Exercise 24(E)

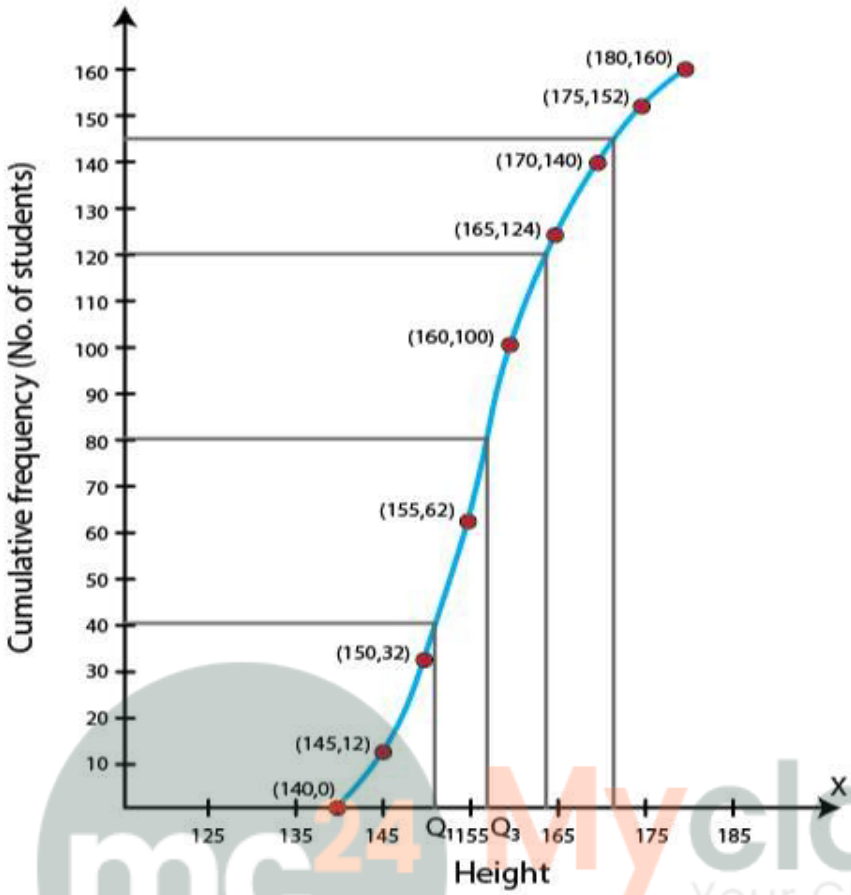
1. The following distribution represents the height of 160 students of a school.

Height (in cm)	No. of Students
140 - 145	12
145 - 150	20
150 - 155	30
155 – 160	38
160 - 165	24
165 - 170	16
170 - 175	12
175 - 180	8

Draw an ogive for the given distribution taking 2 cm = 5 cm of height on one axis and 2 cm = 20 students on the other axis. Using the graph, determine:
i. The median height.
ii. The interquartile range.
iii. The number of students whose height is above 172 cm.
Solution:

Height (in cm)	No. of Students	Cumulative frequency
140 - 145	12	12
145 - 150	20	32
150 - 155	30	62
155 – 160	38	100
160 - 165	24	124
165 - 170	16	140
170 - 175	12	152
175 - 180	8	160
	N = 160	

Now, let's draw an ogive taking height of student along x-axis and cumulative frequency along y-axis.



(i) So,
Median = 160/2 = 80th term
Through mark for 80, draw a parallel line to x-axis which meets the curve; then from the curve draw a vertical line which meets the x-axis at the mark of 157.5.

(ii) As, the number of terms = 160
Lower quartile (Q_1) = (160/4) = 40th term = 152
Upper quartile (Q_3) = (3 x 160/4) = 120th term = 164
Inner Quartile range = $Q_3 - Q_1$
= 164 – 152
= 12

(iii) Through mark for 172 on x-axis, draw a vertical line which meets the curve; then from the curve draw a horizontal line which meets the y-axis at the mark of 145.
Now,
The number of students whose height is above 172 cm
= 160 - 144 = 16

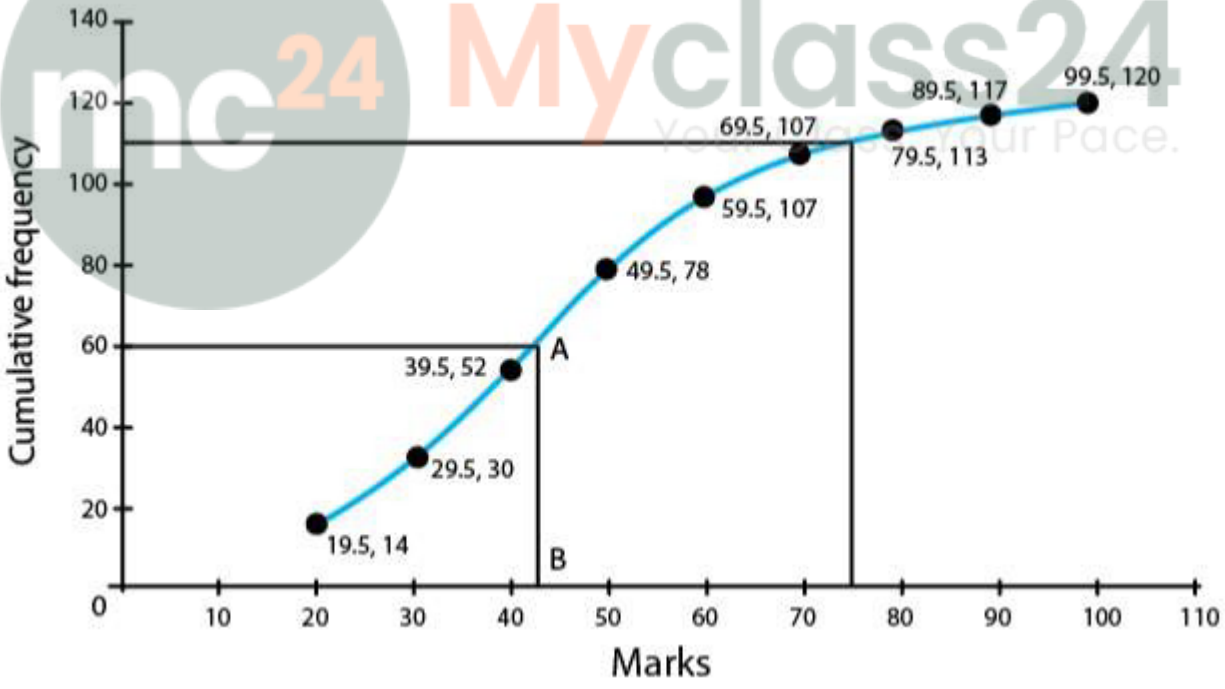
2. Draw ogive for the data given below and from the graph determine: (i) the median marks. (ii) the number of students who obtained more than 75% marks.

Marks	10 - 19	20 -29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 - 99
No. of students	14	16	22	26	18	11	6	4	3

Solution:

Marks	No. of students	Cumulative frequency
9.5 - 19.5	14	14
19.5 - 29.5	16	30
29.5 - 39.5	22	52
39.5 - 49.5	26	78
49.5 - 59.5	18	96
59.5 - 69.5	11	107
69.5 - 79.5	6	113
79.5 - 89.5	4	117
89.5 - 99.5	3	120

Scale:
1cm = 10 marks on X axis
1cm = 20 students on Y axis



(i) So, the median = 120/ 2 = 60th term
Through mark 60, draw a parallel line to x-axis which meets the curve at A. From A, draw a perpendicular to x-axis meeting it at B.
The value of point B is the median = 43

(ii) Total marks = 100

75% of total marks = 75/100 x 100 = 75 marks
Hence, the number of students getting more than 75% marks = 120 - 111 = 9 students.

3. The mean of 1, 7, 5, 3, 4 and 4 is m. The numbers 3, 2, 4, 2, 3, 3 and p have mean m - 1 and median q. Find p and q.
Solution:

Mean of 1, 7, 5, 3, 4 and 4 = (1 + 7 + 5 + 3 + 4 + 4)/ 6 = 24/6 = 4
So, m = 4
Now, given that
The mean of 3, 2, 4, 2, 3, 3 and p = m -1 = 4 - 1 = 3
Thus, 17 + p = 3 x n …. ,where n = 7
17 + p = 21
p = 4
Arranging the terms in ascending order, we have:
2, 2, 3, 3, 3, 3, 4, 4
Mean = 4^{th} term = 3
Hence, q = 3

4. In a malaria epidemic, the number of cases diagnosed were as follows:

Date (July)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Number	**5**	**12**	**20**	**27**	**46**	**30**	**31**	**18**	**11**	**5**	**0**	**1**

On what days do the mode and upper and lower quartiles occur?
Solution:

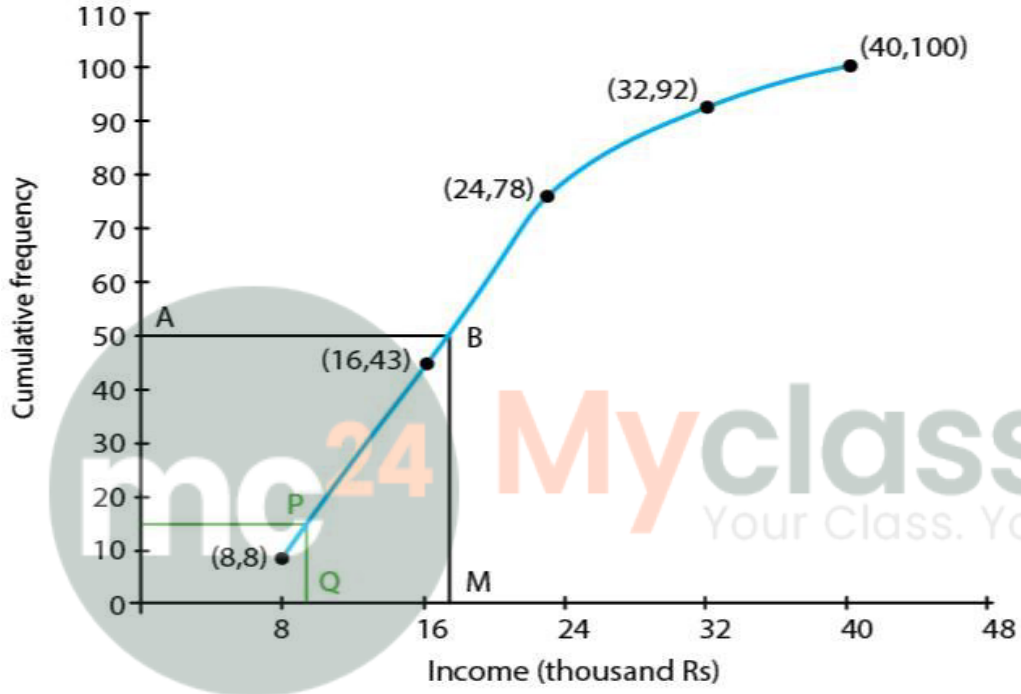
Date	Number	C.f.
1	5	5
2	12	17
3	20	37
4	27	64
5	46	110
6	30	140
7	31	171
8	18	189
9	11	200
10	5	205
11	0	205
12	1	206

(i) Mode = 5^{th} July as it has maximum frequencies.
(ii) Total number of terms = 206
Upper quartile = 206 x (3/4) = 154.5^{th} = 7^{th} July
Lower quartile = 206 x (1/4) = 51.5^{th} = 4^{th} July

5. The income of the parents of 100 students in a class in a certain university are tabulated below.

Income (in thousand Rs)	0 - 8	8 - 16	16 - 24	24 - 32	32 - 40
No. of students	8	35	35	14	8

(i) Draw a cumulative frequency curve to estimate the median income.
(ii) If 15% of the students are given freeships on the basis of the basis of the income of their parents, find the annual income of parents, below which the freeships will be awarded.
(iii) Calculate the Arithmetic mean.
Solution:



(i) Cumulative Frequency Curve

Income (in thousand Rs.)	No. of students f	Cumulative Frequency	Class mark x	fx
0 - 8	8	8	4	32
8 - 16	35	43	12	420
16 - 24	35	78	20	700
24 - 32	14	92	28	392
32 - 40	8	100	36	288
	∑f= 100			∑ fx = 1832

We plot the points (8, 8), (16, 43), (24, 78), (32, 92) and (40, 100) to get the curve as follows:
Here, N = 100
N/2 = 50
At y = 50, affix A.
Through A, draw a horizontal line meeting the curve at B.
Through B, a vertical line is drawn which meets OX at M.

OM = 17.6 units
Hence, median income = 17.6 thousands

(ii) 15% of 100 students = (15 x 100)/ 100 = 15
From c.f. 15, draw a horizontal line which intersects the curve at P.
From P, draw a perpendicular to x – axis meeting it at Q which is equal to 9.6
Thus, freeship will be awarded to students provided annual income of their parents is upto 9.6 thousands.

(ii) Mean = $\sum fx / \sum f = 1832/100 = 18.32$

6. The marks of 20 students in a test were as follows:
2, 6, 8, 9, 10, 11, 11, 12, 13, 13, 14, 14, 15, 15, 15, 16, 16, 18, 19 and 20.
Calculate:
(i) the mean (ii) the median (iii) the mode
Solution:

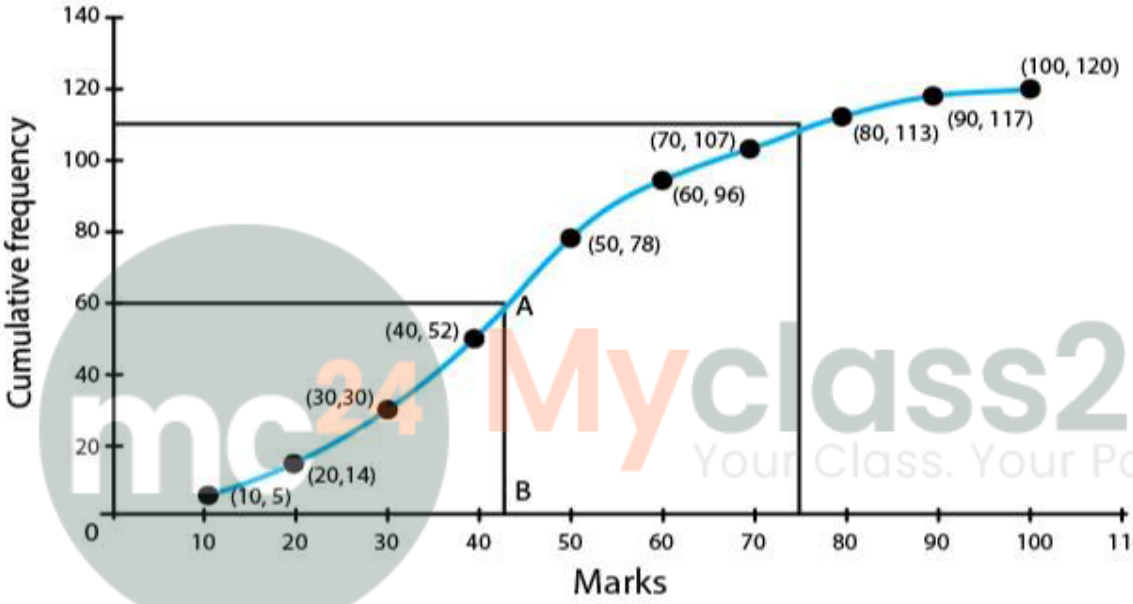
Arranging the terms in ascending order:
2, 6, 8, 9, 10, 11, 11, 12, 13, 13, 14, 14, 15, 15, 15, 16, 16, 18, 19, 20
Number of terms = 20
$\sum x = 2 + 6 + 8 + 9 + 11 + 11 + 12 + 13 + 13 + 14 + 14 + 15 + 15 + 15 + 15 + 16 + 16 + 18 + 19 + 20 = 257$
(i) Mean = $\sum x / \sum n = 257/ 20 = 12.85$
(ii) Median = (10^{th} term + 11^{th} term)/ 2 = (13 + 14)/ 2 = 27/ 2 = 13.5
(iii) Mode = 15 since it has maximum frequencies i.e. 3

7. The marks obtained by 120 students in a mathematics test is given below:

Marks	No. of students
0-10	5
10-20	9
20-30	16
30-40	22
40-50	26
50-60	18
60-70	11
70-80	6
80-90	4
90-100	3

Draw an ogive for the given distribution on a graph sheet. Use a suitable scale for your ogive. Use your ogive to estimate:
(i) the median
(ii) the number of students who obtained more than 75% in test.
(iii) the number of students who did not pass in the test if the pass percentage was 40.
(iv) the lower quartile
Solution:

Marks	No. of students	c.f.
0-10	5	5
10-20	9	14
20-30	16	30
30-40	22	52
40-50	26	78
50-60	18	96
60-70	11	107
70-80	6	113
80-90	4	117
90-100	3	120



(i) Median = (120 + 1)/ 2 = 60.5th term
Through mark 60.5, draw a parallel line to x-axis which meets the curve at A. From A draw a perpendicular to x-axis meeting it at B.
Then, the value of point B is the median = 43

(ii) Number of students who obtained up to 75% marks in the test = 110
Number of students who obtained more than 75% marks in the test = 120 - 110 = 10

(iii) Number of students who obtained less than 40% marks in the test = 52 (from the graph; x = 40, y = 52)

(iv) Lower quartile = Q_1 = 120 x (1/4) = 30th term = 30

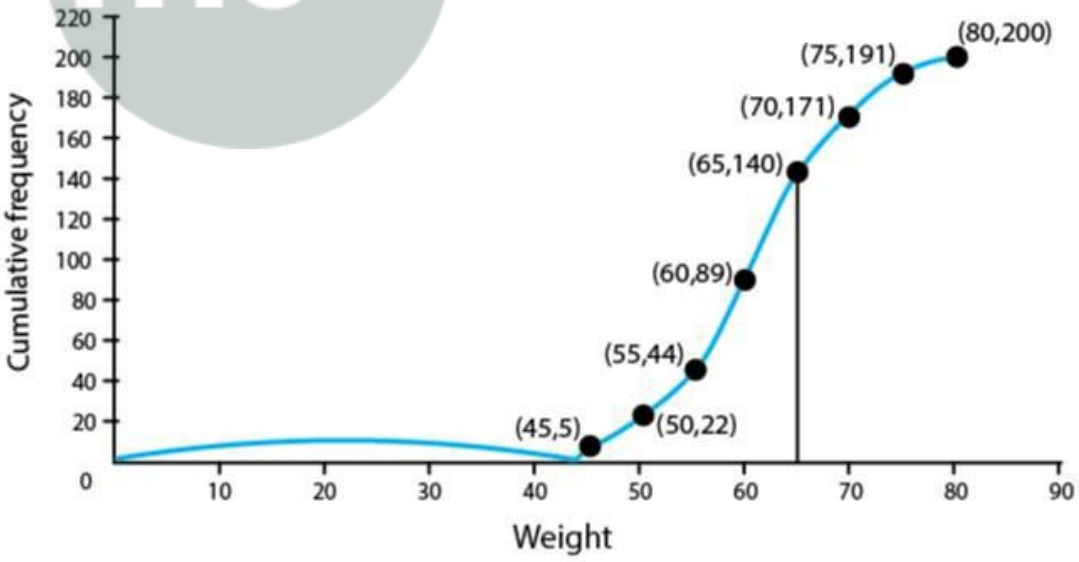
8. Using a graph paper, draw an ogive for the following distribution which shows a record of the width in kilograms of 200 students.

Weight	Frequency
40 - 45	5

45 - 50	**17**
50 - 55	**22**
55 - 60	**45**
60 - 65	**51**
65 - 70	**31**
70 - 75	**20**
75 - 80	**9**

Use your ogive to estimate the following:
(i) The percentage of students weighing 55 kg or more
(ii) The weight above which the heaviest 30% of the student fall
(iii) The number of students who are (a) underweight (b) overweight, if 55.70 kg is considered as standard weight.
Solution:

Weight	Frequency	c. f.
40-45	5	5
45-50	17	22
50-55	22	44
55-60	45	89
60-65	51	140
65-70	31	171
70-75	20	191
75-80	9	200



(i) The number of students weighing more than 55 kg = 200 - 44 = 156
Thus, the percentage of students weighing 55 kg or more = (156/200) x 100 = 78 %

(ii) 30% of students = (30 x 200)/ 100 = 60
Heaviest 60students in weight = 9 + 21 + 30 = 60

Weight = 65 kg (From table)

(iii) (a) underweight students when 55.70 kg is standard = 46 (approx.) from graph
(b) overweight students when 55.70 kg is standard = 200 - 55.70 = 154 (approx.) from graph

9. The distribution, given below, shows the marks obtained by 25 students in an aptitude test. Find the mean, median and mode of the distribution.

Marks obtained	**5**	**6**	**7**	**8**	**9**	**10**
No. of students	**3**	**9**	**6**	**4**	**2**	**1**

Solution:

Marks obtained(x)	No. of students (f)	c.f.	fx
5	3	3	15
6	9	12	54
7	6	18	42
8	4	22	32
9	2	24	18
10	1	25	10
Total	25		171

Number of terms = 25
(i) Mean = 171/25 = 6.84
(ii) Median = $(25 + 1)/ 2^{th}$ = 13^{th} term = 7
(iii) Mode = 6 since it has the maximum frequency i.e. 6

10. The mean of the following distribution is 52 and the frequency of class interval 30 - 40 is 'f'. Find f.

Class Interval	**10 - 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 - 80**
Frequency	**5**	**3**	**f**	**7**	**2**	**6**	**13**

Solution:

C.I.	Frequency(f)	Mid value (x)	fx
10-20	5	15	75
20-30	3	25	75
30-40	f	35	35f
40-50	7	45	315
50-60	2	55	110
60-70	6	65	390
70-80	13	75	975
Total	36 + f		1940 + 35f

Mean = $\sum fx/ \sum f = (1940 + 35f)/ (36 + f)$ …… (i)
But, given mean = 52 …. (ii)

From (i) and (ii), we have
(1940 + 35f)/ (36 + f) = 52
1940 + 35f = 1872 + 52f
17f = 68
Thus, f = 4

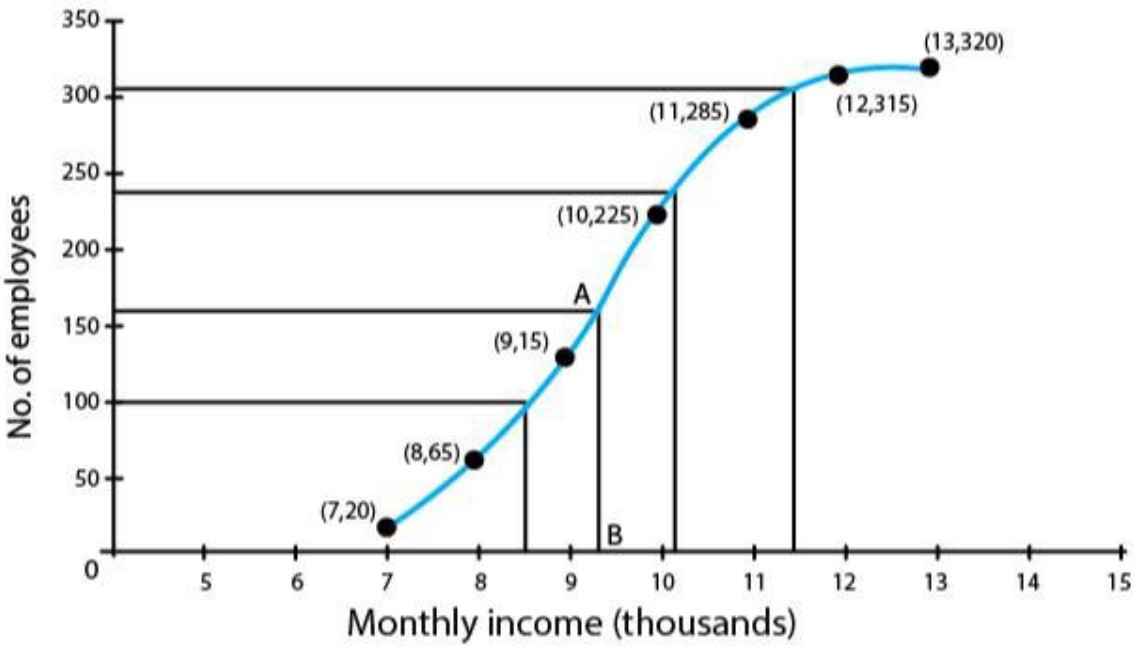
11. The monthly income of a group of 320 employees in a company is given below:

Monthly Income (thousands)	No. of employees
6 - 7	20
7 - 8	45
8 - 9	65
9 - 10	95
10 - 11	60
11 - 12	30
12 - 13	5

Draw an ogive of the given distribution on a graph paper taking 2 cm = Rs 1000 on one axis and 2 cm = 50 employees on the other axis. From the graph determine:
(i) the median wage.
(ii) number of employees whose income is below Rs 8500.
(iii) if salary of a senior employee is above Rs 11,500, find the number of senior employees in the company.
(iv) the upper quartile.
Solution:

Monthly Income (thousands)	No. of employees (f)	Cumulative frequency
6-7	20	20
7-8	45	65
8-9	65	130
9-10	95	225
10-11	60	285
11-12	30	315
12-13	5	320
Total	320	

Number of employees = 320



(i) Median = 320/2 = 160th term
Through mark 160, draw a parallel line to x-axis which meets the curve at A, From A draw a perpendicular to x-axis meeting it at B.
The value of point B is the median = Rs 9.3 thousands

(ii) The number of employees with income below Rs 8,500 = 95 (approx from the graph)

(iii) Number of employees with income below Rs 11,500 = 305 (approx from the graph)
Thus, the number of employees (senior employees) = 320 - 305 = 15

(iv) Upper quartile = Q_3 = 320 x (3/4) = 240th term = 10.3 thousands = Rs 10,300