

# Maharashtra State Board 11th Commerce

## Maths Solutions Chapter 1 Partition Values Ex 1.1

Question 1.

Compute all the quartiles for the following series of observations:

16, 14.9, 11.5, 11.8, 11.1, 14.5, 14, 12, 10.9, 10.7, 10.6, 10.5, 13.5, 13, 12.6

Solution:

The given data can be arranged in ascending order as follows:

10.5, 10.6, 10.7, 10.9, 11.1, 11.5, 11.8, 12, 12.6, 13, 13.5, 14, 14.5, 14.9, 16

Here,  $n = 15$

$Q_1$  = value of  $(\frac{n+1}{4})$ th observation

= value of  $(\frac{15+1}{4})$ th observation

= value of 4th observation

$\therefore Q_1 = 10.9$

$Q_2$  = value of  $2(\frac{n+1}{4})$ th observation

= value of  $2(\frac{15+1}{4})$ th observation

= value of  $(2 \times 4)$ th observation

= value of 8th observation

$\therefore Q_2 = 12$

$Q_3$  = value of  $3(\frac{n+1}{4})$ th observation

= value of  $3(\frac{15+1}{4})$ th observation

= value of  $(3 \times 4)$ th observation

= value of 12th observation

$\therefore Q_3 = 14$

Question 2.

The heights (in cm.) of 10 students are given below:

148, 171, 158, 151, 154, 159, 152, 163, 171, 145

Calculate  $Q_1$  and  $Q_3$  for the above data.

Solution:

The given data can be arranged in ascending order as follows:

145, 148, 151, 152, 154, 158, 159, 163, 171, 171

Here,  $n = 10$

$Q_1$  = value of  $(\frac{n+1}{4})$ th observation

= value of  $(\frac{10+1}{4})$ th observation

= value of (2.75)th observation

= value of 2nd observation + 0.75 (value of 3rd observation – value of 2nd observation)

= 148 + 0.75 (151 – 148)

= 148 + 0.75(3)

= 148 + 2.25

∴  $Q_1 = 150.25$

$Q_3$  = value of  $3(n+14)$ th observation

= value of  $3(10+14)$ th observation

= value of  $(3 \times 2.75)$ th observation

= value of (8.25)th observation

= value of 8th observation + 0.25 (value of 9th observation – value of 8th observation)

= 163 + 0.25(171 – 163)

= 163 + 0.25(8)

= 163 + 2

∴  $Q_3 = 165$

### Question 3.

The monthly consumption of electricity (in units) of families in a certain locality is given below:

205, 201, 190, 188, 195, 172, 210, 225, 215, 232, 260, 230

Calculate electricity consumption (in units) below which 25% of the families lie.

Solution:

To find the consumption of electricity below which 25% of the families lie, we have to find  $Q_1$ .

Monthly consumption of electricity (in units) can be arranged in ascending order as follows:

172, 188, 190, 195, 201, 205, 210, 215, 225, 230, 232, 260.

Here,  $n = 12$

$Q_1 = \text{value of } (n+14)\text{th observation}$

= value of  $(12+14)$ th observation

= value of (3.25)th observation

= value of 3rd observation + 0.25 (value of 4th observation – value of 3rd observation)

$$= 190 + 0.25(195 - 190)$$

$$= 190 + 0.25(5)$$

$$= 190 + 1.25$$

$$= 191.25$$

∴ the consumption of electricity below which 25% of the families lie is 191.25.

**Question 4.**

For the following data of daily expenditure of families (in ₹), compute the expenditure below which 75% of families include their expenditure.

Daily Expenditure (in ₹)	350	450	550	650	750
No. of families	16	19	24	28	13

**Solution:**

To find the expenditure below which 75% of families have their expenditure, we have to find  $Q_3$ .

We construct the less than cumulative frequency table as given below:

Daily Expenditure (in ₹)	No. of families	Less than cumulative frequency (c.f.)
350	16	16
450	19	35
550	24	59
650	28	87 ← $Q_3$
750	13	100
<b>Total</b>	<b>100</b>	

Here,  $n = 100$

$$Q_3 = \text{value of } 3(n+14)\text{th observation}$$

$$= \text{value of } 3(100+14)\text{th observation}$$

$$= \text{value of } (3 \times 25.25)\text{th observation}$$

$$= \text{value of } (75.75)\text{th observation}$$

Cumulative frequency which is just greater than (or equal to) 75.75 is 87.

$$\therefore Q_3 = 650$$

∴ the expenditure below which 75% of families include their expenditure is ₹ 650.

Question 5.

Calculate all the quartiles for the following frequency distribution:

No. of E-transactions per day	0	1	2	3	4	5	6	7
No. of days	10	35	45	95	64	32	10	9

Solution:

We construct the less than cumulative frequency table as given below:

No. of E-transactions per day	No. of days	Less than cumulative frequency (c.f.)
0	10	10
1	35	45
2	45	90 $\leftarrow Q_1$
3	95	185 $\leftarrow Q_2$
4	64	249 $\leftarrow Q_3$
5	32	281
6	10	291
7	9	300
<b>Total</b>	<b>300</b>	

Here,  $n = 300$

$Q_1 = \text{value of } (n+14)^{\text{th}} \text{ observation}$

$= \text{value of } (300+14)^{\text{th}} \text{ observation}$

$= \text{value of } (75.25)^{\text{th}} \text{ observation}$

Cumulative frequency which is just greater than (or equal to) 75.25 is 90.

$\therefore Q_1 = 2$

$Q_2 = \text{value of } 2(n+14)^{\text{th}} \text{ observation}$

$= \text{value of } 2(300+14)^{\text{th}} \text{ observation}$

$= \text{value of } (2 \times 75.25)^{\text{th}} \text{ observation}$

$= \text{value of } (150.50)^{\text{th}} \text{ observation}$

$\therefore$  Cumulative frequency which is just greater than (or equal to) 150.50 is 185.

$\therefore Q_2 = 3$

$Q_3 = \text{value of } 3(n+14)^{\text{th}} \text{ observation}$

= value of  $3(300+14)$ th observation

= value of  $(3 \times 75.25)$ th observation

= value of (225.75)th observation

Cumulative frequency which is just greater than (or equal to) 225.75 is 249.

$$\therefore Q_3 = 4$$

**Question 6.**

The following is the frequency distribution of heights of 200 male adults in a factory:

Height in cm.	No. of male adults
145-150	4
150-155	6
155-160	25
160-165	57
165-170	64
170-175	30
175-180	8
180-185	6

Find the central height.

Solution:

To find the central height, we have to find  $Q_2$ .

We construct the less than cumulative frequency table as given below:

Height (in cm.)	NO. OF male adults (f)	Less than cumulative frequency (c.f.)
145 - 150	4	4
150 - 155	6	10
155 - 160	25	35
160 - 165	57	92
165 - 170	64	156 ← $Q_2$
170 - 175	30	186
175 - 180	8	194
180 - 185	6	200
<b>Total</b>	<b>200</b>	

Here,  $N = 200$

$Q_2$  class = class containing  $(\frac{2N}{4})^{\text{th}}$  observation

$$\therefore \frac{2N}{4} = 2 \times 2004 = 100$$

Cumulative frequency which is just greater than (or equal to) 100 is 156.

$\therefore Q_2$  lies in the class 165 – 170.

$$\therefore L = 165, h = 5, f = 64, c.f. = 92$$

$$Q_2 = L + hf \left( \frac{2N}{4} - c.f. \right)$$

$$= 165 + 564 (100 - 92)$$

$$= 165 + 564 \times 8$$

$$= 165 + 58$$

$$= 165 + 0.625$$

$$= 165.625$$

$\therefore$  Central height is 165.625 cm.

### Question 7.

The following is the data of pocket expenditure per week of 50 students in a class. It is known that the median of the distribution is ₹ 120. Find the missing frequencies.

Expenditure per week (in ₹)	0-50	50-100	100-150	150-200	200-250
No. of students	7	?	15	?	3

Solution:

Let  $a$  and  $b$  be the missing frequencies of class 50 – 100 and class 150 – 200 respectively.

We construct the less than cumulative frequency table as given below:

Expenditure per week (in ₹)	No. of students (f)	Less than cumulative frequency (c.f.)
0 - 50	7	7
50 - 100	a	7 + a
100 - 150	15	22 + a ← Q <sub>2</sub>
150 - 200	b	22 + a + b
200 - 250	3	25 + a + b
<b>Total</b>	<b>25 + a + b</b>	

Here,  $N = 25 + a + b$

Since,  $N = 50$

$$\therefore 25 + a + b = 50$$

$$\therefore a + b = 25 \dots\dots(i)$$

Given, Median =  $Q_2 = 120$

$\therefore Q_2$  lies in the class 100 – 150.

$$\therefore L = 100, h = 50, f = 15, 2 N4 = 2 \times 504 = 25$$

$$\therefore Q_2 = L + hf(2 N4 - c.f.)$$

$$\therefore 120 = 100 + 50 \times 15 [25 - (7 + a)]$$

$$\therefore 120 - 100 = 103 (25 - 7 - a)$$

$$\therefore 20 = 103 (18 - a)$$

$$\therefore 6010 = 18 - a$$

$$\therefore 6 = 18 - a$$

$$\therefore a = 18 - 6 = 12$$

Substituting the value of a in equation (i), we get

$$12 + b = 25$$

$$\therefore b = 25 - 12 = 13$$

$\therefore 12$  and  $13$  are the missing frequencies of the class 50 – 100 and class 150 – 200 respectively.

Question 8.

The following is the distribution of 160 workers according to the wages in a certain factory:

Wages more than (in ₹)	No. of workers
8000	160
9000	155
10000	137
11000	103
12000	57
13000	23
14000	10
15000	1
16000	0

Determine the values of all quartiles and interpret the results.

Solution:

The given table is a more than cumulative frequency.

We transform the given table into less than cumulative frequency.

We construct the less than cumulative frequency table as given below:

Wages (in ₹)	No. of workers (f)	Less than cumulative frequency (c.f.)
8000 - 9000	$160 - 155 = 5$	5
9000 - 10000	$155 - 137 = 18$	23
10000 - 11000	$137 - 91 = 46$	$69 \leftarrow Q_1$
11000 - 12000	$91 - 57 = 34$	$103 \leftarrow Q_2$
12000 - 13000	$57 - 23 = 34$	$137 \leftarrow Q_3$
13000 - 14000	$23 - 10 = 13$	150
14000 - 15000	$10 - 1 = 9$	159
15000 - 16000	$1 - 0 = 1$	160
16000 - 17000	0	160
<b>Total</b>	<b>160</b>	

Here,  $N = 160$

$\therefore Q_1$  class = class containing  $(N_4)^{th}$  observation

$$\therefore N_4 = 160/4 = 40$$

Cumulative frequency which is just greater than (or equal to) 40 is 69.

$\therefore Q_1$  lies in the class 10000 – 11000

$$\therefore L = 10000, h = 1000, f = 46, c.f. = 23$$

$$\begin{aligned}Q_1 &= L + hf(N_4 - c.f.) \\&= 10000 + 100046(40 - 23) \\&= 10000 + 100046(17) \\&= 10000 + 1700046 \\&= 10000 + 369.57 \\&= 10369.57\end{aligned}$$

$Q_2$  class = class containing  $(2N_4)$ th observation

$$\therefore 2N_4 = 2 \times 1604 = 80$$

Cumulative frequency which is just greater than (or equal to) 80 is 103.

$\therefore Q_2$  lies in the class 11000 – 12000.

$$\therefore L = 11000, h = 1000, f = 34, c.f. = 69$$

$$\begin{aligned}\therefore Q_2 &= L + hf(2N_4 - c.f.) \\&= 11000 + 100034(80 - 69) \\&= 11000 + 100034(11) \\&= 11000 + 1100034 \\&= 11000 + 323.529 \\&= 11323.529\end{aligned}$$

$Q_3$  class = class containing  $(3N_4)$ th observation

$$\therefore 3N_4 = 3 \times 1604 = 120$$

Cumulative frequency which is just greater than (or equal to) 120 is 137.

$\therefore Q_3$  lies in the class 12000 – 13000.

$$\therefore L = 12000, h = 1000, f = 34, c.f. = 103$$

$$\begin{aligned}\therefore Q_3 &= L + hf(3N_4 - c.f.) \\&= 12000 + 100034(120 - 103) \\&= 12000 + 100034(17) \\&= 12000 + 10002 \\&= 12000 + 500 \\&= 12500\end{aligned}$$

Interpretation:

$$Q_1 < Q_2 < Q_3$$

Question 9.

Following is grouped data for the duration of fixed deposits of 100 senior citizens from a certain bank:

<b>Fixed deposits (in days)</b>	0- 180	180- 360	360- 540	540- 720	720- 900
<b>No. of senior citizens</b>	15	20	25	30	10

Calculate the limits of fixed deposits of central 50% senior citizens.

Solution:

We construct the less than cumulative frequency table as given below:

<b>Fixed deposit (in days)</b>	<b>No. of senior citizens (f)</b>	<b>Less than cumulative frequency (c.f.)</b>
0 - 180	15	15
180 - 360	20	35 ← $Q_1$
360 - 540	25	60
540 - 720	30	90 ← $Q_3$
720 - 900	10	100
<b>Total</b>	<b>100</b>	

To find the limits of fixed deposits of central 50% senior citizens, we have to find  $Q_1$  and  $Q_3$ .

Here,  $N = 100$

$Q_1$  class = class containing  $(N/4)^{th}$  observation

$$\therefore N/4 = 100/4 = 25$$

Cumulative frequency which is just greater than (or equal to) 25 is 35.

$\therefore Q_1$  lies in the class 180 – 360.

$$\therefore L = 180, h = 180, f = 20, c.f. = 15$$

$$\therefore Q_1 = L + hf(N/4 - c.f.)$$

$$= 180 + 180 \cdot 20 (25 - 15)$$

$$= 180 + 9(10)$$

$$= 180 + 90$$

$$\therefore Q_1 = 270$$

$Q_3$  class = class containing  $(3N/4)^{th}$  observation

$$\therefore 3N/4 = 3 \times 100/4 = 75$$

Cumulative frequency which is just greater than (or equal to) 75 is 90.

$\therefore Q_3$  lies in the class 540 – 720.

$$\therefore L = 540, h = 180, f = 30, c.f. = 60$$

$$\therefore Q_3 = L + hf(3N/4 - c.f.)$$

$$= 540 + 180 \cdot 30 (75 - 60)$$

$$= 540 + 6(15)$$

$$= 540 + 90$$

$$\therefore Q_3 = 630$$

$\therefore$  Limits of duration of fixed deposits of central 50% senior citizens is from 270 to 630.

Question 10.

Find the missing frequency given that the median of the distribution is 1504.

Life in hours	950-1150	1150-1350	1350-1550	1550-1750	1750-1950	1950-2150
No. of bulbs	20	43	100	-	23	13

Solution:

Let  $x$  be the missing frequency of the class 1550 – 1750.

We construct the less than frequency table as given below:

Life in hours	No. of bulbs (f)	Less than Cumulative frequency (c.f.)
950 - 1150	20	20
1150 - 1350	43	63
1350 - 1550	100	163
1550 - 1750	$x$	$163 + x$
1750 - 1950	23	$186 + x$
1950 - 2150	13	$199 + x$
<b>Total</b>	<b><math>199 + x</math></b>	

Here,  $N = 199 + x$

Given, Median ( $Q_2$ ) = 1504

$\therefore Q_2$  lies in the class 1350 – 1550.

$\therefore L = 1350, h = 200, f = 100, c.f. = 63,$

$$2N/4 = 199 + x/2$$

$$\therefore Q_2 = L + hf \left( \frac{2N/4 - c.f.}{f} \right)$$

$$\therefore 1504 = 1350 + 200 \left( \frac{199 + x/2 - 63}{100} \right)$$

$$\therefore 1504 - 1350 = 2 \left( \frac{199 + x/2 - 126}{100} \right)$$

$$\therefore 154 = 199 + x/2 - 126$$

$$\therefore 154 = x/2 + 73$$

$$\therefore x = 81$$

# Maharashtra State Board 11th Commerce

## Maths Solutions Chapter 1 Partition Values Ex 1.2

Question 1.

Calculate  $D_6$  and  $P_{85}$  for the following data:

79, 82, 36, 38, 51, 72, 68, 70, 64, 63

Solution:

The given data can be arranged in ascending order as follows:

36, 38, 51, 63, 64, 68, 70, 72, 79, 82

Here,  $n = 10$

$$D_6 = \text{value of } 6\left(\frac{n+1}{10}\right)\text{th observation}$$

$$= \text{value of } 6\left(\frac{10+1}{10}\right)\text{th observation}$$

$$= \text{value of } (6 \times 1.1)\text{th observation}$$

$$= \text{value of } (6.6)\text{th observation}$$

$$= \text{value of 6th observation} + 0.6(\text{value of 7th observation} - \text{value of 6th observation})$$

$$= 68 + 0.6(70 - 68)$$

$$= 68 + 0.6(2)$$

$$= 68 + 1.2$$

$$\therefore D_6 = 69.2$$

$$P_{85} = \text{value of } \left(\frac{n+1}{10}\right)\text{th observation}$$

$$= \text{value of } \left(\frac{10+1}{10}\right)\text{th observation}$$

$$= \text{value of } (85 \times 0.11)\text{th observation}$$

$$= \text{value of } (9.35)\text{th observation}$$

$$= \text{value of 9th observation} + 0.35(\text{value of 10th observation} - \text{value of 9th observation})$$

$$= 79 + 0.35(82 - 79)$$

$$= 79 + 0.35(3)$$

$$= 79 + 1.05$$

$$\therefore P_{85} = 80.05$$

Question 2.

The daily wages (in ₹) of 15 labourers are as follows:

AllGuideSite :

Digvijay

Arjun

230, 400, 350, 200, 250, 380, 210, 225, 375, 180, 375, 450, 300, 350, 250

Calculate  $D_8$  and  $P_{90}$ .

Solution:

The given data can be arranged in ascending order as follows:

180, 200, 210, 225, 230, 250, 250, 300, 350, 350, 375, 375, 380, 400, 450

Here,  $n = 15$

$D_8 = \text{value of } 8(n+1)^\text{th} \text{ observation}$

$= \text{value of } 8(15+1)^\text{th} \text{ observation}$

$= \text{value of } (8 \times 1.6)^\text{th} \text{ observation}$

$= \text{value of } (12.8)^\text{th} \text{ observation}$

$= \text{value of } 12\text{th observation} - 0.8(\text{value of } 13\text{th observation} - \text{value of } 12\text{th observation})$

$= 375 + 0.8(380 - 375)$

$= 375 + 0.8(5)$

$= 375 + 4$

$\therefore D_8 = 379$

$P_{90} = \text{value of } 90(n+1)^\text{th} \text{ observation}$

$= \text{value of } 90(15+1)^\text{th} \text{ observation}$

$= \text{value of } (90 \times 0.16)^\text{th} \text{ observation}$

$= \text{value of } (14.4)^\text{th} \text{ observation}$

$= \text{value of } 14\text{th observation} + 0.4(\text{value of } 15\text{th observation} - \text{value of } 14\text{th observation})$

$= 400 + 0.4(450 - 400)$

$= 400 + 0.4(50)$

$= 400 + 20$

$\therefore P_{90} = 420$

Question 3.

Calculate 2nd decile and 65th percentile for the following:

$x$	80	100	120	145	200	280	310	380	400	410
$f$	15	18	25	27	40	25	19	16	8	7

Solution:

We construct the less than cumulative frequency table as given below:

<b>x</b>	<b>f</b>	<b>Less than cumulative frequency (c.f.)</b>
80	15	15
100	18	33
120	25	58 ← D <sub>2</sub>
145	27	85
200	40	125
280	25	150 ← P <sub>65</sub>
310	19	169
380	16	185
400	8	193
410	7	200
<b>Total</b>	<b>200</b>	

Here, n = 200

D<sub>2</sub> = value of 2( $n+1$ )<sup>th</sup> observation

= value of 2(200+1)<sup>th</sup> observation

= value of (2 × 20.1)<sup>th</sup> observation

= value of (40.2)<sup>th</sup> observation

Cumulative frequency which is just greater than (or equal to) 40.2 is 58.

∴ D<sub>2</sub> = 120

P<sub>65</sub> = value of 65( $n+1$ )<sup>th</sup> observation

= value of 65(200+1)<sup>th</sup> observation

= value of (65 × 2.01)<sup>th</sup> observation

= value of (130.65)<sup>th</sup> observation

The cumulative frequency which is just greater than (or equal to) 130.65 is 150.  
∴ P<sub>65</sub> = 280

Question 4.

From the following data calculate the rent of the 15th, 65th, and 92nd house.

House Rent (in ₹)	11000	12000	13000	15000	14000	16000	17000	18000
No. of houses	25	17	13	14	15	8	6	2

Solution:

Arranging the given data in ascending order.

House Rent (in ₹)	No. of houses (f)	Less than cumulative frequency (c.f)
11000	25	25 ← $P_{15}$
12000	17	42
13000	13	55
14000	15	70 ← $P_{65}$
15000	14	84
16000	8	92
17000	6	98 ← $P_{92}$
18000	2	100
<b>Total</b>	<b>100</b>	

Here,  $n = 100$

$P_{15} = \text{value of } 15$

= value of  $15(n+1100)^{\text{th}}$  observation

= value of  $15(100+1100)^{\text{th}}$  observation

= value of  $(15 \times 1.01)^{\text{th}}$  observation

= value of (15.15)<sup>th</sup> observation

Cumulative frequency which is just greater than (or equal to) 15.15 is 25.

∴  $P_{15} = 11000$

$P_{65} = \text{value of } 65(n+1100)^{\text{th}}$  observation

= value of  $65(100+1100)^{\text{th}}$  observation

= value of  $(65 \times 1.01)^{\text{th}}$  observation

= value of (65.65)<sup>th</sup> observation

Cumulative frequency which is just greater than (or equal to) 65.65 is 70.

∴  $P_{65} = 14000$

$P_{92} = \text{value of } 92(n+1100)^{\text{th}}$  observation

= value of  $92(100+1100)^{\text{th}}$  observation

= value of  $(92 \times 1.01)^{\text{th}}$  observation

= value of (92.92)<sup>th</sup> observation

Cumulative frequency which is just greater than (or equal to) 92.92 is 98.

∴  $P_{92} = 17000$

## Question 5.

The following frequency distribution shows the weight of students in a class.

Weight (in Kg)	40	45	50	55	60	65
Number of Students	15	40	29	21	10	5

- (a) Find the percentage of students whose weight is more than 50 kg.
- (b) If the weight column provided is of mid values then find the percentage of students whose weight is more than 50 kg.

Solution:

- (a) Let the percentage of students weighing less than 50 kg be x.

$$\therefore Px = 50$$

Weight (in kg)	Number of students (f)	Less than cumulative frequency (c.f.)
40	15	15
45	40	55
50	29	84
55	21	105
60	10	115
65	5	120
<b>Total</b>	<b>120</b>	

From the table, out of 20 students, 84 students have their weight less than 50 kg.

$$\therefore \text{Number of students weighing more than } 50 \text{ kg} = 120 - 84 = 36$$

$$\therefore \text{Percentage of students having their weight more than } 50 \text{ kg} = \frac{36}{120} \times 100 = 30\%$$

- (b) The difference between any two consecutive mid values of weight is 5 kg.

The class intervals must be of width 5, with 40, 45,..... as their mid values.

$$\therefore \text{The class intervals will be } 37.5 - 42.5, 42.5 - 47.5, \text{ etc.}$$

We construct the less than cumulative frequency table as given below:

Weight (in kg)	Number of students (f)	Less than cumulative frequency (c.f.)
37.5 - 42.5	15	15
42.5 - 47.5	40	55
47.5 - 52.5	29	84
52.5 - 57.5	21	105
57.5 - 62.5	10	115
62.5 - 67.5	5	120
<b>Total</b>	<b>120</b>	

Here,  $N = 120$

Let  $P_x = 50$

The value 50 lies in the class  $47.5 - 52.5$

$\therefore L = 47.5, h = 5, f = 29, c.f. = 55$

$$P_x = L + \frac{h}{f} \left( \frac{xN}{100} - c.f. \right)$$

$$\therefore 50 = 47.5 + \frac{5}{29} \left( \frac{x \times 120}{100} - 55 \right)$$

$$\therefore 50 - 47.5 = \frac{5}{29} \left( \frac{6x}{5} - 55 \right)$$

$$\therefore 2.5 = \frac{5}{29} \left( \frac{6x}{5} - 55 \right)$$

$$\therefore \frac{6x}{5} - 55 = 2.5 \times \frac{29}{5}$$

$$\therefore \frac{6x}{5} - 55 = 14.5 \quad \therefore \frac{6x}{5} = 55 + 14.5$$

$$\therefore \frac{6x}{5} = 69.5 \quad \therefore x = 69.5 \times \frac{5}{6}$$

$\therefore x = 58$  (approximately)

$\therefore 58\%$  of students are having weight below 50 kg.

$\therefore$  Percentage of students having weight above 50 kg is  $100 - 58 = 42$

$\therefore 42\%$  of students are having weight above 50 kg.

Question 6.

Calculate  $D_4$  and  $P_{48}$  from the following data:

Mid Value	2.5	7.5	12.5	17.5	22.5	Total
Frequency	7	18	25	30	20	100

Solution:

The difference between any two consecutive mid values is 5, the width of class interval = 5

∴ Class interval with mid-value 2.5

Class interval with mid value 7.5 is 5 – 10, etc.

We construct the less than cumulative frequency table as given below:

Class Interval	Frequency (f)	Less than cumulative frequency (c.f.)
0 - 5	7	7
5 - 10	18	25
10 - 15	25	50 ← D <sub>4</sub> , P <sub>48</sub>
15 - 20	30	80
20 - 25	20	100
<b>Total</b>	<b>100</b>	

Here, N = 100

D<sub>4</sub> class = class containing (4N/10)<sup>th</sup> observation

$$\therefore 4N/10 = 4 \times 100/10 = 40$$

Cumulative frequency which is just greater than (or equal to) 40 is 50.

∴ D<sub>4</sub> lies in the class 10 – 15.

$$\therefore L = 10, h = 5, f = 25, c.f. = 25$$

$$\therefore D_4 = L + hf \left( \frac{4N/10 - c.f.}{f} \right)$$

$$= 10 + 5 \times 25 (40 - 25)$$

$$= 10 + 15 (15)$$

$$= 10 + 3$$

$$\therefore D_4 = 13$$

P<sub>48</sub> class = class containing (48N/100)<sup>th</sup> observation

$$\therefore 48N/100 = 48 \times 100/100 = 48$$

Cumulative frequency which is just greater than (or equal to) 48 is 50.

∴ P<sub>48</sub> lies in the class 10 – 15.

$$\therefore L = 10, h = 5, f = 25, c.f. = 25$$

$$\therefore P_{48} = L + hf \left( \frac{48N/100 - c.f.}{f} \right)$$

$$= 10 + 525 (48 - 25)$$

$$= 10 + 15 (23)$$

$$= 10 + 4.6$$

$$\therefore P_{48} = 14.6$$

Question 7.

Calculate  $D_9$  and  $P_{20}$  of the following distribution.

Length (in Inches)	0-20	20-40	40-60	60-80	80-100	100-120
No. of units	1	14	35	85	90	15

Solution:

We construct the less than cumulative frequency table as given below:

Length (in inches)	No. of Units (f)	Less than cumulative frequency (c.f.)
0 - 20	1	1
20 - 40	14	15
40 - 60	35	50 ← $P_{20}$
60 - 80	85	135
80 - 100	90	225 ← $D_9$
100 - 120	15	240
<b>Total</b>	<b>240</b>	

Here,  $N = 240$

$D_9$  class = class containing  $(9 N/10)^{th}$  observation

$$\therefore 9 N/10 = 9 \times 240/10 = 216$$

Cumulative frequency which is just greater than (or equal to) 216 is 225.

$\therefore D_9$  lies in the class 80 – 100.

$$\therefore L = 80, h = 20, f = 90, c.f. = 135$$

$$\therefore D_9 = L + hf \left( \frac{9N/10 - c.f.}{f} \right)$$

$$= 80 + 20 \times 90 (216 - 135)$$

$$= 80 + 29(81)$$

$$= 80 + 18$$

$$\therefore D_9 = 98$$

$P_{20}$  class = class containing  $(20 N/100)^{th}$  observation

$$\therefore 20 N/100 = 20 \times 240/100 = 48$$

Cumulative frequency which is just greater than (or equal to) 48 is 50.

$\therefore P_{20}$  lies in the class 40 – 60.

$\therefore L = 40, h = 20, f = 35, c.f. = 15$

$$\begin{aligned}\therefore P_{20} &= L + \frac{h}{f} \left( \frac{20N}{100} - c.f. \right) \\ &= 40 + \frac{20}{35} (48 - 15) \\ &= 40 + \frac{4}{7} (33) \\ &= 40 + \frac{132}{7} = 40 + 18.86\end{aligned}$$

$\therefore P_{20} = 58.86$

Question 8.

Weekly wages for a group of 100 persons are given below:

Wages (in ₹)	0-500	500- 1000	1000- 1500	1500- 2000	2000- 2500
No. of per- sons	7	?	25	30	?

$D_3$  for this group is ₹ 1100. Calculate the missing frequencies.

Solution:

Let  $a$  and  $b$  be the missing frequencies of class 500 – 1000 and class 2000 – 2500 respectively.

We construct the less than cumulative frequency table as given below:

Wages (in ₹)	No. of persons (f)	Less than Cumulative frequency (c.f.)
0 - 500	7	7
500 - 1000	a	7 + a
1000 - 1500	25	32 + a $\leftarrow D_3$
1500 - 2000	30	62 + a
2000 - 2500	b	62 + a + b
<b>Total</b>	<b>62 + a + b</b>	

Here,  $N = 62 + a + b$

Since,  $N = 100$

$$\therefore 62 + a + b = 100$$

$$\therefore a + b = 38 \dots\dots(i)$$

Given,  $D_3 = 1100$

$\therefore D_3$  lies in the class 1000 – 1500.

$$\therefore L = 1000, h = 500, f = 25, c.f. = 7 + a$$

$$\therefore 3N10=3\times10010=30$$

$$\therefore D_3 = L+hf(3N10-c.f.)$$

$$\therefore 1100 = 1000 + 50025 [30 - (7 + a)]$$

$$\therefore 1100 - 1000 = 20(30 - 7 - a)$$

$$\therefore 100 = 20(23 - a)$$

$$\therefore 100 = 460 - 20a$$

$$\therefore 20a = 460 - 100$$

$$\therefore 20a = 360$$

$$\therefore a = 18$$

Substituting the value of a in equation (i), we get

$$18 + b = 38$$

$$\therefore b = 38 - 18 = 20$$

$\therefore 18$  and  $20$  are the missing frequencies of the class 500 – 1000 and class 2000 – 2500 respectively.

### Question 9.

The weekly profit (in rupees) of 100 shops are distributed as follows:

Profit per shop	No. of Shops
0-1000	10
1000-2000	16
2000-3000	26
3000-4000	20
4000-5000	20
5000-6000	5
6000-7000	3

Find the limits of the profit of middle 60% of the shops.

Solution:

To find the limits of the profit of the middle 60% of the shops, we have to find  $P_{20}$  and  $P_{80}$ .

We construct the less than cumulative frequency table as given below:

Profit per shop (in ₹)	No. of shops (f)	Less than cumulative frequency (c.f.)
0 - 1000	10	10
1000 - 2000	16	26 ← $P_{20}$
2000 - 3000	26	52
3000 - 4000	20	72
4000 - 5000	20	92 ← $P_{80}$
5000 - 6000	5	97
6000 - 7000	3	100
<b>Total</b>	<b>100</b>	

Here,  $N = 100$

$P_{20}$  class = class containing  $(20N/100)$ th observation

$$\therefore 20N/100 = 20 \times 100/100 = 20$$

Cumulative frequency which is just greater than (or equal to) 20 is 26.

$\therefore P_{20}$  lies in the class 1000 – 2000.

$$\therefore L = 1000, h = 1000, f = 16, c.f. = 10$$

$$\therefore P_{20} = L + hf(20 N/100 - c.f.)$$

$$= 1000 + 1000 \times 16 (20 - 10)$$

$$= 1000 + 1252 (10)$$

$$= 1000 + 625$$

$$\therefore P_{20} = 1625$$

$P_{80}$  class = class containing  $(80 N/100)$ th observation

$$\therefore 80 N/100 = 80 \times 100/100 = 80$$

Cumulative frequency which is just greater than (or equal to) 80 is 92.

$\therefore P_{80}$  lies in the class 4000 – 5000.

$$\therefore L = 4000, h = 1000, f = 20, c.f. = 72$$

$$\therefore P_{80} = L + hf(80 N/100 - c.f.)$$

$$= 4000 + 1000 \times 20 (80 - 72)$$

$$= 4000 + 50(8)$$

$$= 4000 + 400$$

$$\therefore P_{80} = 4400$$

$\therefore$  the profit of middle 60% of the shops lie between the limits ₹ 1,625 to ₹ 4,400.

Question 10.

In a particular factory, workers produce various types of output units. The following distribution was obtained:

Outputs units Produced	No. of workers
70-74	40
75-79	45
80-84	50
85-89	60
90-94	70
95-99	80
100-104	100

Find the percentage of workers who have produced less than 82 output units.

Solution:

Since the given data is not continuous, we have to convert it into a continuous form by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of every class interval.

∴ the class intervals will be 69.5 – 74.5, 74.5 – 79.5, etc.

We construct the less than cumulative frequency table as given below:

Output units produced	NO. OF workers (f)	Less than cumulative frequency (c.f.)
69.5 - 74.5	40	40
74.5 - 79.5	45	85
79.5 - 84.5	50	135
84.5 - 89.5	60	195
89.5 - 94.5	70	265
94.5 - 99.5	80	345
99.5 - 104.5	100	445
<b>Total</b>	<b>445</b>	

Here,  $N = 445$

Let  $P_x = 82$

The value 82 lies in the class 79.5 – 84.5

∴ L = 79.5, h = 5, f = 50, c.f. = 85

$$\therefore P_x = L + \frac{h}{f} \left( \frac{xN}{100} - c.f. \right)$$

$$\therefore 82 = 79.5 + \frac{5}{50} \left( \frac{x \times 445}{100} - 85 \right)$$

$$\therefore 82 - 79.5 = \frac{1}{10} \left( \frac{89x}{20} - 85 \right)$$

$$\therefore 2.5 \times 10 = \frac{89x}{20} - 85$$

$$\therefore 25 + 85 = \frac{89x}{20}$$

$$\therefore 110 = \frac{89x}{20}$$

$$\therefore x = \frac{110 \times 20}{89} = 24.72$$

$\therefore$  24.72% of workers produced less than 82 output units.

## Maharashtra State Board 11th Commerce Maths Solutions Chapter 1 Partition Values Ex 1.3

Question 1.

The following table gives the frequency distribution of marks of 100 students in an examination.

Marks	15-20	20-25	25-30	30-35	35-40	40-45	45-50
No. of students	9	12	23	31	10	8	7

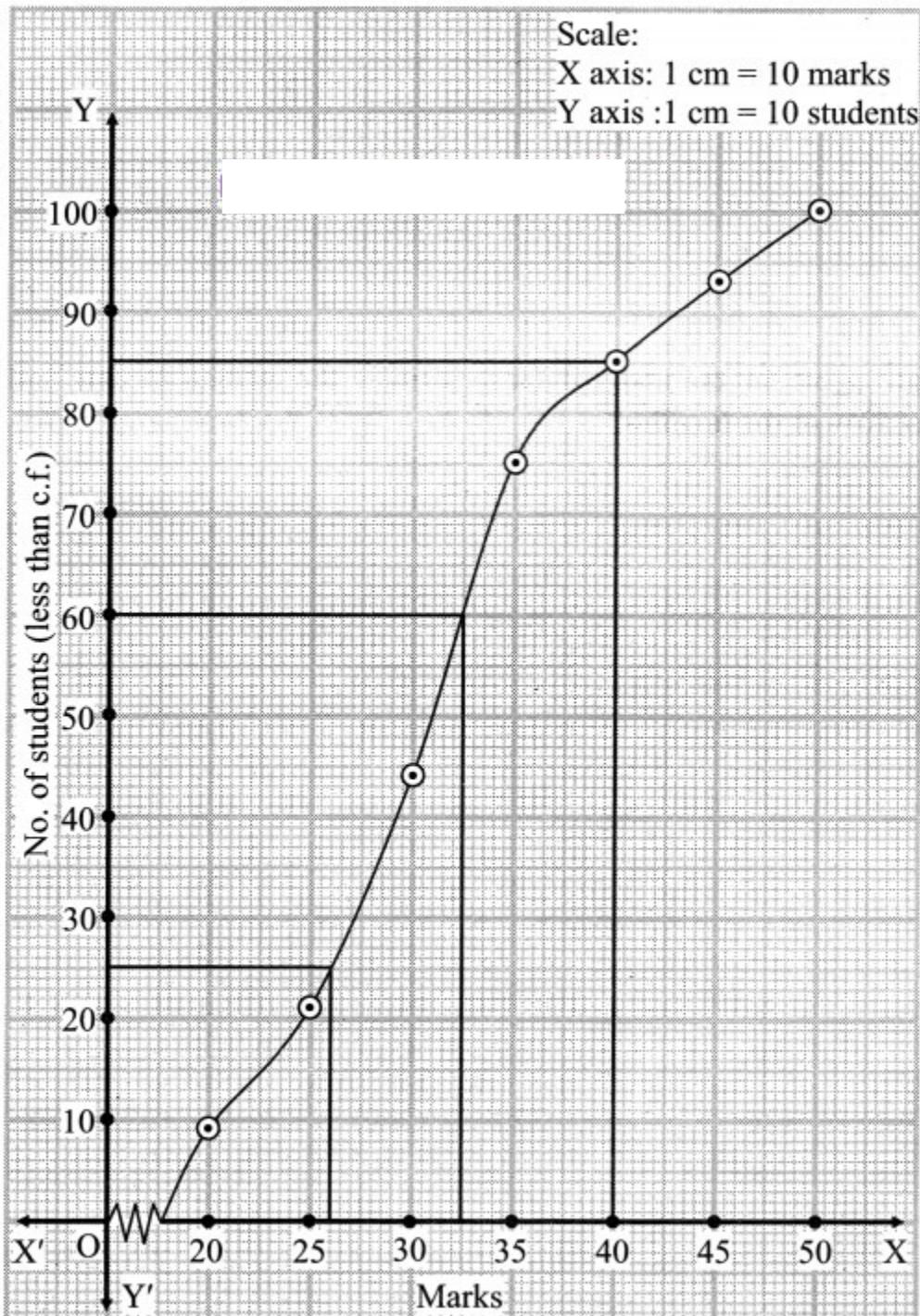
Determine  $D_6$ ,  $Q_1$ , and  $P_{85}$  graphically.

Solution:

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

Marks	No. of students (f)	Less than cumulative frequency (c.f.)
15-20	9	9
20-25	12	21
25-30	23	44
30-35	31	75
35-40	10	85
40-45	8	93
45-50	7	100
<b>Total</b>	<b>100</b>	

The points to be plotted for less than ogive are (20, 9), (25, 21), (30, 44) , (35, 75), (40, 85), (45, 93), (50, 100).



Here, N = 100

$$\text{For } D_6, 6 \times 10 = 60$$

$$\text{For } Q_1, N_4 = 100/4 = 25$$

$$\text{For } P_{85}, 85 \times 100 = 850$$

∴ We take the points having Y co-ordinates 60, 25 and 85 on Y-axis.

From these points, we draw lines parallel to X-axis.

From the points where these lines intersect the curve, we draw

perpendiculars on X-axis.

X co-ordinates of these points give the values of  $D_6$ ,  $Q_1$  and  $P_{85}$ .

$$\therefore D_6 = 32.5, Q_1 = 26, P_{85} = 40$$

Question 2.

The following table gives the distribution of daily wages of 500 families in a certain city.

Daily wages	No. of families
Below 100	50
100-200	150
200-300	180
300-400	50
400-500	40
500-600	20
600 above	10

Draw a 'less than' ogive for the above data. Determine the median income and obtain the limits of income of central 50% of the families.

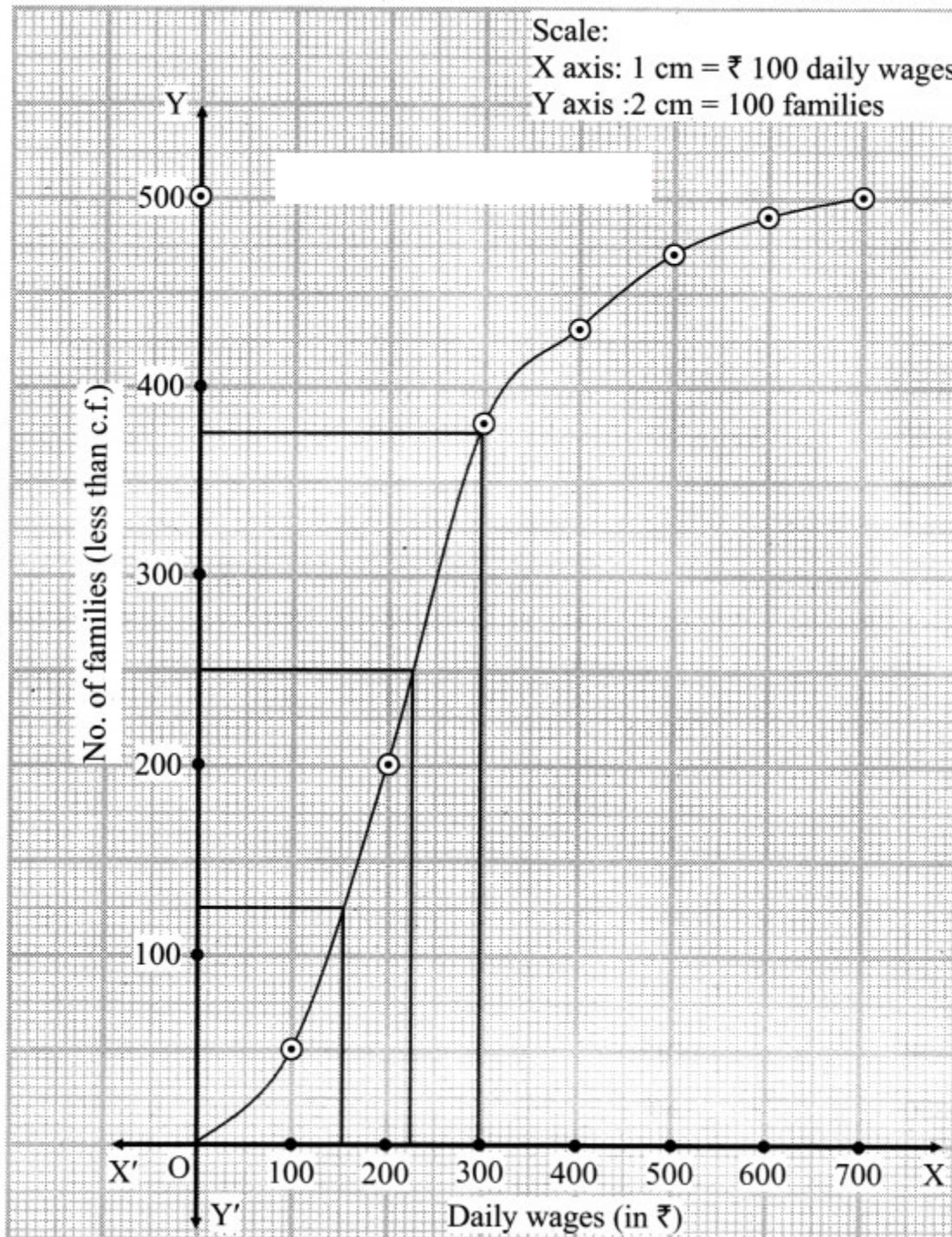
Solution:

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

Daily Wages	No. of families (f)	Less than cumulative frequency (c.f.)
Below 100	50	50
100 - 200	150	200
200 - 300	180	380
300 - 400	50	430
400 - 500	40	470
500 - 600	20	490
600 above	10	500
<b>Total</b>	<b>500</b>	

The points to be plotted for less than ogive are (100, 50), (200, 200), (300,

380), (400, 430), (500, 470), (600, 490) and (700, 500).



Here,  $N = 500$

For  $Q_1$ ,  $N_4=5004 = 125$

For  $Q_2$ ,  $N_2=5002 = 250$

For  $Q_3$ ,  $3 N_4=3 \times 5004 = 375$

∴ We take the points having Y co-ordinates 125, 250 and 375 on Y-axis.

From these points we draw lines parallel to X-axis.

From the points where these lines intersect the curve, we draw perpendiculars on X-axis.

X-Co-ordinates of these points give the values of  $Q_1$ ,  $Q_2$  and  $Q_3$ .

$\therefore Q_1 \sim 150$ ,  $Q_2 \sim 228$ ,  $Q_3 \sim 297$

$\therefore$  Median = 228

50% families lie between  $Q_1$  and  $Q_3$

$\therefore$  Limits of income of central 50% families are from ₹ 150 to ₹ 297

Question 3.

From the following distribution, determine the median graphically.

Daily wages (in ₹)	No. of employees
Above 300	520
Above 400	470
Above 500	399
Above 600	210
Above 700	105
Above 800	45
Above 900	7

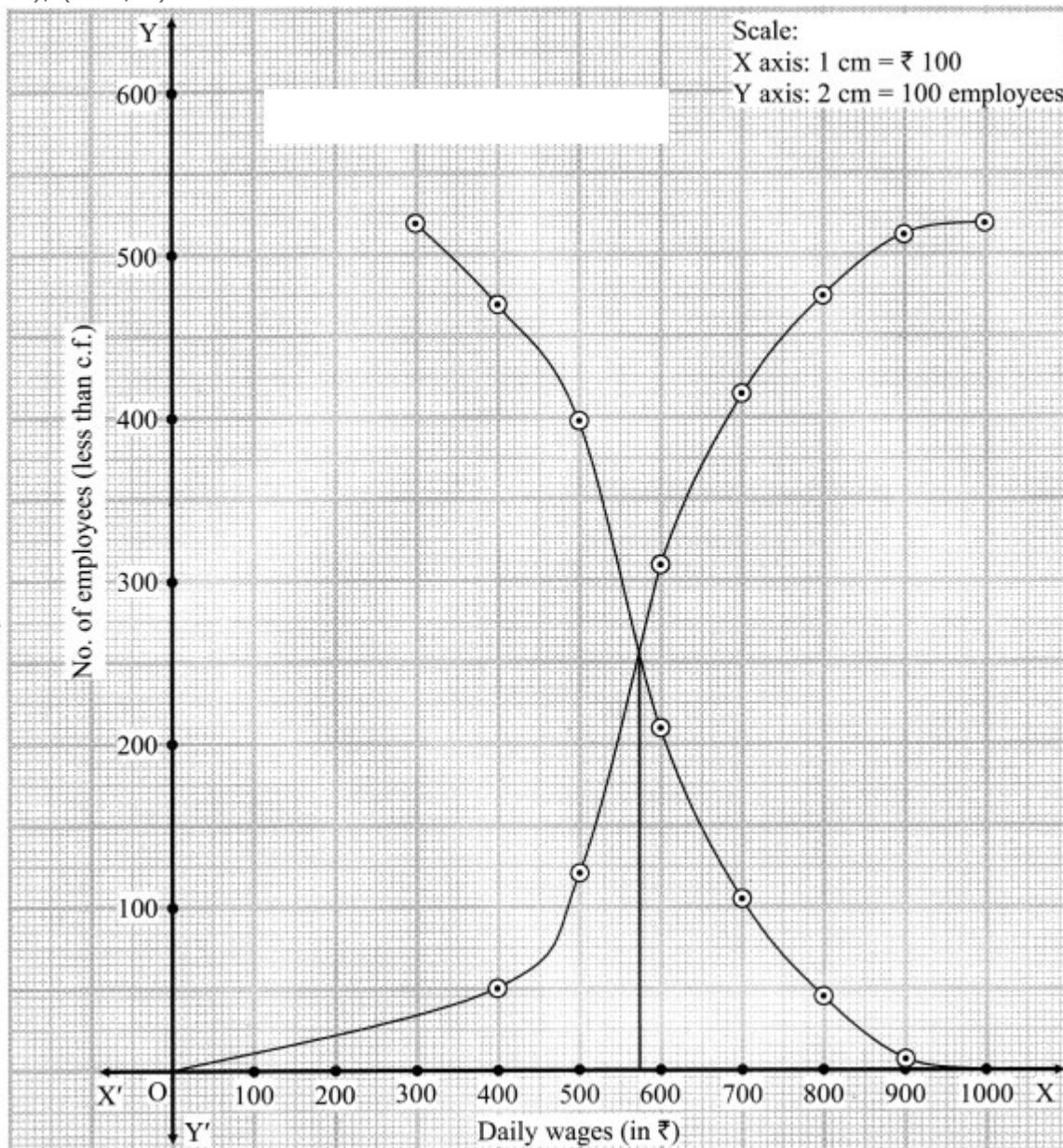
Solution:

To draw an ogive curve, we construct the less than and more than cumulative frequency table as given below:

Daily wages (in ₹)	No. of employees (f)	Less than cumulative frequency (c.f.)	More than cumulative frequency (c.f.)
300-400	50	50	520
400-500	71	121	470
500-600	189	310	399
600-700	105	415	210
700-800	60	475	105
800-900	38	513	45
900-1000	7	520	7
<b>Total</b>	<b>520</b>		

The points to be plotted for less than ogive are (400, 50), (500, 121), (600, 310), (700, 415), (800, 475), (900, 513) and (1000, 520) and that for more than ogive are (300, 520), (400, 470), (500, 399), (600, 210), (700, 105), (800,

45), (900, 7).



From the point of intersection of two ogives, we draw a perpendicular on X-axis.

The point where it meets the X-axis gives the value of the median.

∴ Median  $\sim 574$

Question 4.

The following frequency distribution shows the profit (in ₹) of shops in a particular area of the city.

Profit per shop (in '000)	No. of shops
0-10	12
10-20	18
20-30	27
30-40	20
40-50	17
50-60	6

Find graphically

- (i) the Unfits of middle 40% shops.
- (ii) the number of shops having a profit of fewer than 35,000 rupees.

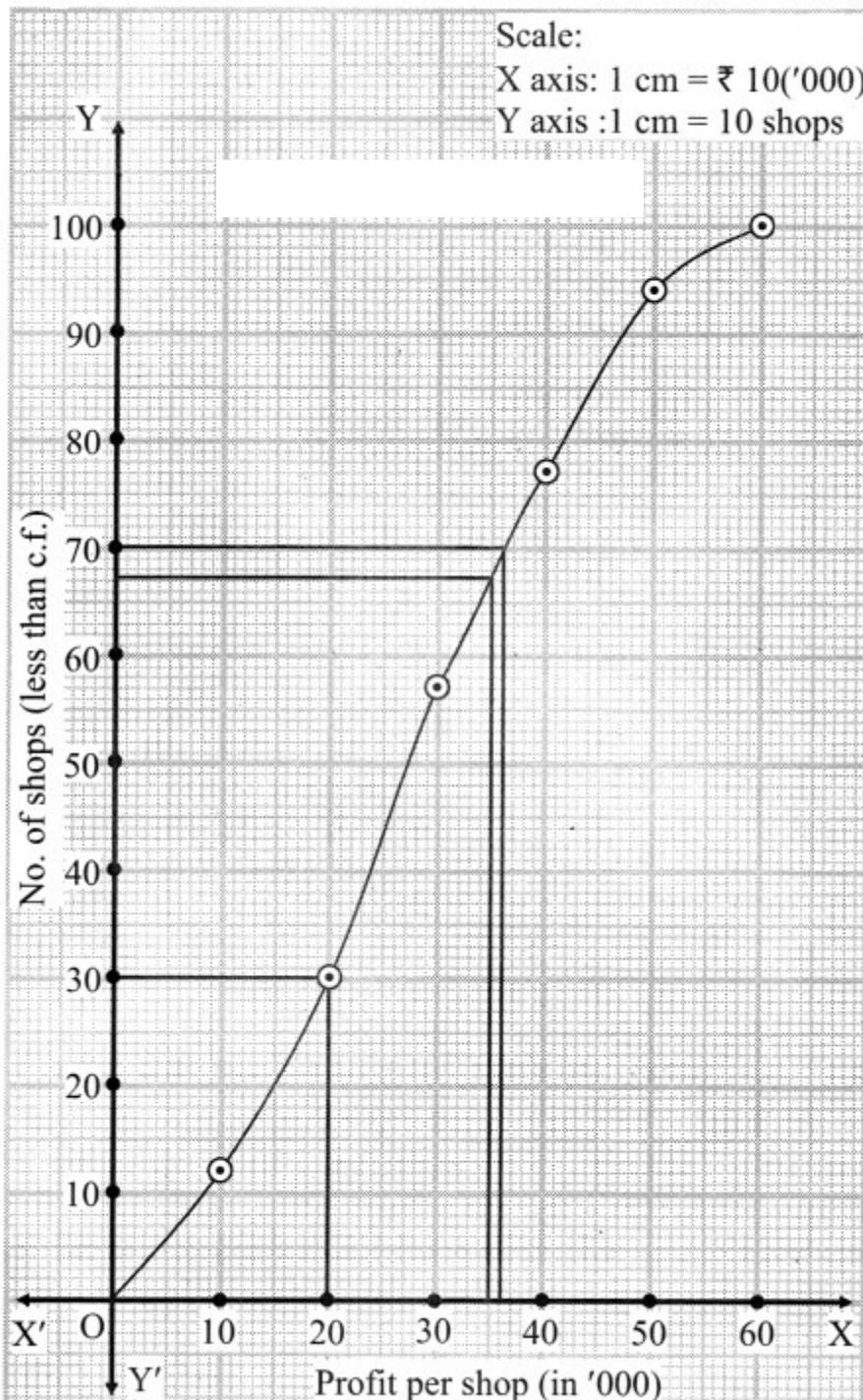
Solution:

To draw an ogive curve, we construct a less than cumulative frequency table as given below:

Profit per shop (in '000)	No. of shops (f)	Less than cumulative frequency (c.f.)
0-10	12	12
10-20	18	30
20-30	27	57
30-40	20	77
40-50	17	94
50-60	6	100
<b>Total</b>	<b>100</b>	

Points to be plotted are (10, 12), (20, 30), (30, 57), (40, 77), (50, 94), (60, 100).

All



The Middle 40% value lies in between  $P_{30}$  and  $P_{70}$ .

$$N = 100$$

$$\text{For } P_{30} = 30 \quad N/100 = 30 \times 100/100 = 30$$

$$\text{For } P_{70} = 70 \quad N/100 = 70 \times 100/100 = 70$$

∴ We take the points having Y co-ordinates 30 and 70 on Y-axis. From these points we draw lines parallel to X-axis.

From the points where these lines intersect the curve, we draw

perpendiculars on X-axis.

X-Co-ordinates of these points give the values of  $P_{30}$  and  $P_{70}$ .

$$\therefore P_{30} \sim 20, P_{70} \sim 36$$

Limits of middle 40% shops lie between ₹ 20,000 to ₹ 36,000

To find the number of shops having a profit of less than ₹ 35,000, we take the value 35 on the X-axis.

From this point, we draw a line parallel to Y-axis, and from the point where it intersects the less than ogive we draw a perpendicular on Y-axis. It intersects the Y-axis at approximately 67.

$\therefore$  No. of shops having profit less than ₹ 35,000 is 67.

Question 5.

The following is the frequency distribution of overtime (per week) performed by various workers from a certain company. Determine the values of  $D_2$ ,  $Q_2$ , and  $P_{61}$  graphically.

Overtime (in hours)	Below 8	8-12	12-16	16-20	20-24	24 and above
No. of workers	4	8	16	18	20	14

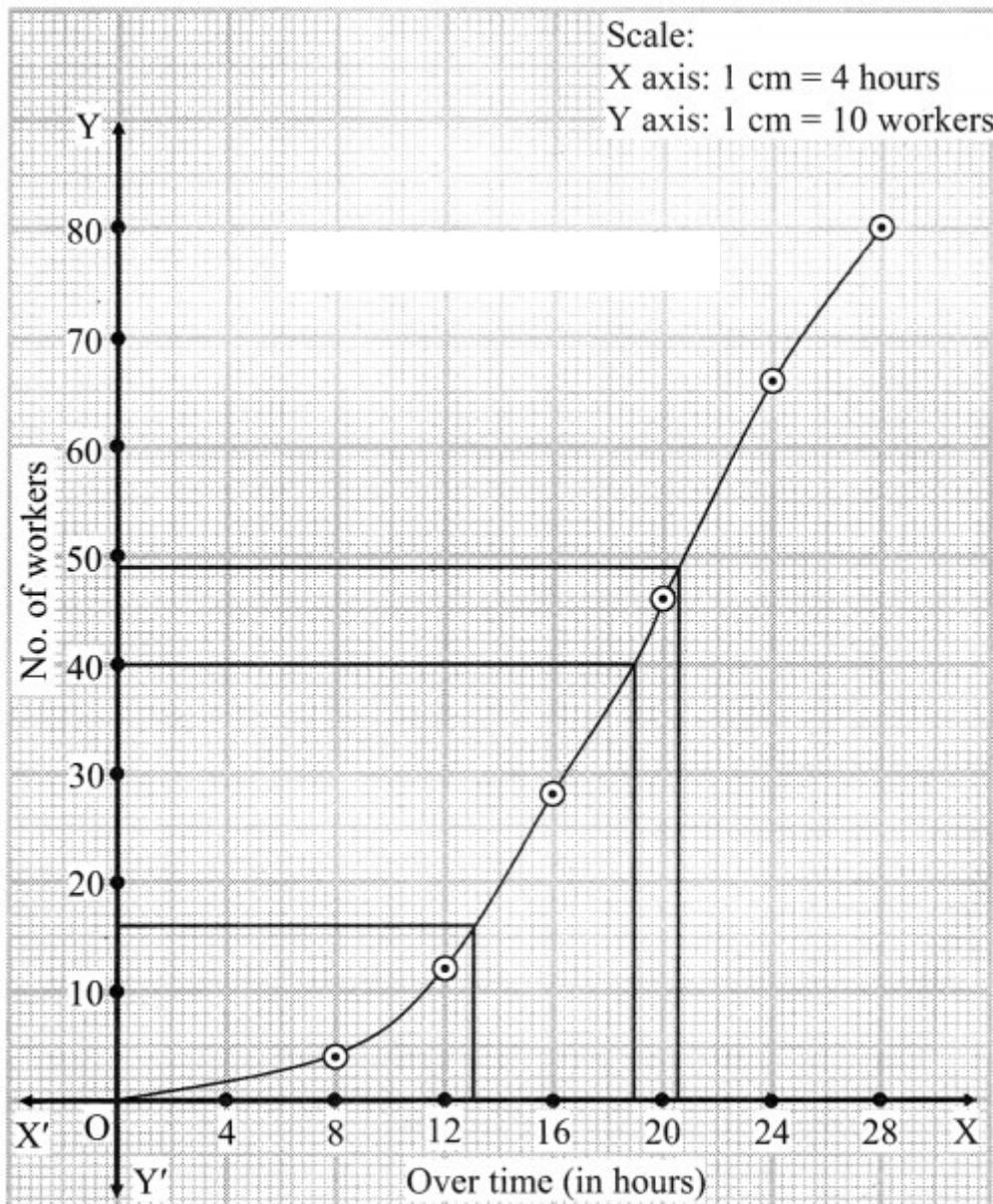
Solution:

To draw an ogive curve, we construct a less than cumulative frequency table as given below:

Over time (in hours)	No. of workers (f)	Less than cumulative frequency (c.f.)
Below 8	4	4
8-12	8	12
12-16	16	28
16-20	18	46
20-24	20	66
24 and above	14	80
<b>Total</b>	<b>80</b>	

Points to be plotted are (8, 4), (12, 12), (16, 28), (20, 46), (24, 66) and (28, 80)

Here,  $N = 80$



For D<sub>2</sub>, we have to consider 2 N10 = 2 × 8010 = 16

For Q<sub>2</sub>, we have to consider N2 = 802 = 40

and for P<sub>61</sub>, we have to consider 61 N100 = 61 × 80100 = 48.8

∴ We consider the values 16, 40 and 48.8 on the Y-axis.

From these points, we draw the lines which are parallel to the X-axis.

From the points where they intersect the less than ogive, we draw perpendiculars to X-axis.

The values at the foot of perpendiculars represent the values of D<sub>2</sub>, Q<sub>2</sub>, and P<sub>61</sub> respectively.

∴ D<sub>2</sub> ~ 13, Q<sub>2</sub> ~ 19, P<sub>61</sub> ~ 20.5

## Question 6.

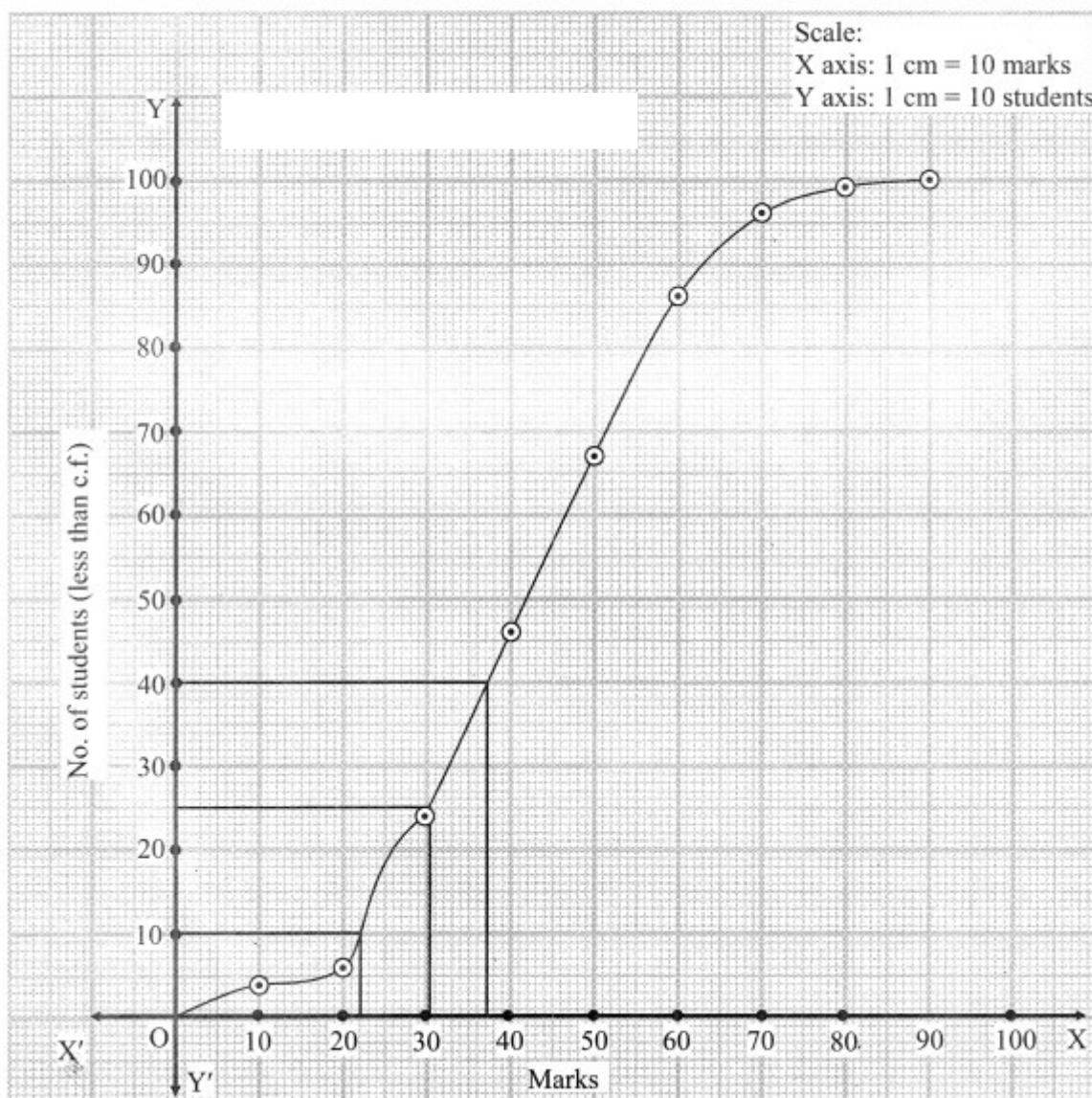
Draw ogive for the following data and hence find the values of  $D_1$ ,  $Q_1$ , and  $P_{40}$ .

Marks less than	10	20	30	40	50	60	70	80	90
No. of students	4	6	24	46	67	86	96	99	100

Solution:

$$N = 100$$

To draw the less than ogive we have to plot the points (10, 4), (20, 6), (30, 24), (40, 46), (50, 67), (60, 86), (70, 96), (80, 99), (90, 100).



For  $D_1$ , we have to consider  $N_{10} = 100/10 = 10$

For  $Q_1$ , we have to consider  $N_{4} = 100/4 = 25$

For  $P_{40}$ , we have to consider  $40 \times 100 = 40 \times 100 / 100 = 40$

$\therefore$  We consider the values 10, 25 and 40 on the Y-axis. From these points we draw lines parallel to X-axis.

From the points where they intersect the less than ogive, we draw perpendiculars on the X-axis.

The values at the foot of perpendicular represent the values of  $D_1$ ,  $Q_1$  and  $P_{40}$  respectively.

$\therefore D_1 \sim 22, Q_1 \sim 30.5, P_{40} \sim 37$

### Question 7.

The following table shows the age distribution of heads of the families in a certain country. Determine the third, fifth, and eighth decile of the distribution graphically.

Age of head of family (in years)	Numbers (million)
Under 35	46
35-45	85
45-55	64
55-65	75
65-75	90
75 & Above	40

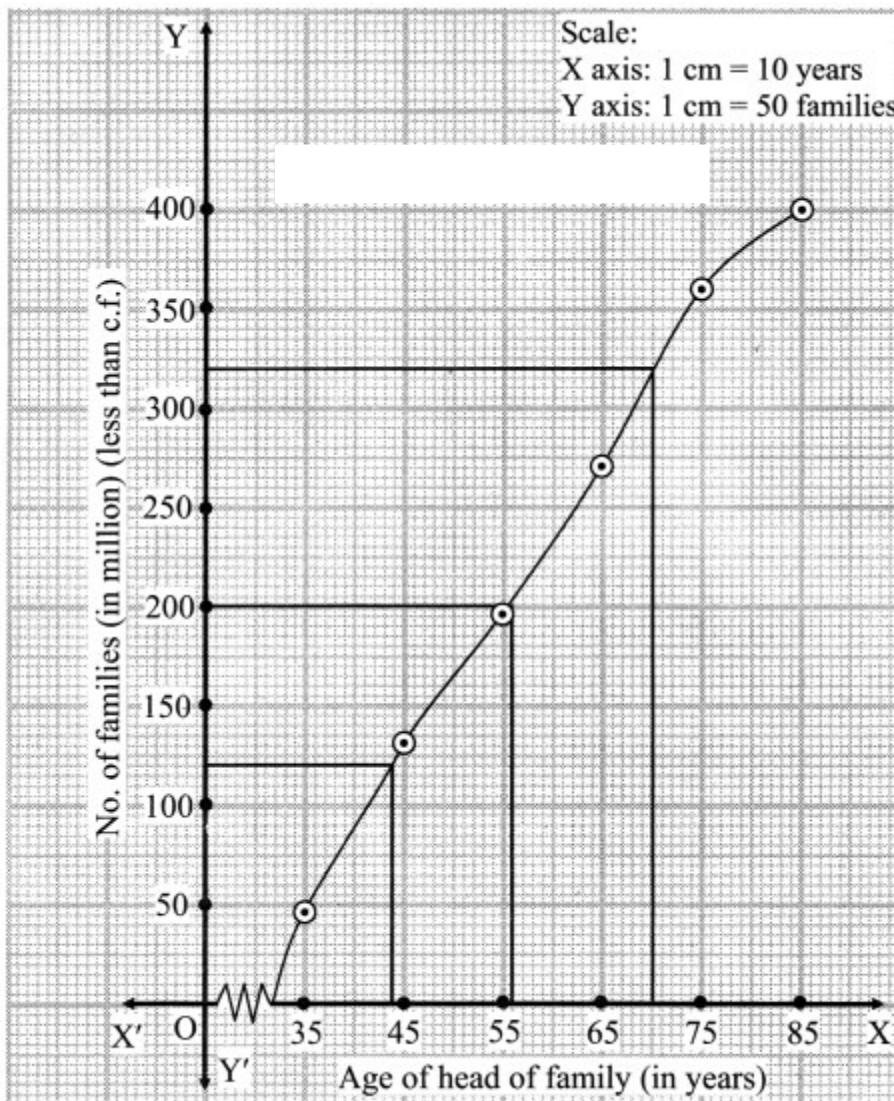
Solution:

To draw an ogive curve, we construct a less than cumulative frequency table as given below:



<b>Age of head of family (in years)</b>	<b>Numbers (Million) (f)</b>	<b>Less than cumulative frequency (c.f.)</b>
Under 35	46	46
35-45	85	131
45-55	64	195
55-65	75	270
65-75	90	360
75 and above	40	400
<b>Total</b>	<b>400</b>	

Points to be plotted are (35, 46), (45, 131), (55, 195), (65, 270), (75, 360), (85, 400).



$$N = 400$$

For  $D_3$ , we have to consider  $3 \times N/10 = 3 \times 400/10 = 120$

For  $D_5$ , we have to consider  $5 \times N/10 = 5 \times 400/10 = 200$

For  $D_8$ , we have to consider  $8 \times N/10 = 8 \times 400/10 = 320$

$\therefore$  We consider the values 120, 200 and 320 on Y-axis. From these points we draw the lines parallel to X-axis.

From the points where they intersect the less than ogive, we draw perpendiculars on the X-axis.

The foot of perpendicular represent the values of  $D_3$ ,  $D_5$  and  $D_8$ .

$$\therefore D_3 \sim 44, D_5 \sim 55.5 \text{ and } D_8 \sim 70$$

Question 8.

The following table gives the distribution of females in an Indian village.

Determine the median age graphically.

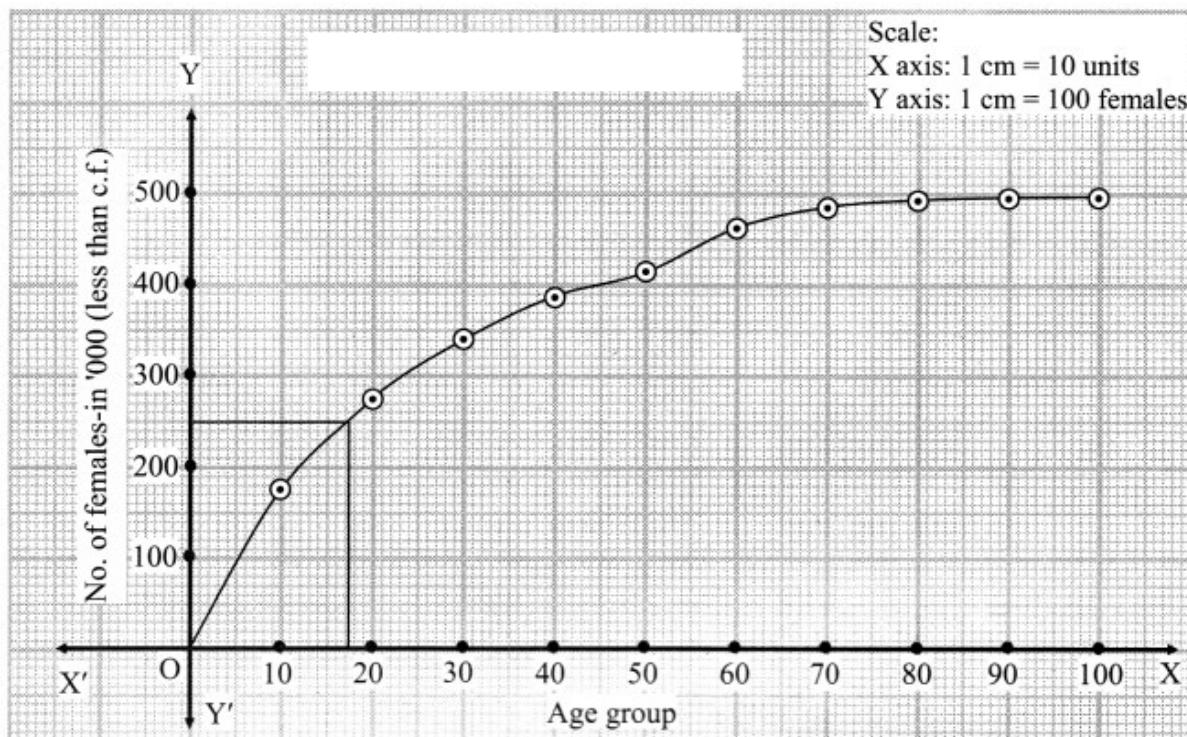
Age group	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No. of females (in '000')	175	100	68	48	25	50	23	8	2	1

Solution:

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

Age group	No. of females (in '000) (f)	Less than cumulative frequency (c.f.)
0-10	175	175
10-20	100	275
20-30	68	343
30-40	48	391
40-50	25	416
50-60	50	466
60-70	23	489
70-80	8	497
80-90	2	499
90-100	1	500
<b>Total</b>	<b>496</b>	

Points to be plotted are (10, 175), (20, 275), (30, 343), (40, 391), (50, 416), (60, 466), (70, 489), (80, 497), (90, 499), (100, 500).



$$N = 500$$

For median we have to consider  $N_2 = \frac{500}{2} = 250$

∴ We consider the value 250 on Y-axis. From this point, we draw a line parallel to X-axis.

From the point it intersects the less than ogive, we draw a perpendicular to X-axis.

The foot perpendicular represents the value of the median.

$$\therefore \text{Median} \approx 17.5$$

### Question 9.

Draw ogive for the following distribution and hence find graphically the limits of the weight of middle 50% fishes.

Weight of fishes (in gms)	800-890	900-990	1000-1090	1100-1190	1200-1290	1300-1390	1400-1490
No. of fishes	8	16	20	25	40	6	5

Solution:

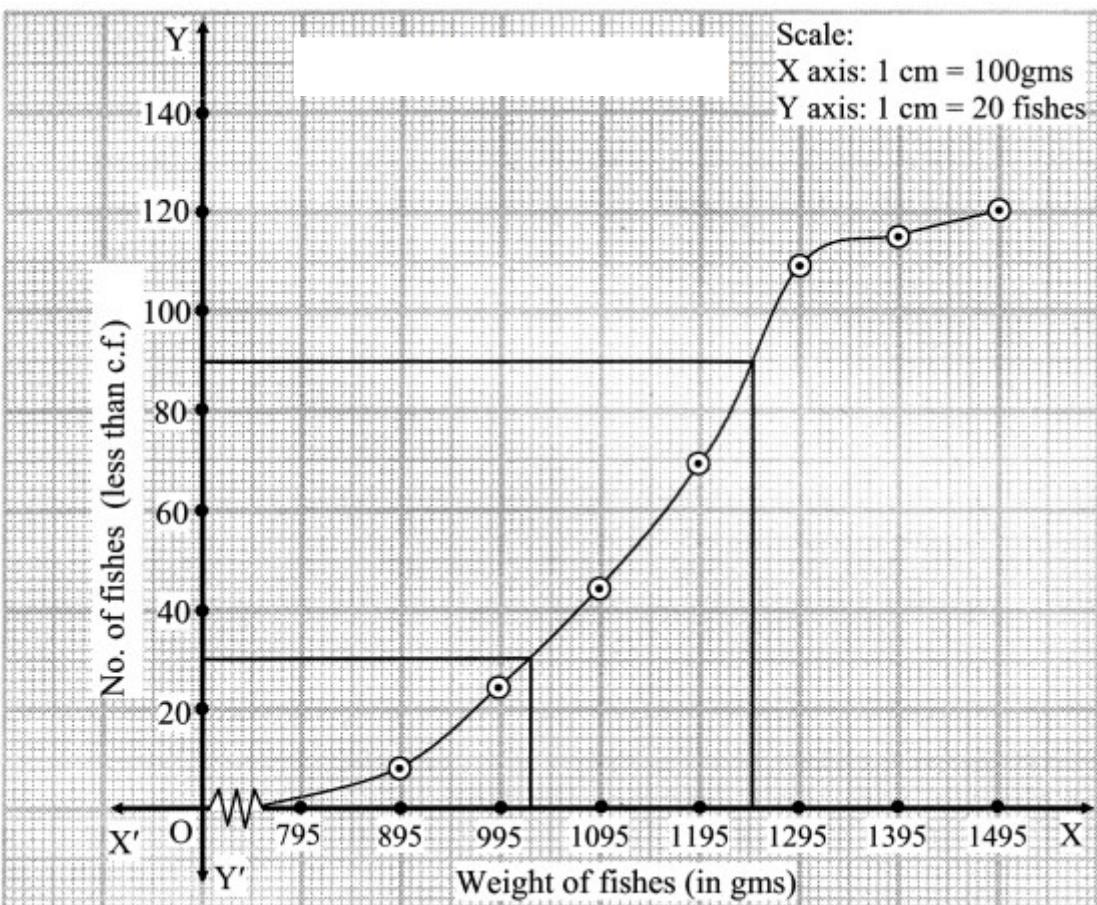
Since the given data is not continuous, we have to convert it into the continuous form by subtracting 5 from the lower limit and adding 5 to the upper limit of every class interval.

To draw an ogive curve, we construct the less than cumulative frequency

table as given below:

<b>Weight of fishes (in gms)</b>	<b>No. of fishes (f)</b>	<b>Less than cumulative frequency (c.f.)</b>
795 - 895	8	8
895 - 995	16	24
995 - 1095	20	44
1095 - 1195	25	69
1195 - 1295	40	109
1295 - 1395	6	115
1395 - 1495	5	120
<b>Total</b>	<b>120</b>	

Points to be plotted are (895, 8), (995, 24), (1095, 44), (1195, 69), (1295, 109), (1395, 115), (1495, 120).



$$N = 120$$

For  $Q_1$  and  $Q_3$  we have to consider

$$N_4 = 120/4 = 30$$

$$3 N_4 = 3 \times 1204 = 90$$

For finding  $Q_1$  and  $Q_3$  we consider the values 30 and 90 on the Y-axis.

From these points, we draw the lines which are parallel to X-axis.

From the points where these lines intersect the less than ogive, we draw perpendicular on X-axis.

The feet of perpendiculars represent the values  $Q_1$  and  $Q_3$ .

$$\therefore Q_1 \sim 1025 \text{ and } Q_3 \sim 1248$$

$\therefore$  the limits of the weight of the middle 50% of fishes lie between 1025 to 1248.

Question 10.

Find graphically the values of  $D_3$  and  $P_{65}$  for the data given below:

I.Q. of students	60-69	70-79	80-89	90-99	100-109	110-119	120-129
No. of students	20	40	50	50	20	10	10

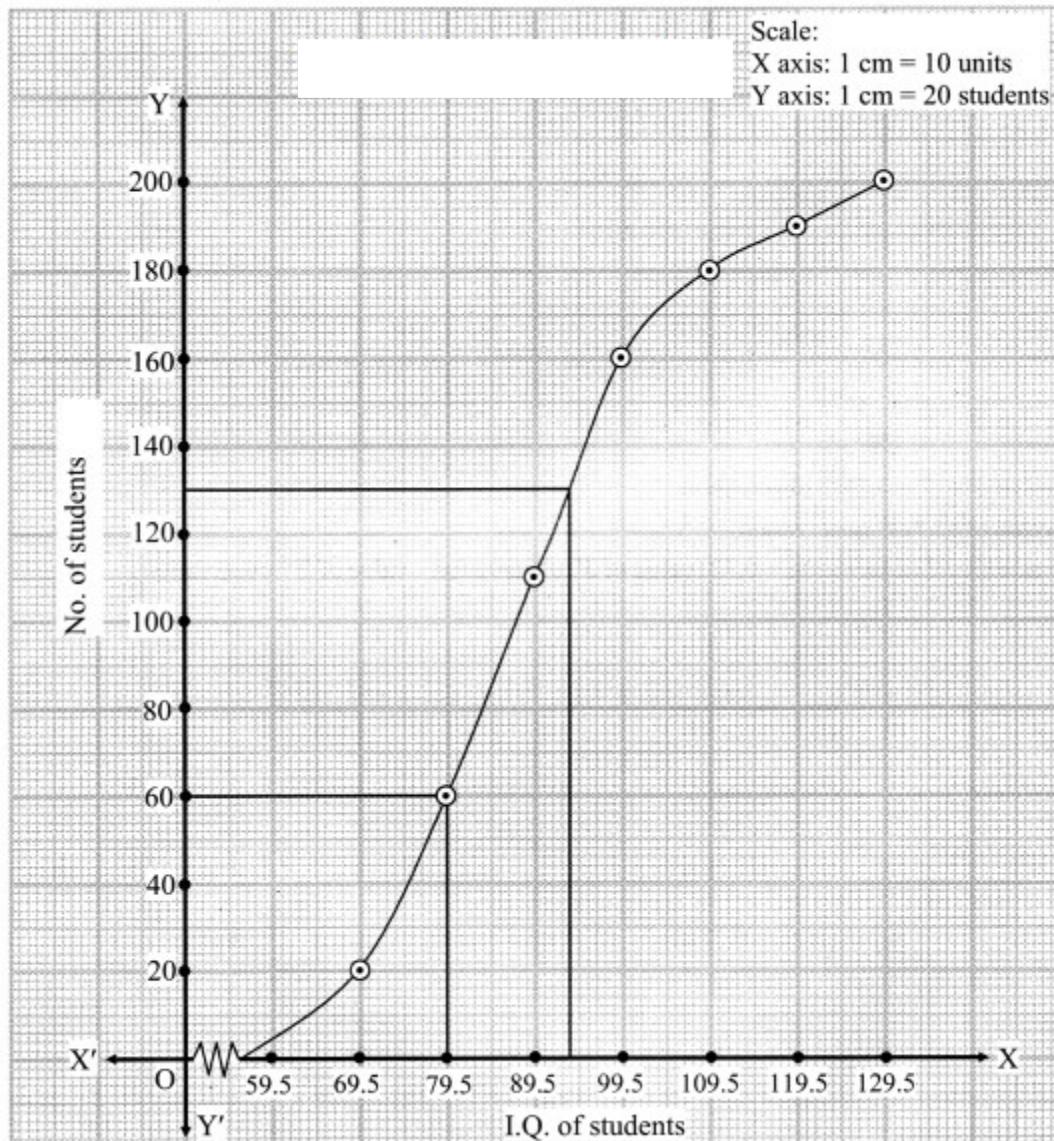
Solution:

Since the given data is not continuous, we have to convert it into a continuous form by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of every class interval.

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

I.Q. of students	No. of students (f)	Less than cumulative frequency (c.f.)
59.5 - 69.5	20	20
69.5 - 79.5	40	60
79.5 - 89.5	50	110
89.5 - 99.5	50	160
99.5 - 109.5	20	180
109.5 - 119.5	10	190
119.5 - 129.5	10	200
<b>Total</b>	<b>200</b>	

Points to be plotted are (69.5, 20), (79.5, 60), (89.5, 110), (99.5, 160), (109.5, 180), (119.5, 190), (129.5, 200).



$$N = 200$$

$$\text{For } D_3, 3N10 = 3 \times 20010 = 60$$

$$\text{For } P_{65}, 65N100 = 65 \times 200100 = 130$$

$\therefore$  We take the values 60 and 130 on the Y-axis.

From these points we draw lines parallel to X-axis and from the points where these lines intersect less than ogive, we draw perpendiculars on X-axis.

The foot of perpendiculars represents the median of the values,  $D_3$  and  $P_{65}$ .

$$\therefore D_3 = 79.5, P_{65} = 93.5$$

# Maharashtra State Board 11th Commerce

## Maths Solutions Chapter 1 Partition Values

### Miscellaneous Exercise 1

Question 1.

The data gives the number of accidents per day on a railway track.

Compute  $Q_2$ ,  $P_{17}$ , and  $D_7$ .

4, 2, 3, 5, 6, 3, 4, 1, 2, 3, 2, 3, 4, 3, 2

Solution:

The given data can be arranged in ascending order as follows:

1, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 5, 6

Here,  $n = 15$

$Q_2$  = value of  $2(n+14)$ th observation

= value of  $2(15+14)$ th observation

= value of  $(2 \times 4)$ th observation

= value of 8th observation

$\therefore Q_2 = 3$

$P_{17}$  = value of  $17(n+1100)$ th observation

= value of  $17(15+1100)$ th observation

= value of  $(17 \times 0.16)$ th observation

= value of  $(2.72)$ th observation

= value of 2nd observation + 0.72 (value of 3rd observation – value of 2nd observation)

=  $2 + 0.72 (2 - 2)$

$\therefore P_{17} = 2$

$D_7$  = value of  $7(n+110)$ th observation

= value of  $7(15+110)$ th observation

= value of  $(7 \times 1.6)$ th observation

= value of  $(11.2)$ th observation

= value of 11th observation + 0.2(value of 12th observation – value of 11th observation)

=  $4 + 0.2(4 - 4)$

$\therefore D_7 = 4$

Question 2.

The distribution of daily sales of shoes (size-wise) for 100 days from a certain shop is as follows:

<b>Size of shoes</b>	2	4	3	5	7	6	8
<b>No. of days</b>	14	20	13	19	13	13	8

Compute  $Q_1$ ,  $D_2$ , and  $P_{95}$ .

Solution:

By arranging the given data in ascending order, we construct the less than cumulative frequency table as given below:

<b>Size of shoes</b>	<b>No. of days (f)</b>	<b>Less than cumulative frequency (c.f.)</b>
2	14	14
3	13	27 $\leftarrow Q_1, D_2$
4	20	47
5	19	66
6	13	79
7	13	92
8	8	100 $\leftarrow P_{95}$
<b>Total</b>	<b>100</b>	

Here,  $n = 100$

$Q_1$  = value of  $(n+14)/2$ th observation

= value of  $(100+14)/2$ th observation

= value of  $(25.25)$ th observation

Cumulative frequency which is just greater than (or equal) to 25.25 is 27.

$\therefore Q_1 = 3$

$D_2$  = value of  $2(n+110)/2$ th observation

= value of  $2(100+110)/2$ th observation

= value of  $(2 \times 10.1)$ th observation

= value of  $(20.2)$ th observation

Cumulative frequency which is just greater than (or equal) to 20.2 is 27.

$\therefore D_2 = 3$

$P_{95}$  = value of  $95(n+1100)/2$ th observation

= value of  $95(100+1100)/2$ th observation

= value of  $(95 \times 1.01)$ th observation

= value of (95.95)th observation

The cumulative frequency which is just greater than (or equal) to 95.95 is 100.

$$\therefore P_{95} = 8$$

**Question 3.**

Ten students appeared for a test in Mathematics and Statistics and they obtained the marks as follows:

Sr. No.	1	2	3	4	5	6	7	8	9	10
Marks in Mathematics	42	38	36	32	23	25	35	37	25	23
Marks in Statistics	22	26	29	34	50	45	23	28	32	36

If the median will be the criteria, in which subject, the level of knowledge of the students is higher?

**Solution:**

Marks in Mathematics can be arranged in ascending order as follows:

23, 23, 25, 25, 32, 35, 36, 37, 38, 42

Here,  $n = 10$

$\therefore$  Median = value of  $(\frac{n+1}{2})$ th observation

Median = value of  $(\frac{10+1}{2})$ th observation

= value of (5.5)th observation

= value of 5th observation + 0.5(value of 6th observation – value of 5th observation)

$$= 32 + 0.5 (35 - 32)$$

$$= 32 + 0.5(3)$$

$$= 32 + 1.5$$

$$= 33.5$$

Marks in Statistics can be arranged in ascending order as follows:

22, 23, 26, 28, 29, 32, 34, 36, 45, 50

Here,  $n = 10$

$\therefore$  Median = value of  $(\frac{n+1}{2})$ th observation

= value of  $(\frac{10+1}{2})$ th observation

= value of (5.5)th observation

= value of 5th observation + 0.5(value of 6th observation – value of 5th observation)

$$= 29 + 0.5(32 - 29)$$

$$= 29 + 0.5(3)$$

$$= 29 + 1.5$$

$$= 30.5$$

$\therefore$  Median marks for Mathematics = 33.5 and

Median marks for Statistics = 30.5

$\therefore$  The level of knowledge in Mathematics is higher than that of Statistics.

#### Question 4.

In the frequency distribution of families given below, the number of families corresponding to expenditure group 2000 – 4000 is missing from the table. However, the value of the 25th percentile is 2880. Find the missing frequency.

Weekly Expenditure (₹ 1000)	0-2	2-4	4-6	6-8	8-10
No. of families	14	?	39	7	15

Solution:

Let  $x$  be the missing frequency of expenditure group 2000 – 4000.

We construct the less than cumulative frequency table as given below:

Weekly Expenditure	No. of families (f)	Less than cumulative frequency (c.f.)
0 - 2000	14	14
2000 - 4000	$x$	$14 + x \leftarrow P_{25}$
4000 - 6000	39	$53 + x$
6000 - 8000	7	$60 + x$
8000 - 10000	15	$75 + x$
<b>Total</b>	<b><math>75 + x</math></b>	

Here,  $N = 75 + x$

Given,  $P_{25} = 2880$

$\therefore P_{25}$  lies in the class 2000 – 4000.

$\therefore L = 2000, h = 2000, f = x, c.f. = 14$

$\therefore P_{25} = L + hf \left( \frac{P_{25} - c.f.}{f} \right)$

$\therefore 2880 = 2000 + 2000x \left( \frac{2880 - 14}{75 + x} \right)$

$\therefore 2880 - 2000 = 2000x \left( \frac{2880 - 14}{75 + x} \right)$

$$\therefore 880x = 500(x + 19)$$

$$\therefore 880x = 500x + 9500$$

$$\therefore 880x - 500x = 9500$$

$$\therefore 380x = 9500$$

$$\therefore x = 25$$

$\therefore 25$  is the missing frequency of the expenditure group 2000 – 4000.

Question 5.

Calculate  $Q_1$ ,  $D_6$ , and  $P_{15}$  for the following data:

Mid value	25	75	125	175	225	275
Frequency	10	70	80	100	150	90

Solution:

Since the difference between any two consecutive mid values is 50, the width of each class interval is 50.

$\therefore$  the class intervals will be 0 – 50, 50 – 100, etc.

We construct the less than cumulative frequency table as given below:

Class interval	Frequency (f)	Less than cumulative frequency (c.f.)
0 - 50	10	10
50 - 100	70	80 $\leftarrow P_{15}$
100 - 150	80	160 $\leftarrow Q_1$
150 - 200	100	260
200 - 250	150	410 $\leftarrow D_6$
250 - 300	90	500
<b>Total</b>	<b>500</b>	

Here,  $N = 500$

$Q_1$  class = class containing  $(N_4)$ th observation

$$\therefore N_4 = 500 \times \frac{1}{4} = 125$$

Cumulative frequency which is just greater than (or equal) to 125 is 160.

$Q_1$  lies in the class 100 – 150.

$$\therefore L = 100, h = 50, f = 80, c.f. = 80$$

$$\therefore Q_1 = L + [N_4 - c.f.]$$

$$= 100 + \frac{50}{80}(125 - 80)$$

$$= 100 + 58(45)$$

$$= 100 + 28.125$$

$$= 128.125$$

$D_6$  class = class containing  $(6 N_{10})^{\text{th}}$  observation

$$\therefore 6 N_{10} = 6 \times 50010 = 300$$

Cumulative frequency which is just greater than (or equal) to 300 is 410.

$\therefore D_6$  lies in the class 200 – 250.

$$\therefore L = 200, h = 50, f = 150, c.f. = 260$$

$$\therefore D_6 = L + hf(6 N_{10} - c.f.)$$

$$= 200 + 50 \times 150(300 - 260)$$

$$= 200 + 13(40)$$

$$= 200 + 13.33$$

$$= 213.33$$

$P_{15}$  class = class containing  $(15 N_{100})^{\text{th}}$  observation

$$\therefore 15 N_{100} = 15 \times 500100 = 75$$

Cumulative frequency which is just greater than (or equal) to 75 is 80.

$\therefore P_{15}$  lies in the class 50 – 100.

$$\therefore L = 50, h = 50, f = 70, c.f. = 10$$

$$\therefore P_{15} = L + hf(15 N_{100} - c.f.)$$

$$= 50 + 50 \times 70(75 - 10)$$

$$= 50 + 57 (65)$$

$$= 50 + 3257$$

$$= 50 + 46.4286$$

$$= 96.4286$$

$$\therefore Q_1 = 128.125, D_6 = 213.33, P_{15} = 96.4286$$

### Question 6.

Daily income for a group of 100 workers are given below:

Daily In- come (in ₹)	0-50	50- 100	100- 150	150- 200	200- 250
No. of per- sons	7	?	25	30	?

$P_{30}$  for this group is ₹ 110. Calculate the missing frequencies.

Solution:

Let  $a$  and  $b$  be the missing frequencies of class 50 – 100 and class 200 – 250 respectively.

We construct the less than cumulative frequency table as given below:

Daily income (in ₹)	No. of persons (f)	Less than cumulative frequency (c.f.)
0-50	7	7
50-100	$a$	$7 + a$
100-150	25	$32 + a \leftarrow P_{30}$
150-200	30	$62 + a$
200-250	$b$	$62 + a + b$
<b>Total</b>	<b><math>62 + a + b</math></b>	

$$\text{Here, } N = 62 + a + b$$

$$\text{Since, } N = 100$$

$$\therefore 62 + a + b = 100$$

$$\therefore a + b = 38 \dots\dots(i)$$

$$\text{Given, } P_{30} = 110$$

$$\therefore P_{30} \text{ lies in the class } 100 - 150.$$

$$\therefore L = 100, h = 50, f = 25, c.f. = 7 + a$$

$$30 \times 100 = 30 \times 100 / 100 = 30$$

$$\therefore P_{30} = L + hf(30 - c.f.)$$

$$\therefore 110 = 100 + 50 \times 25 [30 - (7 + a)]$$

$$\therefore 110 - 100 = 2(30 - 7 - a)$$

$$\therefore 10 = 2(23 - a)$$

$$\therefore 5 = 23 - a$$

$$\therefore a = 23 - 5$$

$$\therefore a = 18$$

Substituting the value of  $a$  in equation (i), we get

$$18 + b = 38$$

$$\therefore b = 38 - 18$$

$$\therefore b = 20$$

$\therefore 18$  and  $20$  are the missing frequencies of the class 50 – 100 and class 200 – 250 respectively.

Question 7.

The distribution of a sample of students appearing for a C.A. examination is:

Marks	0-100	100-200	200-300	300-400	400-500	500-600
No. of students	130	150	190	220	280	130

Help C.A. institute to decide cut-off marks for qualifying for an examination when 3% of students pass the examination.

Solution:

To decide cut-off marks for qualifying for an examination when 3% of students pass, we have to find P97.

We construct the less than cumulative frequency table as given below:

Marks	No. of students (f)	Less than cumulative frequency (c.f.)
0 - 100	130	130
100 - 200	150	280
200 - 300	190	470
300 - 400	220	690
400 - 500	280	970
500 - 600	130	1100 ← P <sub>97</sub>
<b>Total</b>	<b>1100</b>	

Here, N = 1100

P<sub>97</sub> class = class containing  $(97 \times 1100)^{th}$  observation

$$\therefore 97 \times 1100 = 97 \times 1100 = 1067$$

Cumulative frequency which is just greater than (or equal) to 1067 is 1100.

$\therefore P_{97}$  lies in the class 500 – 600.

$$\therefore L = 500, h = 100, f = 130, c.f. = 970$$

$$\therefore P_{97} = L + hf \left( \frac{97}{N} - c.f. \right)$$

$$= 500 + 100 \times 130 \left( \frac{97}{1100} - \frac{970}{1100} \right)$$

$$= 500 + 1013 \times 0.0909$$

$$= 500 + 91.09$$

$$= 591.09 \approx 591$$

$\therefore$  the cut off marks for qualifying an examination is 591.

Question 8.

Determine graphically the value of median, D<sub>3</sub>, and P<sub>35</sub> for the data given below:

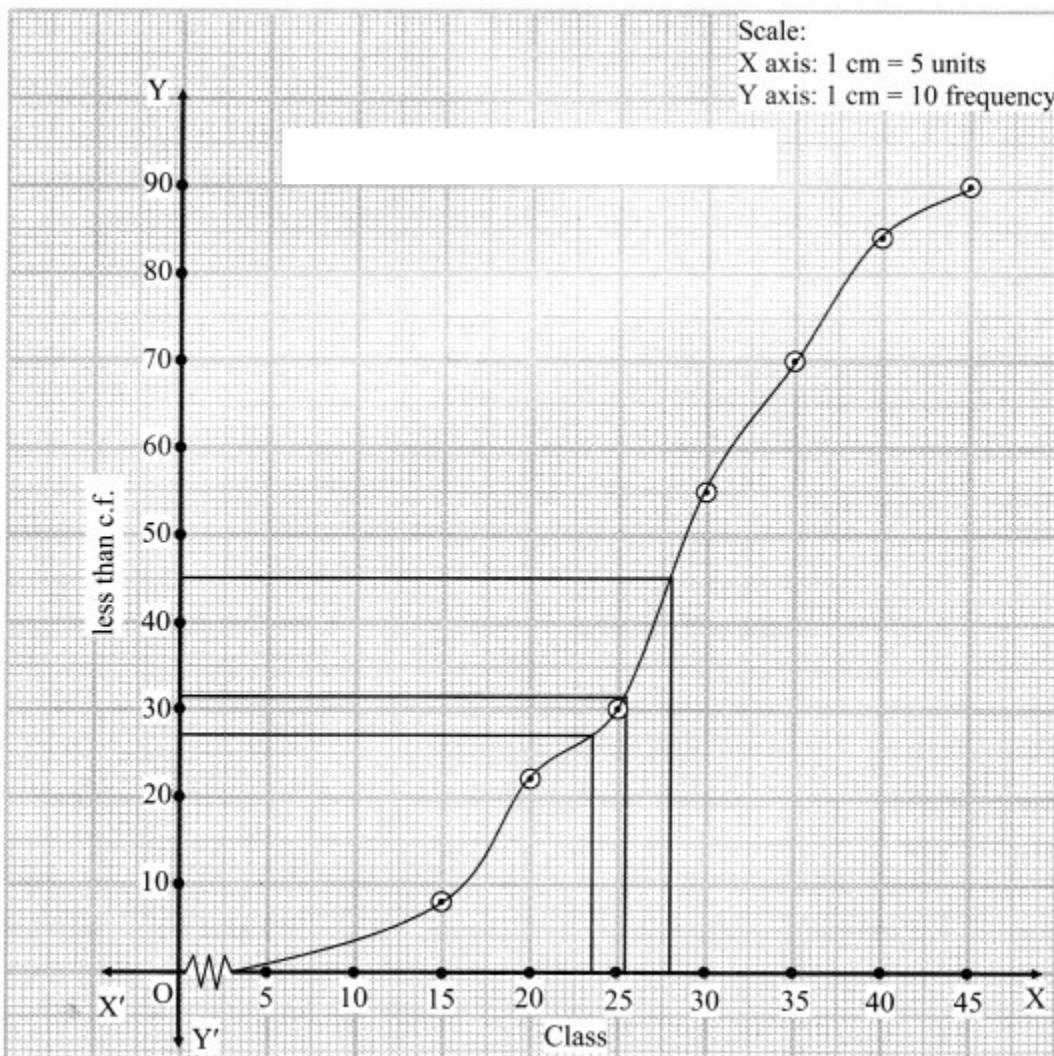
Class	10-15	15-20	20-25	25-30	30-35	35-40	40-45
Frequency	8	14	8	25	15	14	6

Solution:

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

Class	Frequency (f)	Less than cumulative frequency (c.f.)
10-15	8	8
15-20	14	22
20-25	8	30
25-30	25	55
30-35	15	70
35-40	14	84
40-45	6	90
<b>Total</b>	<b>90</b>	

The points to be plotted for less than ogive are (15, 8), (20, 22), (25, 30), (30, 55), (35, 70), (40, 84), (45, 90).



$$N = 90$$

For median, consider  $N_2 = 90/2 = 45$

For  $D_3$ , consider  $3 N_{10} = 3 \times 90/10 = 27$

For  $P_{35}$ , consider  $35 N_{100} = 35 \times 90/100 = 31.5$

$\therefore$  We take the values 45, 27 and 31.5 on the Y-axis and draw lines from these points parallel to X-axis.

From the points where they intersect the less than ogive, we draw perpendicular on the X-axis.

Foot of the perpendicular represent the values of median,  $D_3$  and  $P_{35}$  respectively.

$$\therefore \text{Median} \sim 29, D_3 \sim 23.5, P_{35} \sim 26$$

Question 9.

The I.Q. test of 500 students of a college is as follows:

I.Q.	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Number of students	41	52	64	180	67	45	40	11

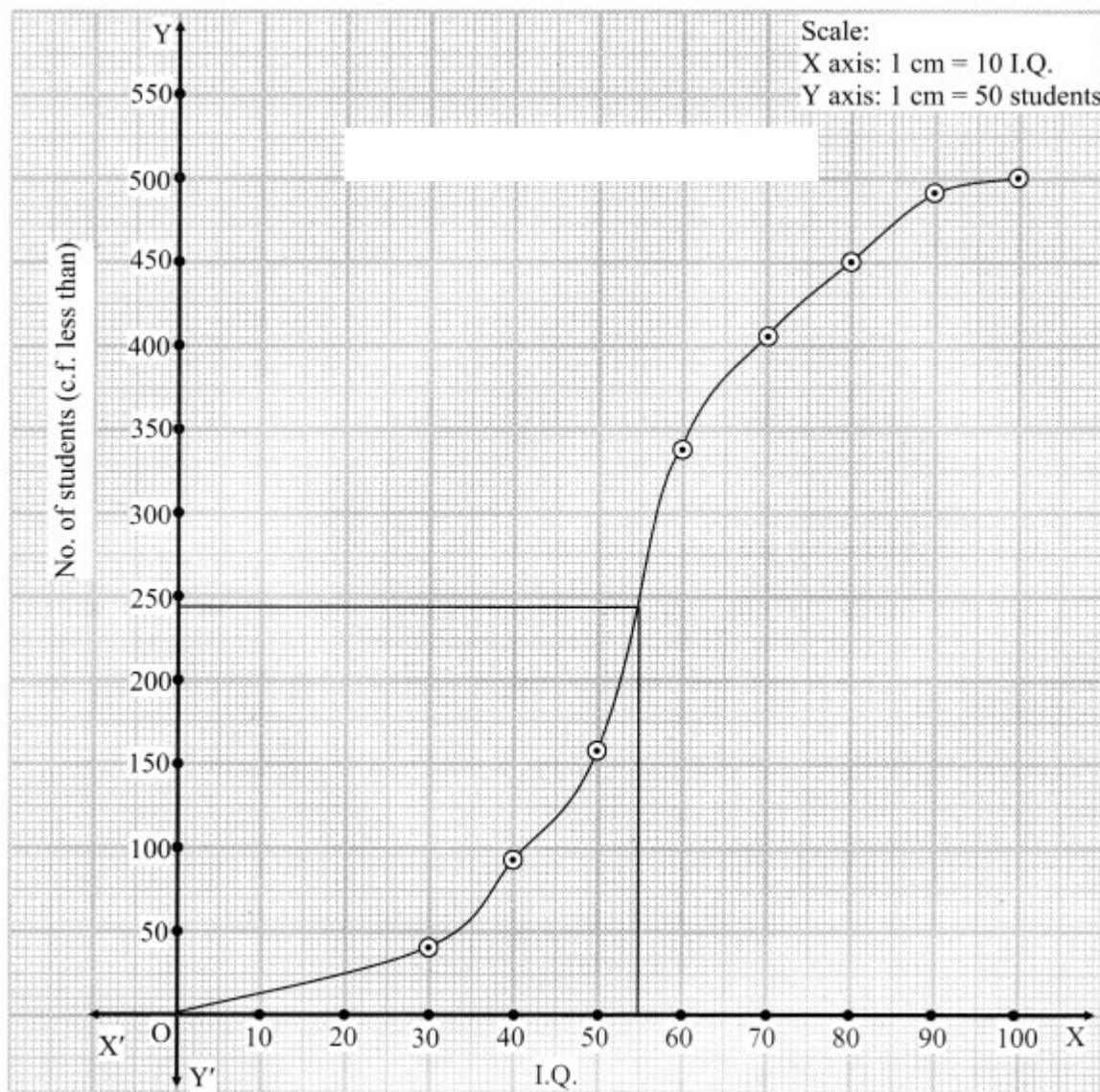
Find graphically the number of students whose I.Q. is more than 55 graphically.

I.Q.	Number of students (f)	Less than cumulative frequency (c.f.)
20 - 30	41	
30 - 40	52	93
40 - 50	64	157
50 - 60	180	337
60 - 70	67	404
70 - 80	45	449
80 - 90	40	489
90 - 100	11	500
<b>Total</b>	<b>500</b>	

Solution:

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

The points to be plotted for less than ogive are (30, 41), (40, 93), (50, 157), (60, 337), (70, 404), (80, 449), (90, 489), (100, 500)



To find the number of students whose I.Q. is more than 55, we consider the value 55 on the X-axis.

From this point, we draw a line that is parallel to Y-axis.

From the point this line intersects the less than ogive, we draw a perpendicular on the Y-axis.

The foot of perpendicular gives the number of students whose I.Q. is less than 55.

$\therefore$  The foot of perpendicular  $\sim 244$

$\therefore$  No. of students whose I.Q. is less than 55  $\sim 244$

$\therefore$  No. of Students whose I.Q. is more than 55  $= 500 - 244 = 256$

Question 10.

Draw an ogive for the following distribution. Determine the median graphically and verify your result by a mathematical formula.

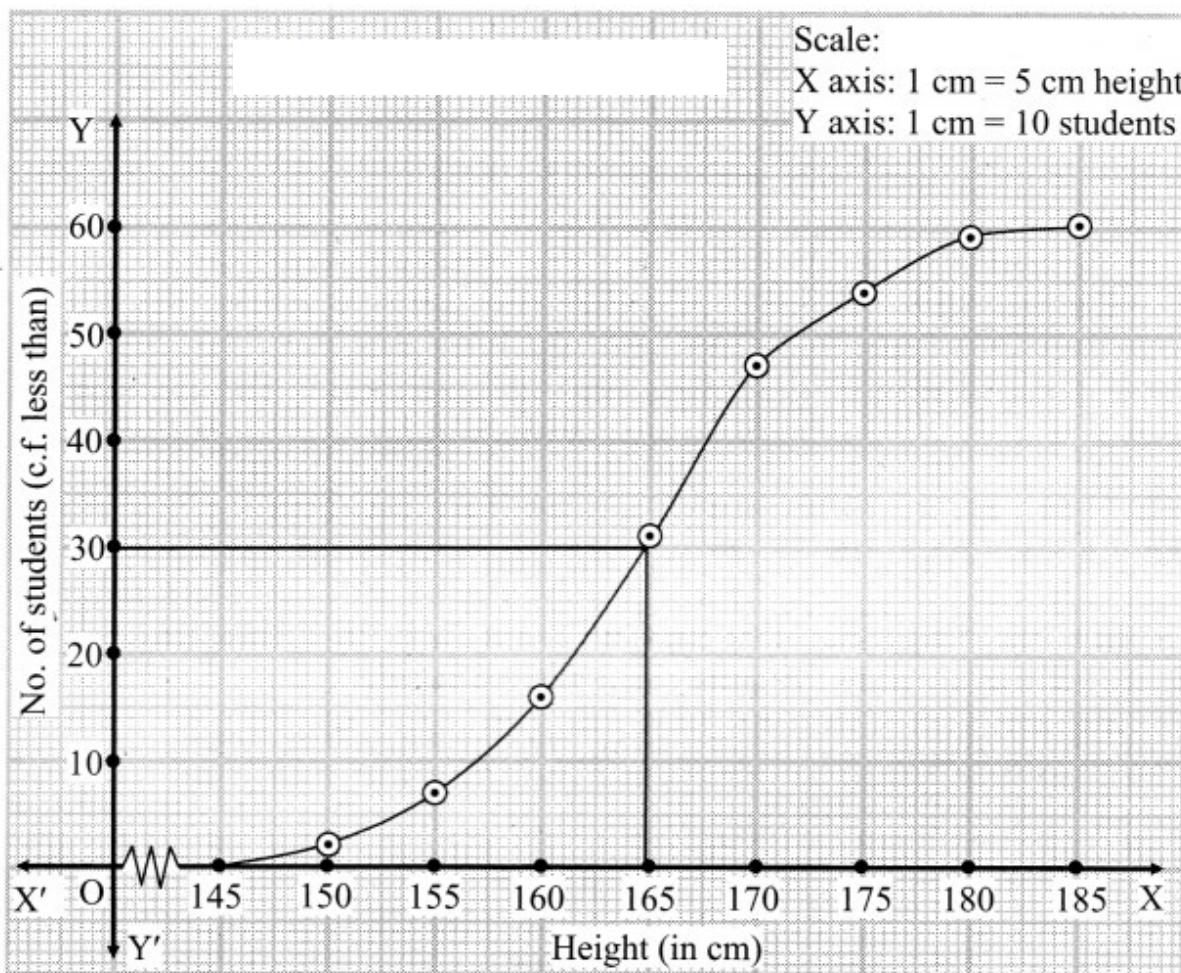
Height (in cms.)	No. of students
145-150	2
150-155	5
155-160	9
160-165	15
165-170	16
170-175	7
175-180	5
180-185	1

Solution:

To draw an ogive curve, we construct the less than cumulative frequency table as given below:

Height (in cms)	No. of students (f)	Less than cumulative frequency (c.f.)
145-150	2	2
150-155	5	7
155-160	9	16
160-165	15	31
165-170	16	47
170-175	7	54
175-180	5	59
180-185	1	60
<b>Total</b>	<b>60</b>	

The points to be plotted for less than ogive are (150, 2), (155, 7), (160, 16), (165, 31), (170, 47), (175, 54), (180, 59) and (185, 60).



$$N = 60$$

$$\therefore N_2 = 60/2 = 30$$

$\therefore$  We take the value 30 on the Y-axis and from this point, we draw a line parallel to X-axis.

From the point where this line intersects the less than ogive, we draw a perpendicular on X-axis.

The foot perpendicular gives the value of the median.

$$\therefore \text{Median} \approx 164.67$$

Now, let us calculate the median from the mathematical formula.

$$\therefore N_2 = 30$$

The median lies in the class interval 160 – 165.

$$\therefore L = 160, h = 5, f = 15, c.f. = 16$$

$$\text{Median} = L + hf(N_2 - c.f.)$$

$$= 160 + 5 \times 15 (30 - 16)$$

$$= 160 + 13 \times 14$$

$$= 160 + 4.67$$

$$= 164.67$$

Question 11.

In a group of 25 students, 7 students failed and 6 students got distinction and the marks of the remaining 12 students are 61, 36, 44, 59, 52, 56, 41, 37, 39, 38, 41, 64. Find the median marks of the whole group.

Solution:

$$n = 25$$

$$\text{Median} = \frac{n+1}{2} = \frac{25+1}{2} = 13\text{th observation}$$

We have been stated that 7 students failed (assuming passing marks on 35) and 6 students got distinction (assuming distinction as 70+), and the marks of the remaining 12 students (who will be situated between the two groups mentioned above, if arranged in ascending order), we have,

F, F, F, F, F, F, 36, 37, 38, 39, 41, 41, 44, 52, 56, 59, 61, 64, D, D, D, D, D, D

∴ median = 13th observation = 41.

Question 12.

The median weight of a group of 79 students is found to be 55 kg. 6 more students are added to this group whose weights are 50, 51, 52, 59.5, 60, 61 kg. What will be the value of the median of the combined group if the lowest and the highest weights were 53 kg and 59 kg respectively?

Solution:

$$n = 79$$

$$\text{Median} = 55\text{kg}$$

$$\text{Lowest observation} = 53 \text{ kg}$$

$$\text{Highest observation} = 59 \text{ kg}$$

6 new students are added to the group having weights in Kg as follows:

50, 51, 52, 59.5, 60, 61

From the above, we see that of the 6 new students, 3 have weights which are below the lowest weight of the earlier group and 3 have weights which are above the highest weight of the earlier group.

∴ the median remains the same

∴ median = 55 kg.

Question 13.

The median of the following incomplete table is 92. Find the missing frequencies:

C I	30-50	50-70	70-90	90-110	110-130	130-150	Total
f	6	?	18	20	?	10	80

Solution:

Let  $a$  and  $b$  be the missing frequencies of class  $50 - 70$  and class  $110 - 130$  respectively.

We construct the less than cumulative frequency table as given below:

C.I.	f	Less than cumulative frequency (c.f.)
30 - 50	6	6
50 - 70	a	6 + a
70 - 90	18	24 + a
90 - 110	20	44 + a $\leftarrow Q_2$
110 - 130	b	44 + a + b
130 - 150	10	54 + a + b
<b>Total</b>	<b>N = 80</b>	

Here,  $N = 54 + a + b$

Since,  $N = 80$

$$\therefore 54 + a + b = 80$$

$$\therefore a + b = 26 \dots\dots(i)$$

Given, Median =  $Q_2 = 92$

$\therefore Q_2$  lies in the class  $90 - 110$ .

$$\therefore L = 90, h = 20, f = 20, c.f. = 24 + a$$

$$2N/4 = 2 \times 80/4 = 40$$

$$\therefore Q_2 = L + hf(2N/4 - c.f.)$$

$$\therefore 92 = 90 + 20(40 - (24 + a))$$

$$\therefore 92 - 90 = 40 - 24 - a$$

$$\therefore 2 = 16 - a$$

$$\therefore a = 14$$

Substituting the value of  $a$  in equation (i), we get

$$14 + b = 26$$

$$\therefore b = 26 - 14 = 12$$

$\therefore 14$  and  $12$  are the missing frequencies of the class  $50 - 70$  and class  $110 - 130$  respectively.

Question 14.

A company produces tables which are packed in batches of 100. An analysis of the defective tubes in different batches has received the following information:

No. of defective tubes	Less than 5	5-9	10-14	15-19	20-24	25-29	30 and above
No. of tubes	45	51	84	39	20	8	4

estimate the number of defective tubes in the central batch.

Solution:

To find the number of defective tubes in the central batch, we have to find  $Q_2$ .

Since the given data is not continuous, we have to convert it into a continuous form by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of every class interval.

$\therefore$  the class intervals will be Less than 4.5, 4.5 – 9.5, etc.

We construct the less than cumulative frequency table as given below:

No. of defective tubes	No. of tubes (f)	Less than cumulative frequency (c.f.)
Less than 4.5	45	45
4.5 – 9.5	51	96
9.5 – 14.5	84	180 $\leftarrow Q_2$
14.5 – 19.5	39	219
19.5 – 24.5	20	239
24.5 – 29.5	8	247
29.5 and above	4	251
<b>Total</b>	<b>251</b>	

Here,  $N = 251$

$Q_2$  class = class containing  $(\frac{2}{4}N)$ th observation

$$\therefore \frac{2}{4}N = \frac{2}{4} \times 251 = 125.5$$

Cumulative frequency which is just greater than (or equal to) 125.5 is 180.

$\therefore Q_2$  lies in the class 9.5 – 14.5.

$$\therefore L = 9.5, h = 5, f = 84, c.f. = 96$$

$$\therefore Q_2 = L + hf \left( \frac{2}{4}N - c.f. \right)$$

$$= 9.5 + 5 \times 84 (125.5 - 96)$$

$$\begin{aligned}
 &= 9.5 + 584 \times 29.5 \\
 &= 9.5 + 147.584 \\
 &= 9.5 + 1.76 \\
 &= 11.26
 \end{aligned}$$

Question 15.

In a college, there are 500 students in junior college, 5% score less than 25 marks, 68 scores from 26 to 30 marks, 30% score from 31 to 35 marks, 70 scores from 36 to 40 marks, 20% score from 41 to 45 marks and the rest score 46 and above marks. What are the median marks?

Solution:

Given data can be written in tabulated form as follows:

Marks	No. of students
Less than 25	$5\% \text{ of } 500 = \frac{5}{100} \times 500 = 25$
26 – 30	68
31 – 35	$30\% \text{ of } 500 = \frac{30}{100} \times 500 = 150$
36 – 40	70
41 – 45	$20\% \text{ of } 500 = \frac{20}{100} \times 500 = 100$
46 and above	$500 - (25 + 68 + 150 + 70 + 100) = 87$

Since the given data is not continuous, we have to convert it into the continuous form by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of every class interval.

∴ the class intervals will be Less than 25.5, 25.5 – 30.5, etc.

We construct the less than cumulative frequency table as given below:

Marks	No. of students (f)	Less than cumulative frequency (c.f.)
Less than 25.5	25	25
25.5 – 30.5	68	93
30.5 – 35.5	150	243
35.5 – 40.5	70	313 ← Q <sub>2</sub>
40.5 – 45.5	100	413
45.5 and above	87	500
<b>Total</b>	<b>500</b>	

Here, N = 500

$Q_2$  class = class containing  $(\frac{N}{4})^{\text{th}}$  observation

$$\therefore \frac{N}{4} = 2 \times 500 = 250$$

Cumulative frequency which is just greater than (or equal to) 250 is 313.

$\therefore Q_2$  lies in the class 35.5 – 40.5.

$$\therefore L = 35.5, h = 5, f = 70, c.f. = 243$$

$$\therefore \text{Median} = Q_2 = L + hf \left( \frac{2 \times N - c.f.}{f} \right)$$

$$= 35.5 + 570 (250 - 243)$$

$$= 35.5 + 114 (7)$$

$$= 35.5 + 0.5$$

$$= 36$$

### Question 16.

Draw a cumulative frequency curve more than typical for the following data and hence locate  $Q_1$  and  $Q_3$ . Also, find the number of workers with daily wages

(i) Between ₹ 170 and ₹ 260

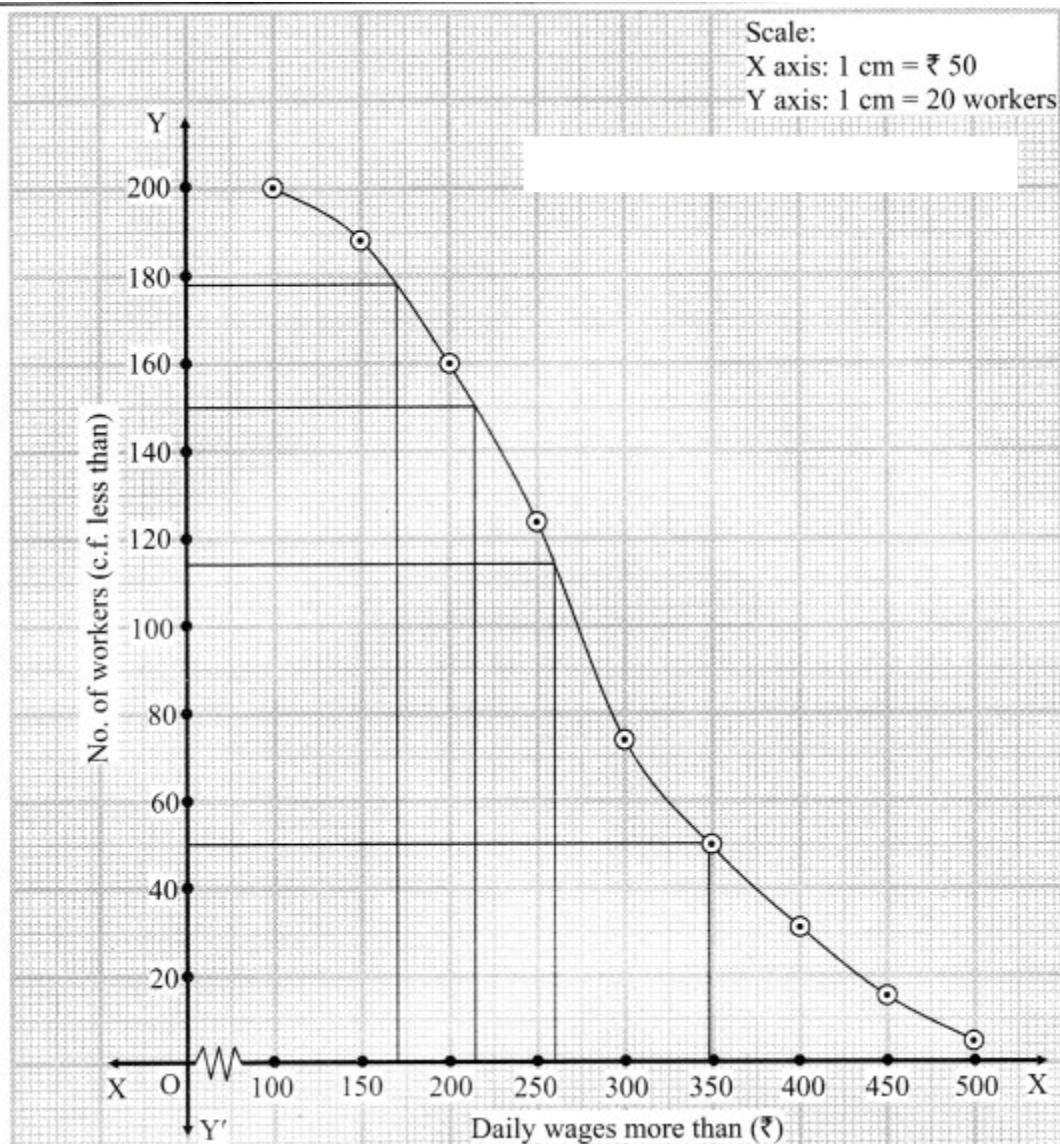
(ii) less than ₹ 260

Daily wages more than (₹)	100	150	200	250	300	350	400	450	500
No. of workers	200	188	160	124	74	49	31	15	5

Solution:

For more than ogive points to be plotted are (100, 200), (150, 188), (200, 160), (250, 124), (300, 74), (350, 49), (400, 31), (450, 15), (500, 5)





Here, N = 200

For Q<sub>1</sub>, N<sub>4</sub>=2004 = 4

For Q<sub>3</sub>, 3 N<sub>4</sub>=3×2004 = 150

We take the points having Y co-ordinates 50 and 150 on Y-axis.

From these points, we draw lines which are parallel to X-axis.

From the points of intersection of these lines with the curve, we draw perpendicular on X-axis.

X-Co-ordinates of these points gives the values of Q<sub>1</sub> and Q<sub>3</sub>.

Since X-axis has daily wages more than and not less than the given amounts.

∴ Q<sub>1</sub> = Q<sub>3</sub> and Q<sub>3</sub> = Q<sub>1</sub>

∴ Q<sub>2</sub> ~ 215 , Q<sub>3</sub> ~ 348

(i) To find the number of workers with daily wages between ₹ 170 and ₹ 260,

Take the values 170 and 260 on X-axis. From these points, we draw lines parallel to Y-axis.

From the point where they intersect the more than ogive, we draw perpendiculars on Y-axis.

The points where they intersect the Y-axis gives the values 178 and 114.

∴ Number of workers having daily wages between ₹ 170 and ₹ 260 = 178 – 114 = 64

(ii) To find the number of workers having daily wages less than ₹ 260, we consider the value 260 on the X-axis.

From this point, we draw a line that is parallel to Y-axis.

From the point where the line intersects the more than ogive, we draw a perpendicular on the Y-axis.

The foot of perpendicular gives the number of workers having daily wages of more than 260.

The foot of perpendicular ~ 114

∴ No. of workers whose daily wages are more than ₹ 260 ~ 114

∴ No. of workers whose daily wages are less than ₹ 260 = 200 – 114 = 86

**Question 17.**

Draw ogive of both the types for the following frequency distribution and hence find the median.

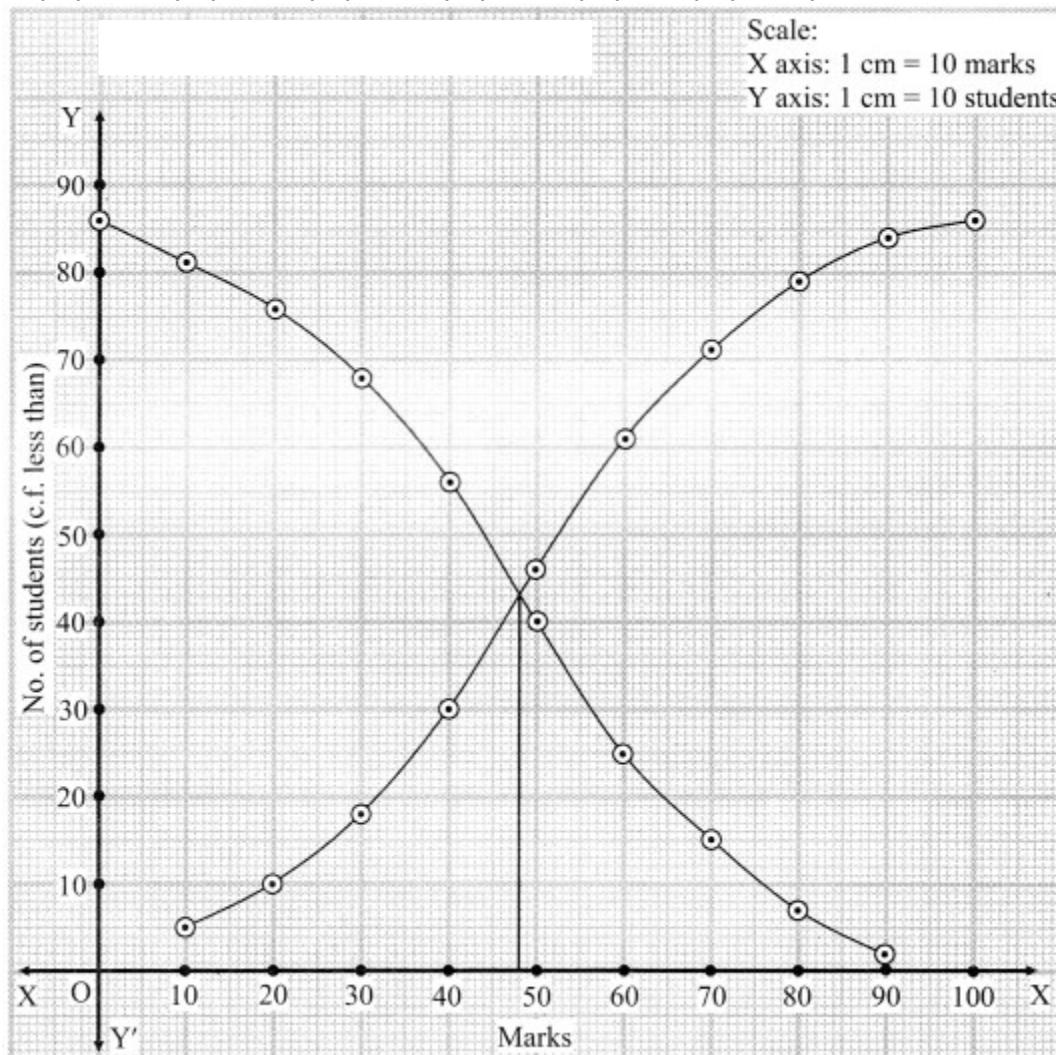
Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No. of students	5	5	8	12	16	15	10	8	5	2

**Solution:**

Marks	No. of students	Less than cumulative frequency (c.f.)	More than cumulative frequency (c.f.)
0 – 10	5	5	86
10 – 20	5	10	81
20 – 30	8	18	76
30 – 40	12	30	68
40 – 50	16	46	56
50 – 60	15	61	40
60 – 70	10	71	25
70 – 80	8	79	15
80 – 90	5	84	7
90 – 100	2	86	2

For less than given points to be plotted are (10, 5), (20, 10), (30, 18), (40, 30), (50, 46), (60, 61), (70, 71), (80, 79), (90, 84), (100, 86)

For more than given points to be plotted are (0, 86), (10, 81), (20, 76), (30, 68), (40, 56), (50, 40), (60, 25), (70, 15), (80, 7), (90, 2)



From the point of intersection of two ogives. We draw a perpendicular on

X-axis.

The point where it meets the X-axis gives the value of the median.

Question 18.

Find Q<sub>1</sub>, D<sub>6</sub> and P<sub>78</sub> for the following data:

C.I.	8-8.95	9-9.95	10-	11-	12-
			10.95	11.95	12.95
f	5	10	20	10	5

Solution:

Since the given data is not in the form of a continuous frequency distribution, we have to convert it into that form by subtracting 0.025 from the lower limit and adding 0.025 to the upper limit of each class interval.  
 $\therefore$  the class intervals will be 7.975 – 8.975, 8.975 – 9.975, etc.

We construct the less than cumulative frequency table as given below:

C.I.	f	Less than cumulative frequency (c.f.)
7.975 – 8.975	5	5
8.975 – 9.975	10	15 $\leftarrow$ Q <sub>1</sub>
9.975 – 10.975	20	35 $\leftarrow$ D <sub>6</sub>
10.975 – 11.975	10	45 $\leftarrow$ P <sub>78</sub>
11.975 – 12.975	5	
<b>Total</b>	<b>50</b>	

Here, N = 50

Q<sub>1</sub> class = class containing (N<sub>4</sub>)<sup>th</sup> observation

$$\therefore N_4 = 50 \times \frac{4}{10} = 20$$

Cumulative frequency which is just greater than (or equal) to 20 is 25.

$\therefore$  Q<sub>1</sub> lies in the class 8.975 – 9.975.

$$\therefore L = 8.975, h = 1, f = 10, c.f. = 5$$

$$Q_1 = L + hf \left( \frac{N_4 - c.f.}{f} \right)$$

$$= 8.975 + 10 \left( \frac{20 - 5}{10} \right)$$

$$= 8.975 + 0.1(15)$$

$$= 8.975 + 1.5$$

$$= 9.725$$

D<sub>6</sub> class = class containing (6 N<sub>10</sub>)<sup>th</sup> observation

$$\therefore 6 N_{10} = 6 \times 50 \times \frac{6}{10} = 180$$

Cumulative frequency which is just greater than (or equal) to 30 is 35.

$\therefore D_6$  lies in the class 9.975 – 10.975.

$\therefore L = 9.975, h = 1, f = 20, c.f. = 15$

$$D_6 = L + hf(6N10 - c.f.)$$

$$= 9.975 + 120(30 - 15)$$

$$= 9.975 + 0.05(15)$$

$$= 9.975 + 0.75$$

$$= 10.725$$

$P_{78}$  class = class containing  $(78 N100)$ th observation

$$78 N100 = 78 \times 50100 = 39$$

Cumulative frequency which is just greater than (or equal) to 39 is 45.

$\therefore P_{78}$  lies in the class 10.975 – 11.975.

$\therefore L = 10.975, h = 1, f = 10, c.f. = 35$

$$\therefore P_{78} = L + hf(78 N100 - c.f.)$$

$$= 10.975 + 110(39 - 35)$$

$$= 10.975 + 0.1(4)$$

$$= 10.975 + 0.4$$

$$= 11.375$$

Question 19.

Weight (kg)	40- 45	45- 50	50- 55	55- 60	60- 65	65- 70	70- 75	75- 80
No. of persons	4	15	20	30	20	10	8	4

For the above data, find all quartiles and number of persons weighing between 57 kg and 72 kg.

Solution:

We construct the less than cumulative frequency table as given below:



<b>Weight (kg)</b>	<b>No. of persons (f)</b>	<b>Less than cumulative frequency (c.f.)</b>
40 – 45	4	4
45 – 50	15	19
50 – 55	20	39 $\leftarrow Q_1$
55 – 60	30	69 $\leftarrow Q_2, P_x$
60 – 65	20	89 $\leftarrow Q_3$
65 – 70	10	99
70 – 75	8	107 $\leftarrow P_y$
75 – 80	4	111
<b>Total</b>	<b>N = 111</b>	

Here, N = 111

$Q_1$  class = class containing  $(N_4)$ th observation

$$\therefore N_4 = 111 \times 4 = 27.75$$

Cumulative frequency which is just greater than (or equal) to 27.75 is 39.

$\therefore Q_1$  lies in the class 50 – 55.

$$\therefore Q_1 = L + hf(N_4 - c.f.)$$

$$= 50 + \frac{5}{2} (27.75 - 19)$$

$$= 50 + 14 \times 8.75$$

$$= 50 + 2.1875$$

$$= 52.1875$$

$Q_2$  class = class containing  $(2 N_4)$ th observation

$$\therefore 2N_4 = 2 \times 111 \times 4 = 55.5$$

Cumulative frequency which is just greater than (or equal) to 55.5 is 69.

$\therefore Q_2$  lies in the class 55 – 60.

$$\therefore L = 55, h = 5, f = 30, c.f. = 39$$

$$\therefore Q_2 = L + hf(2N_4 - c.f.)$$

$$= 55 + \frac{5}{2} (55.5 - 39)$$

$$= 55 + 16 \times 16.5$$

$$= 55 + 2.75$$

$$= 57.75$$

$Q_3$  class = class containing  $(3 N_4)$ th observation

$$\therefore 3N_4 = 3 \times 111 \times 4 = 83.25$$

Cumulative frequency which is just greater than (or equal) to 83.25 is 89.

$\therefore Q_3$  lies in the class 60 – 65.

$$\therefore L = 60, h = 5, f = 20, c.f. = 69$$

$$\therefore Q_3 = L + hf(3N_4 - c.f.)$$

$$= 60 + 520 (83.25 - 69)$$

$$= 60 + 14 \times 14.25$$

$$= 60 + 3.5625$$

$$= 63.5625$$

In order to find the number of persons between 57 kg and 72 kg,

We need to find x in  $P_x$ , where  $P_x = 57$  kg and y in  $P_y$ , where  $P_y = 72$  kg

Then  $(y - x)$  would be the % of persons weighing between 57 kg and 72 kg

$$P_x = 57$$

$$\therefore L + hf(x \times N100 - c.f.) = 57$$

$$\therefore 55 + 530 (1.11x - 39) = 57$$

$$\therefore 16 (1.11x - 39) = 2$$

$$\therefore 1.11x - 39 = 12$$

$$\therefore 1.11x = 51$$

$$\therefore x = 45.95$$

$$\therefore P_y = 72$$

$$\therefore L + hf(y \times N100 - c.f.) = 72$$

$$\therefore 70 + 58 (1.11y - 99) = 72$$

$$\therefore 0.625(1.11y - 99) = 2$$

$$\therefore 1.11y - 99 = 3.2$$

$$\therefore 1.11y = 102.2$$

$$\therefore y = 92.07$$

$$\therefore \% \text{ of people weighing between } 57 \text{ kg and } 72 \text{ kg} = 92.07 - 45.95 = 46.12$$

%

$$\therefore \text{No. of people weighing between } 57 \text{ kg and } 72 \text{ kg} = 111 \times 46.12\% = 51.1932 \sim 51$$

### Question 20.

For the following data showing weights of 100 employees, find the maximum weight of the lightest 25% of employees.

Weight (kg)	45-50	50-55	55-60	60-65	65-70	70-75	75-80
No. of em-employees	6	8	15	26	20	14	11

Solution:

We construct the less than cumulative frequency table as given below:

<b>Weight (kg)</b>	<b>No. of employees (f)</b>	<b>Less than cumulative frequency (c.f.)</b>
45 – 50	6	6
50 – 55	8	14
55 – 60	15	29 ← $Q_1$
60 – 65	26	55
65 – 70	20	75
70 – 75	14	89
75 – 80	11	100
<b>Total</b>	<b>N = 100</b>	

Here,  $N = 100$

$Q_1$  class = class containing  $(N_4)^{th}$  observation

$$\therefore N_4 = 100 \times 0.25 = 25$$

Cumulative frequency which is just greater than (or equal) to 25 is 29.

$\therefore Q_1$  lies in the class 55 – 60.

$$\therefore L = 55, h = 5, f = 15, c.f. = 14$$

$$\therefore Q_1 = L + hf(N_4 - c.f.)$$

$$= 55 + 5 \times 15 (25 - 14)$$

$$= 55 + 13 \times 11$$

$$= 55 + 3.67$$

$$= 58.67$$

$\therefore$  Maximum weight of the lightest 25% of employees is 58.67 kg.

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