_i = 303 + 9p$

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

$$\Rightarrow 7.5 = \frac{303 + 9p}{41 + p}$$

$$\Rightarrow 7.5(41+p) = 303 + 9p$$

$$\Rightarrow 307.5 + 7.5p = 303 + 9p$$

$$\Rightarrow 7.5p - 9p = 303 - 307.5$$

$$\Rightarrow -1.5p = -4.5$$

$$\Rightarrow p = 3$$

14. Question

Find the mean of the following data:

Class interval	0-10	10-20	20-30	30-40	40-50
Frequency	12	11	8	10	9

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
0 - 10	12	5	60
10 - 20	11	15	165
20 - 30	8	25	200
30 - 40	10	35	350
40 - 50	9	45	405
Total	$\sum f_i = 50$		$\sum f_i x_i = 1180$

$$\text{Now, } \bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{1180}{50} = 23.6$$

15. Question

Find the mean of the following distribution:

Class	Number of students
4 – 8	2
8 – 12	12
12 – 16	15
16 – 20	25
20 – 24	18
24 – 28	12
28 - 32	13
32 – 36	3

Answer

Class	No. of students (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
4 - 8	2	6	12
8 - 12	12	10	120
12 - 16	15	14	210
16 - 20	25	18	450
20 - 24	18	22	396
24 - 28	12	26	312
28 - 32	13	30	390
32 - 36	3	34	102
Total	$\Sigma f_i = 100$		$\Sigma f_i x_i = 1992$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{1992}{100} = 19.92$$

16. Question

The arithmetic mean of the following frequency distribution is 53. Find the value of p:

Class	0-20	20-40	40-60	60-80	80-100
Frequency	12	15	32	p	13

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
0 - 20	12	10	120
20 - 40	15	30	450
40 - 60	32	50	1600
60 - 80	p	70	$70p$
80-100	13	90	1170
Total	$\Sigma f_i = 72+p$		$\Sigma f_i x_i = 3340+70p$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 53 = \frac{1900 + 70p}{72 + p}$$

$$\Rightarrow 53 (72+p) = 3340 + 70p$$

$$\Rightarrow 3816 + 53p = 3340 + 70p$$

$$\Rightarrow 53p - 70p = 3340 - 3816$$

$$\Rightarrow -17p = -476$$

$$\Rightarrow p = 28$$

17. Question

If the mean of the following distribution is 5. Find the value of f_1 :

Class	0-20	20-40	40-60	60-80	80-100
Frequency	17	28	32	f_1	19

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
0 - 20	17	10	170
20 - 40	28	30	840
40 - 60	32	50	1600
60 - 80	f_1	70	$70 f_1$
80-100	19	90	1710
Total	$\Sigma f_i = 96+f_1$		$\Sigma f_i x_i = 4320+70f_1$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 5 = \frac{4320 + 70f_1}{96 + f_1}$$

$$\Rightarrow 5(96 + f_1) = 4320 + 70f_1$$

$$\Rightarrow 480 + 5f_1 = 4320 + 70f_1$$

$$\Rightarrow 5f_1 - 70f_1 = 4320 - 480$$

$$\Rightarrow -65f_1 = +3840$$

$$\Rightarrow f_1 = -59.07$$

This is not possible as frequency can not be negative.

18. Question

Find the mean of the following frequency distribution:

Class	0-20	20-40	40-60	60-80	80-100
Frequency	15	18	21	29	17

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
0 - 20	15	10	150
20 - 40	18	30	540
40 - 60	21	50	1050
60 - 80	29	70	2030
80 - 100	17	90	1530
Total	$\Sigma f_i = 100$		$\Sigma f_i x_i = 5300$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{5300}{100} = 53$$

19. Question

The mean of the following frequency distribution is 62.8 and the sum of all frequency is 50. Compute the missing frequency f_1 and f_2 :

Class	0-20	20-40	40-60	60-80	80-100	100-120	Total
Frequency	5	f_1	10	f_2	7	8	50

Answer

Class	Frequency (f_i)	Class Mark (x_i)	$x_i f_i$
0 - 20	5	10	50
20 -40	f_1	30	$30f_1$
40 - 60	10	50	500
60 - 80	f_2	70	$70f_2$
80-100	7	90	630
100-120	8	110	880
Total	$\Sigma f_i = 30+f_1+f_2$		$\Sigma f_i x_i = 2060+30f_1+70f_2$

Now, $\bar{X} = \frac{\Sigma f_i x_i}{\Sigma f_i}$

$$\Rightarrow 62.8 = \frac{2060+30f_1+70f_2}{50} \text{ [given: } \Sigma f_i = 50 \text{]}$$

$$\Rightarrow 62.8(50) = 2060 + 30f_1 + 70f_2$$

$$\Rightarrow 3140 = 2060 + 30f_1 + 70f_2$$

$$\Rightarrow 3140 - 2060 = 30f_1 + 70f_2$$

$$\Rightarrow 1080 = 30f_1 + 70f_2$$

$$\Rightarrow 108 = 3f_1 + 7f_2 \dots(i)$$

$$\text{and } 30 + f_1 + f_2 = 50$$

$$\Rightarrow f_1 + f_2 = 50 - 30$$

$$\Rightarrow f_1 + f_2 = 20$$

$$\Rightarrow f_1 = 20 - f_2 \dots(ii)$$

Now, putting the value of f_1 in eq. (i), we get

$$3(20 - f_2) + 7f_2 = 108$$

$$\Rightarrow 60 - 3f_2 + 7f_2 = 108$$

$$\Rightarrow 4f_2 = 108 - 60$$

$$\Rightarrow 4f_2 = 48$$

$$\Rightarrow f_2 = 12$$

Now, substitute the value of f_2 in eq. (ii), we get

$$f_1 = 20 - 12$$

$$\Rightarrow f_1 = 8$$

20. Question

The mean of the following frequency distribution is 57.6 and the sum of the frequencies is 50. Find the missing frequencies f_1 and f_2 :

Class interval	0-20	20-40	40-60	60-80	80-100	100-120
Frequency	7	f_1	12	f_2	8	5

Answer

Class	Frequency (f_i)	Class Mark (x_i)	$x_i f_i$
0 - 20	7	10	70
20 - 40	f_1	30	$30f_1$
40 - 60	12	50	600
60 - 80	f_2	70	$70f_2$
80-100	8	90	720
100-120	5	110	550
Total	$\Sigma f_i = 32 + f_1 + f_2$		$\Sigma f_i x_i = 1940 + 30f_1 + 70f_2$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 57.6 = \frac{2060 + 30f_1 + 70f_2}{50} \quad [\text{given: } \Sigma f_i = 50]$$

$$\Rightarrow 57.6(50) = 1940 + 30f_1 + 70f_2$$

$$\Rightarrow 2880 = 1940 + 30f_1 + 70f_2$$

$$\Rightarrow 2880 - 1940 = 30f_1 + 70f_2$$

$$\Rightarrow 940 = 30f_1 + 70f_2$$

$$\Rightarrow 94 = 3f_1 + 7f_2 \dots (i)$$

$$\text{and } 32 + f_1 + f_2 = 50$$

$$\Rightarrow f_1 + f_2 = 50 - 32$$

$$\Rightarrow f_1 + f_2 = 18$$

$$\Rightarrow f_1 = 18 - f_2 \dots (ii)$$

Now, putting the value of f_1 in eq. (i), we get

$$3(18 - f_2) + 7f_2 = 94$$

$$\Rightarrow 54 - 3f_2 + 7f_2 = 94$$

$$\Rightarrow 4f_2 = 94 - 54$$

$$\Rightarrow 4f_2 = 40$$

$$\Rightarrow f_2 = 10$$

Now, substitute the value of f_2 in eq. (ii), we get

$$f_1 = 18 - 10$$

$$\Rightarrow f_1 = 8$$

21. Question

Find the mean of the following data:

Class interval	50 –60	60 –70	70–80	80–90	90–100
Frequency	8	6	12	11	13

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
50 - 60	8	55	440
60 - 70	6	65	390
70 - 80	12	75	900
80 - 90	11	85	935
90 - 100	13	95	1235
Total	$\Sigma f_i = 50$		$\Sigma f_i x_i = 3900$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{3900}{50} = 78$$

22. Question

Find the mean of the following frequency distribution:

Class interval	15-25	25-35	35-45	45-55	55-65
Frequency	60	35	22	18	15

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
15 - 25	60	20	1200
25 - 35	35	30	1050
35 - 45	22	40	880
45 - 55	18	50	900
55 - 65	15	60	900
Total	$\Sigma f_i = 150$		$\Sigma f_i x_i = 4930$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{4930}{150} = 32.87$$

23. Question

Find the mean of the following frequency distribution:

Class interval	50-60	70-90	90-110	110-130	130-150	150-170
Frequency	18	12	13	27	8	22

Answer

Here, the class size varies, and x_i 's are large. Now, we apply the step deviation method with $a = 120$ and $h = 20$

Class	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{20}$	$f_i u_i$
50 - 70	18	60	-60	-3	-54
70 - 90	12	80	-40	-2	-24
90 -110	13	100	-20	-1	-13
110-130	27	120 = a	0	0	0
130-150	8	140	20	1	8
150-170	22	160	40	2	44
Total	$\Sigma f_i = 100$				$\Sigma f_i u_i = -39$

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

$$\Rightarrow \bar{x} = 120 + 20 \left(\frac{-39}{100} \right)$$

$$\Rightarrow \bar{x} = 120 + \left(\frac{-78}{10} \right)$$

$$\Rightarrow \bar{x} = \frac{1200 - 78}{10}$$

$$\Rightarrow \bar{x} = 112.2$$

24. Question

Find the mean of the following frequency distribution:

Class	25-29	30-34	35-39	40-44	45-49	550-54	555-59
Frequency	14	22	16	6	5	3	4

Answer

Here, we can see that the class interval is not continuous. So, we make it continuous.

Class	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{5}$	$f_i u_i$
24.5 - 29.5	14	27	-15	-3	-42
29.5 - 34.5	22	32	-10	-2	-44
34.5 - 39.5	16	37	-5	-1	-16
39.5 - 44.5	6	42 = a	0	0	0
44.5 - 49.5	5	47	5	1	5
49.5 - 54.5	3	52	10	2	6
54.5 - 59.5	4	57	15	3	12
Total	$\Sigma f_i = 70$				$\Sigma f_i u_i = -79$

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

$$\Rightarrow \bar{x} = 42 + 5 \left(\frac{-79}{70} \right)$$

$$\Rightarrow \bar{x} = \frac{2940 - 395}{70}$$

$$\Rightarrow \bar{x} = 36.36$$

25. Question

The following table gives the marks scored by 50 students in a class-test:

Marks	0-100	100-200	200-300	300-400	400-500	500-600
Number of students	2	8	12	20	5	3

Find the mean marks scored by a student in the class-test.

Answer

Here, the x_i 's are large. Now, we apply the step deviation method with $a = 350$ and $h = 100$

Class	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{100}$	$f_i u_i$
0 - 100	2	50	-300	-3	-6
100 - 200	8	150	-200	-2	-16
200 - 300	12	250	-100	-1	-12
300 - 400	20	350=a	0	0	0
400 - 500	5	450	100	1	5
500 - 600	3	550	200	2	6
Total	$\Sigma f_i = 50$				$\Sigma f_i u_i = -23$

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

$$\Rightarrow \bar{x} = 350 + 100 \left(\frac{-23}{50} \right)$$

$$\Rightarrow \bar{x} = 350 - 46$$

$$\Rightarrow \bar{x} = 304$$

Hence, the mean marks scored by a student in the class-test is 304

26. Question

Find the mean of the following data:

Classes	0-10	10-20	20-30	30-40	40-50
Frequency	3	5	9	5	3

Answer

Class	Frequency (f_i)	Class Mark (x_i) $x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$	$x_i f_i$
0 - 10	3	5	15
10 - 20	5	15	75
20 - 30	9	25	225
30 - 40	5	35	175
40 - 50	3	45	135
Total	$\Sigma f_i = 25$		$\Sigma f_i x_i = 625$

$$\text{Now, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{625}{25} = 25$$

27. Question

Find the mean of the following data:

Classes	0-100	100-200	200-300	300-400	400-500
Frequency	6	9	15	12	8

Answer

Here, the x_i 's are large. Now, we apply the step deviation method with $a = 250$ and $h = 100$

Class	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{100}$	$f_i u_i$
0 - 100	6	50	-200	-2	-12
100 - 200	9	150	-100	-1	-9
200 - 300	15	250 = a	0	0	0
300 - 400	12	350	100	1	12
400 - 500	8	450	200	2	16
Total	$\Sigma f_i = 50$				$\Sigma f_i u_i = 7$

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

$$\Rightarrow \bar{x} = 250 + 100 \left(\frac{7}{50} \right)$$

$$\Rightarrow \bar{x} = 250 + 14$$

$$\Rightarrow \bar{x} = 264$$

28. Question

The following table gives the marks scored by 80 students in a class-test:

Marks	0-50	50-100	100-150	150-200	200-250	250-300
Number of students	8	12	20	25	10	5

Find the mean marks scored by a student in the class-test.

Answer

Here, the x_i 's are large. Now, we apply the step deviation method with $a = 175$ and $h = 50$

Class	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{50}$	$f_i u_i$
0 - 50	8	25	-150	-3	-24
50 - 100	12	75	-100	-2	-24
100 - 150	20	125	-50	-1	-20
150 - 200	25	175=a	0	0	0
200 - 250	10	225	50	1	10
250 - 300	5	275	100	2	10
Total	$\Sigma f_i = 50$				$\Sigma f_i u_i = -48$

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

$$\Rightarrow \bar{x} = 175 + 50 \left(\frac{-48}{80} \right)$$

$$\Rightarrow \bar{x} = 175 - 30$$

$$\Rightarrow \bar{x} = 145$$

Hence, the mean marks scored by a student in the class-test is 145

29. Question

The following table gives the distribution of expenditure of different families on education. Find the mean expenditure on education of a family:

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

Answer

Here, the x_i 's are large. Now, we apply the step deviation method with $a = 3250$ and $h = 500$

Expenditure (in Rs.)	No. of families	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{500}$	$f_i u_i$
1000-1500	24	1250	-2000	-4	-96
1500- 2000	40	1750	-1500	-3	-120
2000-2500	33	2250	-1000	-2	-66
2500-3000	28	2750	-500	-1	-28
3000-3500	30	3250=a	0	0	0
3500- 4000	22	3750	500	1	22
4000-4500	16	4250	1000	2	32
4500-5000	7	4750	1500	3	21
Total	$\Sigma f_i = 200$				$\Sigma f_i u_i = -235$

Now, $\bar{x} = a + h \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right)$

$$\Rightarrow \bar{x} = 3250 + 500 \left(\frac{-235}{200} \right)$$

$$\Rightarrow \bar{x} = 3250 - 587.5$$

$$\Rightarrow \bar{x} = 2662.5$$

Hence, the mean expenditure on education of a family is Rs 2662.5

Exercise 6.2

1. Question

Find mode of the following data:

64, 61, 62, 62, 63, 61, 63, 64, 64, 60, 65, 63, 64, 65, 66, 64

Answer

Value(x)	60	61	62	63	64	65	66
Frequency	1	2	2	3	5	2	1

Here, we can see that 64 observation has the maximum frequency.

Hence, Mode = 64

2. Question

Find the mode of the following distribution:

Marks	4	5	6	7	8	9	10
Frequency	3	8	10	12	16	12	10

Answer

Here, the marks 8 has the maximum frequency '16'.

\therefore Mode = 8

3. Question

Find the mode of the following data:

Class interval	11	12	13	14	15	16	17	18
Frequency	2	9	3	4	8	7	8	3

Answer

Here, the class interval 12 has the maximum frequency '9'.

\therefore Mode = 12

4. Question

A survey conducted on 20 households in a locality by a group of students resulted in the following frequency table for the number of family members in a household.

Family size	1-3	3-5	5-7	7-9	9-11
Number of families	7	8	2	2	1

Find the mode of this data.

Answer

Here, the maximum class frequency is 8, and the class corresponding to this frequency is 3 – 5.

So, the modal class is 3 – 5.

Now, modal class = 3 – 5, lower limit (l) of modal class = 3, class size(h) = 2

frequency (f_1) of the modal class = 8

frequency (f_0) of class preceding the modal class = 7

frequency (f_2) of class succeeding the modal class = 2

Now, let us substitute these values in the formula

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

$$= 3 + \left(\frac{8 - 7}{2 \times 8 - 7 - 2} \right) \times 2$$

$$= 3 + \frac{2}{7} \times 2$$

$$= 3.286$$

5. Question

Find the mode of the following distribution:

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Number of students	15	20	24	24	12	31	71	52

Answer

Here, the maximum number of students i.e. 71 have got marks in the interval 60 – 70.

So, the modal class is 60 – 70.

Now, modal class = 60 – 70, lower limit (l) of modal class = 60, class size(h) = 10

frequency (f_1) of the modal class = 71

frequency (f_0) of class preceding the modal class = 31

frequency (f_2) of class succeeding the modal class = 52

Now, let us substitute these values in the formula

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

$$= 60 + \left(\frac{71 - 31}{2 \times 71 - 31 - 52} \right) \times 10$$

$$= 60 + \frac{40}{59} \times 10$$

$$= 60 + 6.78$$

$$= 66.78$$

6. Question

Find the mode of the following distribution:

Age in (years)	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	8	14	25	28	25	10	5

Answer

Here, the maximum class frequency is 28, and the class corresponding to this frequency is 30 – 40.

So, the modal class is 30 – 40.

Now, modal class = 30 – 40, lower limit (l) of modal class = 30, class size(h) = 10

frequency (f_1) of the modal class = 28

frequency (f_0) of class preceding the modal class = 25

frequency (f_2) of class succeeding the modal class = 25

Now, let us substitute these values in the formula

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\&= 30 + \left(\frac{28 - 25}{2 \times 28 - 25 - 25} \right) \times 10 \\&= 30 + \frac{3}{6} \times 10 \\&= 30 + 5 \\&= 35\end{aligned}$$

7. Question

The given distribution shows the number of runs scored by some top batsman of the world in one-day international cricket matches.

Runs scored	Number of batsman
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

Here, the maximum number of batsman i.e. 18 have scored the runs in the interval 4000 – 5000.

So, the modal class is 4000 – 5000 .

Now, modal class = 4000 – 5000,

lower limit (l) of modal class = 4000,

class size(h) = 1000

frequency (f_1) of the modal class = 18

frequency (f_0) of class preceding the modal class = 4

frequency (f_2) of class succeeding the modal class = 9

Now, let us substitute these values in the formula

$$\begin{aligned}
 \text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\
 &= 4000 + \left(\frac{18 - 4}{2 \times 18 - 4 - 9} \right) \times 1000 \\
 &= 4000 + \frac{14}{36 - 13} \times 1000 \\
 &= 4000 + 608.7 \\
 &= 4608.7
 \end{aligned}$$

8. Question

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

Answer

Here, the maximum class frequency is 20, and the class corresponding to this frequency is 40 – 50.

So, the modal class is 40 – 50.

Now, modal class = 40 – 50, lower limit (l) of modal class = 40, class size(h) = 10

frequency (f_1) of the modal class = 20

frequency (f_0) of class preceding the modal class = 12

frequency (f_2) of class succeeding the modal class = 11

Now, let us substitute these values in the formula

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\&= 40 + \left(\frac{20 - 12}{2 \times 20 - 12 - 11} \right) \times 10 \\&= 40 + \frac{8}{17} \times 10 \\&= 40 + 4.7 \\&= 44.7\end{aligned}$$

9. Question

Find the mode of the following distribution:

Class interval	6-10	11-15	16-20	21-25	26-30
Frequency	20	30	50	40	10

Answer

Here, the maximum class frequency is 50, and the class corresponding to this frequency is 16 – 20.

So, the modal class is 16 – 20.

Now, modal class = 16 – 20, lower limit (l) of modal class = 16, class size(h) = 4

frequency (f_1) of the modal class = 50

frequency (f_0) of class preceding the modal class = 30

frequency (f_2) of class succeeding the modal class = 40

Now, let us substitute these values in the formula

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\ &= 16 + \left(\frac{50 - 30}{2 \times 50 - 30 - 40} \right) \times 4 \\ &= 16 + \frac{20}{30} \times 4 \\ &= 16 + 2.67 \\ &= 18.67\end{aligned}$$

10. Question

Find the mode of the following distribution:

Income (in rupees)	500- 600	400- 500	300- 400	200- 300	100- 200
Number of persons	17	20	30	18	15

Answer

Income (in rupees)	100- 200	200- 300	300- 400	400- 500	500- 600
No. of persons	15	18	30	20	17

Here, the maximum number of persons i.e. 30 have income in the interval 300 – 400.

So, the modal class is 300 – 400.

lower limit (l) of modal class = 300,

class size(h) = 100

frequency (f_1) of the modal class = 30

frequency (f_0) of class preceding the modal class = 18

frequency (f_2) of class succeeding the modal class = 20

Now, let us substitute these values in the formula

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\&= 300 + \left(\frac{30 - 18}{2 \times 30 - 20 - 18} \right) \times 100 \\&= 300 + \frac{12}{60 - 38} \times 100 \\&= 300 + 54.54 \\&= \text{Rs. } 354.54\end{aligned}$$

11. Question

Find the mode of the following data:

Marks below	10	20	30	40	50
Number of students	3	8	17	20	22

Answer

Marks Below	No. of students f_i	CF
0-10	3	3
10-20	8-3=5	8
20-30	17-8=9	17
30-40	20-17=3	20
40-50	22-20=2	22
Total	$\Sigma f_i = 22$	

Here, the maximum no. of students is 9, and the class corresponding to the frequency is 20 – 30.

So, the modal class is 20 – 30.

lower limit (l) of modal class = 20,

class size(h) = 10

frequency (f_1) of the modal class = 9

frequency (f_0) of class preceding the modal class = 5

frequency (f_2) of class succeeding the modal class = 3

Now, let us substitute these values in the formula

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

$$= 20 + \left(\frac{9 - 5}{2 \times 9 - 5 - 3} \right) \times 10$$

$$= 20 + \frac{4}{10} \times 10$$

$$= 20 + 4$$

$$= 24$$

12. Question

Find the mode of the following distribution:

Marks more than	0	10	20	30	40	50
Number of students	50	46	40	20	10	3

Answer

Marks	No. of Students	Class Interval	Frequency
More than 0	50	0-10	4
More than 10	46	10-20	6
More than 20	40	20-30	20
More than 30	20	30-40	10
More than 40	10	40-50	7
More than 50	3	50-60	3
			$\Sigma f_i = 50$

Here, the maximum no. of students is 20, and the class corresponding to this frequency is 20 – 30

So, the modal class is 20 – 30.

lower limit (l) of modal class = 20,

class size(h) = 10

frequency (f_1) of the modal class = 20

frequency (f_0) of class preceding the modal class = 6

frequency (f_2) of class succeeding the modal class = 10

Now, let us substitute these values in the formula

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

$$= 20 + \left(\frac{20 - 6}{2 \times 20 - 6 - 10} \right) \times 10$$

$$= 20 + \frac{14}{24} \times 10$$

$$= 20 + 5.83$$

$$= 25.83$$

13. Question

Find the mode of the following distribution:

Class mark	15	25	35	45	55	65
Frequency	5	10	12	25	10	4

Answer

Class Mark $x_i = \frac{\text{Upper limit} + \text{lower limit}}{2}$	Frequency	Class Interval
15	5	10-20
25	10	20-30
35	12	30-40
45	25	40-50
55	10	50-60
65	4	60-70

Here, the maximum frequency is 25, and the class corresponding to this frequency is 40 - 50

So, the modal class is 40 - 50.

lower limit (l) of modal class = 40,

class size(h) = 10

frequency (f_1) of the modal class = 25

frequency (f_0) of class preceding the modal class = 12

frequency (f_2) of class succeeding the modal class = 10

Now, let us substitute these values in the formula

$$\begin{aligned}\text{Mode} &= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h \\&= 40 + \left(\frac{25 - 12}{2 \times 25 - 12 - 10} \right) \times 10 \\&= 40 + \frac{13}{28} \times 10 \\&= 40 + 4.64\end{aligned}$$

Mode = 44.64(approx.)

14. Question

If the mode of the following distribution is Rs. 24, find the missing frequency:

Expenditure	0-10	10-20	20-30	30-40	40-50	Total
Number of families	14	?	27	?	15	100

Answer

Given: Mode = Rs. 24

Frequency (f_i) = 100

Class size = 10

Let frequency of the class 10 – 20 be f_0 . Then, the frequency of the class 30 – 40 will be equal to $100 - 14 - f_0 - 27 - 15 = 44 - f_0$.

It is given that mode = 24, therefore, modal class is 20 – 30.

Thus, lower limit of the modal class (l) = 20

frequency (f_0) of class preceding the modal class = f_0

frequency (f_2) of class succeeding the modal class = $44 - f_0$

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

$$\Rightarrow 24 = 20 + \left(\frac{27 - f_0}{2 \times 27 - f_0 - 44 + f_0} \right) \times 10$$

$$\Rightarrow 24 - 20 = \left(\frac{27 - f_0}{10} \right) \times 10$$

$$\Rightarrow 4 = 27 - f_0$$

$$\Rightarrow -23 = -f_0$$

$$\Rightarrow f_0 = 23$$

$$\therefore f_2 = 44 - 23 = 21$$

Hence, the missing frequencies are 23 and 21.

15. Question

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/UT	3	8	9	10	3	0	0	2

Answer

No. of students per teacher	No. of States/UT (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{5}$	$u_i f_i$
15 - 20	3	17.5	-20	-4	-12
20 - 25	8	22.5	-15	-3	-24
25 - 30	9	27.5	-10	-2	-18
30 - 35	10	32.5	-5	-1	-10
35 - 40	3	37.5 = a	0	0	0
40 - 45	0	42.5	5	1	0
45 - 50	0	47.5	10	2	0
50 - 55	2	52.5	15	3	6
Total	$\Sigma f_i = 35$				$\Sigma f_i x_i = -58$

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

$$\Rightarrow \bar{x} = 37.5 + 5 \left(\frac{-58}{35} \right)$$

$$\Rightarrow \bar{x} = 37.5 - 8.28$$

$$\Rightarrow \bar{x} = 29.22$$

$$\therefore \text{Mean} = 29.22$$

Here, the maximum no. of students per teacher i.e. 10, and the class corresponding to this frequency is 30 – 35

So, the modal class is 30 – 35 .

lower limit (l) of modal class = 30,

class size(h) = 5

frequency (f_1) of the modal class = 10

frequency (f_0) of class preceding the modal class = 9

frequency (f_2) of class succeeding the modal class = 3

Now, let us substitute these values in the formula

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

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

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

$$= 30 + 0.625$$

$$\text{Mode} = 30.625(\text{approx.})$$

Exercise 6.3

1. Question

Find the median of the following data:

Value of the variate	11	12	13	14	15	16	17	18	
Frequency	5	7	11	9	8	7	3	2	

Answer

Value of the variate	Frequency	Cumulative frequency
11	5	5
12	7	5 + 7=12
13	11	12 + 11=23
14	9	23 + 9=32
15	8	32 + 8=40
16	7	40 + 7=47
17	3	47 + 3=50
18	2	50 + 2=52
Total	$\Sigma f_i = 52$	

Median = size of $\frac{(\text{cumulative frequency} + 1)^{\text{th}}}{2}$ item or $\frac{(n + 1)^{\text{th}}}{2}$

$$\text{Median} = \frac{(52 + 1)^{\text{th}}}{2} \text{ item}$$

$$= \frac{53}{2} = 26.5^{\text{th}} \text{ item}$$

Now, items from 23 to 32 have value of variate 14 as shown by cumulative frequency.

\therefore Median = 14

2. Question

Find the median of the following distribution:

Daily wages (in rupees)	25	26	27	28	29	30	31	32
No. of persons	25	15	20	40	10	30	35	25

Answer

Daily Wages	No. of Persons	Cumulative Frequency
25	25	25
26	15	25 + 15=40
27	20	40 + 20=60
28	40	60 + 40=100
29	10	100 + 10=110
30	30	110 + 30=140
31	35	140 + 35=175
32	25	175 + 25=200
Total	$\Sigma f_i = 200$	

$$\text{Median} = \text{size of } \frac{(\text{cumulative frequency} + 1)^{\text{th}}}{2} \text{ item or } \frac{(n + 1)^{\text{th}}}{2}$$

$$\text{Median} = \frac{(200 + 1)^{\text{th}}}{2} \text{ observation}$$

$$= \frac{201}{2} = 100.5^{\text{th}} \text{ observation}$$

Now, persons from 100 to 110 have daily wages 29 as shown by cumulative frequency.

\therefore Median = 29

3. Question

Find the median of the following data:

Class-interval	0-5	5-10	10-15	15-20	20-25	25-30	30-35
Frequency	26	34	32	28	20	16	34

Class-interval	0-5	5-10	10-15	15-20	20-25	25-30	30-35
Frequency	26	34	32	28	20	16	34

Answer

Class Interval	Frequency	Cumulative frequency
0 - 5	26	26
5 - 10	34	26 + 34=60
10 - 15	32	60 + 32=92 (F)
15 - 20	28 (f)	92 + 28=120
20 - 25	20	120 + 20=140
25 - 30	16	140 + 16=156
30 - 35	34	156 + 34=190

We have $n = 190$

$$\text{So, } \frac{n}{2} = \frac{190}{2} = 95$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 120 then the median class is 15 – 20 such that

the lower limit (l) = 15

cumulative frequency of the class preceding 15 – 20 (cf) = 92

the frequency of the median class 15 – 20 = 28,

class size (h) = 5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 15 + \frac{95-92}{28} \times 5$$

$$= 15 + 0.53$$

$$= 15.53$$

4. Question

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
No. of students	2	3	8	6	6	3	2

Answer

Weight (in kg)	No. of Students	Cumulative frequency
40 – 45	2	2
45 – 50	3	2 + 3=5
50 – 55	8	5 + 8=13(F)
55 – 60	6 (f)	13 + 6=19
60 – 65	6	19 + 6=25
65 – 70	3	25 + 3=28
70 – 75	2	28 + 2=30

We have n = 30

$$\text{So, } \frac{n}{2} = \frac{30}{2} = 15$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 19 then the median class is 55 – 60 such that

the lower limit (l) = 55

cumulative frequency of the class preceding 55 – 60 (cf) = 13

frequency of the median class 55 – 60 = 6,

class size (h) = 5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 55 + \frac{15-13}{6} \times 5$$

$$= 55 + 1.66$$

$$= 56.66$$

So, the median weight of the students is 56.66kg

5. Question

Find the median of the following distribution:

Class interval	9.3-9.7	9.8-10.2	10.3-10.7	10.8-11.2	11.3-11.7
Frequency	2	5	12	17	14

Answer

Class Interval	Class interval	Frequency	Cumulative frequency
9.3 – 9.7	9.25 – 9.75	2	2
9.8 – 10.2	9.75 – 10.25	5	2 + 5 = 7
10.3 – 10.7	10.25 – 10.75	12	7 + 12 = 19(F)
10.8 – 11.2	10.75 – 11.25	17(f)	19 + 17 = 36
11.3 – 11.7	11.25 – 11.75	14	36 + 14 = 50

We have $n = 50$

$$\text{So, } \frac{n}{2} = \frac{50}{2} = 25$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 36 then the median class is 10.75 – 11.25 such that

the lower limit (l) = 10.75

cumulative frequency of the class preceding 10.75 – 11.25 (cf) = 19

frequency of the median class 10.75 – 11.25 = 17,

class size (h) = 0.5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 10.75 + \frac{25-19}{17} \times 0.5$$

$$= 10.75 + 0.176$$

$$= 10.93$$

6. Question

Find the median from the following table:

Marks below	10	20	30	40	50	60	70	80
Number of students	5	11	22	37	56	68	75	80

Answer

Marks Below	No. of Students	Class Interval	Frequency	Cumulative Frequency
10	5	0 – 10	5	5
20	11	10 – 20	6	5 + 6=11
30	22	20 – 30	11	11 + 11=22
40	37	30 – 40	15	22 + 15=37(F)
50	56	40 – 50	19(f)	37 + 19=56
60	68	50 – 60	12	56 + 12=68
70	75	60 – 70	7	68 + 7=75
80	80	70 – 80	5	75 + 5=80

We have $n = 80$

$$\text{So, } \frac{n}{2} = \frac{80}{2} = 40$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 56 then the median class is 40 – 50 such that

the lower limit (l) = 40

cumulative frequency of the class preceding 40 – 50 (cf) = 37

the frequency of the median class 40 – 50 = 19,

class size (h) = 10

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 40 + \frac{40-37}{19} \times 10$$

$$= 40 + 1.58$$

$$= 41.58$$

7. Question

A life insurance agent found the following data for the distribution of ages of 100 policy holders. Calculate the median age, if policies are only given to persons having age 18 years onwards but less than 60 years.

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

Age (in yrs.)	No. of policy holders	Class Interval	Frequency	Cumulative Frequency
Below 20	2	18 – 20	2	2
Below 25	6	20 – 25	4	2 + 4=6
Below 30	24	25 – 30	18	6 + 18=24
Below 35	45	30 – 35	21	24 + 21=45(F)
Below 40	78	35 – 40	33(f)	45 + 33=78
Below 45	89	40 – 45	11	78 + 11=89
Below 50	92	45 – 50	3	89 + 3=92
Below 55	98	50 – 55	6	92 + 6=98
Below 60	100	55 – 60	2	98 + 2=100

We have $n = 100$

$$\text{So, } \frac{n}{2} = \frac{100}{2} = 50$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 78 then the median class is 35 – 40 such that

the lower limit (l) = 35

cumulative frequency of the class preceding 35 – 40 (cf) = 45

frequency of the median class 35 – 40 = 33,

class size (h) = 5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 35 + \frac{50 - 45}{33} \times 5$$

$$= 35 + 0.757$$

$$= 35.76$$

So, the median age of the policy holders is 35.76 years

8. Question

A survey regarding the heights (in cm) of 51 girls of Class X of a school was conducted, and the following data was obtained:

Height (in cm)	Number of girls
Less than 140	4
Less than 145	11
Less than 150	29
Less than 155	40
Less than 160	46
Less than 165	51

Find the median height.

Answer

Height (in cm)	No. of girls	Class Interval	Frequency	Cumulative Frequency
Less than 140	4	Below 140	4	4
Less than 145	11	140 – 145	7	4 + 7=11(F)
Less than 150	29	145 – 150	18(f)	11 + 18=29
Less than 155	40	150 – 155	11	29 + 11=40
Less than 160	46	155 – 160	6	40 + 6=46
Less than 165	51	160 – 165	5	46 + 5=51

We have $n = 51$

$$\text{So, } \frac{n}{2} = \frac{51}{2} = 25.5$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 29 then the median class is 145-150 such that

the lower limit (l) = 145

cumulative frequency of the class preceding 145-150 (cf) = 11

frequency of the median class 145-150 = 18,

class size (h) = 5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 145 + \frac{25.5 - 11}{18} \times 5$$

$$= 145 + 4.027$$

$$= 149.03$$

So, the median height of the girls is 149.03cm

9. Question

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

Answer

Life time (in hours)	Number of lamps	Cumulative Frequency
1500 — 2000	14	14
2000 — 2500	56	14 + 56=70
2500 — 3000	60	70 + 60=130(F)
3000 — 3500	86(f)	130 + 86=216
3500 — 4000	74	216 + 74=290
4000 — 4500	62	290 + 62=352
4500 — 5000	48	352 + 48=400

We have $n = 400$

$$\text{So, } \frac{n}{2} = \frac{400}{2} = 200$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 216 then the median class is 3000-3500 such that

the lower limit (l) = 3000

cumulative frequency of the class preceding 3000-3500 (cf) = 130

frequency of the median class 3000-3500 = 86,

class size (h) = 500

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 3000 + \frac{200-130}{86} \times 500$$

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

$$= 3000 + 406.98$$

$$= 3406.98$$

So, median life time of lamps is 3406.98 hours

10. Question

Find the median life time of a lamp. 10. The frequency distribution of the number of letters in the English alphabets in the names of 100 students is as given below:

No. of letters	1-5	6-10	11-15	16-20	21-25	26-30	31-35
No. of names	7	10	13	32	14	18	6

Determine the median numbers of letters in the names.

Answer

No. of Letters	Class Interval (inclusive)	No. of Names	Cumulative frequency
1 – 5	0.5 – 5.5	7	7
6 – 10	5.5 – 10.5	10	7 + 10 = 17
11 – 15	10.5 – 15.5	13	17 + 13 = 30 (F)
16 – 20	15.5 – 20.5	32 (f)	30 + 32 = 62
21 – 25	20.5 – 25.5	14	62 + 14 = 76
26 – 30	25.5 – 30.5	18	76 + 18 = 94
31 – 35	30.5 – 35.5	6	94 + 6 = 100

We have $n = 100$

$$\text{So, } \frac{n}{2} = \frac{100}{2} = 50$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 62 then the median class is 15.5 – 20.5 such that

the lower limit (l) = 15.5

cumulative frequency of the class preceding 15.5-20.5 (cf) = 30

frequency of the median class 15.5 – 20.5 = 32,

class size (h) = 5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 15.5 + \frac{50-30}{32} \times 5$$

$$= 15.5 + \frac{20}{32} \times 5$$

$$= 15.5 + 3.125$$

$$= 18.625 = 18.63$$

So, the median numbers of letters in the names is 18.63

11. Question

The length of 40 leaves of a plant are measured correct to the nearest milli-metre 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.

Answer

Length (in mm)	Class Interval (inclusive)	Number of leaves	Cumulative Frequency
118 –126	117.5 – 126.5	3	3
127 –135	126.5 – 135.5	5	3 + 5=8
136 –144	135.5 – 144.5	9	8 + 9=17(F)
145 –153	144.5 – 153.5	12(f)	17 + 12=29
154 –162	153.5 – 162.5	5	29 + 5=34
163 –171	162.5 – 171.5	4	34 + 4=38
172 –180	171.5 – 180.5	2	38 + 2=40

We have $n = 40$

$$\text{So, } \frac{n}{2} = \frac{40}{2} = 20$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 29 then the median class is 144.5 – 153.5 such that

the lower limit (l) = 144.5

cumulative frequency of the class preceding 144.5 – 153.5 (cf) = 17

frequency of the median class 144.5 – 153.5 = 12,

class size (h) = 9

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 144.5 + \frac{20-17}{12} \times 9$$

$$= 144.5 + \frac{3}{12} \times 9$$

$$= 144.5 + 2.25$$

$$= 146.75$$

So, the median length of the leaves is 146.75mm

12. Question

Find the median of the following data:

Class marks	35	45	55	65	75	85
Frequency	20	26	7	12	15	10

Answer

Class Marks	Frequency	Class Interval	Cumulative Frequency
35	20	30 – 40	20(F)
45	26(f)	40 – 50	20 + 26=46
55	7	50 – 60	46 + 7=53
65	12	60 – 70	53 + 12=65
75	15	70-80	65 + 15=80
85	10	80 – 90	80 + 10=90

Here, the class mark is given.

$$\therefore \text{Class size} = 45 - 35 = 10$$

If a is a class mark and h is the size of the class interval, then the lower limit and upper limit of the class interval are $a - \frac{h}{2}$ and $a + \frac{h}{2}$ respectively.

$$\therefore, \text{we have } h = 10$$

$$\therefore \text{Lower Limit of first class interval} = 35 - \frac{10}{2} = 35 - 5 = 30$$

$$\text{The upper limit of first class interval} = 35 + \frac{10}{2} = 35 + 5 = 40$$

$$\therefore \text{The first class interval is } 30 - 40$$

Hence, the class intervals are 30 – 40, 40 – 50, 50 – 60, 60 – 70, 70 – 80, 80 – 90.

Now, We find the median

$$\text{We have } n = 90$$

$$\text{So, } \frac{n}{2} = \frac{90}{2} = 45$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 46 then the median class is 40 – 50 such that

$$\text{the lower limit (l)} = 40$$

$$\text{cumulative frequency of the class preceding 40 – 50 (cf)} = 20$$

frequency of the median class $40 - 50 = 26$,

class size $(h) = 10$

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 40 + \frac{45-20}{26} \times 10$$

$$= 40 + \frac{25}{26} \times 10$$

$$= 40 + 9.61$$

$$= 49.61$$

13. Question

Find the median from the following table:

Class mark	0-5	5-6	6-9	9-12	12-14	14-18	18-20	20-24
Frequency	3	2	7	5	16	12	15	20

Answer

Here, we can see that the intervals are unequal.

Class mark	<div>0-5 5</div>	<div>5-6 1</div>	<div>6-9 3</div>	<div>9-12 3</div>	<div>12-14 2</div>	<div>14-18 4</div>	<div>18-20 2</div>	<div>20-24 4</div>
Frequency	3	2	7	5	16	12	15	20

Firstly, we convert the unequal class intervals into equal class intervals.

Class Interval	Frequency	Cumulative Frequency
Combining both the interval (0 – 5) & (5 – 6) 0 – 6	Combining frequencies of both the interval $3 + 2 = \mathbf{5}$	5
Combining both the interval (6 – 9) & (9 – 12) 6 – 12	$7 + 5 = \mathbf{12}$	$5 + 12 = 17$
Combining both the interval (12 – 14) & (14 – 18) 12 – 18	$16 + 12 = \mathbf{28}$	$17 + 28 = 45$
Combining both the interval (18 – 20) & (20 – 24) 18 – 24	$15 + 20 = \mathbf{35}$	$45 + 35 = 80$

We have $n = 80$

$$\text{So, } \frac{n}{2} = \frac{80}{2} = 40$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 45 then the median class is 12-18 such that

the lower limit (l) = 12

cumulative frequency of the class preceding 12 – 18 (cf) = 17

frequency of the median class 12 – 18 = 28,

class size (h) = 6

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 12 + \frac{40 - 17}{28} \times 6$$

$$= 12 + 4.928$$

$$= 14.93$$

14. Question

Find the missing frequency of the following incomplete frequency distribution if the median is 46 and find the mean of the complete distribution.

Class-interval	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Total
Total Frequency	12	30	x	65	y	25	18	229

Answer

Class Interval	Frequency	Cumulative Frequency
10 – 20	12	12
20 – 30	30	12 + 30=42
30 – 40	x	42 + x (F)
40 – 50	65(f)	42 + x + 65=107 + x
50 – 60	y	107 + x + y
60 – 70	25	107 + x + y + 25=132 + x + y
70 – 80	18	132 + x + y + 18=150 + x + y
Total	150 + x + y	

Given Median =46

Then, median Class = 40 – 50

the lower limit (l) = 40

cumulative frequency of the class preceding 40 – 50 (cf) = 42 + x

frequency of the median class 40 – 50 = 65,

class size (h) = 10

Total frequencies (n) = 229

So, $150 + x + y = 229$

$\Rightarrow x + y = 229 - 150$

$\Rightarrow x + y = 79 \dots(i)$

and $\frac{n}{2} = \frac{229}{2} = 114.5$

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$46 = 40 + \frac{114.5 - (42 + x)}{65} \times 10$$

$$\Rightarrow 46 - 40 = \frac{114.5 - 42 - x}{65} \times 10$$

$$\Rightarrow \frac{6 \times 65}{10} = 72.5 - x$$

$$\Rightarrow 39 = 72.5 - x$$

$$\Rightarrow x = 33.5$$

Putting the value of x in eq. (i), we get

$$\Rightarrow 33.5 + y = 79$$

$$\Rightarrow y = 79 - 33.5$$

$$\Rightarrow y = 45.5$$

15. Question

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

Class-interval	Frequency	Cumulative Frequency
0 —10	5	5
10 —20	X	5 + x (F)
20 —30	20(f)	5 + x + 20=25 + x
30 — 40	15	25 + x + 15=40 + x
40 —50	Y	40 + x + y
50 — 60	5	40 + x + y + 5=45 + x + y
Total	45 + x + y	

Given Median =28.5

Then, median Class = 20 – 30

the lower limit (l) = 20

cumulative frequency of the class preceding 20 – 30 (cf) = 5 + x

frequency of the median class 20 – 30 = 20,

class size (h) = 10

Total frequencies (n) = 60

So, $45 + x + y = 60$

$\Rightarrow x + y = 60 - 45$

$\Rightarrow x + y = 15 \dots(i)$

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

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

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

$$\Rightarrow 28.5 - 20 = \frac{30 - 5 - x}{2}$$

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

$$\Rightarrow 17 = 25 - x$$

$$\Rightarrow x = 8$$

Putting the value of x in eq. (i), we get

$$\Rightarrow 8 + y = 15$$

$$\Rightarrow y = 15 - 8$$

$$\Rightarrow y = 7$$

16. Question

The median of the following data is 525. Find the values of x and y, if the total frequency is 100:

Class-interval	Frequency
0 —100	2
100 — 200	5
200 —300	X
300 — 400	12
400 — 500	17
500 — 600	20
600 — 700	Y
700 —800	9
800 — 900	7
900 —1000	4

Answer

Class-interval	Frequency	Cumulative Frequency
0 —100	2	2
100 — 200	5	$2 + 5 = 7$
200 —300	x	$7 + x$
300 — 400	12	$7 + x + 12 = 19 + x$
400 — 500	17	$19 + x + 17 = 36 + x$ (F)
500 — 600	20(f)	$36 + x + 20 = 56 + x$
600 — 700	y	$56 + x + y$
700 —800	9	$56 + x + y + 9 = 65 + x + y$
800 — 900	7	$65 + x + y + 7 = 72 + x + y$
900 —1000	4	$72 + x + y + 4 = 76 + x + y$

Given Median =525

Then, median Class = 500-600

the lower limit (l) = 500

cumulative frequency of the class preceding 500-600(cf) = $36 + x$

frequency of the median class 500-600 = 20,

class size (h) = 100

Total frequencies (n) = 100

So, $76 + x + y = 100$

$\Rightarrow x + y = 100 - 76$

$\Rightarrow x + y = 24 \dots(i)$

and $\frac{n}{2} = \frac{100}{2} = 50$

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$525 = 500 + \frac{50 - (36 + x)}{20} \times 100$$

$$\Rightarrow 525 - 500 = \frac{14 - x}{20} \times 100$$

$$\Rightarrow 25 = (14 - x) \times 5$$

$$\Rightarrow 5 = 14 - x$$

$$\Rightarrow x = 9$$

Putting the value of x in eq. (i), we get

$$\Rightarrow 9 + y = 24$$

$$\Rightarrow y = 24 - 9$$

$$\Rightarrow y = 15$$

17. Question

Find the mean and median of the following data:

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of students	15	20	24	24	12	31	71	52

Answer

Class	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{10}$	$u_i f_i$
0 – 10	15	5	-40	-4	-60
10 – 20	20	15	-30	-3	-60
20 – 30	24	25	-20	-2	-48
30 – 40	25	35	-10	-1	-25
40 – 50	12	45=a	0	0	0
50 – 60	31	55	10	1	31
60 – 70	71	65	20	2	142
70 – 80	52	75	30	3	156
Total	$\Sigma f_i = 250$				$\Sigma f_i x_i = 136$

Now, Mean $\bar{x} = a + h \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right)$

$$\Rightarrow \bar{x} = 45 + 10 \left(\frac{136}{250} \right)$$

$$\Rightarrow \bar{x} = 45 + 5.44$$

$$\Rightarrow \bar{x} = 50.44$$

Class	Frequency (f_i)	Cumulative Frequency
0 – 10	15	15
10 – 20	20	15 + 20=35
20 – 30	24	35 + 24=59
30 – 40	25	59 + 25=84
40 – 50	12	84 + 12=96(F)
50 – 60	31 (f)	96 + 31=127
60 – 70	71	127 + 71=198
70 – 80	52	198 + 52=250
Total	$\Sigma f_i = 250$	

We have $n = 250$

$$\text{So, } \frac{n}{2} = \frac{250}{2} = 125$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 127 then the median class is 50-60 such that

the lower limit (l) = 50

cumulative frequency of the class preceding 50 – 60 (cf) = 96

frequency of the median class 50 – 60 = 31,

class size (h) = 10

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 50 + \frac{125-96}{31} \times 10$$

$$= 50 + 9.35$$

$$= 59.35$$

18. Question

Find the mean, median and mode from the following table:

Class interval	0-7	7-14	14-21	21-28	28-35	35-42	42-49
Frequency	19	25	36	72	51	43	28

Answer

Class Interval	Frequency (f_i)	Class Mark (x_i)	$d_i = x_i - a$	$u_i = \frac{d_i}{7}$	$u_i f_i$
0 - 7	19	3.5	-21	-3	-57
7 - 14	25	10.5	-14	-2	-50
14 - 21	36	17.5	-7	-1	-36
21 - 28	72	24.5=a	0	0	0
28 - 35	51	31.5	7	1	51
35 - 42	43	38.5	14	2	86
42 - 49	28	45.5	21	3	84
Total	$\Sigma f_i = 274$				$\Sigma f_i u_i = 78$

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

$$\Rightarrow \bar{x} = 24.5 + 7 \left(\frac{78}{274} \right)$$

$$\Rightarrow \bar{x} = 24.5 + 1.99$$

$$\Rightarrow \bar{x} = 26.5$$

Now, we calculate the median

Class Interval	Frequency (f _i)	Cumulative Frequency
0 – 7	19	19
7 – 14	25	19 + 25=44
14 – 21	36	44 + 36=80 (F)
21 – 28	72 (f)	80 + 72=152
28 – 35	51	152 + 51=203
35 – 42	43	203 + 43=246
42 – 49	28	246 + 28=274
Total	$\Sigma f_i = 274$	

We have $n = 274$

$$\text{So, } \frac{n}{2} = \frac{274}{2} = 137$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 152 then the median class is 21 – 28 such that

the lower limit (l) = 21

cumulative frequency of the class preceding 21 – 28 (cf) = 80

frequency of the median class 21-28 = 72,

class size (h) = 7

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 21 + \frac{137-80}{72} \times 7$$

$$= 21 + 5.57$$

$$= 26.57$$

Now, we have to find the mode

Here, the maximum class frequency is 72, and the class corresponding to this frequency is 21 – 28.

So, the modal class is 21 – 28.

Now, modal class = 21 – 28, lower limit (l) of modal class = 21, class size(h) = 7

frequency (f₁) of the modal class = 72

frequency (f₀) of class preceding the modal class = 36

frequency (f₂) of class succeeding the modal class = 51

Now, let us substitute these values in the formula

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

$$= 21 + \left(\frac{72 - 36}{2 \times 72 - 36 - 51} \right) \times 7$$

$$= 21 + \frac{36}{57} \times 7$$

$$= 21 + 4.42$$

$$= 25.42$$

19. Question

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 surname 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 letter in the surnames? Also, find the modal size of the surnames.

Answer

Class Interval	Frequency (f _i)	Cumulative Frequency
1 – 4	6	6
4 – 7	30	6 + 30=36 (F)
7 – 10	40 (f)	36 + 40=76
10 – 13	16	76 + 16=92
13 – 16	4	92 + 4=96
16 – 19	4	96 + 4=100
Total	Σf _i =100	

We have n = 100

$$\text{So, } \frac{n}{2} = \frac{100}{2} = 50$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 36 then the median class is 7 – 10 such that

the lower limit (l) = 7

cumulative frequency of the class preceding 7 – 10 (cf) = 36

frequency of the median class 7 – 10 = 40,

class size (h) = 3

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 7 + \frac{50-36}{40} \times 3$$

$$= 7 + 1.05$$

$$= 8.05$$

Now, we calculate the Mean

Class Interval	Frequency (f _i)	Class Mark (x _i)	d _i = x _i - a	u _i = $\frac{d_i}{3}$	u _i f _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 = a	0	0	0
13 – 16	4	14.5	3	1	4
16 – 19	4	17.5	6	2	8
Total	Σf _i = 100				Σf _i u _i = -106

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

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

$$\Rightarrow \bar{x} = 11.5 - 3.18$$

$$\Rightarrow \bar{x} = 8.32$$

Now, we have to find the mode

Here, the maximum class frequency is 40, and the class corresponding to this frequency is 7 – 10.

So, the modal class is 7 – 10.

Now, modal class = 7 – 10, lower limit (l) of modal class = 7, class size(h) = 3

frequency (f_1) of the modal class = 40

frequency (f_0) of class preceding the modal class = 30

frequency (f_2) of class succeeding the modal class = 16

Now, let us substitute these values in the formula

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

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

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

$$= 7 + 0.88$$

$$= 7.88$$

Exercise 6.4

1. Question

The following distribution gives the daily income of 50 workers of a factory:

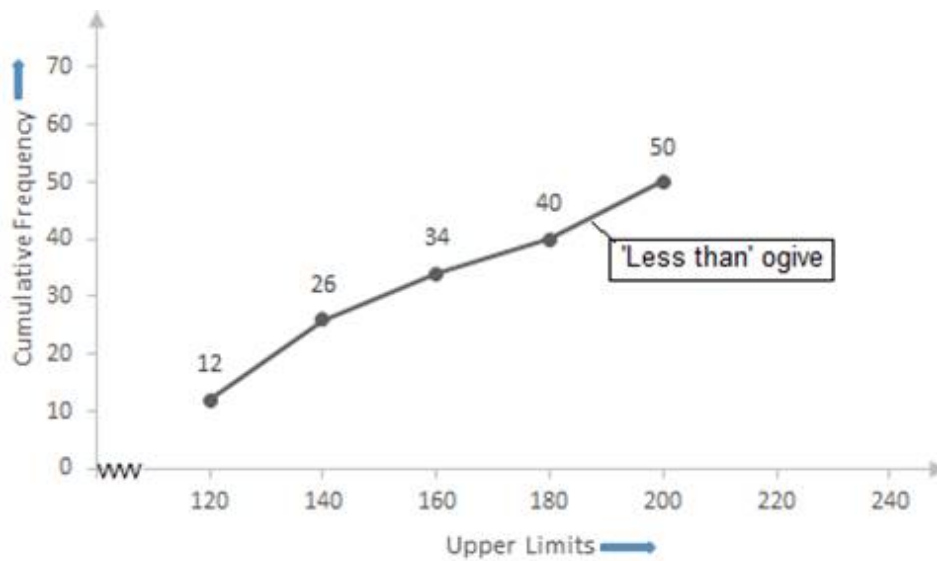
Daily income (in Rs.)	100-120	120-140	140-160	160-180	180-200
Number of workers	12	14	8	6	10

Convert the distribution above to a less than type cumulative frequency distribution, and draw its ogive.

Answer

Daily Income (in Rs.)	No. of workers	Cumulative Frequency
Less than 120	12	12
Less than 140	14	12+14=26
Less than 160	8	26+8=34
Less than 180	6	34+6=40
Less than 200	10	40+10=50
Total	$\Sigma f_i = 50$	

Now, taking upper class limits on x- axis and their respective frequencies on y-axis we can draw its ogive as follows:



2. Question

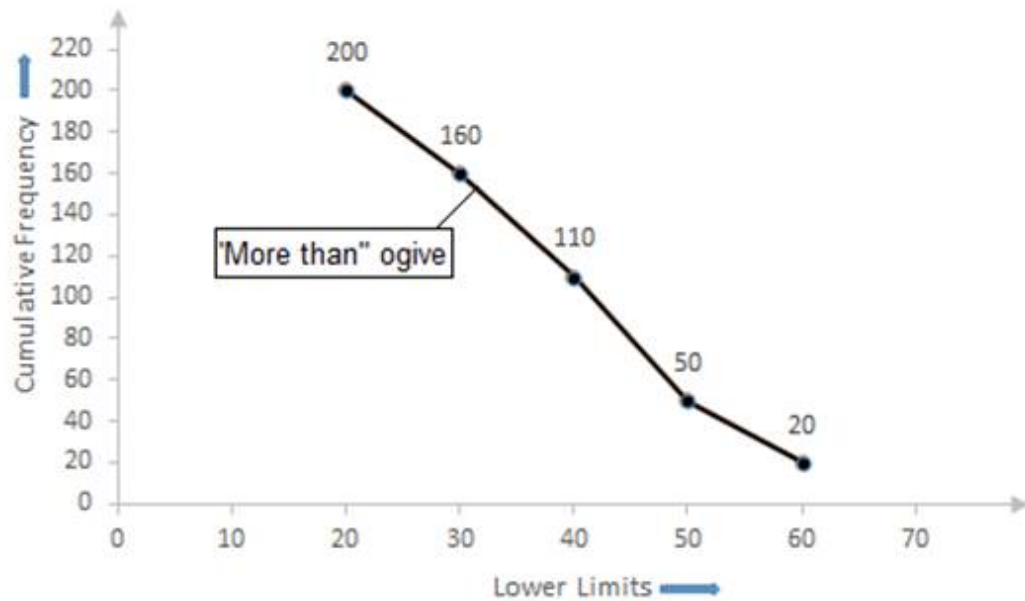
Draw 'more than' ogive of the following distribution:

Wages (in Rs.)	20- 30	30- 40	40- 50	50- 60	60- 70
Number of workers	40	50	60	30	20

Answer

Wages (in Rs.)	No. of workers	Cumulative Frequency
More than 20	20	200
More than 30	30	160
More than 40	60	110
More than 50	50	50
More than 60	40	20

Now, taking lower class limits on x- axis and their respective frequencies on y-axis we can draw its ogive as follows:



3. Question

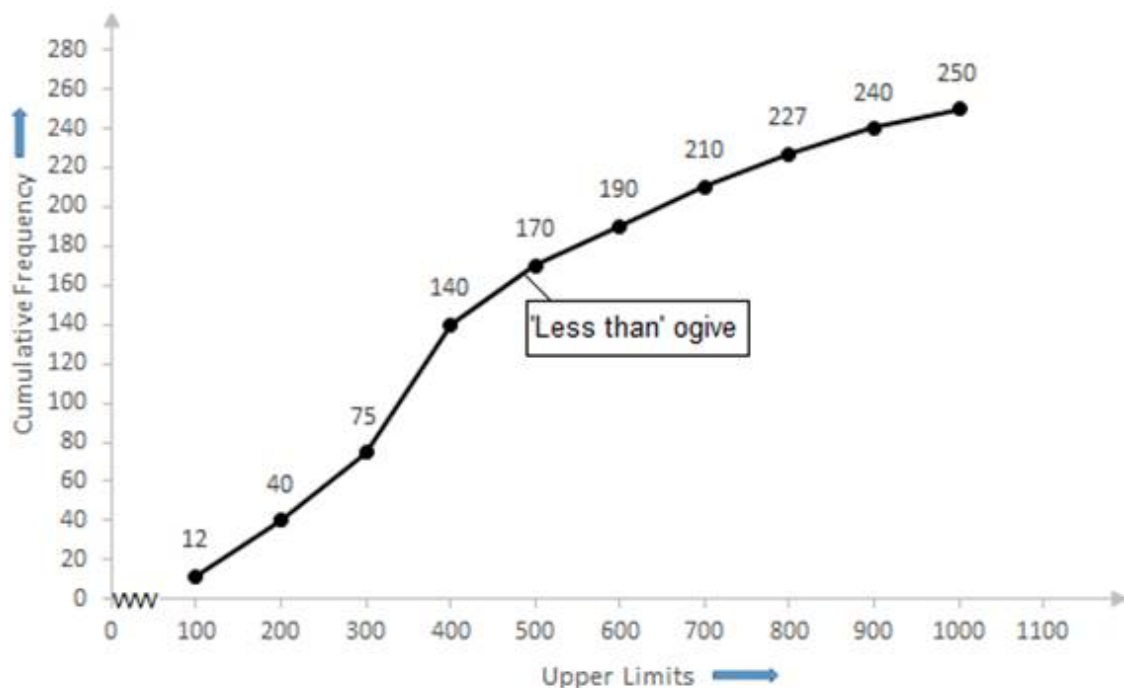
Draw a less than type cumulative frequency curve for the following data and from the graph find the median:

Monthly Income	Number of workers
0 — 100	12
100 — 200	28
200 — 300	35
300 — 400	65
400 — 500	30
500 — 600	20
600 — 700	20
700 — 800	17
800 — 900	13
900 — 1000	10

Answer

Monthly Income	Number of workers	Monthly Income	Cumulative Frequency
0 — 100	12	Less than 100	12
100 — 200	28	Less than 200	12+28=40
200 — 300	35	Less than 300	40+35=75(F)
300 — 400	65 (f)	Less than 400	75+65=140
400 — 500	30	Less than 500	140+30=170
500 — 600	20	Less than 600	170+20=190
600 — 700	20	Less than 700	190+20=210
700 — 800	17	Less than 800	210+17=227
800 — 900	13	Less than 900	227+13=240
900 — 1000	10	Less than 1000	240+10=250

Now, taking upper class limits on x- axis and their respective frequencies on y-axis we can draw its ogive as follows:



Now, we have $n = 250$

$$\Rightarrow \frac{n}{2} = \frac{250}{2} = 125$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 140 then the median class is 300-400 such that

the lower limit (l) = 300

cumulative frequency of the class preceding 300-400 (cf) = 75

frequency of the median class 300-400 = 65,

class size (h) = 100

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 300 + \frac{125 - 75}{65} \times 100$$

$$= 300 + 76.9$$

$$= 376.9$$

$$= 377 \text{ (approx.)}$$

4. Question

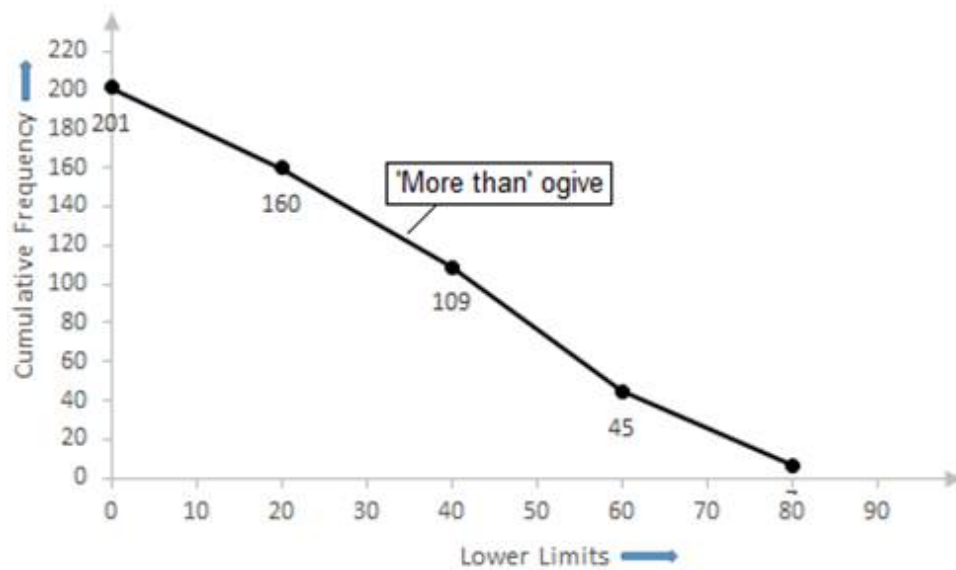
Convert the following distribution into 'more than' frequency distribution and draw more than' ogive. Also find the median from it.

Weekly wages less than (in Rs.)	Number of workers
20	41
40	92
60	156
80	194
100	201

Answer

Weekly wages (in Rs.)	No. of workers (Cumulative Frequency)	Frequency	Weekly Wages (in Rs.)	Cumulative frequency
0 – 20	41	41	More than 0	201
20 – 40	92 (F)	51	More than 20	160
40 – 60	156	64(f)	More than 40	109
60 – 80	194	38	More than 60	45
80 - 100	201	7	More than 80	7

Now, taking lower class limits on x-axis and their respective frequencies on y-axis we can draw its ogive as follows:



Now, we have $n = 201$

$$\Rightarrow \frac{n}{2} = \frac{201}{2} = 100.5$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 109 then the median class is 40 – 60 such that

the lower limit (l) = 40

cumulative frequency of the class preceding 40 - 60 (cf) = 92

frequency of the median class 40-60 = 64,

class size (h) = 20

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 40 + \frac{100.5 - 92}{64} \times 20$$

$$= 40 + 2.65$$

$$= 42.65$$

$$= 42.7$$

5. Question

The annual profits earned by 30 shops of a shopping complex in a locality give the following distribution:

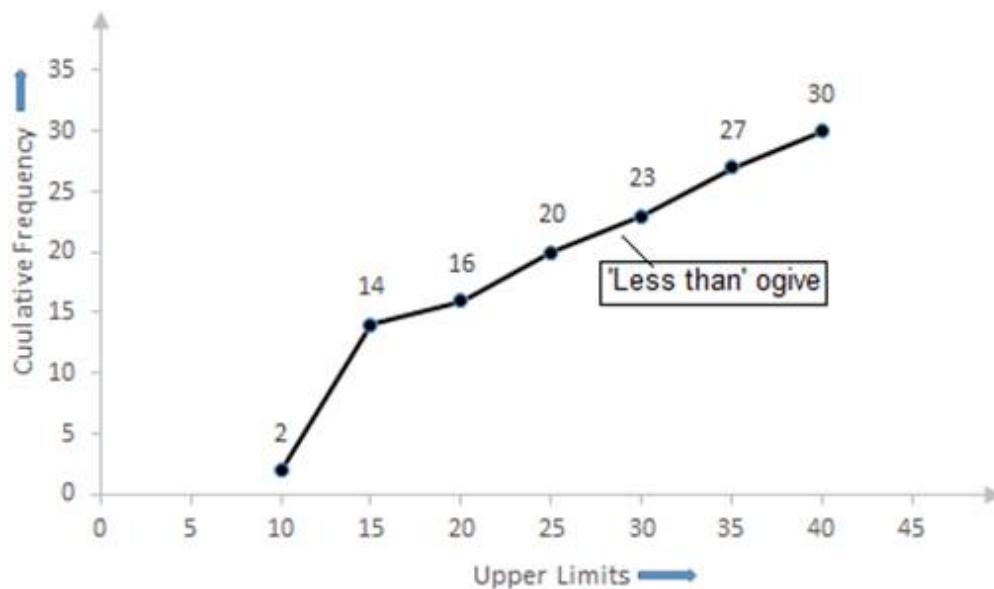
Profit (in lakhs of Rs.)	Number of shops (frequency)
More than or equal to 5	30
More than or equal to 10	28
More than or equal to 15	16
More than or equal to 20	14
More than or equal to 25	10
More than or equal to 30	7
More than or equal to 35	3

Draw both ogives for the data given above and hence obtain the median profit.

Answer

Class	Frequency	Profit	Cumulative Frequency
5 – 10	2	Less than 10	2
10 – 15	12	Less than 15	$2+12=14(F)$
15 – 20	2(f)	Less than 20	$14+2=16$
20 – 25	4	Less than 25	$16+4=20$
25 – 30	3	Less than 30	$20+3=23$
30 – 35	4	Less than 35	$23+4=27$
35 – 40	3	Less than 40	$27+3=30$

Now, taking upper-class limits on x-axis and their respective frequencies on y-axis we can draw its ogive as follows:



Now, we have $n = 30$

$$\Rightarrow \frac{n}{2} = \frac{30}{2} = 15$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 16 then the median class is 15 – 20 such that

the lower limit (l) = 15

cumulative frequency of the class preceding 15 – 20 (cf) = 14

the frequency of the median class 15 – 20 = 2,

class size (h) = 5

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 15 + \frac{15 - 14}{2} \times 5$$

$$= 15 + 2.5$$

$$= 17.5$$

So, the median profit is Rs. 17.5

6. Question

The following table gives the distribution of the monthly income of 600 families in a certain city:

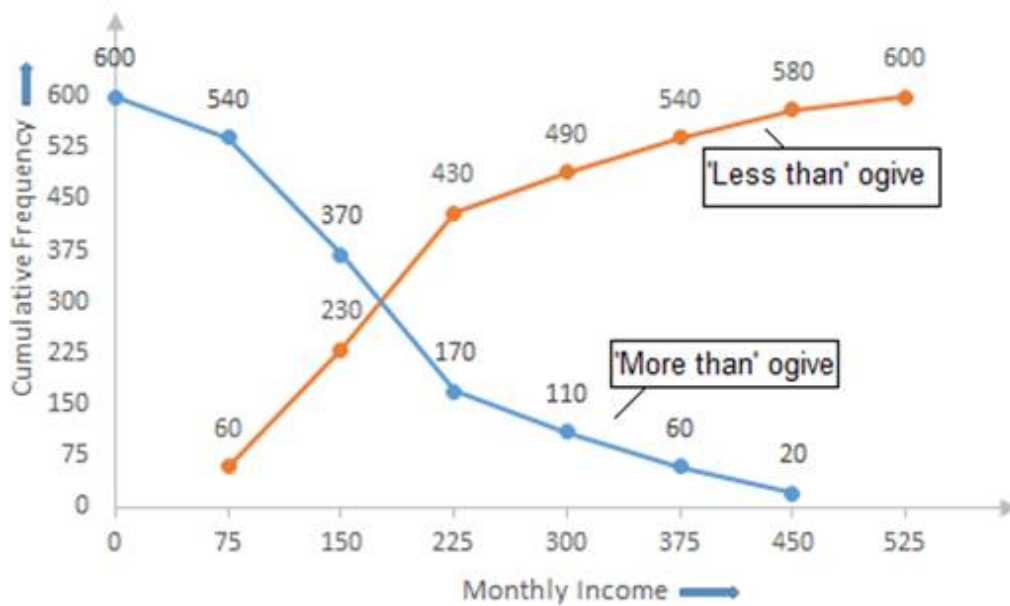
Monthly income	No. of families
Below 75	60
75 —150	170
150 —225	200
225 —300	60
300 — 375	50
375 — 450	40
450 and above	20

Draw a 'less than' and 'more than' ogive curve for the above data on the same graph and from these find the median.

Answer

Monthly income	No. of families	Monthly income Less than	Cumulative Frequency (CF)	Monthly income More than	(CF)
Below 75	60	75	60	0	600
75 -150	170	150	$60+170=230$	75	540
150 -225	200	225	$230+200=430$	150	370
225 -300	60	300	$430+60=490$	225	170
300 - 375	50	375	$490+50=540$	300	110
375 - 450	40	450	$540+40=580$	375	60
450 & above	20	525	$580+20=600$	450	20

Now, taking monthly income on x-axis and their respective frequencies on y-axis we can draw its ogive as follows:



Now, we have $n = 600$

$$\Rightarrow \frac{n}{2} = \frac{600}{2} = 300$$

The cumulative Frequency just greater than $\frac{n}{2}$ is 430 then the median class is 150 – 225 such that

the lower limit (l) = 150

cumulative frequency of the class preceding 150 – 225 (cf) = 230

frequency of the median class 150 – 225 = 200,

class size (h) = 75

Using the formula, $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$, we have

$$\text{Median} = 150 + \frac{300 - 230}{200} \times 75$$

$$= 150 + \frac{70}{200} \times 75$$

$$= 150 + 26.25$$

$$= 176.25$$

$$= 176(\text{approx.})$$