Measures of Central Tendency

Exercise 24(A)

Question 1.

Find the mean of the following set of numbers:
(i) 6, 9, 11, 12 and 7
(ii) 11, 14, 23, 26, 10, 12, 18 and 6

Solution:

(i)

$$\bar{x} = \frac{x_1 + x_2 + \ldots\ldots + x_n}{n}$$

Here $n = 5$

$$\therefore \bar{x} = \frac{6 + 9 + 11 + 12 + 7}{5} = \frac{45}{5} = 9$$

(ii)

$$\bar{x} = \frac{x_1 + x_2 + \ldots\ldots + x_n}{n}$$

Here $n = 8$

$$\therefore \bar{x} = \frac{11 + 14 + 23 + 26 + 10 + 12 + 18 + 6}{8} = \frac{120}{8} = 15$$

Question 2.

Marks obtained (in mathematics) by 9 student are given below:
60, 67, 52, 76, 50, 51, 74, 45 and 56
(a) find the arithmetic mean
(b) if marks of each student be increased by 4; what will be the new value of arithmetic mean.

Solution:

(a) Here $n = 9$

$$\bar{x} = \frac{x_1 + x_2 + \ldots\ldots + x_n}{n}$$

$$\therefore \bar{x} = \frac{60 + 67 + 52 + 76 + 50 + 51 + 74 + 45 + 56}{9} = \frac{531}{9} = 59$$

(b)

If marks of each student be increased by 4 then new arithmetic mean will be = 59 + 4 = 63

Question 3.
Find the mean of the natural numbers from 3 to 12.
Solution:
Numbers between 3 to 12 are 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12.
Here n = 10

$$\bar{x} = \frac{x_1 + x_2 + \ldots + x_n}{n}$$

$$\therefore \bar{x} = \frac{3+4+5+6+7+8+9+10+11+12}{10} = \frac{75}{10} = 7.5$$

Question 4.
(a) Find the mean of 7, 11, 6, 5, and 6
(b) If each number given in (a) is diminished by 2, find the new value of mean.
Solution:
(a) The mean of 7, 11, 6, 5 and 6

$$\bar{x} = \frac{7+11+6+5+6}{5} = \frac{35}{5} = 7$$

(b)

If we subtract 2 from each number, then the mean will be 7-2 = 5

Question 5.
If the mean of 6, 4, 7, ‘a’ and 10 is 8. Find the value of ‘a’
Solution:
No. of terms = 5
Mean = 8
Sum of numbers = 8 x 5 = 40 .(i)
But, sum of numbers = 6+4+7+a+10 = 27+a ..(ii)
From (i) and (ii)
27+a = 40
a = 13

Question 6.
The mean of the number 6, ‘y’, 7, ‘x’ and 14 is 8. Express ‘y’ in terms of ‘x’.
Solution:
No. of terms = 5 and mean = 8
Sum of numbers = 5 x 8 = 40 ..(i)
but sum of numbers = 6+y+7+x+14 = 27+y+x .(ii)
from (i) and (ii)
27 + y + x = 40
x + y = 13
y = 13 – x

Question 7.

The ages of 40 students are given in the following table:

Age(in yrs)	12	13	14	15	16	17	18
Frequency	2	4	6	9	8	7	4

Find the arithmetic mean.

Solution:

Age in yrs x_i	Frequency (f_i)	f_ix_i
12	2	24
13	4	52
14	6	84
15	9	135
16	8	128
17	7	119
18	4	72
Total	40	614

$$\bar{x} = \frac{\sum f_i x_i}{\sum f} = \frac{614}{40} = 15.35$$

Question 8.

If 69.5 is the mean of 72, 70, ‘x’, 62, 50, 71, 90, 64, 58 and 82, find the value of ‘x’.

Solution:

No. of terms = 10
Mean = 69.5
Sum of the numbers = 69.5 x 10 = 695 …….(i)
But sum of numbers = 72+70+x+62+ 50+71+90+64+58+82
= 619 + x ……(ii)
from (i) and (ii)
619 + x = 695
x = 76

Question 9.

The following table gives the heights of plants in centimeter. If the mean height of plants is 60.95 cm; find the value of 'f'.

Height (cm)	50	55	58	60	65	70	71
No. of plants	2	4	10	f	5	4	3

Solution:

Height (cm) x_i	No. of Plants f_i	f_ix_i
50	2	100
55	4	220
58	10	580
60	f	60f
65	5	325
70	4	280
71	3	213
Total	28+f	1718 + 60f

Mean = 60.95

$$\therefore \frac{1718 + 60f}{28 + f} = 60.95$$

$$\Rightarrow 1718 + 60f = 60.95(28 + f)$$

$$\Rightarrow 1718 + 60f = 1706.6 + 60.95f$$

$$\Rightarrow (60.95 - 60)f = 1718.0 - 1706.6$$

$$\Rightarrow 0.95f = 11.4$$

$$\therefore f = \frac{11.4}{0.95} = 12$$

Question 10.

From the data given below, calculate the mean wage, correct to the nearest rupee.

Category	A	B	C	D	E	F
Wages (Rs/day)	50	60	70	80	90	100
No. of workers	2	4	8	12	10	6

(i) If the number of workers in each category is doubled, what would be the new mean wage?

(ii) If the wages per day in each category are increased by 60%; what is the new mean wage?

(iii) If the number of workers in each category is doubled and the wages per day per worker are reduced by 40%, what would be the new mean wage?

Solution:

Wages (Rs/day) (x)	No. of Workers (f)	fx
50	2	100
60	4	240
70	8	560
80	12	960
90	10	900
100	6	600
Total	42	3360

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{3360}{42} = 80$$

(i) Mean remains the same if the number of workers in each category is doubled.

Mean = 80

(ii) Mean will be increased by 60% if the wages per day per worker is increased by 60%

$$\text{New mean} = 80 \times \frac{160}{100} = 128$$

(iii) No change in the mean if the number of workers is doubled but if wages per worker is reduced by 40%, then

$$\text{New mean} = 80 \times \frac{60}{100} = 48$$

Question 11.

The contents of 100 match boxes were checked to determine the number of matches they contained.

No. of matches	35	36	37	38	39	40	41
No. of boxes	6	10	18	25	21	12	8

(i) calculate, correct to one decimal place, the mean number of matches per box.

(ii) Determine how many extra matches would have to be added to the total contents of the 100 boxes to bring the mean up to exactly 39 matches.

Solution:

No. of matches (x)	No. of boxes (f)	fx
35	6	210
36	10	360
37	18	666
38	25	950
39	21	819
40	12	480
41	8	328
Total	100	3813

(i) $\bar{x} = \frac{\sum fx}{\sum f} = \frac{3813}{100} = 38.13$

(ii) In the second case,

New mean = 39 matches

Total contents = 39 x 100 = 3900

But total number of matches already given = 3813

Number of new matches to be added = 3900 - 3813 = 87

Solution 12.

We have,

x	f	fx
1	9	9
2	6	12
3	9	27
5	3	15
p + 4	6	6p + 24
	$\sum f = 33$	$\sum fx = 6p + 87$

Now, Mean $= \frac{\sum fx}{\sum f}$

$\Rightarrow 3 = \frac{6p + 87}{33}$

$\Rightarrow 99 = 6p + 87$

$\Rightarrow 6p = 12$

$\Rightarrow p = 2$

Solution 13.

We have,

x	f	fx
0	46	0
50	f_1	$50f_1$
100	f_2	$100f_2$
150	25	3750
200	10	2000
250	5	1250
	$\sum f = 86 + f_1 + f_2$	$\sum fx = 7000 + 50f_1 + 100f_2$

Given, $\sum f = 200$

$\Rightarrow 86 + f_1 + f_2 = 200$

$\Rightarrow f_1 + f_2 = 114 \quad \ldots.(i)$

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\Rightarrow 73 = \frac{7000 + 50f_1 + 100f_2}{200}$$

$\Rightarrow 7000 + 50f_1 + 100f_2 = 14600$

$\Rightarrow 50f_1 + 100f_2 = 7600$

$\Rightarrow f_1 + 2f_2 = 152 \quad \ldots.(ii)$

Subtracting (ii) from (i), we get

$f_2 = 38$

$\Rightarrow f_1 = 114 - 38 = 76$

Hence, $f_1 = 76$ and $f_2 = 38$

Solution 14.

Let the assumed mean A = 30

x	f	d = x − A	$t = \frac{x-A}{i} = \frac{x-30}{5}$	ft
5	20	−25	−5	−100
10	43	−20	−4	−172
15	75	−15	−3	−225
20	67	−10	−2	−134
25	72	−5	−1	−72
A = 30	45	0	0	0
35	39	5	1	39
40	9	10	2	18
45	8	15	3	24
50	6	20	4	24
	$\Sigma f = 384$			$\Sigma ft = -598$

$$\therefore \text{Mean} = A + \frac{\Sigma ft}{\Sigma f} \times i$$

$$= 30 + \frac{(-598)}{384} \times 5$$

$$= 30 - \frac{299}{192} \times 5$$

$$= 30 - \frac{1495}{192}$$

$$= \frac{5760 - 1495}{192}$$

$$= \frac{4265}{192}$$

$$= 22.21$$

$$= 22$$

Solution 15.

Let the assumed mean A = 45

x	f	d = x − A = x − 45	fd
40	14	−5	−70
41	28	−4	−112
43	38	−2	−76
A = 45	50	0	0
46	40	1	40
49	20	4	80
50	10	5	50
	$\Sigma f = 200$		$\Sigma fd = -88$

$$\therefore \text{Mean} = A + \frac{\Sigma fd}{\Sigma f}$$

$$= 45 + \frac{(-88)}{200}$$

$$= 45 - \frac{11}{25}$$

$$= \frac{1125 - 11}{25}$$

$$= \frac{1114}{25}$$

$$= 44.6$$

Exercise 24(B)

Question 1.

The following table gives the ages of 50 students of a class. Find the arithmetic mean of their ages.

Age - Years	16 - 18	18 - 20	20 - 22	22- 24	24-26
No. of Students	2	7	21	17	3

Solution:

Age in years C.I.	x_i	Number of students (f_i)	$x_i f_i$
16 - 18	17	2	34
18 - 20	19	7	133
20 - 22	21	21	441
22 - 24	23	17	391
24 - 26	25	3	75
Total		50	1074

$$\bar{x} = \frac{f_i x_i}{\sum f} = \frac{1074}{50} = 21.48$$

Question 2.

The following table gives the weekly wages of workers in a factory.

Weekly Wages (Rs)	No. of Workers
50-55	5
55-60	20
60-65	10
65-70	10
70-75	9
75-80	6
80-85	12
85-90	8

Calculate the mean by using:

(i) Direct Method

(ii) Short - Cut Method

Solution:

(i) Direct Method

Weekly Wages (Rs)	Mid-Value x_i	No. of Workers (f_i)	f_ix_i
50-55	52.5	5	262.5
55-60	57.5	20	1150.0
60-65	62.5	10	625.0
65-70	67.5	10	675.0
70-75	72.5	9	652.5
75-80	77.5	6	465.0
80-85	82.5	12	990.0
85-90	87.5	8	700.0
Total		80	5520.00

$$\bar{x} = \frac{f_ix_i}{\sum f} = \frac{5520}{80} = 69$$

(ii) Short - cut method

Weekly wages (Rs)	No. of workers (f_i)	Mid-value x_i	A = 72.5 d_i=x-A	f_id_i
50-55	5	52.5	-20	-100
55-60	20	57.5	-15	-300
60-65	10	62.5	-10	-100
65-70	10	67.5	-5	-50
70-75	9	A=72.5	0	0
75-80	6	77.5	5	30
80-85	12	82.5	10	120
85-90	8	87.5	15	120
Total	80			-280

$$\bar{x} = A + \frac{\sum f_id_i}{\sum f_i} = 72.5 + \left(\frac{-280}{80}\right) = 72.5 - 3.5 = 69$$

Question 3.

The following are the marks obtained by 70 boys in a class test:

Marks	No. of boys
30 - 40	10
40 - 50	12
50 - 60	14
60 - 70	12
70 - 80	9
80 - 90	7
90 - 100	6

Calculate the mean by:

(i) Short - cut method

(ii) Step - deviation method

Solution:

(i) Short - cut method

Marks	No. of boys (f_i)	Mid-value x_i	A = 65 $d_i = x - A$	$f_i d_i$
30 - 40	10	35	-30	-300
40 - 50	12	45	-20	-240
50 - 60	14	55	-10	-140
60 - 70	12	A = 65	0	0
70 - 80	9	75	10	90
80 - 90	7	85	20	140
90 - 100	6	95	30	180
Total	70			-270

$$\bar{x} = A + \frac{\sum f_i d_i}{\sum f_i} = 65 + \left(\frac{-270}{70}\right) = 65 - 3.86 = 61.14$$

(ii) Step - deviation method

Marks	No. of boys (f_i)	Mid-value x_i	A = 65 $u_i = \frac{x_i - A}{h}$	f_iu_i
30 - 40	10	35	-3	-30
40 - 50	12	45	-2	-24
50 - 60	14	55	-1	-14
60 - 70	12	A = 65	0	0
70 - 80	9	75	1	9
80 - 90	7	85	2	14
90 - 100	6	95	3	18
Total	70			-27

Here A = 65 and h = 10

$$\bar{x} = A + h \times \frac{\sum f_i u_i}{\sum f_i} = 65 + 10 \times \left(\frac{-27}{70}\right) = 65 - 3.86 = 61.14$$

Question 4.

Find mean by step - deviation method:

C. I.	63-70	70-77	77-84	84-91	91-98	98-105	105-112
Freq	9	13	27	38	32	16	15

Solution:

C. I.	Frequency (f_i)	Mid-value x_i	A = 87.50 $u_i = \frac{x_i - A}{h}$	$f_i u_i$
63 - 70	9	66.50	-3	-27
70 - 77	13	73.50	-2	-26
77 - 84	27	80.50	-1	-27
84 - 91	38	A = 87.50	0	0
91 - 98	32	94.50	1	32
98 - 105	16	101.50	2	32
105 - 112	15	108.50	3	45
Total	150			29

Here A = 87.50 and h = 7

$$\bar{x} = A + h \times \frac{\sum f_i u_i}{\sum f_i} = 87.5 + 7 \times \frac{29}{150} = 87.5 + 1.35 = 88.85$$

Question 5.

The mean of the following frequency distribution is $21\frac{1}{7}$. Find the value of 'f'.

C. I.	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
freq	8	22	31	f	2

Solution:

$\bar{x} = 21\frac{1}{7} = \frac{148}{7}$

C. I.	frequency	Mid-value (x_i)	f_ix_i
0-10	8	5	40
10-20	22	15	330
20-30	31	25	775
30-40	f	35	35f
40-50	2	45	90
Total	63+f		1235+35f

$$\bar{x} = \frac{\sum f_ix_i}{\sum f_i} = \frac{1235 + 35f}{63 + f}$$

$$\Rightarrow \frac{148}{7} = \frac{1235 + 35f}{63 + f}$$

$$\Rightarrow 9324 + 148f = 8645 + 245f$$

$$\Rightarrow 245f - 148f = 9324 - 8645$$

$$\Rightarrow f = \frac{679}{97}$$

$$\Rightarrow f = 7$$

Question 6.

Using step-deviation method, calculate the mean marks of the following distribution.

C.I	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90
Frequency	5	20	10	10	9	6	12	8

Solution:

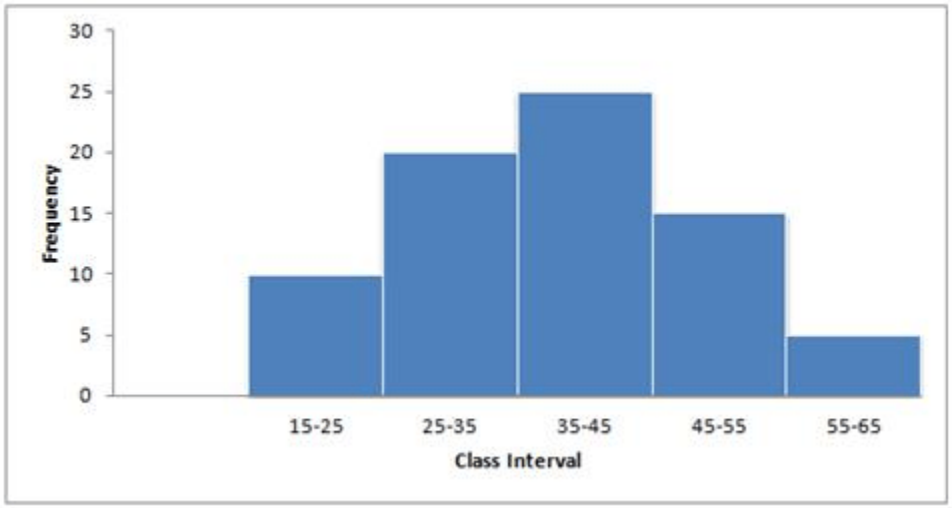
Let the assumed mean A= 72.5

C.I	f_i	Mid value (x_i)	$d_i=x_i$ -; A	f_id_i
50-55	5	52.5	-20	-100
55-60	20	57.5	-15	-300
60-65	10	62.5	-10	-100
65-70	10	67.5	-5	-50
70-75	9	72.5	0	0
75-80	6	77.5	5	30
80-85	12	82.5	10	120
85-90	8	87.5	15	120
Total	80		-280	

$$\text{Mean} = A + \frac{\sum f_i d_i}{\sum f_i} = 72.5 + \left(-\frac{280}{80}\right) = 69$$

Question 7.

Using the information given in the adjoining histogram, calculate the mean.



Solution:

C.I.	Frequency	Mid value x	fx
15-25	10	20	200
25-35	20	30	600
35-45	25	40	1000
45-55	15	50	750
55-65	5	60	300
Total	75		2850

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{2850}{75} = 38$$

Question 8.

If the mean of the following observations is 54, find the value of 'p'.

Class	0 - 20	20 - 40	40 - 60	60 - 80	80 - 100
Frequency	7	p	10	9	13

Solution:

Class	Frequency (f)	Mid Value (x)	fx
0 - 20	7	10	70
20 - 40	p	30	30p
40 - 60	10	50	500
60 - 80	9	70	630
80 - 100	13	90	1170
Total	39 + p		2370 + 30p

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{2370 + 30p}{39 + p} \ldots\ldots (i)$$

Here mean = 54 ..(ii)

from (i) and (ii)

$$\frac{2370 + 30p}{39 + p} = 54$$

$$\Rightarrow 2370 + 30p = 2106 + 54p$$

$$\Rightarrow 54p - 30p = 2370 - 2106$$

$$\Rightarrow p = \frac{264}{24} = 11$$

Question 9.

The mean of the following distribution is 62.8 and the sum of all the frequencies is 50. Find the missing frequ

Class	0-20	20-40	40-60	60-80	80-100	100-120
Freq	5	f_1	10	f_2	7	8

Solution:

Class	Freq (f)	Mid value	fx
0-20	5	10	50
20-40	f_1	30	$30f_1$
40-60	10	50	500
60-80	f_2	70	$70f_2$
80-100	7	90	630
100-120	8	110	880
Total	$30+f_1+f_2$		$2060+30f_1+70f_2$

Now, $\sum f = 30 + f_1 + f_2$ and $\sum fx = 2060 + 30f_1 + 70f_2$.....(i)

$\sum f = 50$; mean = 62.8....(ii)

from (i)

$30 + f_1 + f_2 = 50$

$f_1 + f_2 = 20$.....(iii)

using (i) and (ii)

$$\text{mean} = \frac{2060 + 30f_1 + 70f_2}{50}$$

$$62.8 = \frac{2060 + 30f_1 + 70f_2}{50}$$

$2060 + 30f_1 + 70f_2 = 62.8 \times 50$

$2060 + 30f_1 + 70f_2 = 3140$

$30f_1 + 70f_2 = 1080$

$3f_1 + 7f_2 = 108$....(iv)

from (iii) and (iv)

$f_1 = 8$

$f_2 = 12$

Solution 10.

Marks	f	x	$d = x - A$ $= x - 45.5$	fd
11 – 20	2	15.5	–30	–60
21 – 30	6	25.5	–20	–120
31 – 40	10	35.5	–10	–100
41 – 50	12	A = 45.5	0	0
51 – 60	9	55.5	10	90
61 – 70	7	65.5	20	140
71 – 80	4	75.5	30	120
	$\Sigma f = 50$			$\Sigma fd = 70$

$$\therefore \text{Mean} = A + \frac{\Sigma fd}{\Sigma f}$$

$$= 45.5 + \frac{70}{50}$$

$$= 45.5 + \frac{7}{5}$$

$$= \frac{227.5 + 7}{5}$$

$$= \frac{234.5}{5}$$

$$= 46.9$$

Solution 11.

We have,

C.I.	f	Class mark x	fx
0 – 10	8	5	40
10 – 20	5	15	75
20 – 30	12	25	300
30 – 40	35	35	1225
40 – 50	24	45	1080
50 – 60	16	55	880
	$\Sigma f = 100$		$\Sigma fx = 3600$

Now, $\text{Mean} = \frac{\Sigma fx}{\Sigma f} = \frac{3600}{100} = 36$

Exercise 24(C)

Question 1.
A student got the following marks in 9 questions of a question paper.
3, 5, 7, 3, 8, 0, 1, 4 and 6.
Find the median of these marks.
Solution:
Arranging the given data in descending order:
8, 7, 6, 5, 4, 3, 3, 1, 0
The middle term is 4 which is the 5th term.
Median = 4

Question 2.
The weights (in kg) of 10 students of a class are given below:
21, 28.5, 20.5, 24, 25.5, 22, 27.5, 28, 21 and 24.
Find the median of their weights.
Solution:
Arranging the given data in descending order:

28.5, 28, 27.5, 25.5, 24, 24, 22, 21, 21, 20.5

The middle terms are 24 and 24, 5^{th} and 6^{th} terms

$$\therefore \text{median} = \frac{24+24}{2} = \frac{48}{2} = 24$$

Question 3.
The marks obtained by 19 students of a class are given below:
27, 36, 22, 31, 25, 26, 33, 24, 37, 32, 29, 28, 36, 35, 27, 26, 32, 35 and 28. Find:
(i) median
(ii) lower quartile
(iii) upper quartile
(iv) interquartile range

Solution:

Arranging in ascending order:

22, 24, 25, 26, 26, 27, 27, 28, 28, 29, 21, 32, 32, 33, 35, 35, 36, 36, 37

(i) Middle term is 10^{th} term i.e. 29

Median = 29

(ii) Lower quartile =

$$q_1 = \frac{n+1}{4}^{th} \text{ term}$$

$$q_1 = \frac{19+1}{4}^{th} \text{ term}$$

$$q_1 = 5^{th} \text{term} = 26$$

(iii) Upper quartile =

$$q_3 = \left[\frac{3(n+1)}{4}\right]^{th} \text{ term}$$

$$q_3 = \left[\frac{3(19+1)}{4}\right]^{th} \text{ term}$$

$$q_3 = 15^{th} \text{term} = 35$$

(iv) Interquartile range = $q_3 - q_1 = 35 - 26 = 9$

Question 4.

From the following data, find:

(i) Median

(ii) Upper quartile

(iii) Inter-quartile range

25, 10, 40, 88, 45, 60, 77, 36, 18, 95, 56, 65, 7, 0, 38 and 83

Solution:

Arrange in ascending order:

0, 7, 10, 18, 25, 36, 38, 40, 45, 56, 60, 65, 77, 83, 88, 95

(i) Median is the mean of 8^{th} and 9^{th} term

$$= \frac{40+45}{2} = \frac{85}{2} = 42.5$$

(ii) Upper quartile =

$$q_3 = \left(\frac{3(n)}{4}\right)^{th} \text{ term}$$

$$q_3 = \frac{3 \times 16^{th}}{4} \text{ term} = 12^{th} \text{ term} = 65$$

(iii) Interquartile range =

$$q_1 = \frac{16^{th}}{4} \text{ term} = 18; q_3 = 65$$

Interquartile range $= q_3 - q_1$

$\therefore\ q_3 - q_1 = 65 - 18$

$= 47$

Question 5.

The ages of 37 students in a class are given in the following table:

Age (in years)	11	12	13	14	15	16
Frequency	2	4	6	10	8	7

Find the median.

Solution:

Age (in years)	Frequency	Cumulative Frequency
11	2	2
12	4	6
13	6	12
14	10	22
15	8	30
16	7	37

Number of terms = 37

$$\text{Median} = \frac{37+1^{th}}{2} \text{ term} = 19^{th} \text{ term}$$

Median = 14

Question 6.

The weight of 60 boys are given in the following distribution table:

Weight (kg)	37	38	39	40	41
No. of boys	10	14	18	12	6

Find:

(i) median

(ii) lower quartile

(iii) upper quartile

(iv) interquartile range

Solution:

Weight (kg) x	no. of boys f	cumulative frequency
37	10	10
38	14	24
39	18	42
40	12	54
41	6	60

Number of terms = 60

(i) median = the mean of the 30^{th} and the 31^{st} terms

$$\therefore \text{median} = \frac{39+39}{2} = \frac{78}{2} = 39$$

(ii) lower quartile (Q_1) = $\frac{60^{th}}{4}$ term = 15^{th} term = 38

(iii) upper quartile (Q_3) = $\frac{3 \times 60^{th}}{4}$ term = 45^{th} term = 40

(iv) Interquartile range = $Q_3 - Q_1 = 40 - 38 = 2$

Question 7.

Estimate the median for the given data by drawing an ogive:

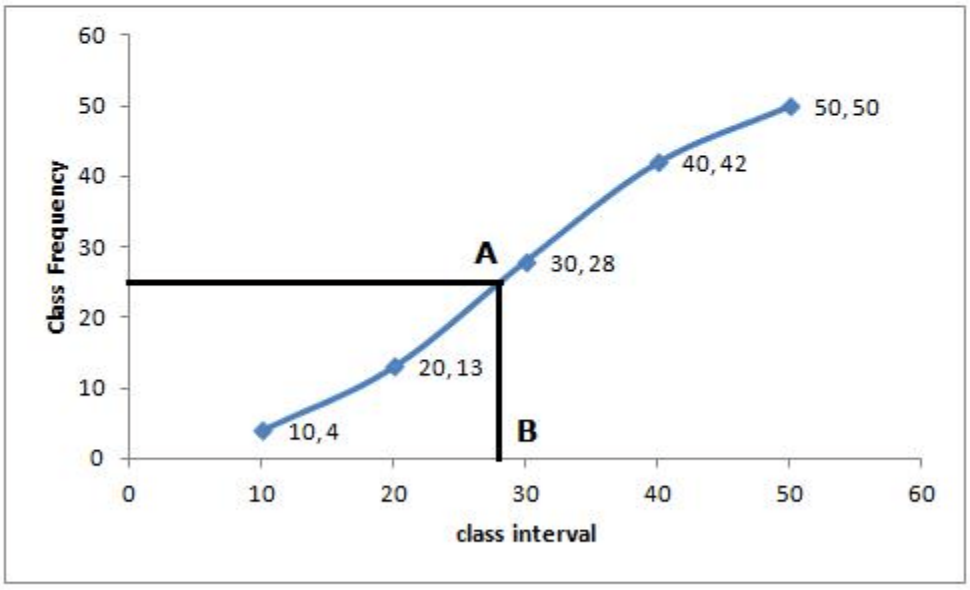
Class	0-10	10-20	20-30	30-40	40-50
frequency	4	9	15	14	8

Solution:

Class	Frequency	Cumulative Frequency
0-10	4	4
10-20	9	13
20-30	15	28
30-40	14	42
40-50	8	50

Number of terms = 50

$$\therefore \text{Median} = \frac{25 + 26^{th}}{2} \text{ term} = 25.5^{th} \text{ term}$$



Through mark of 25.5 on the y-axis, draw a line parallel to x-axis which meets the curve at A. From A, draw a perpendicu x-axis at B.

The value of B is the median which is 28.

Question 8.

By drawing an ogive, estimate the median for the following frequency distribution:

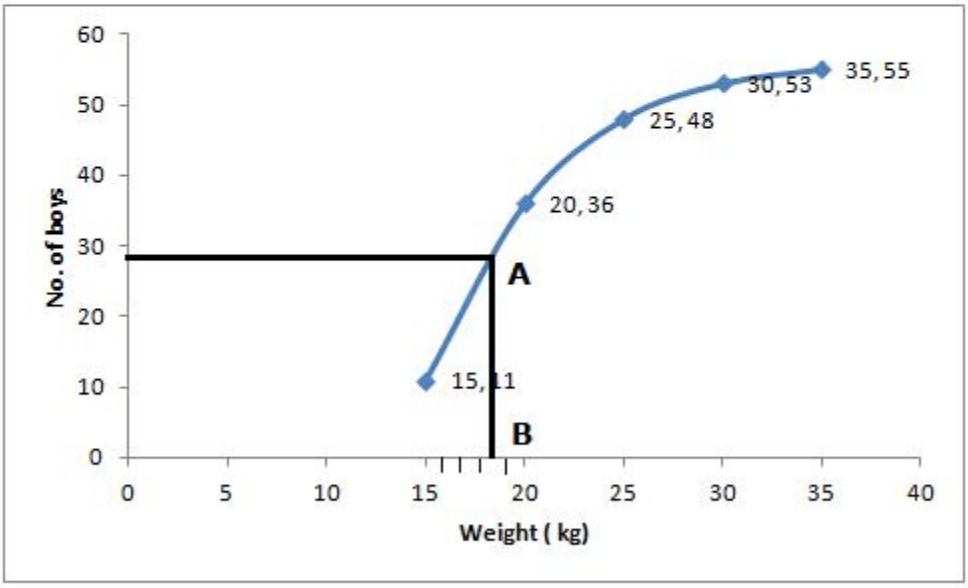
Weight (kg)	10-15	15-20	20-25	25-30	30-35
No. of boys	11	25	12	5	2

Solution:

Weight (kg)	No. of boys	Cumulative Frequency
10-15	11	11
15-20	25	36
20-25	12	48
25-30	5	53
30-35	2	55

Number of terms = 55

$$\therefore \text{Median} = \frac{55+1^{th}}{2} \text{ term} = 28^{th} \text{term}$$



Through mark of 28 on the y-axis, draw a line parallel to x-axis which meets the curve at A. From A, draw a perpendicu axis at B.

The value of B is the median which is 18.4 kg

Question 9.

From the following cumulative frequency table, find:

(i) median

(ii) lower quartile

(iii) upper quartile

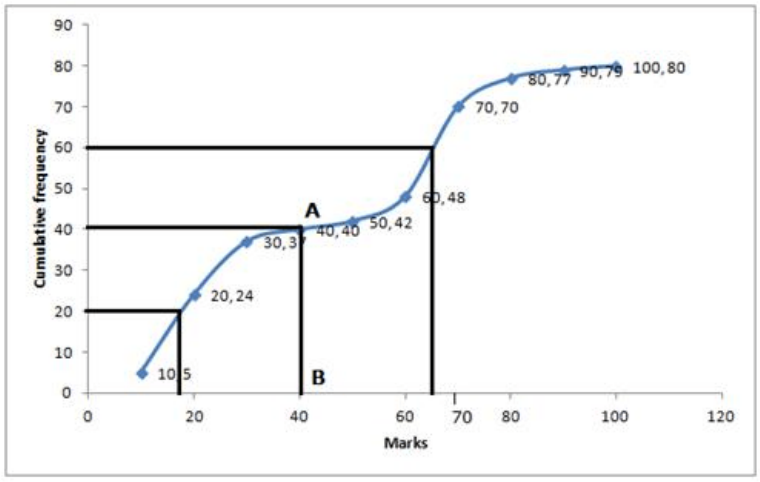
Marks(less than)	10	20	30	40	50	60	70	80	90	100
Cumulative frequency	5	24	37	40	42	48	70	77	79	80

Solution:

Marks (less than)	Cumulative frequency
10	5
20	24
30	37
40	40
50	42
60	48
70	70
80	77
90	79
100	80

Number of terms = 80

\Median = 40^{th} term.



(i) Median = Through 40^{th} term mark draw a line parallel to the x-axis which meets the curve at A. From A, draw a perpendicular to x-axis which meets it at B.

Value of B is the median = 40

(ii) Lower quartile (Q_1) = 20^{th} term = 18

(iii) Upper Quartile (Q_3) = 60^{th} term = 66

Question 10.

In a school, 100 pupils have heights as tabulated below:

Height (in cm)	No. of pupils
121 - 130	12
131 - 140	16
141 - 150	30
151 - 160	20
161 - 170	14
171 - 180	8

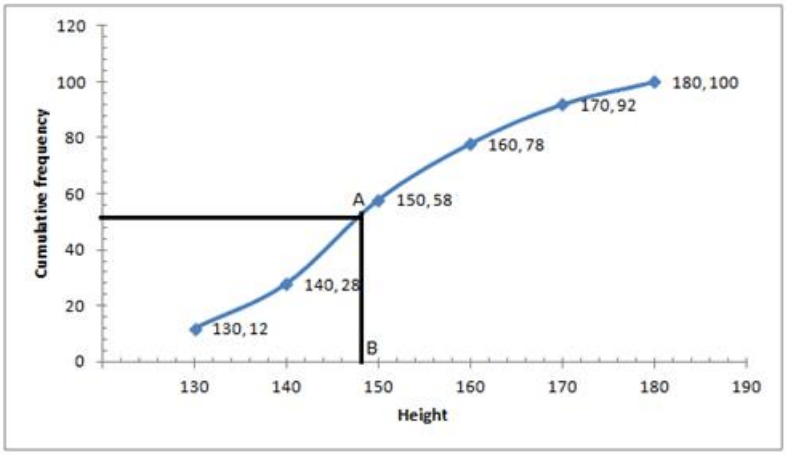
Find the median height by drawing an ogive.

Solution:

Height (in cm)	No. of pupils	Cumulative Frequency
121 - 130	12	12
131 - 140	16	28
141 - 150	30	58
151 - 160	20	78
161 - 170	14	92
171 - 180	8	100

Number of terms = 100

$\therefore$ Median = $\frac{100}{2}$ = 50^{th} term



Through 50^{th} term mark draw a line parallel to the x-axis which meets the curve at A. From A, draw a perpendicular to x-axis which meets it at B.

Value of B is the median = 148

$\Rightarrow$ Median height = 148cm

Question 11.

Attempt this question on a graph paper. The table shows the distribution of marks gained by a group of 400 students in an examination.

Marks(less than)	10	20	30	40	50	60	70	80	90	100
No. Of Students	5	10	30	60	105	180	270	355	390	400

Using a scale of 2 cm to represent 10 marks and 2 cm to represent 50 students, plot these points and draw a smooth curve through the points.

Estimate from the graph:

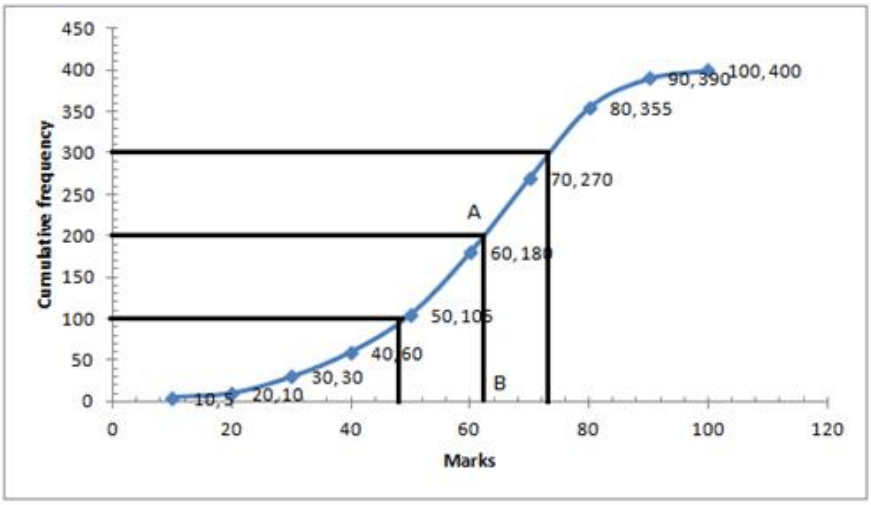
(i) the median marks

(ii) the quartile marks

Solution:

Marks (less than)	No. of students
10	5
20	10
30	30
40	60
50	105
60	180
70	270
80	355
90	390
100	400

Number of terms = 400



(i) $\therefore$ Median $= \frac{400}{2} = 200^{th}$ term

Through 200^{th} term mark draw a line parallel to the x-axis which meets the curve at A. From A, draw a perpendicular t

Value of B is the median = 62

(ii) Lower Quartile = $Q_1 = \frac{400}{4} = 100^{th}$ term = 49

Upper Quartile = $400 \times \frac{3}{4} = 300^{th}$ term = 74

Question 12.

Attempt this question on graph paper.

Age (yrs)	5-15	15-25	25-35	35-45	45-55	55-65	65-75
No. of casual-ties	6	10	15	13	24	8	7

(i) Construct the 'less than' cumulative frequency curve for the above data. Using 2 cm = 10 years on one axis and 2 cm = 10 casualties on the other.

(ii) From your graph determine:

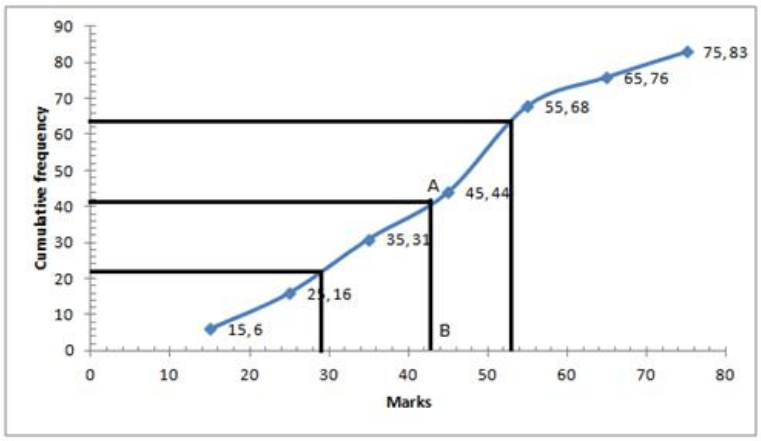
(a) the median

(b) the lower quartile

Solution:

Age (years)	No. of casualties	Cumulative Frequency
5-15	6	6
15-25	10	16
25-35	15	31
35-45	13	44
45-55	24	68
55-65	8	76
65-75	7	83

Number of terms = 83



(i) $\therefore$ Median $= \frac{83}{2} = 41.5^{th}$ term

Through 41.5^{th} term mark draw a line parallel to the x-axis which meets the curve at A. From A, draw a perpendicular to x-axis which meets it at B.

Value of B is the median = 43

(ii) Lower Quartile = $Q_1 = \frac{83}{4} = 20\frac{3}{4}^{th}$ term = 29

Upper Quartile = $83 \times \frac{3}{4} = 62\frac{1}{4}^{th}$ term = 53

Exercise 24(D)

Question 1.

Find the mode of the following data:
(i) 7, 9, 8, 7, 7, 6, 8, 10, 7 and 6
(ii) 9, 11, 8, 11, 16, 9, 11, 5, 3, 11, 17 and 8

Solution:

(i) Mode = 7
Since 7 occurs 4 times
(ii) Mode = 11
Since it occurs 4 times

Question 2.

The following table shows the frequency distribution of heights of 50 boys:

Height (cm)	120	121	122	123	124
Frequency	5	8	18	10	9

Find the mode of heights.

Solution:

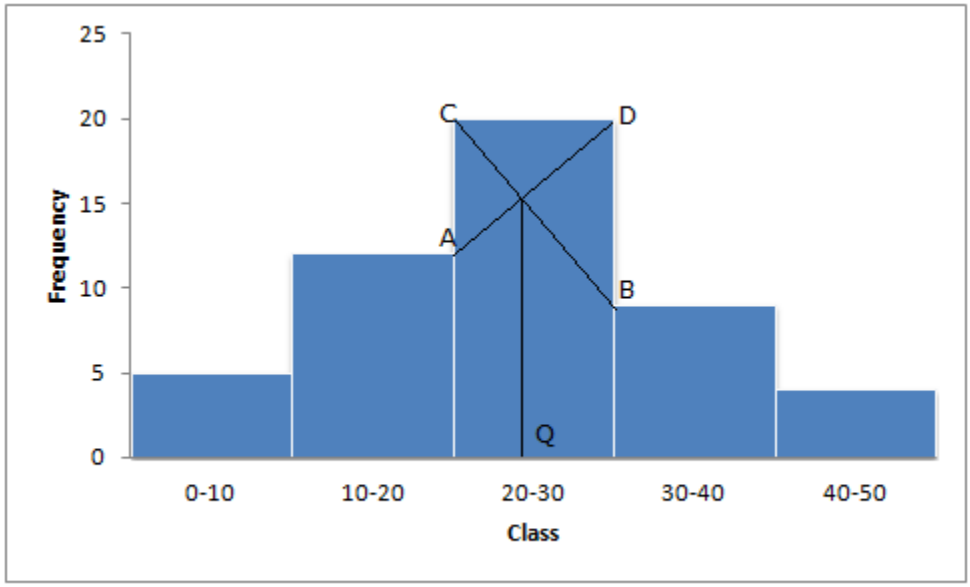
Mode is 122 cm because it occur maximum number of times. i.e. frequency is 18.

Question 3.

Find the mode of following data, using a histogram:

Class	0-10	10-20	20-30	30-40	40-50
Frequency	5	12	20	9	4

Solution:



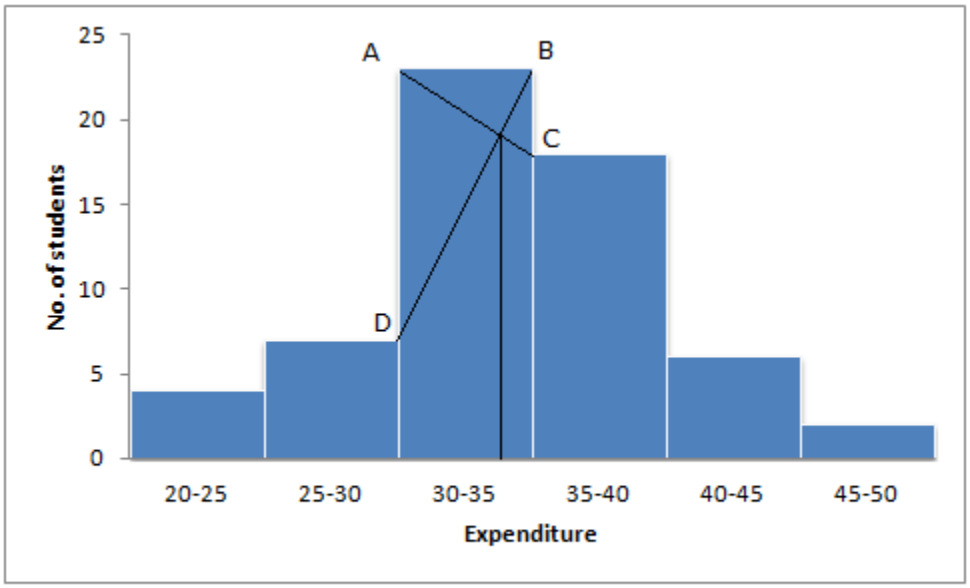
Mode is in 20-30, because in this class there are 20 frequencies.

Question 4.

The following table shows the expenditure of 60 boys on books. Find the mode of their expenditure:

Expenditure (Rs)	No. of students
20-25	4
25-30	7
30-35	23
35-40	18
40-45	6
45-50	2

Solution:



Mode is in 30-35 because it has the maximum frequency.

Question 5.

Find the median and mode for the set of numbers:
2, 2, 3, 5, 5, 5, 6, 8 and 9

Solution:

$$\text{Median} = \frac{9+1}{2} = 5^{th}\text{ term}$$ which is 5.

Mode = 5 because it occurs maximum number of times.

Question 6.

A boy scored following marks in various class tests during a term; each test being marked out of 20.
15, 17, 16, 7, 10, 12, 14, 16, 19, 12 and 16
(i) What are his modal marks?
(ii) What are his median marks?
(iii) What are his total marks?
(iv) What are his mean marks?

Solution:

Arranging the given data in ascending order:

7, 10, 12, 12, 14, 15, 16, 16, 16, 17, 19

(i) Mode = 16 as it occurs maximum number of times.

(ii) $\text{Median} = \frac{11+1}{2} = 6^{th}\text{term} = 15$

(iii)Total marks = 7+10+12+12+14+15+16+16+16+17+19 =

154

(iv) $\text{Mean}(\bar{x}) = \frac{x_1 + x_2 + x_3 \ldots + x_n}{n} = \frac{154}{11} = 14$

Question 7.

Find the mean, median and mode of the following marks obtained by 16 students in a class test marked out of 10 marks.
0, 0, 2, 2, 3, 3, 3, 4, 5, 5, 5, 5, 6, 6, 7 and 8.

Solution:

(i)$\text{Mean} = \frac{0+0+2+2+3+3+3+4+5+5+5+5+6+6+7+8}{16} = \frac{64}{16} = 4$

(ii) Median = mean of 8^{th} and 9^{th} term

$= \frac{4+5}{2} = \frac{9}{2} = 4.5$

(iii) Mode = 5 as it occurs maximum number of times.

Question 8.

At a shooting competition the score of a competitor were as given below:

Score	0	1	2	3	4	5
No. of shots	0	3	6	4	7	5

(i) What was his modal score?

(ii) What was his median score?

(iii) What was his total score?

(iv) What was his mean score?

Solution:

Score x	No. of shots f	fx
0	0	0
1	3	3
2	6	12
3	4	12
4	7	28
5	5	25
Total	25	80

(i) Modal score = 4 as it has maximum frequency 7.

(ii) $\text{Median} = \frac{25+1}{2} = 13^{th}\text{ term} = 3$

(iii) Total score = 80

(iv) $\text{Mean} = \frac{80}{25} = 3.2$

Exercise 24(E)

Question 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

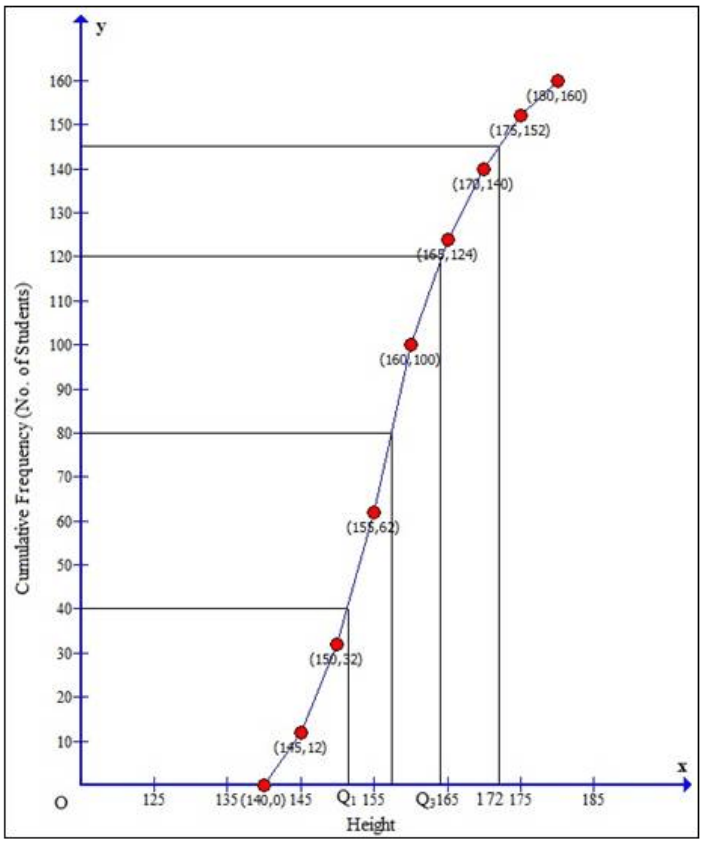
Draw an ogive for the given distribution taking 2 cm = 5 cm of height on one axis and 2 cm = 20 students on the other axis. Using the graph, determine:

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	

Taking Height of student along x-axis and cumulative frequency along y-axis we will draw an ogive.



(i)

$\therefore$ Median = $\frac{160}{2}$ = 80^{th} 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)Since, number of terms = 160

$$\text{Lower quartile } (Q_1) = \left(\frac{160}{4}\right) = 40^{th} \text{ term} = 152$$

$$\text{Upper quartile } (Q_3) = \left(\frac{3 \times 160}{4}\right) = 120^{th} \text{ term} = 164$$

$$\text{Inner Quartile range} = Q_3 - Q_1$$
$$= 164 - 152$$
$$= 12$$

(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.

The number of students whose height is above 172 cm

= 160 - 144 = 16

Question 2.

The following table gives the weekly wages of workers in a factory:

Weekly wages (in Rs)	No. of workers
50-55	5
55-60	20
60-65	10
65-70	10
70-75	9
75-80	6
80-85	12
85-90	8

Calculate: (i) the mean, (ii) the modal class, (iii) the number of workers getting weekly wages below Rs.80 and (iv) the number of workers getting Rs.65 or more but less than Rs.85 as weekly wages.

Solution:

Weekly wages (in Rs)	No. of workers (f)	Cumulative frequency	Class Marks (x)	fx
50-55	5	5	52.5	262.5
55-60	20	25	57.5	1150.0
60-65	10	35	62.5	625.0
65-70	10	45	67.5	675.0
70-75	9	54	72.5	652.5
75-80	6	60	77.5	465.0
80-85	12	72	82.5	990.0
85-90	8	80	87.5	700.0
Total	80			5520.0

(i) Mean $= \frac{\sum fx}{\sum f} = \frac{5520}{80} = 69$

(ii) Modal class = 55-60 as it has maximum frequencies.

(iii) Number of workers getting wages below Rs.80 = 60

(iv) Number of workers getting Rs.65 or more and less than Rs.85 = 72 - 35 = 37

Question 3.

Draw an ogive for the data given below and from the graph determine:

(i) the median marks

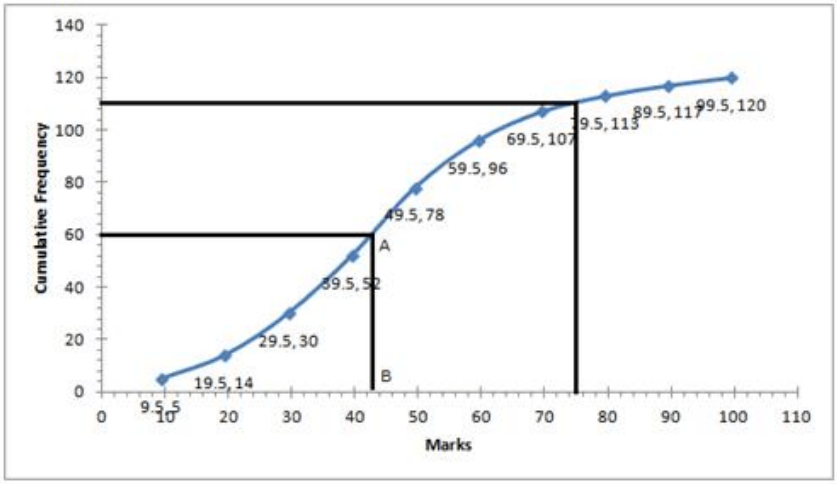
(ii) the number of students who obtained more than 75% marks

Marks	No. of Students
0-9	5
10-19	9
20-29	16
30-39	22
40-49	26
50-59	18
60-69	11
70-79	6
80-89	4
90-99	3

Solution:

Marks	No. of Students	Cumulative frequency
0.5-9.5	5	5
9.5-19.5	9	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

Total number of terms = 120



(i) $\therefore$ Median $= \frac{120}{2} = 60^{th}$ 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 $= \frac{75}{100} \times 100 = 75$

The number of students getting more than 75% marks = 120 - 111 = 9

Question 4.

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 = $\frac{24}{6} = 4$

$\Rightarrow$ m=4

Now, mean of 3, 2, 4, 2, 3, 3 and p = m-1 = 4-1 = 3

Therefore, 17+p = 3 x n .... Where n = 7

17+p = 21

p = 4

Arranging in ascending order:

2, 2, 3, 3, 3, 3, 4, 4

Mean = 4^{th} term = 3

Therefore, q = 3

Question 5.

The marks of 200 students in a test were recorded as follows:

Marks	No. of students
10-19	7
20-29	11
30-39	20
40-49	46
50-59	57
60-69	37
70-79	15
80-89	7

Construct the cumulative frequency table. Draw the ogive and use it to find:

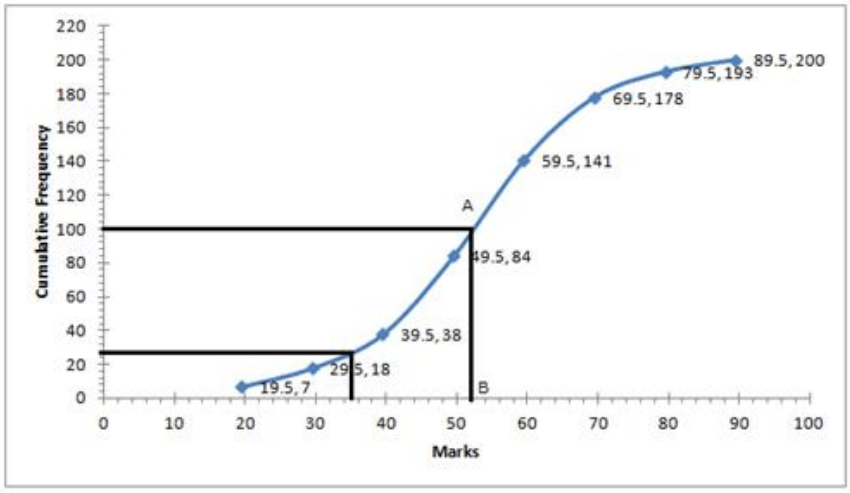
(i) the median and

(ii) the number of students who score more than 35% marks.

Solution:

Marks	No. of students	Cumulative frequency
9.5-19.5	7	7
19.5-29.5	11	18
29.5-39.5	20	38
39.5-49.5	46	84
49.5-59.5	57	141
59.5-69.5	37	178
69.5-79.5	15	193
79.5-89.5	7	200

Number of terms = 200



(i) $\therefore$ Median $= \frac{200}{2} = 100^{th}$ term

Through mark 100, 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 = 52.5

(ii) Total marks = 100

35% of total marks $= \frac{35}{100} \times 100 = 35$

The number of students who score more than 35% marks = 200 - 28 = 172

Question 6.

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
Num	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 = $206 \times \frac{3}{4} = 154.5^{th}\text{term} = 7^{th}$ July

Lower quartile = $206 \times \frac{1}{4} = 51.5^{th}\text{term} = 4^{th}$ July

Question 7.
Solution:

Question 8.
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

$$\sum x = 2+6+8+9+10+11+11+12+13+13+14+14+15+15+15+16+16+18+19+20$$
$$= 257$$

(i) $\text{Mean} = \frac{\sum x}{\sum n} = \frac{257}{20} = 12.85$

(ii) $\text{Median} = \frac{10^{th}\text{ term} + 11^{th}\text{ term}}{2} = \frac{13+14}{2} = \frac{27}{2} = 13.5$

(iii) Mode = 15 as it has maximum frequencies i.e. 3

Question 9.

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

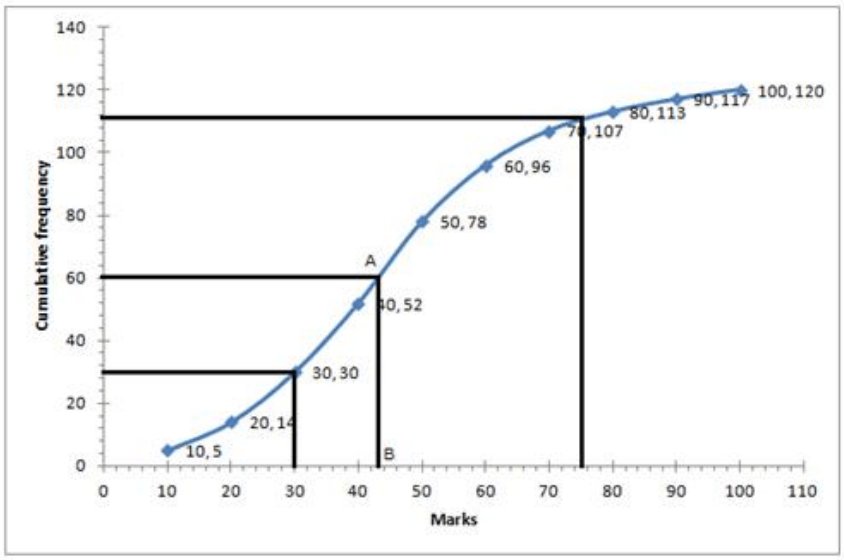
Marks	No. of students
0-10	5
10-20	9
20-30	16
30-40	22
40-50	26
50-60	18
60-70	11
70-80	6
80-90	4
90-100	3

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 = $\frac{120+1}{2} = 60.5^{th}$ 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.

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 = $Q_1 = 120 \times \frac{1}{4} = 30^{th}$ term = 30

Question 10.

Find the mean for the following frequency distribution:

C.I.	0-50	50-100	100-150	150-200	200-250	250-300
freq	4	8	16	13	6	3

Solution:

Class Interval	Frequency (f)	Class mark (x)	fx
0-50	4	25	100
50-100	8	75	600
100-150	16	125	2000
150-200	13	175	2275
200-250	6	225	1350
250-300	3	275	825
Total	50		7150

$$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{7150}{50} = 143$$

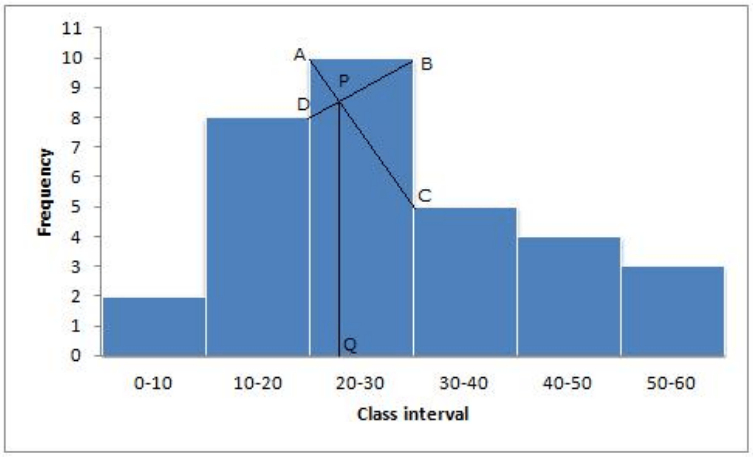
Question 11.

Draw a histogram and hence estimate the mode for the following frequency distribution:

Class	0-10	10-20	20-30	30-40	40-50	50-60
Freq	2	8	10	5	4	3

Solution:

(i) Draw the histogram



(ii) In the highest rectangle which represents modal class draw two lines AC and BD intersecting at P.

(iii) From P, draw a perpendicular to x-axis meeting at Q.

(iv) Value of Q is the mode = 23

Question 12.

For the following set of data, find the median:
10, 75, 3, 81, 17, 27, 4, 48, 12, 47, 9 and 15.

Solution:

Arrange the given terms in ascending order:

3, 4, 9, 10, 12, 15, 17, 27, 47, 48, 75, 81

Number of terms = 12

$$\therefore \text{Median} = \left(\frac{\left(\frac{n}{2}\right)^{th} + \left(\frac{n+1}{2}\right)^{th}}{2} \right)^{th} \text{ term}$$

$$= \left(\frac{\left(\frac{12}{2}\right)^{th} + \left(\frac{12+1}{2}\right)^{th}}{2} \right)^{th} \text{ term}$$

$$= \frac{6^{th} + 7^{th}}{2} \text{ term}$$

$$= \frac{15+17}{2} = \frac{32}{2} = 16$$

$$\therefore \text{Median} = 16$$

Question 14.

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

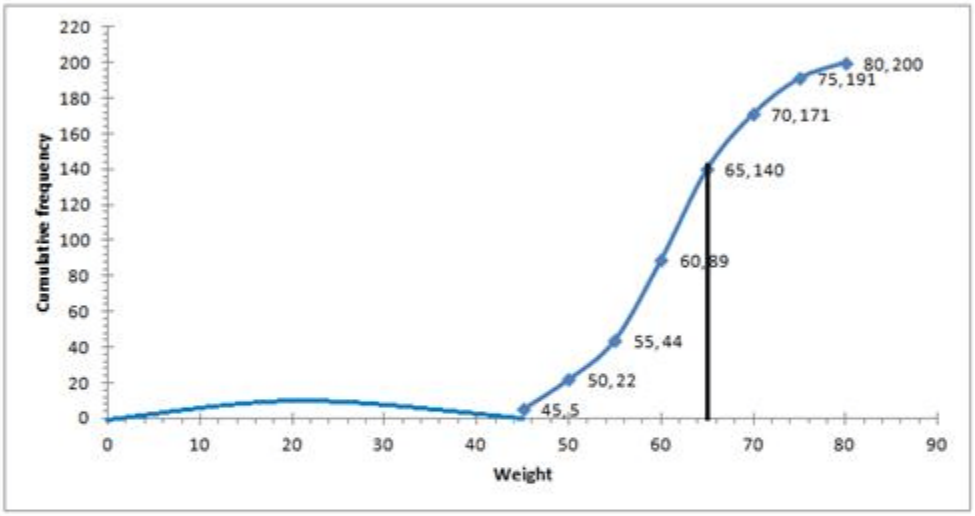
(a) underweight

(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) Number of students weighing more than 55 kg = 200-44 = 156

Therefore, percentage of students weighing 55 kg or more

$$= \frac{156}{200} \times 100 = 78\%$$

(ii) 30% of students = $\frac{30 \times 200}{100} = 60$

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

Question 15.

The daily wages of 80 workers in a building project are given below:

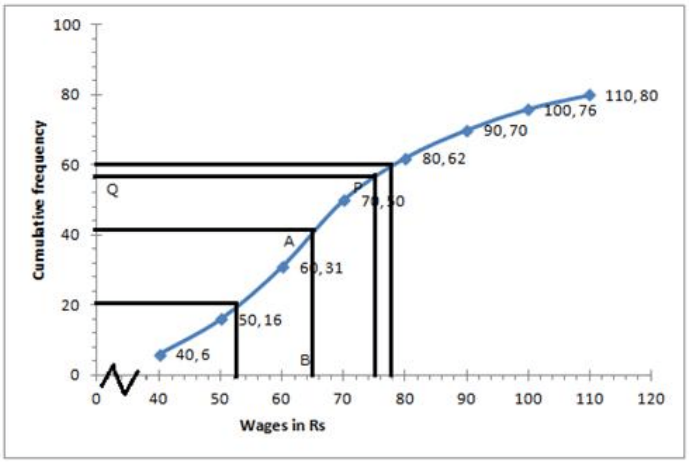
Wages (Rs)	No. of workers
30-40	6
40-50	10
50-60	15
60-70	19
70-80	12
80-90	8
90-100	6
100-110	4

Using graph paper, draw an ogive for the above distribution. Use your ogive, to estimate:

(i)the median wages of workers
(ii) the percentage of workers who earn more than Rs 75 a day.
(iii)The upper quartile wage of the workers
(iv)The lower quartile wage of the workers
(v)Inter quartile range

Solution:

Wages (Rs)	No. of workers	c.f.
30-40	6	6
40-50	10	16
50-60	15	31
60-70	19	50
70-80	12	62
80-90	8	70
90-100	6	76
100-110	4	80



(i) Number of terms = 80

$$\therefore \text{Median} = \left(\frac{\left(\frac{n}{2}\right)^{th} + \left(\frac{n+1}{2}\right)^{th}}{2} \right)^{th} \text{ term}$$

$$= \left(\frac{\left(\frac{80}{2}\right)^{th} + \left(\frac{80+1}{2}\right)^{th}}{2} \right)^{th} \text{ term}$$

$$= \frac{40^{th} + 41^{th}}{2} \text{ term}$$

$$= 40.5^{th} \text{ term}$$

Through mark 40.5, 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.

The value of point B is the median = Rs 65

(ii) From the graph, workers earning up to Rs 75 = 57

Therefore, workers earning more than Rs 75 a day = 80 - 57 = 23

Percentage = $\frac{23 \times 100}{80} = \frac{115}{4} = 28.75\%$

(iii) Upper quartile = $Q_3 = 80 \times \frac{3}{4} = 60^{th}$ term = Rs 78

(iv) Lower quartile = $Q_1 = 80 \times \frac{1}{4} = 20^{th}$ term = Rs 52

(v)Inter quartile range = $Q_3 - Q_1$ = Rs.78 -Rs.52 =Rs.26

Question 16.

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 = $\frac{171}{25} = 6.84$

(ii) Median = $\frac{25+1^{th}}{2}$ term = 13^{th} term = 7

(iii) Mode = 6 as it has maximum frequencies i.e. 6

Question 17.

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

C.I	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Freq	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

$$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{1940+35f}{36+f} \ldots\ldots(i)$$

But, mean = 52.....(ii)

From (i) and (ii)

$$\frac{1940+35f}{36+f} = 52$$

$$1940+35f = 1872+52f$$

$$17f = 68$$

$$f = 4$$

Question 18.

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.

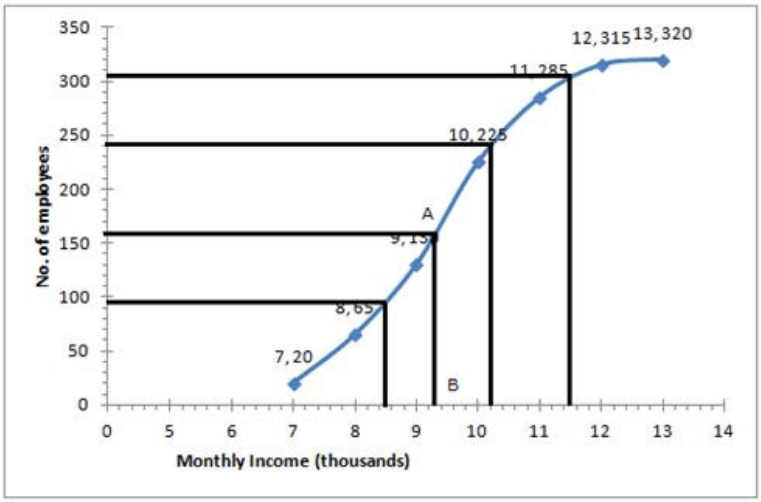
(iii) if salary of a senior employee is above Rs 11,500, find the number of senior employees in the company.

(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 = $\frac{320}{2}$ = 160^{th} 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 8500 = 95 (approx from the graph)

(iii) Number of employees with income below Rs 11500 = 305 (approx from the graph)

Therefore number of employees (senior employees) = 320-305 =15

(iv) Upper quartile = $Q_3 = 320 \times \frac{3}{4} = 240^{th}\,\text{term} = 10.3$ thousands=Rs. 10,300

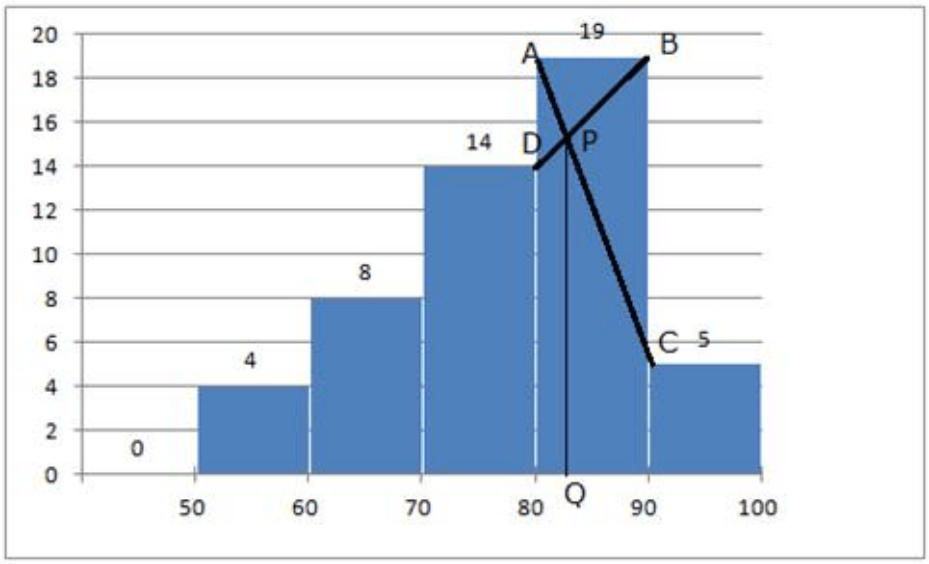
Question 19.

A mathematics aptitude test of 50 students was recorded as follows:

Marks	No. of students
50-60	4
60-70	8
70-80	14
80-90	19
90-100	5

Draw a histogram for the above data using a graph paper and locate the mode.

Solution:



(i)Draw the histogram

(ii) In the highest rectangle which represents modal class draw two lines AC and BD intersecting at P.

(iii) From P, draw a perpendicular to x-axis meeting at Q.

(iv) Value of Q is the mode = 82 (approx)

Question 20.

Marks obtained by 200 students in an examination are given below:

Marks	No. of students
0-10	5
10-20	11
20-30	10
30-40	20
40-50	28
50-60	37
60-70	40
70-80	29
80-90	14
90-100	6

Draw an ogive of the given distribution on a graph paper taking 2 cm = 10 marks on one axis and 2 cm = 20 students on the other axis. Using the graph:

(i) the median wage.

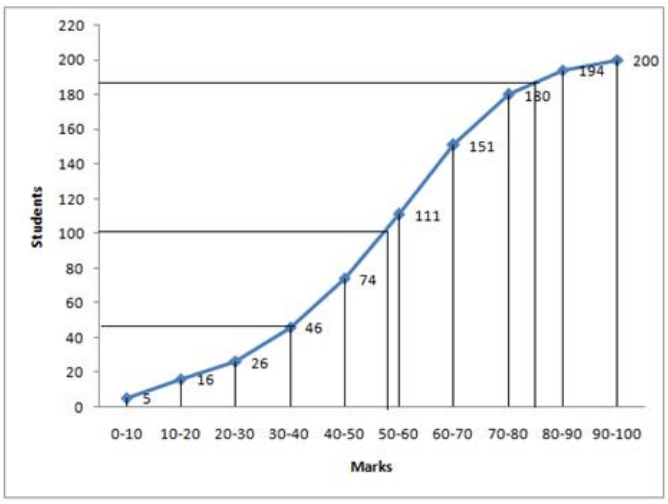
(ii) number of students who failed if minimum marks required to pass is 40

(iii) if scoring 85 and more marks is considered as grade one, find the number of students who secured grade one in the examination.

Solution:

Marks	No. of students	Cumulative frequency
0-10	5	5
10-20	11	16
20-30	10	26
30-40	20	46
40-50	28	74
50-60	37	111
60-70	40	151
70-80	29	180
80-90	14	194
90-100	6	200

Number of students = 200



(i) Median = $\frac{200}{2}$ = 100^{th} term

Through mark 100, 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 = 57 marks (approx)

(ii) The number of students who failed (if minimum marks required to pass is 40)= 46 (approx from the graph)

(iii) The number of students who secured grade one in the examination = 200 - 188 = 12 (approx from the graph)

Question 21.

The marks obtained by 40 students in a short assessment is given below, where a and b are two missing data.

Marks	5	6	7	8	9
Number of Students	6	a	16	13	b

If mean of the distribution is 7.2, find a and b.

Solution:

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\Rightarrow 7.2 = \frac{6\times 5 + a\times 6 + 16\times 7 + 13\times 8 + b\times 9}{6 + a + 16 + 13 + b}$$

$$\Rightarrow 7.2 = \frac{246 + 6a + 9b}{35 + a + b}$$

$$\Rightarrow 1.2a - 1.8b = -6 \ldots\ldots\ldots\ldots (i)$$

Total number of students $= 6 + a + 16 + 13 + b$

$\Rightarrow 40 = 35 + a + b$

$\Rightarrow a + b = 5 \ldots\ldots\ldots (ii)$

Multiply equation (ii) by 1.8 and add it to equation (i)

$1.8a + 1.8b = 9$

$1.2a - 1.8b = -6$

$3a = 3$

$\Rightarrow a = 1$

Substituting $a = 1$ in equation (ii) we get,

$1 + b = 5$

$\Rightarrow b = 4$

Question 22.

Find the mode and the median of the following frequency distribution.

x	10	11	12	13	14	15
f	1	4	7	5	9	3

Solution:

Since the frequency for x = 14 is maximum.

So Mode = 14.

x	f	Cumulative frequency
10	1	1
11	4	5
12	7	12
13	5	17
14	9	26
15	3	29
	N = 29	

$$\text{Median} = \left(\frac{n+1}{2}\right)^{th} \text{ term}$$

$$= \left(\frac{30}{2}\right)^{th} \text{ term}$$

$$= 15^{th} \text{ term}$$

$$= \text{frequency of the } 15^{th} \text{ term}$$

According to the table it can be observed that the value of x from the 13^{th} term to the 17^{th} term is 13.

So the median = 13.

Solution 23.

Data in ascending order:

11, 12, 14, (x − 2), (x + 4), (x + 9), 32, 38, 47

Total number of observations = n = 9 (odd)

$$\Rightarrow \text{Median} = \left(\frac{n+1}{2}\right)^{th} \text{ term} = \left(\frac{9+1}{2}\right)^{th} \text{ term} = 5^{th} \text{ term}$$

Given, median = 24

$\Rightarrow 5^{th}$ term = 24

$\Rightarrow x + 4 = 24$

$\Rightarrow x = 20$

Thus, the observation are as follows:

11, 12, 14, 18, 24, 29, 32, 38, 47

$$\therefore \text{Mean} = \frac{\Sigma x}{n} = \frac{11+12+14+18+24+29+32+38+47}{9} = \frac{225}{9} = 25$$

Solution 24.

Data in ascending order: 6, 8, 10, 12, 13 and x

Total number of observations = n = 6 (even)

$$\therefore \text{Mean} = \frac{\Sigma x}{n} = \frac{6+8+10+12+13+x}{6} = \frac{49+x}{6}$$

$$\text{Median} = \frac{\left(\frac{n}{2}\right)^{th} \text{ term} + \left(\frac{n}{2}+1\right)^{th} \text{ term}}{2} = \frac{3^{rd} \text{ term} + 4^{th} \text{ term}}{2} = \frac{10+12}{2} = \frac{22}{2} = 11$$

Given,

Mean = Median

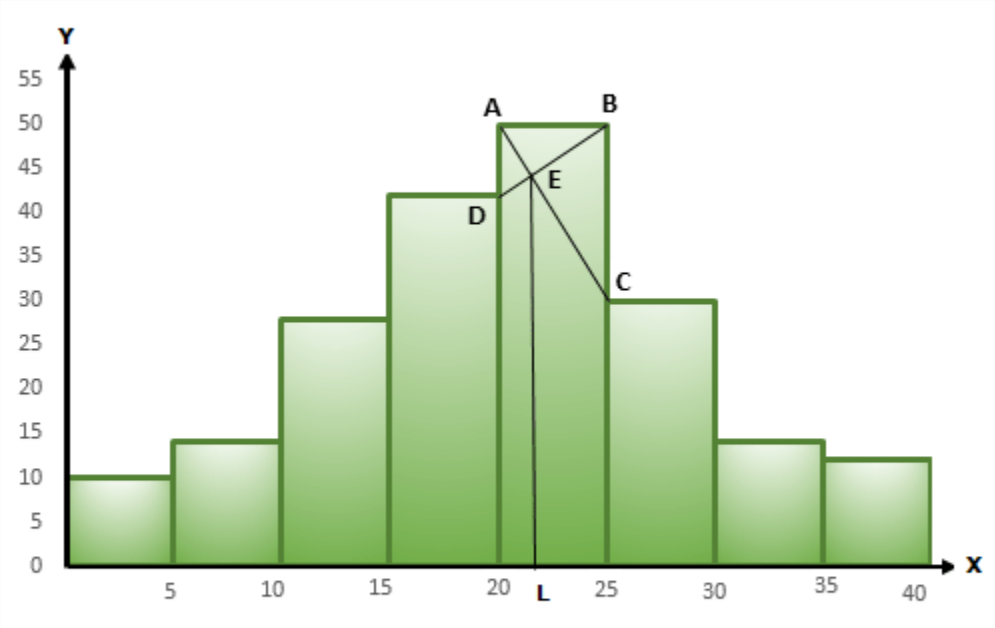
$$\Rightarrow \frac{49+x}{6} = 11$$

$\Rightarrow 49 + x = 66$

$\Rightarrow x = 17$

Solution 25.

Histogram is as follows:

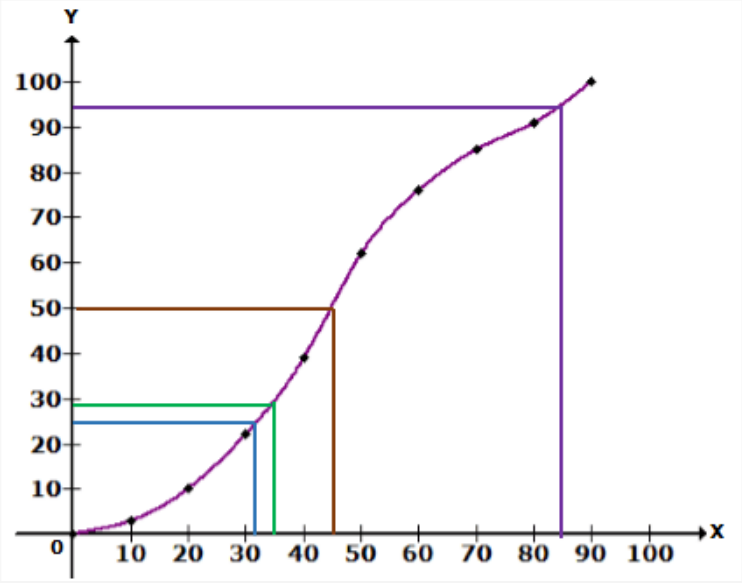


In the highest rectangle which represents modal class draw two lines AC and BD intersecting at E.
From E, draw a perpendicular to x-axis meeting at L.
Value of L is the mode. Hence, mode = 21.5

Solution 26.

Marks	Number of students (Frequency)	Cumulative Frequency
0-10	3	3
10-20	7	10
20-30	12	22
30-40	17	39
40-50	23	62
50-60	14	76
60-70	9	85
70-80	6	91
80-90	5	96
90-100	4	100

The ogive is as follows:



(i) Median $= \left(\frac{N}{2}\right)^{th}$ term $= \left(\frac{100}{2}\right)^{th}$ term $= 50^{th}$ term $= 45$

(ii) Lower quartile $= \left(\frac{N}{4}\right)^{th}$ term $= \left(\frac{100}{4}\right)^{th}$ term $= 25^{th}$ term $= 32$

(iii) Number of students who obtained more than 85% marks

$= 100 - 94$

$= 6$

(iv) Number of students who failed

$= 29$

$= 6$

Solution 27.

We have,

Marks x	No. of students f	fx	Cumulative Frequency
0	1	0	1
1	3	3	4
2	6	12	10
3	10	30	20
4	5	20	25
5	5	25	30
	$n = \sum f = 30$	$\sum fx = 90$	

$$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{90}{30} = 3$$

Total number of observations = 30 (even)

$$\therefore \text{Median} = \frac{\left(\frac{n}{2}\right)^{th} \text{ term} + \left(\frac{n}{2}+1\right)^{th}}{2} = \frac{15^{th} \text{ term} + 16^{th} \text{ term}}{2} = \frac{3+3}{2} = 3$$

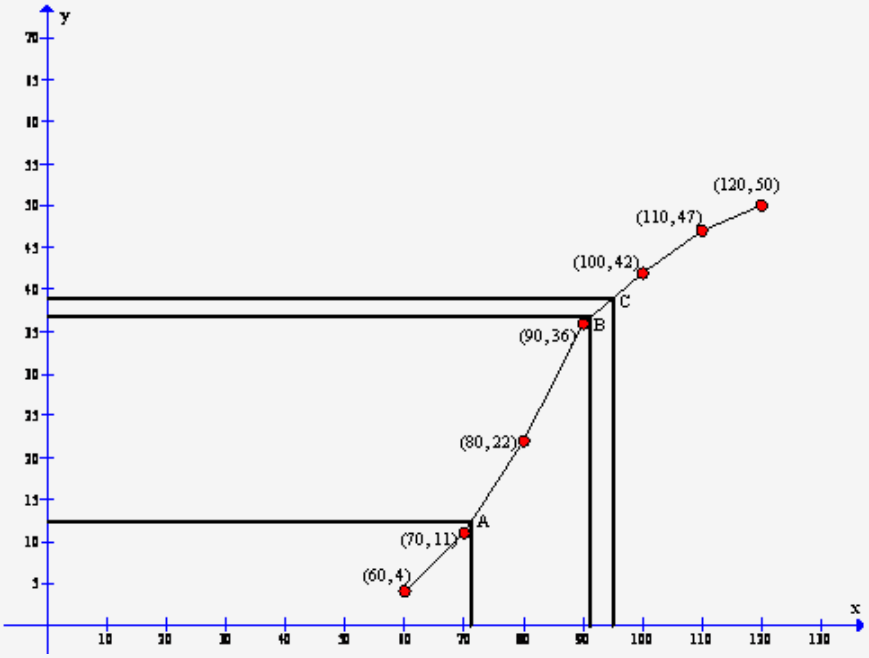
Mode = The number (marks) with highest frequency = 3

Solution 28.

The cumulative frequency table of the given distribution table is as follows:

Weight in Kg	Number of workers (f)	Cumulative frequency
50-60	4	4
60-70	7	11
70-80	11	22
80-90	14	36
90-100	6	42
100-110	5	47
110-120	3	50

Plot the points (60, 4), (70, 11), (80, 22), (90, 36), (100, 42), (110, 47) and (120, 50) on a graph paper and join them to get an ogive.



Number of workers, $N = 50$

(i) Upper quartile $(Q_3) = \left(\frac{3 \times N}{4}\right)^{th}$ term $= \left(\frac{3 \times 50}{4}\right)^{th}$ term $= (37.5)^{th}$ term $= 92$

Lower quartile $(Q_1) = \left(\frac{N}{4}\right)^{th}$ term $= \left(\frac{50}{4}\right)^{th}$ term $= (12.5)^{th}$ term $= 71$

(ii) Through mark of 95 kg on the x – axis, draw a vertical line which meets the graph at point C.
Through point C, draw a horizontal line which meets the y-axis at the mark of 39.
∴ Number of workers who are overweight = 50 – 39 = 11