Exercise 7.1 Page No: 7.5

1. Calculate the mean for the following distribution:

x:	5	6	7	8	9
f:	4	8	14	11	3

Solution:

x	f	fx
5	4	20
6	8	48
7	14	98
8	11	88
9	3	27
	N = 40	Σ fx = 281

Mean = **Σ** fx/ N = 281/40
∴ Mean = 7.025

2. Find the mean of the following data:

x:	19	21	23	25	27	29	31
f:	13	15	16	18	16	15	13

Solution:

x	f	fx
19	13	247
21	15	315
23	16	368
25	18	450
27	16	432
29	15	435
31	13	403
	N = 106	Σ fx = 2620

Mean = **Σ** fx/ N = 2620/106
∴ Mean = 25

3. If the mean of the following data is 20.6. Find the value of p.

x:	10	15	p	25	35
f:	3	10	25	7	5

Solution:

x	f	fx

10	3	30
15	10	150
p	25	25p
25	7	175
35	5	175
	N = 50	Σ fx = 530 + 25p

We know that,

Mean = Σ fx/ N = (2620 + 25p)/ 50

Given,

Mean = 20.6

⇒ 20.6 = (530 + 25p)/ 50

(20.6 x 50) – 530 = 25p

p = 500/ 25

∴ p = 20

4. If the mean of the following data is 15, find p.

x:	**5**	**10**	**15**	**20**	**25**
f:	**6**	**p**	**6**	**10**	**5**

Solution:

x	f	fx
5	6	30
10	p	10p
15	6	90
20	10	200
25	5	125
	N = p + 27	Σ fx = 445 + 10p

We know that,

Mean = Σ fx/ N = (445 + 10p)/ (p + 27)

Given,

Mean = 15

⇒ 15 = (445 + 10p)/ (p + 27)

15p + 405 = 445 + 10p

5p = 40

∴ p = 8

5. Find the value of p for the following distribution whose mean is 16.6

x:	**8**	**12**	**15**	**p**	**20**	**25**	**30**
f:	**12**	**16**	**20**	**24**	**16**	**8**	**4**

Solution:

x	f	fx
8	12	96
12	16	192
15	20	300
P	24	24p
20	16	320
25	8	200
30	4	120
	N = 100	Σ fx = 1228 + 24p

We know that,

Mean = Σ fx/ N = (1228 + 24p)/ 100

Given,

Mean = 16.6

⇒ 16.6 = (1228 + 24p)/ 100

1660 = 1228 + 24p

24p = 432

∴ p = 18

6. Find the missing value of p for the following distribution whose mean is 12.58

x:	5	8	10	12	p	20	25
f:	**2**	**5**	**8**	**22**	**7**	**4**	**2**

Solution:

x	f	fx
5	2	10
8	5	40
10	8	80
12	22	264
P	7	7p
20	4	80
25	2	50
	N = 50	Σ fx = 524 + 7p

We know that,

Mean = Σ fx/ N = (524 + 7p)/ 50

Given,

Mean = 12.58

⇒ 12.58 = (524 + 7p)/ 50

629 = 524 + 7p

7p = 629 – 524 = 105

∴ p = 15

7. Find the missing frequency (p) for the following distribution whose mean is 7.68

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

Solution:

x	f	fx
3	6	18
5	8	40
7	15	105
9	p	9p
11	8	88
13	4	52
	N = 41 + p	Σ fx = 303 + 9p

We know that,

Mean = Σ fx/ N = (303 + 9p)/ (41 + p)

Given,

Mean = 7.68

⇒ 7.68 = (303 + 9p)/ (41 + p)

7.68(41 + p) = 303 + 9p

7.68p + 314.88 = 303 + 9p

1.32p = 11.88

∴ p = 11.88/1.32 = 9

Exercise 7.2 Page No: 7.5

1. The number of telephone calls received at an exchange per interval for 250 successive one-minute intervals are given in the following frequency table:

No. of calls (x):	0	1	2	3	4	5	6
No. of intervals (f):	15	24	29	46	54	43	39

Compute the mean number of calls per interval.

Solution:

Let the assumed mean(A) = 3

No. of calls x_i	No. of intervals f_i	$u_i = x_i - A = x_i - 3$	$f_i u_i$
0	15	-3	-45
1	24	-2	-48
2	29	-1	-29
3	46	0	0
4	54	1	54
5	43	2	86
6	39	3	117
	N = 250		$\Sigma f_i x_i = 135$

Mean number of calls = A + $\Sigma f_i x_i$ / N
= 3 + 135/250
= (750 + 135)/ 250 = 885/ 250
= 3.54

2. Five coins were simultaneously tossed 1000 times, and at each toss the number of heads was observed. The number of tosses during which 0, 1, 2, 3, 4 and 5 heads were obtained are shown in the table below. Find the mean number of heads per toss.

No. of heads per toss (x):	0	1	2	3	4	5
No. of tosses (f):	38	144	342	287	164	25

Solution:

Let the assumed mean(A) = 2

No. of heads per toss x_i	No of intervals f_i	$u_i = x_i - A = x_i - 2$	$f_i u_i$
0	38	-2	-76
1	144	-1	-144

2	342	0	0
3	287	1	287
4	164	2	328
5	25	3	75
	N = 1000		$\Sigma f_i x_i = 470$

Mean number of heads per toss = $A + \Sigma f_i x_i / N$
= 2 + 470/1000
= 2 + 0.470
= 2.470

3. The following table gives the number of branches and number of plants in the garden of a school.

No of branches (x):	**2**	**3**	**4**	**5**	**6**
No of plants (f):	**49**	**43**	**57**	**38**	**13**

Calculate the average number of branches per plant.

Solution:

Let the assumed mean (A) = 4

No of branches xi	No of plants f_i	$u_i = x_i - A = x_i - 4$	$f_i u_i$
2	49	-2	-98
3	43	-1	-43
4	57	0	0
5	38	1	38
6	13	2	26
	N = 200		$\Sigma f_i x_i = -77$

Average number of branches per plant = $A + \Sigma f_i x_i / N$ = 4 + (-77/200)
= 4 -77/200
= (800 -77)/200
= 3.615

4. The following table gives the number of children of 150 families in a village

No of children (x):	**0**	**1**	**2**	**3**	**4**	**5**
No of families (f):	**10**	**21**	**55**	**42**	**15**	**7**

Find the average number of children per family.

Solution:

Let the assumed mean (A) = 2

No of children x_i	No of families f_i	$u_i = x_i - A = x_i - 2$	$f_i u_i$
0	10	-2	-20
1	21	-1	-21
2	55	0	0
3	42	1	42
4	15	2	30
5	7	3	21
	N = 150		$\Sigma f_i x_i = 52$

Average number of children for family = A + $\Sigma f_i x_i$ / N = 2 + 52/150
= (300 +52)/150
= 352/150
= 2.35 (corrected to neat decimal)

Exercise 7.3 Page No: 7.22

1. The following table gives the distribution of total household expenditure (in rupees) of manual workers in a city.

Expenditure (in rupees) (x)	Frequency (f_i)	Expenditure (in rupees) (x_i)	Frequency (f_i)
100 – 150	24	300 – 350	30
150 – 200	40	350 – 400	22
200 – 250	33	400 – 450	16
250 – 300	28	450 – 500	7

Find the average expenditure (in rupees) per household.

Solution:

Let the assumed mean (A) = 275

Class interval	Mid value (x_i)	$d_i = x_i – 275$	$u_i = (x_i - 275)/50$	Frequency f_i	f_iu_i
100 – 150	125	-150	-3	24	-72
150 – 200	175	-100	-2	40	-80
200 – 250	225	-50	-1	33	-33
250 – 300	275	0	0	28	0
300 – 350	325	50	1	30	30
350 – 400	375	100	2	22	44
400 – 450	425	150	3	16	48
450 – 500	475	200	4	7	28
				N = 200	$\Sigma f_iu_i = -35$

It's seen that A = 275 and h = 50

So,

Mean = A + h x ($\Sigma f_i u_i$/N)

= 275 + 50 (-35/200)

= 275 – 8.75

= 266.25

2. A survey was conducted by a group of students as a part of their environmental awareness program, in which they collected the following data regarding the number of plants in 200 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 house:	1	2	1	5	6	2	3

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

Solution:

From the given data,

To find the class interval we know that,
Class marks (x_i) = (upper class limit + lower class limit)/2
Now, let's compute x_i and f_ix_i by the following

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

Here,

Mean = $\Sigma f_iu_i / N$
= 162/ 20
= 8.1

Thus, the mean number of plants in a house is 8.1

We have used the direct method as the values of class mark x_i and f_i is very small.

3. Consider the following distribution of daily wages of workers of a factory

Daily wages (in ₹)	**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.

Solution:

Let the assume mean (A) = 150

Class interval	Mid value x_i	$d_i = x_i - 150$	$u_i = (x_i - 150)/20$	Frequency f_i	f_iu_i
100 – 120	110	-40	-2	12	-24
120 - 140	130	-20	-1	14	-14
140 - 160	150	0	0	8	0
160 - 180	170	20	1	6	6
180 - 200	190	40	2	10	20
				N= 50	$\Sigma f_iu_i = -12$

It's seen that,

A = 150 and h = 20

So,

Mean = A + h x ($\Sigma f_i u_i/N$)

= 150 + 20 x (-12/50)
= 150 – 24/5
= 150 = 4.8
= 145.20

4. Thirty women were examined in a hospital by a doctor and the number of heart beats per minute 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**

Solution:

Using the relation (x_i) = (upper class limit + lower class limit)/ 2
And, class size of this data = 3
Let the assumed mean (A) = 75.5
So, let's calculate d_i, u_i, f_iu_i as following:

Number of heart beats per minute	Number of women (f_i)	x_i	$d_i = x_i – 75.5$	$u_i = (x_i - 755)/h$	f_iu_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
	N = 30				$\Sigma f_iu_i = 4$

From table, it's seen that
N = 30 and h = 3
So, the mean = A + h x ($\Sigma f_i u_i$/N)
= 75.5 + 3 x (4/30
= 75.5 + 2/5
= 75.9
Therefore, the mean heart beats per minute for those women are 75.9 beats per minute.

Find the mean of each of the following frequency distributions: (5 - 14)
5.

Class interval:	0 – 6	6 - 12	12 - 18	18 – 24	24 - 30
Frequency:	6	8	10	9	7

Solution:

Let's consider the assumed mean (A) = 15

Class interval	Mid - value x_i	$d_i = x_i – 15$	$u_i = (x_i – 15)/6$	f_i	f_iu_i
0 – 6	3	-12	-2	6	-12
6 - 12	9	-6	-1	8	-8
12 - 18	15	0	0	10	0
18 – 24	21	6	1	9	9
24 - 30	27	12	2	7	14
				N = 40	$\Sigma f_iu_i = 3$

From the table it's seen that,

A = 15 and h = 6

Mean = A + h x $(\Sigma f_i u_i/N)$

= 15 + 6 x (3/40)

= 15 + 0.45

= 15.45

6.

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

Solution:

Let's consider the assumed mean (A) = 100

Class interval	Mid - value x_i	$d_i = x_i – 100$	$u_i = (x_i – 100)/20$	f_i	f_iu_i
50 – 70	60	-40	-2	18	-36
70 – 90	80	-20	-1	12	-12
90 – 110	100	0	0	13	0
110 – 130	120	20	1	27	27
130 – 150	140	40	2	8	16
150 - 170	160	60	3	22	66
				N= 100	$\Sigma f_iu_i = 61$

From the table it's seen that,

A = 100 and h = 20

Mean = A + h x $(\Sigma f_i u_i/N)$

= 100 + 20 x (61/100)

= 100 + 12.2

= 112.2

7.

Class interval:	**0 – 8**	**8 - 16**	**16 - 24**	**24 – 32**	**32 - 40**
Frequency:	**6**	**7**	**10**	**8**	**9**

Solution:

Let's consider the assumed mean (A) = 20

Class interval	Mid - value x_i	$d_i = x_i - 20$	$u_i = (x_i - 20)/8$	f_i	f_iu_i
0 – 8	4	-16	-2	6	-12
8 – 16	12	-8	-1	7	-7
16 – 24	20	0	0	10	0
24 – 32	28	8	1	8	8
32 – 40	36	16	2	9	18
				N = 40	$\Sigma f_iu_i = 7$

From the table it's seen that,

A = 20 and h = 8

Mean = A + h x ($\Sigma f_i u_i$/N)

= 20 + 8 x (7/40)

= 20 + 1.4

= 21.4

8.

Class interval:	**0 – 6**	**6 - 12**	**12 - 18**	**18 – 24**	**24 - 30**
Frequency:	**7**	**5**	**10**	**12**	**6**

Solution:

Let's consider the assumed mean (A) = 15

Class interval	Mid - value x_i	$d_i = x_i - 15$	$u_i = (x_i - 15)/6$	f_i	f_iu_i
0 – 6	3	-12	-2	7	-14
6 - 12	9	-6	-1	5	-5
12 - 18	15	0	0	10	0
18 – 24	21	6	1	12	12
24 - 30	27	12	2	6	12
				N = 40	$\Sigma f_iu_i = 5$

From the table it's seen that,

A = 15 and h = 6

Mean = A + h x ($\Sigma f_i u_i$/N)

= 15 + 6 x (5/40)

= 15 + 0.75
= 15.75

9.

Class interval:	**0 - 10**	**10 - 20**	**20 - 30**	**30 – 40**	**40 - 50**
Frequency:	**9**	**12**	**15**	**10**	**14**

Solution:

Let's consider the assumed mean (A) = 25

Class interval	Mid - value x_i	$d_i = x_i - 25$	$u_i = (x_i - 25)/10$	f_i	f_iu_i
0 – 10	5	-20	-2	9	-18
10 – 20	15	-10	-1	12	-12
20 – 30	25	0	0	15	0
30 – 40	35	10	1	10	10
40 - 50	45	20	2	14	28
				N = 60	$\Sigma f_iu_i = 8$

From the table it's seen that,

A = 25 and h = 10

Mean = A + h x ($\Sigma f_i u_i$/N)

= 25 + 10 x (8/60)

= 25 + 4/3

= 79/3 = 26.333

10.

Class interval:	**0 - 8**	**8 - 16**	**16 – 24**	**24 – 32**	**32 - 40**
Frequency:	**5**	**9**	**10**	**8**	**8**

Solution:

Let's consider the assumed mean (A) = 20

Class interval	Mid - value x_i	$d_i = x_i - 20$	$u_i = (x_i - 20)/8$	f_i	f_iu_i
0 – 8	4	-16	-2	5	-10
8 – 16	12	-4	-1	9	-9
16 – 24	20	0	0	10	0
24 – 32	28	4	1	8	8
32 – 40	36	16	2	8	16
				N = 40	$\Sigma f_iu_i = 5$

From the table it's seen that,

A = 20 and h = 8

Mean = A + h x ($\Sigma f_i u_i$/N)

= 20 + 8 x (5/40)
= 20 + 1
= 21

11.

Class interval:	**0 – 8**	**8 - 16**	**16 - 24**	**24 – 32**	**32 – 40**
Frequency:	**5**	**6**	**4**	**3**	**2**

Solution:

Let's consider the assumed mean (A) = 20

Class interval	Mid - value x_i	$d_i = x_i – 20$	$u_i = (x_i – 20)/8$	f_i	f_iu_i
0 – 8	4	-16	-2	5	-12
8 – 16	12	-8	-1	6	-8
16 – 24	20	0	0	4	0
24 – 32	28	8	1	3	9
32 – 40	36	16	2	2	14
				N = 20	$\Sigma f_iu_i = -9$

From the table it's seen that,

A = 20 and h = 8

Mean = A + h x ($\Sigma f_i u_i$/N)

= 20 + 6 x (-9/20)
= 20 – 72/20
= 20 – 3.6
= 16.4

12.

Class interval:	**10 - 30**	**30 - 50**	**50 - 70**	**70 – 90**	**90 - 110**	**110 - 130**
Frequency:	**5**	**8**	**12**	**20**	**3**	**2**

Solution:

Let's consider the assumed mean (A) = 60

Class interval	Mid - value x_i	$d_i = x_i –60$	$u_i = (x_i – 60)/20$	f_i	f_iu_i
10 – 30	20	-40	-2	5	-10
30 – 50	40	-20	-1	8	-8
50 – 70	60	0	0	12	0
70 – 90	80	20	1	20	20
90 – 110	100	40	2	3	6
110 – 130	120	60	3	2	6
				N = 50	$\Sigma f_iu_i = 14$

From the table it's seen that,

$A = 60$ and $h = 20$

Mean $= A + h \times (\Sigma f_i u_i/N)$

$= 60 + 20 \times (14/50)$

$= 60 + 28/5$

$= 60 + 5.6$

$= 65.6$

13.

Class interval:	**25 – 35**	**35 - 45**	**45 - 55**	**55 – 65**	**65 – 75**
Frequency:	**6**	**10**	**8**	**12**	**4**

Solution:

Let's consider the assumed mean (A) = 50

Class interval	Mid - value x_i	$d_i = x_i – 50$	$u_i = (x_i – 50)/10$	f_i	f_iu_i
25 - 35	30	-20	-2	6	-12
35 - 45	40	-10	-1	10	-10
45 - 55	50	0	0	8	0
55 - 65	60	10	1	12	12
65 - 75	70	20	2	4	8
				N = 40	$\Sigma f_iu_i = -2$

From the table it's seen that,

$A = 50$ and $h = 10$

Mean $= A + h \times (\Sigma f_i u_i/N)$

$= 50 + 10 \times (-2/40)$

$= 50 - 0.5$

$= 49.5$

14.

Class interval:	**25 – 29**	**30 – 34**	**35 – 39**	**40 – 44**	**45 – 49**	**50 – 54**	**55 – 59**
Frequency:	**14**	**22**	**16**	**6**	**5**	**3**	**4**

Solution:

Let's consider the assumed mean (A) = 42

Class interval	Mid - value x_i	$d_i = x_i – 42$	$u_i = (x_i – 42)/5$	f_i	f_iu_i
25 – 29	27	-15	-3	14	-42
30 – 34	32	-10	-2	22	-44

35 – 39	37	-5	-1	16	-16
40 – 44	42	0	0	6	0
45 – 49	47	5	1	5	5
50 – 54	52	10	2	3	6
55 – 59	57	15	3	4	12
				N = 70	$\Sigma f_i u_i = -79$

From the table it's seen that,

$A = 42$ and $h = 5$

Mean = $A + h \times (\Sigma f_i u_i/N)$

$= 42 + 5 \times (-79/70)$

$= 42 - 79/14$

$= 42 - 5.643$

$= 36.357$

Exercise 7.4 Page No: 7.34

1. Following are the lives in hours of 15 pieces of the components of aircraft engine. Find the median:
715, 724, 725, 710, 729, 745, 694, 699, 696, 712, 734, 728, 716, 705, 719.
Solution:

Arranging the given data in ascending order, we have
694, 696, 699, 705, 710, 712, 715, 716, 719, 721, 725, 728, 729, 734, 745

As the number of terms is an old number i.e., N = 15
We use the following procedure to find the median.
Median = $(N + 1)/2^{\text{th}}$ term
= $(15 + 1)/2^{\text{th}}$ term
= 8^{th} term
So, the 8^{th} term in the arranged order of the given data should be the median.
Therefore, 716 is the median of the data.

2. The following is the distribution of height of students of a certain class in a certain city:

Height (in cm):	**160 - 162**	**163 - 165**	**166 - 168**	**169 - 171**	**172 - 174**
No of students:	**15**	**118**	**142**	**127**	**18**

Find the median height.

Solution:

Class interval (exclusive)	Class interval (inclusive)	Class interval frequency	Cumulative frequency
160 – 162	159.5 – 162.5	15	15
163 – 165	162.5 – 165.5	118	133(F)
166 – 168	165.5 – 168.5	142(f)	275
169 – 171	168.5 – 171.5	127	402
172 – 174	171.5 – 174.5	18	420
		N = 420	

Here, we have N = 420,
So, N/2 = 420/ 2 = 210

The cumulative frequency just greater than N/2 is 275 then 165.5 - 168.5 is the median class such, that
L = 165.5, f = 142, F = 133 and h = (168.5 - 165.5) = 3

$$\text{Medain} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 165.5 + \frac{210 - 133}{142} \times 3$$

$$= 165.5 + \frac{77}{142} \times 3$$

$$= 165.5 + \frac{231}{142}$$

= 165.5 + 1.63
= 167.13

3. Following is the distribution of I.Q of 100 students. Find the median I.Q.

I.Q:	**55 - 64**	**65 - 74**	**75 - 84**	**85 - 94**	**95 - 104**	**105 - 114**	**115 - 124**	**125 - 134**	**135 - 144**
No of students:	**1**	**2**	**9**	**22**	**33**	**22**	**8**	**2**	**1**

Solution:

Class interval (exclusive)	Class interval (inclusive)	Class interval frequency	Cumulative frequency
55 - 64	54.5 – 64-5	1	1
65 - 74	64.5 – 74.5	2	3
75 - 84	74.5 – 84.5	9	12
85 - 94	84.5 – 94.5	22	34(F)
95 - 104	94.5 – 104.5	33(f)	67
105 - 114	104.5 – 114.5	22	89
115 - 124	114.5 – 124.5	8	97
125 - 134	124.5 – 134.5	2	98
135 - 144	134.5 – 144.5	1	100
		N = 100	

Here, we have N = 100,
So, N/2 = 100/ 2 = 50

The cumulative frequency just greater than N/ 2 is 67 then the median class is (94.5 - 104.5) such that L = 94.5, F = 33, h = (104.5 - 94.5) = 10

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 94.5 + \frac{50 - 34}{33} \times 10$$

= 94.5 + 4.85
= 99.35

4. Calculate the median from the following data:

Rent (in Rs):	**15 - 25**	**25 - 35**	**35 - 45**	**45 - 55**	**55 - 65**	**65 - 75**	**75 - 85**	**85 - 95**
No of houses:	**8**	**10**	**15**	**25**	**40**	**20**	**15**	**7**

Solution:

Class interval	Frequency	Cumulative frequency
15 - 25	8	8
25 - 35	10	18
35 - 45	15	33
45 - 55	25	58(F)
55 - 65	40(f)	98
65 - 75	20	118
75 - 85	15	133
85 - 95	7	140
	N = 140	

Here, we have N = 140,
So, N/2 = 140/ 2 = 70

The cumulative frequency just greater than N/ 2 is 98 then median class is 55 - 65 such that L = 55, f = 40, F = 58, h = 65 - 55 = 10

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 55 + \frac{70 - 58}{40} \times 10$$

= 55 + 3 = 58

5. Calculate the median from the following data:

Marks below:	10 – 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	85 - 95
No of students:	15	35	60	84	96	127	198	250

Solution:

Marks below	No. of students	Class interval	Frequency	Cumulative frequency
10	15	0 – 10	15	15
20	35	10 – 20	20	35
30	60	20 – 30	25	60
40	84	30 – 40	24	84
50	96	40 – 50	12	96(F)
60	127	50 – 60	31(f)	127
70	198	60 – 70	71	198
80	250	70 – 80	52	250
			N = 250	

Here, we have N = 250,
So, N/2 = 250/ 2 = 125

The cumulative frequency just greater than N/ 2 is 127 then median class is 50 – 60 such that L = 50, f = 31, F = 96, h = 60 -50 = 10

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

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

= 50 + 9.35
= 59.35

6. Calculate the missing frequency from the following distribution, it being given that the median of the distribution is 24.

Age in years:	0 - 10	10 – 20	20 - 30	30 - 40	40 - 50
No of persons:	5	25	?	18	7

Solution:

Let the unknown frequency be taken as x,

Class interval	Frequency	Cumulative frequency
0 – 10	5	5
10 – 20	25	30(F)
20 - 30	x (f)	30 + x
30 - 40	18	48 + x
40 - 50	7	55 + x
	N = 170	

It's given that
Median = 24
Then, median class = 20 - 30; L = 20, h = 30 -20 = 10, f = x, F = 30

$$\text{Median} = L + \frac{\frac{N}{2} - F}{f} \times h$$

$$24 = 20 + \frac{\frac{55 + x}{2} - 30}{x} \times 10$$

$$24 - 20 = \frac{\frac{55 + x}{2} - 30}{x} \times 10$$

$$4x = \left(\frac{55 + x}{2} - 30\right) \times 10$$

4x = 275 + 5x - 300
4x - 5x = – 25
- x = – 25
x = 25

Therefore, the Missing frequency = 25

7. The following table gives the frequency distribution of married women by age at marriage.

Age (in years)	**Frequency**	**Age (in years)**	**Frequency**
15 – 19	**53**	**40 – 44**	**9**
20 – 24	**140**	**45 – 49**	**5**
25 – 29	**98**	**45 – 49**	**3**
30 – 34	**32**	**55 – 59**	**3**
35 – 39	**12**	**60 and above**	**2**

Calculate the median and interpret the results.

Solution:

Class interval (exclusive)	Class interval (inclusive)	Frequency	Cumulative frequency
15 – 19	14.5 – 19.5	53	53 (F)
20 – 24	19.5 – 24.5	140 (f)	193
25 – 29	24.5 – 29.5	98	291
30 – 34	29.5 – 34.5	32	323
35 – 39	34.5 – 39.5	12	335
40 – 44	39.5 – 44.5	9	344
45 – 49	44.5 – 49.5	5	349
50 – 54	49.5 – 54.5	3	352
55 - 54	54.5 – 59.5	3	355
60 and above	59.5 and above	2	357
		N =357	

Here, we have N = 357,
So, N/2 = 357/ 2 = 178.5

The cumulative frequency just greater than N/2 is 193, so then the median class is (19.5 – 24.5) such that l = 19.5, f = 140, F = 53, h = 25.5 – 19.5 = 5

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$\text{Median} = 19.5 + \frac{178.5 - 53}{140} \times 5$$

Median = 23.98

Which means nearly half the women were married between the ages of 15 and 25

8. 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.

Solution:

Life time	Number of lamps fi	Cumulative frequency (cf)
1500 – 2000	14	14
2000 – 2500	56	70
2500 – 3000	60	130(F)
3000 – 3500	86(f)	216
3500 – 4000	74	290
4000 – 4500	62	352
4500 – 5000	48	400
	N = 400	

It's seen that, the cumulative frequency just greater than n/2 (400/2 = 200) is 216 and it belongs to the class interval 3000 – 3500 which becomes the Median class = 3000 - 3500
Lower limits (l) of median class = 3000 and,
Frequency (f) of median class = 86
Cumulative frequency (cf) of class preceding median class = 130
And, the Class size (h) = 500

Thus, calculating the median by the formula, we get

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

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

= 3000 + (35000/86)
= 3406.98

Thus, the median life time of lamps is 3406.98 hours

9. The distribution below gives the weight of 30 students in a class. Find the median weight of 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**

Solution:

Weight (in kg)	Number of students fi	Cumulative frequency (cf)
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

It's seen that, the cumulative frequency just greater than n/ 2 (i.e. 30/ 2 = 15) is 19, belongs to class interval 55 – 60.

So, it's chosen that
Median class = 55 – 60
Lower limit (l) of median class = 55
Frequency (f) of median class = 6
Cumulative frequency (cf) = 13
And, Class size (h) = 5

Thus, calculating the median by the formula, we get

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

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

= 55 + 10/6 = 56.666

So, the median weight is 56.67 kg.

10. Find the missing frequencies and the median for the following distribution if the mean is 1.46

No. of accidents:	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
Frequencies (no. of days):	**46**	**?**	**?**	**25**	**10**	**5**	**200**

Solution:

No. of accidents (x)	No. of days (f)	fx
0	46	0
1	x	x
2	y	2y
3	25	75
4	10	40
5	5	25
	N = 200	Sum = x + 2y + 140

It's given that, N = 200

⇒ $46 + x + y + 25 + 10 + 5 = 200$

⇒ $x + y = 200 – 46 – 25 – 10 – 5$

⇒ $x + y = 114$ ---- (i)

And also given, Mean = 1.46

⇒ Sum/ N = 1.46

⇒ $(x + 2y + 140)/ 200 = 1.46$

⇒ $x + 2y = 292 – 140$

⇒ $x + 2y = 152$ ---- (ii)

Subtract equation (i) from equation (ii), we get

$x + 2y – x – y = 152 – 114$

⇒ $y = 38$

Now, on putting the value of y in equation (i), we find $x = 114 – 38 = 76$

Thus, the table become:

No. of accidents (x)	No. of days (f)	Cumulative frequency
0	46	46
1	76	122
2	38	160
3	25	185
4	10	195
5	5	200
	N = 200	

It's seen that,

N = 200 N/2 = 200/2 = 100

So, the cumulative frequency just more than N/2 is 122

Therefore, the median is 1.

Exercise 7.5

1. Find the mode of the following data:
(i) 3, 5, 7, 4, 5, 3, 5, 6, 8, 9, 5, 3, 5, 3, 6, 9, 7, 4
(ii) 3, 3, 7, 4, 5, 3, 5, 6, 8, 9, 5, 3, 5, 3, 6, 9, 7, 4
(iii) 15, 8, 26, 25, 24, 15, 18, 20, 24, 15, 19, 15

Solution:

(i)

Value (x)	3	4	5	6	7	8	9
Frequency (f)	4	2	5	2	2	1	2

Thus, the mode = 5 since it occurs the maximum number of times.

(ii)

Value (x)	3	4	5	6	7	8	9
Frequency (f)	5	2	4	2	2	1	2

Thus, the mode = 3 since it occurs the maximum number of times.

(iii)

Value (x)	8	15	18	19	20	24	25
Frequency (f)	1	4	1	1	1	2	1

Thus, the mode = 15 since it occurs the maximum number of times.

2. The shirt size worn by a group of 200 persons, who bought the shirt from a store, are as follows:

Shirt size:	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**
Number of persons:	**15**	**25**	**39**	**41**	**36**	**17**	**15**	**12**

Find the model shirt size worn by the group.

Solution:

Shirt size:	37	38	39	40	41	42	43	44
Number of persons:	15	25	39	41	36	17	15	12

From the data its observed that,

Model shirt size = 40 since it was the size which occurred for the maximum number of times.

3. Find the mode of the following distribution.

(i)

Class interval:	**0 – 10**	**10 – 20**	**20 – 30**	**30 – 40**	**40 – 50**	**50 – 60**	**60 – 70**	**70 – 80**
Frequency:	**5**	**8**	**7**	**12**	**28**	**20**	**10**	**10**

Solution:

Class interval:	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency:	5	8	7	12	28	20	10	10

It's seen that the maximum frequency is 28.
So, the corresponding class i.e., 40 – 50 is the modal class.
And,

$l = 40$, $h = 50\ 40 = 10$, $f = 28$, $f_1 = 12$, $f_2 = 20$

Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 40 + \frac{28 - 12}{2 \times 28 - 12 - 20} \times 10$$

$= 40 + 160/ 24$
$= 40 + 6.67$
$= 46.67$

(ii)

Class interval	**10 – 15**	**15 – 20**	**20 – 25**	**25 – 30**	**30 – 35**	**35 – 40**
Frequency	**30**	**45**	**75**	**35**	**25**	**15**

Solution:

Class interval	10 – 15	15 – 20	20 – 25	25 – 30	30 – 35	35 – 40
Frequency	30	45	75	35	25	15

It's seen that the maximum frequency is 75.
So, the corresponding class i.e., 20 - 25 is the modal class.
And,

$l = 20$, $h = 25 - 20 = 5$, $f = 75$, $f_1 = 45$, $f_2 = 35$

Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 20 + \frac{75 - 45}{2 \times 75 - 45 - 35} \times 5$$

= 20 + 150/70
= 20 + 2.14
= 22.14

(iii)

Class interval	**25 – 30**	**30 – 35**	**35 – 40**	**40 – 45**	**45 – 50**	**50 – 55**
Frequency	**25**	**34**	**50**	**42**	**38**	**14**

Solution:

Class interval	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55
Frequency	25	34	50	42	38	14

It's seen that the maximum frequency is 50.
So, the corresponding class i.e., 35 - 40 is the modal class.
And,
$l = 35$, $h = 40 - 35 = 5$, $f = 50$, $f_1 = 34$, $f_2 = 42$

Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 35 + \frac{50 - 34}{2 \times 50 - 34 - 42} \times 5$$

= 35 + 80/24
= 35 + 3.33
= 38.33

4. Compare the modal ages of two groups of students appearing for an entrance test:

Age in years	**16 – 18**	**18 – 20**	**20 – 22**	**22 – 24**	**24 – 26**
Group A	**50**	**78**	**46**	**28**	**23**
Group B	**54**	**89**	**40**	**25**	**17**

Solution:

Age in years	16 – 18	18 – 20	20 – 22	22 – 24	24 – 26

Group A	50	78	46	28	23
Group B	54	89	40	25	17

For Group A:
It's seen that the maximum frequency is 78.
So, the corresponding class 18 – 20 is the model class.
And,

$l = 18$, $h = 20 - 18 = 2$, $f = 78$, $f_1 = 50$, $f_2 = 46$

Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 18 + \frac{78 - 50}{2 \times 78 - 50 - 46} \times 2$$

= 18 + 56/60
= 18 + 0.93
= 18.93 years

For group B:
It's seen that the maximum frequency is 89
So, the corresponding class 18 - 20 is the modal class.
And,

$l = 18$, $h = 20 - 18 = 2$, $f = 89$, $f_1 = 54$, $f_2 = 40$

Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 18 + \frac{89 - 54}{2 \times 89 - 54 - 40} \times 2$$

= 18 + 70/84
= 18 + 0.83
= 18.83 years

Therefore, the modal age of the Group A is higher than that of Group B.

5. The marks in science of 80 students of class X are given below. Find the mode of the marks obtained by the students in science.

Marks	**0 – 10**	**10 – 20**	**20 – 30**	**30 – 40**	**40 – 50**	**50 – 60**	**60 – 70**	**70 – 80**	**80 – 90**	**90 – 100**
Frequency	**3**	**5**	**16**	**12**	**13**	**20**	**5**	**4**	**1**	**1**

Solution:

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80	80 – 90	90 – 100
Frequency	3	5	16	12	13	20	5	4	1	1

It's seen that the maximum frequency is 20.
So, the corresponding class 50 - 60 is the modal class.

And,
$l = 50$, $h = 60 - 50 = 10$, $f = 20$, $f_1 = 13$, $f_2 = 5$

Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 50 + \frac{20 - 13}{2 \times 20 - 13 - 5} \times 10$$

$= 50 + 70/22$
$= 50 + 3.18$
$= 53.18$

6. The following is the distribution of height of students of a certain class in a city:

Height (in cm):	160 – 162	163 – 165	166 – 168	169 – 171	172 – 174
No of students:	**15**	**118**	**142**	**127**	**18**

Find the average height of maximum number of students.

Solution:

Heights(exclusive)	160 – 162	163 – 165	166 – 168	169 – 171	172 – 174
Heights (inclusive)	159.5 – 162.5	162.5 – 165.5	165.5 – 168.5	168.5 – 171.5	171.5 – 174.5
No of students	15	118	142	127	18

It's seen that the maximum frequency is 142.
So, the corresponding class 165.5 – 168.5 is the modal class.

And,
$l = 165.5$, $h = 168.5 - 165.5 = 3$, $f = 142$, $f_1 = 118$, $f_2 = 127$
Using the formula for finding mode, we get

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 165.5 + \frac{142 - 118}{2 \times 142 - 118 - 127} \times 3$$

= 165.5 + 72/39
= 165.5 + 1.85
= 167.35 cm

7. The following table shows the ages of the patients admitted in a hospital during a year:

Ages (in years):	**5 – 15**	**15 – 25**	**25 – 35**	**35 – 45**	**45 – 55**	**55 – 65**
No of students:	**6**	**11**	**21**	**23**	**14**	**5**

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

Solution:

To find the mean:
For the given data let the assumed mean (A) = 30

Age (in years)	Number of patients f_i	Class marks x_i	$d_i = x_i – 275$	fidi
5 – 15	6	10	- 20	-120
15 – 25	11	20	- 10	-110
25 – 35	21	30	0	0
35 – 45	23	40	10	230
45 – 55	14	50	20	280
55 – 65	5	60	30	150
	N = 80			$\Sigma f_i d_i = 430$

It's observed from the table that $\Sigma f_i = N = 80$ and $\Sigma f_i d_i = 430$.
Using the formula for mean,

$$\text{Mean } (\bar{x}) = A + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

= 30 + 430/80
= 30 + 5.375
= 35.375
= 35.38

Thus, the mean of this data is 35.38. It can also be interpreted as that on an average the age of a patients admitted to hospital was 35.38 years.

It is also observed that maximum class frequency is 23 and it belongs to class interval 35 – 45

So, modal class is 35 – 45 with the Lower limit (l) of modal class = 35
And, Frequency (f) of modal class = 23
Class size (h) = 10
Frequency (f_1) of class preceding the modal class = 21
Frequency (f_2) of class succeeding the modal class = 14

Mode $= l + \frac{f - f_1}{2f - f_1 - f_2} \times h$

$$= 35 + \frac{23 - 21}{2 \times 23 - 21 - 14} \times 10$$

$$= 35 + \frac{2}{46 - 35} \times 10$$

$$= 35 + 1.81 = 36.8$$

Therefore, the mode is 36.8. This represents that maximum number of patients admitted in hospital were of 36.8 years.

Hence, it's seen that mode is greater than the mean.

8. 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**
No. of components:	**10**	**35**	**52**	**61**	**38**	**29**

Determine the modal lifetimes of the components.

Solution:

From the data given as above its observed that maximum class frequency is 61 which belongs to class interval 60 – 80.
So, modal class limit (l) of modal class = 60
Frequency (f) of modal class = 61
Frequency (f_1) of class preceding the modal class = 52
Frequency (f_2) of class succeeding the modal class = 38
Class size (h) = 20

Using the formula for find mode, we have

Mode $= l + \frac{f - f_1}{2f - f_1 - f_2} \times h$

$= 60 + \frac{61 - 52}{2 \times 61 - 52 - 38} \times 20$

$= 60 + \frac{9}{122 - 90} \times 20$

$= 60 + \frac{9 \times 20}{32}$

$= 60 + \frac{90}{16}$

$= 60 + 5.625 = 65.625$

Thus, the modal lifetime of electrical components is 65.625 hours

9. The following table gives the daily income of 50 workers of a factory:

Daily income	**100 – 120**	**120 – 140**	**140 – 160**	**160 – 180**	**180 – 200**
Number of workers	**12**	**14**	**8**	**6**	**10**

Find the mean, mode and median of the above data.

Solution:

Class interval	Mid value (x)	Frequency (f)	fx	Cumulative frequency
100 – 120	110	12	1320	12
120 – 140	130	14	1820	26
140 – 160	150	8	1200	34
160 – 180	170	6	1000	40
180 – 200	190	10	1900	50
		N = 50	Σfx = 7260	

We know that,

Mean = Σfx / N

= 7260/ 50

= 145.2

Then,

We have, N = 50

⇒ N/2 = 50/2 = 25

So, the cumulative frequency just greater than N/2 is 26, then the median class is 120 - 140

Such that l = 120, h = 140 - 120 = 20, f = 14, F = 12

$$\text{Median} = l + \frac{\frac{N}{2} - F}{f} \times h$$

$$= 120 + \frac{25 - 12}{14} \times 20$$

= 120 + 260/14

= 120 + 18.57

= 138.57

From the data, its observed that maximum frequency is 14, so the corresponding class 120 - 140 is the modal class

And,

l = 120, h = 140 - 120 = 20, f = 14, f_1 = 12, f_2 = 8

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 120 + \frac{14 - 12}{2 \times 14 - 12 - 8 \times 20}$$

$$= 120 + \frac{40}{8}$$

= 120 + 5

= 125

Therefore, mean = 145.2, median = 138.57 and mode = 125

Exercise 7.6

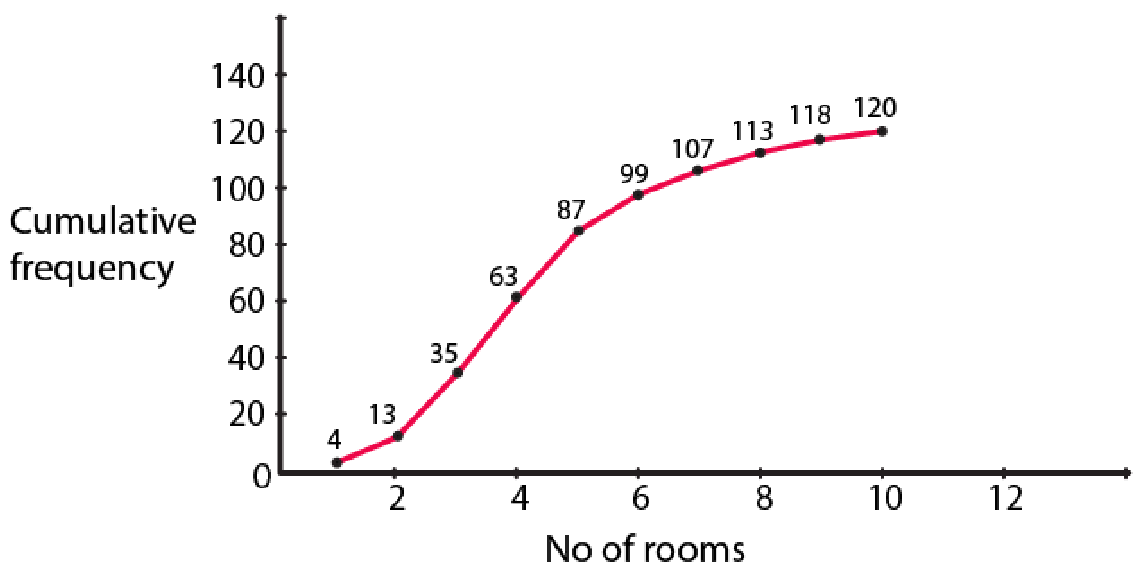
1. Draw an ogive by less than the method for the following data:

No. of rooms	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. of houses	**4**	**9**	**22**	**28**	**24**	**12**	**8**	**6**	**5**	**2**

Solution:

No. of rooms	No. of houses	Cumulative Frequency
Less than or equal to 1	4	4
Less than or equal to 2	9	13
Less than or equal to 3	22	35
Less than or equal to 4	28	63
Less than or equal to 5	24	87
Less than or equal to 6	12	99
Less than or equal to 7	8	107
Less than or equal to 8	6	113
Less than or equal to 9	5	118
Less than or equal to 10	2	120

It's required to plot the points (1, 4), (2, 13), (3, 35), (4, 63), (5, 87), (6, 99), (7, 107), (8, 113), (9, 118), (10, 120), by taking upper class limit over the x-axis and cumulative frequency over the y-axis.



2. The marks scored by 750 students in an examination are given in the form of a frequency distribution table:

Marks	**No. of Students**
600 – 640	**16**

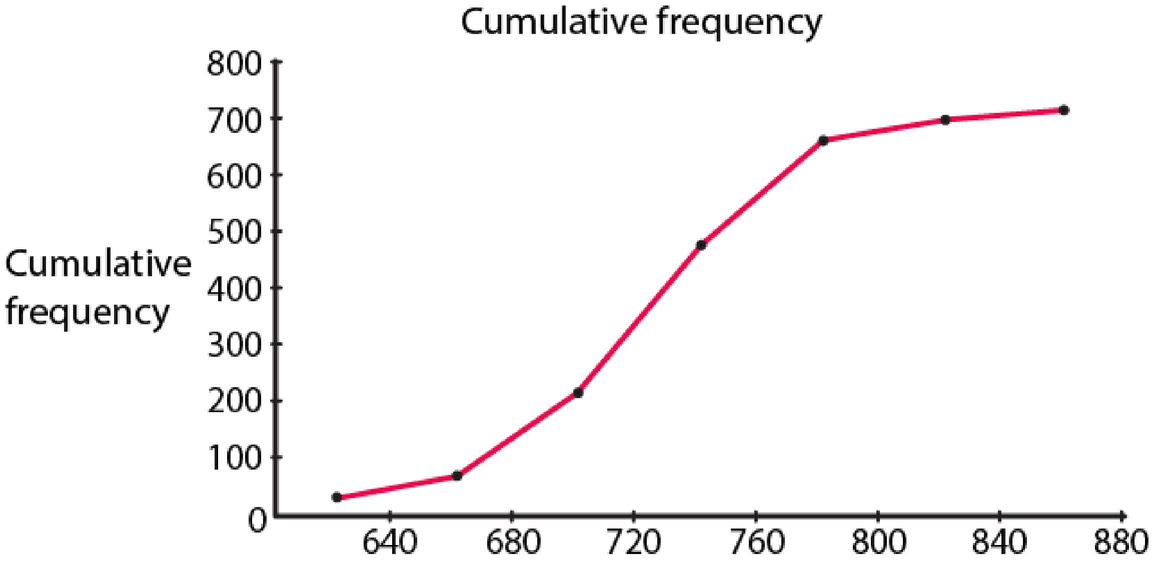
640 – 680	**45**
680 – 720	**156**
720 – 760	**284**
760 – 800	**172**
800 – 840	**59**
840 – 880	**18**

Prepare a cumulative frequency distribution table by less than method and draw an ogive.

Solution:

Marks	No. of Students	Marks Less than	Cumulative Frequency
600 – 640	16	640	16
640 – 680	45	680	61
680 – 720	156	720	217
720 – 760	284	760	501
760 – 800	172	800	673
800 – 840	59	840	732
840 – 880	18	880	750

Plot the points (640, 16), (680, 61), (720, 217), (760, 501), (800, 673), (840, 732), (880, 750) by taking upper class limit over the x-axis and cumulative frequency over the y-axis.



3. Draw an Ogive to represent the following frequency distribution:

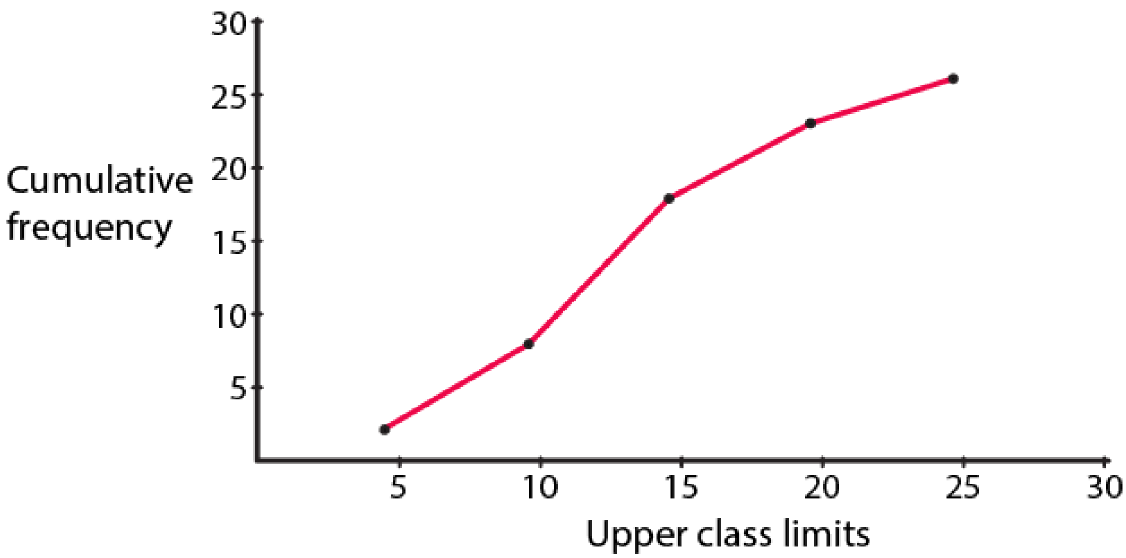
Class-interval	**0 – 4**	**5 – 9**	**10 – 14**	**15 – 19**	**20 – 24**
No. of students	**2**	**6**	**10**	**5**	**3**

Solution:

Since the given frequency distribution is not continuous we will have to first make it continuous and then prepare the cumulative frequency:

Class-interval	No. of Students	Less than	Cumulative frequency
0.5 – 4.5	2	4.5	2
4.5 – 9.5	6	9.5	8
9.5 – 14.5	10	14.5	18
14.5 – 19.5	5	19.5	23
19.5 – 24.5	3	24.5	26

Plot the points (4.5, 2), (9.5, 8), (14.5, 18), (19.5, 23), (24.5, 26) by taking the upper class limit over the x-axis and cumulative frequency over the y-axis.



4. The monthly profits (in Rs) of 100 shops are distributed as follows:

Profit per shop	**No of shops:**
0 – 50	**12**
50 – 100	**18**
100 – 150	**27**
150 – 200	**20**
200 – 250	**17**
250 – 300	**6**

Draw the frequency polygon for it.

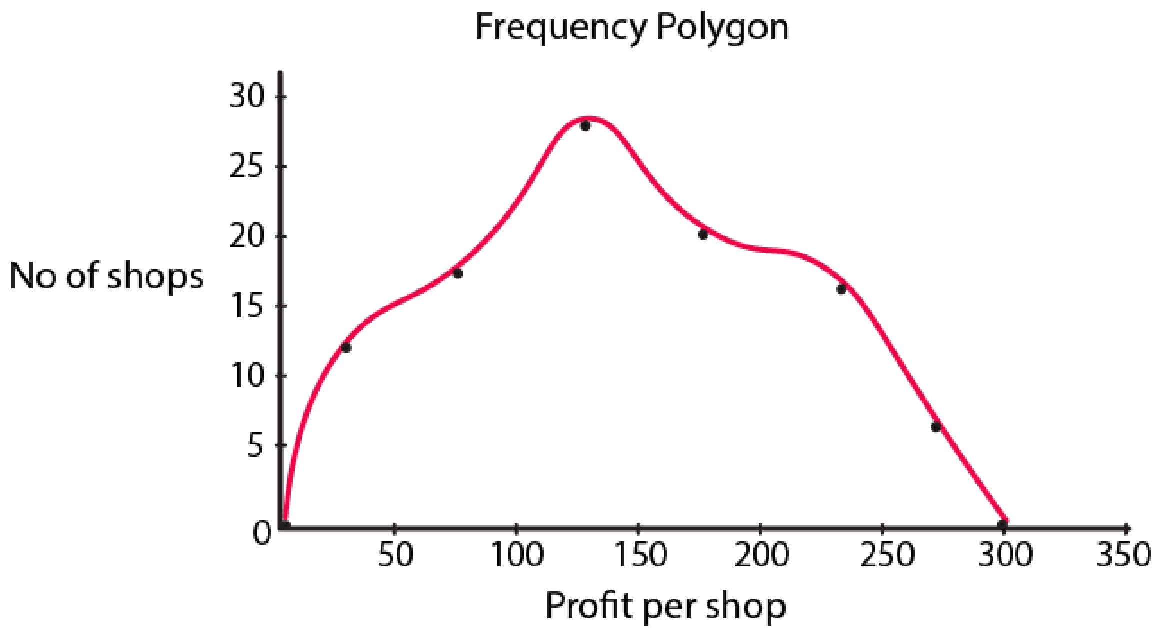
Solution:

Doing for the less than method, we have

Profit per shop	Mid-value	No of shops:
Less than 0	0	0
Less than 0 – 50	25	12
Less than 50 – 100	75	18

Less than 100 – 150	125	27
Less than 150 – 200	175	20
Less than 200 – 250	225	17
Less than 250 – 300	275	6
Above 300	300	0

By plotting the respectively coordinates we can get the frequency polygon.



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

Daily income (in Rs):	**No of workers:**
100 – 120	**12**
120 – 140	**14**
140 – 160	**8**
160 – 180	**6**
180 – 200	**10**

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

Solution:

Firstly, we prepare the cumulative frequency table by less than method as given below:

Daily income	Cumulative frequency
Less than 120	12
Less than 140	26
Less than 160	34
Less than 180	40
Less than 200	50

Now we mark on x-axis upper class limit, y-axis cumulative frequencies. Thus we plot the point (120, 12), (140, 26), (160, 34), (180, 40), (200, 50).