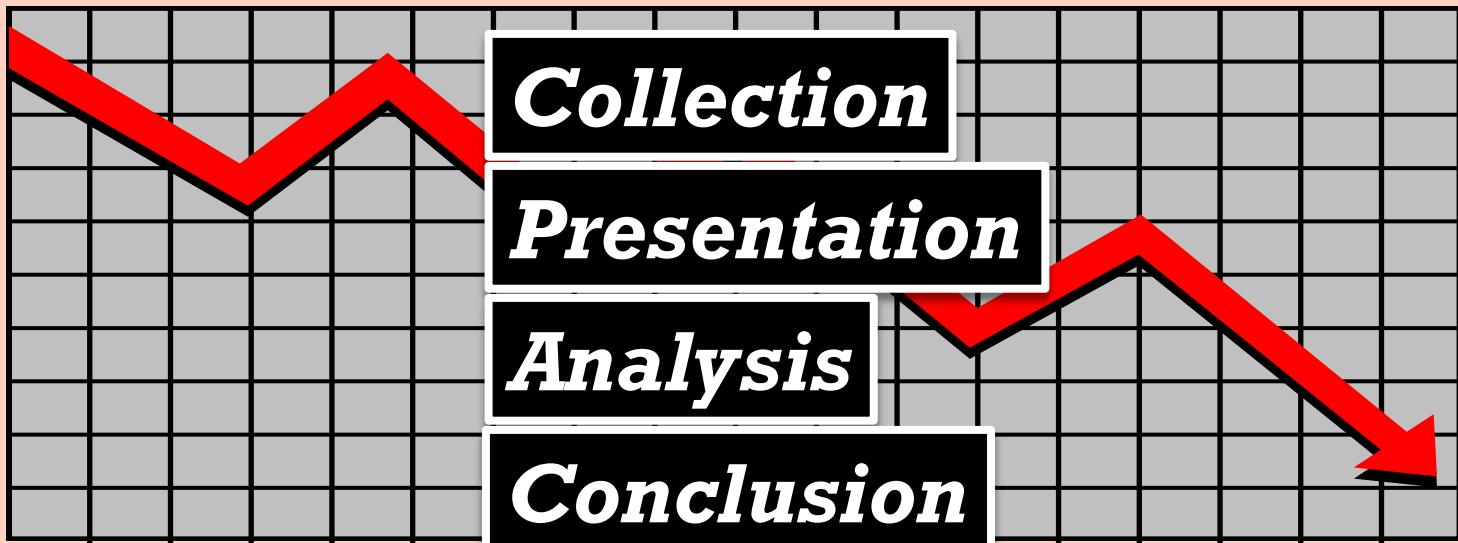


Lecture_01

Module_01

Chap 14 Statistics

What is Statistics ?



GROUPED FREQUENCY DISTRIBUTION TABLE

Classes	Frequency
0 - 10	5
10 - 20	7
20 - 30	10
30 - 40	8

CLASS

SPES

Lets convert
discontinuous class
into continuous

$$\frac{11 - 10}{2} = \frac{1}{2} = 0.5$$

Discontinuous Classes

Continuous Classes

For e.g. :

1 - 10

11 - 20

21 - 30

For e.g. → 0.5 - 10.5

$$1 - 0.5 = 0.5$$

$$10 + 0.5 = 10.5$$

$$11 - 0.5 = 10.5$$

$$20 + 0.5 = 20.5$$

$$21 - 0.5 = 20.5$$

$$30 + 0.5 = 30.5$$

To convert discontinuous to continuous

steps-

1) Find $x = (\text{difference between consecutive limits}) \div 2$

2) Subtract (x) from the lower limit and add (x) to upper limit of every class in the given set of Discontinuous Classes

Also if we add class width (h) to one class mark we get the next class mark .

Now we will learn to find Class mark or Midpoint of a class.

$$\text{Class Mark} = \frac{\text{Lower limit} + \text{Upper limit}}{2}$$

It is denoted as x , in the entire chapter.

Class	Class
1 - 10	$\frac{1 + 10}{2}$
11 - 20	$\frac{11 + 20}{2}$
21 - 30	$\frac{21 + 30}{2}$

Class	Class
0 - 10	$\frac{0 + 10}{2}$
10 - 20	$\frac{10 + 20}{2}$
20 - 30	$\frac{20 + 30}{2}$

Class width (h) is found by subtracting two consecutive lower limits or two consecutive upper limits.

Class width (h) can also be found by subtracting two consecutive Class marks.

Module_02

1. Measurement of central tendency of data.

- 1. Direct Method
- 2. Assumed Mean Method
- 3. Step Deviation Method

Mean

Median

Mode

Direct Method

Step 1

Class width =

class interval	class mark (x_i)	frequency (f_i)	$f_i x_i$
Total		$\sum f_i =$	$\sum f_i x_i =$

Step 2

$$\text{Mean (} \bar{x} \text{)} = \frac{\sum f_i x_i}{\sum f_i}$$

Ex.14.1)1) A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

No. of plants	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12-14
No. of houses	1	2	1	5	6	2	3

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

Sol: Class width(h)

$$\frac{0 + 2}{2}$$

(class interval)

Class width (h) is found by
subtracting consecutive lower
limits from consecutive upper
limits

What we need to find?

0 - 2	1	1	1	1	1	1	1
2 - 4	2	2	2	2	2	2	2
4 - 6							
6 - 8							
8 - 10							
10 - 12							
12 - 14							
Total	--	$\Sigma f_i = 20$		$\Sigma f_i x_i = 162$			

$$\text{Mean} (\bar{x}) = \frac{\sum f_i x_i}{\sum f_i}$$

$$= \frac{162}{20} = 8.1$$

∴ Mean = 8.1 plants

We used direct method because the values of f_i and x_i are small .

Module_03

Q. Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarised as follows.
Find the mean heart beats per minute for these women, choosing a suitable method.

No. of heart beats per minute	65 - 68	68 - 71	71 - 74	74 - 77	77 - 80	80 - 83	83-86
No. of women	2	4	3	8	5	7	6

Sol:

Class width(h)

$\frac{65 + 68}{2}$

(class interval)

$65 - 68$

$68 - 71$

$71 - 74$

$74 - 77$

$77 - 80$

$80 - 83$

$83 - 86$

What we need to find?

$\sum f_i$

$= \frac{2277}{30} = 75.9$

$\text{Mean} = 75.9 \text{ heart beats per minute}$

Adding all f_i

$\Sigma f_i = 30$

Adding all $f_i x_i$

$\Sigma f_i x_i = 2277$

Total	--	$\Sigma f_i = 30$	$\Sigma f_i x_i = 2277$
-------	----	-------------------	-------------------------

Module_04

Q. The following table gives the literacy rate (in percentage) of 35 cities.
Find the mean literacy rate.

Literacy rate (in %)	45 - 55	55 - 65	65 - 75	75 - 85	85 - 95
No. of cities	3	10	11	8	3

Sol: Class width(h)

(Class interval)

$\frac{45 + 55}{2}$

Class width (h) is found by subtracting two consecutive limits.

By adding h to x_i , we get next x_i .

Adding all $f_i x_i$

480 69.43

69.43

45 - 55	50 × 3	60 × 10	70 × 11	80 × 8	90 × 3
55 - 65					
65 - 75					
75 - 85					
85 - 95					
Total	--	$\sum f_i = 35$	$\sum f_i x_i = 2430$		

∴ Mean = 69.43%

Module_05

Ex.14.1) 7) To find out the concentration of SO_2 in the air (in parts per million, i.e., ppm), the data was collected for 30 localities in a certain city and is presented below .

Concentration of SO_2 (in ppm)	Frequency
0.00 – 0.04	1
0.04 – 0.08	9
0.08 – 0.12	9
0.12 – 0.16	2
0.16 – 0.20	4
0.20 – 0.24	2

Find the mean concentration of SO_2 in the air

Sol:

$$\text{Class width}(h) = \dots$$

class interval

0.00 – 0.04

0.04 – 0.08

0.08 –

0.12 –

0.16 –

0.20 – 0.24

$$\text{freq}$$

0

9

9

2

4

2

0.22

1

9

9

2

4

2

0.44

30

2.96

0.099

0.099

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Ex.14.1) 3) The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is Rs. 18. Find the missing frequency 'f'.

Daily pocket allowance	11 - 13	13 - 15	15 - 17	17 - 19	19 - 21	21 - 23	23 - 25
No. of children	7	6	9	13	f	5	4

Sol:

$$\text{Class width}(h) = 2$$

class interval	frequency	$f_i \times x_i$
11 - 13	7	7 \times 12
13 - 15	6	6 \times 14
15 - 17	9	9 \times 16
17 - 19	13	13 \times 18
19 - 21	f	$f \times 20$
21 - 23	5	5 \times 22
23 - 25	4	4 \times 24
Total	$\Sigma f_i = 44 + f$	$\Sigma f_i x_i = 752 + 20f$

should use direct method to solve this problem

width (h) 84 found by adding two class widths

Adding all $f_i x_i$

By direct method

But mean is 18 given

$$\begin{aligned} (\bar{x}) &= \frac{\sum f_i x_i}{\sum f_i} \\ 18 &= \frac{752 + 20f}{44 + f} \\ 18(44 + f) &= 752 + 20f \\ 792 + 18f &= 752 + 20f \\ 2f &= 40 \\ f &= 20 \end{aligned}$$

Module_06

Q.

The mean of the following frequency distribution is 62.8 and the sum of all the frequencies is 50.
Compute the missing frequency f_1 and f_2 . (3 marks)

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

Sol. Class width = 20

Class interval	Class Mark (x_i)	Frequency	$f_i x_i$
0 - 20	0 + 20 / 2	X	50
20 - 40	10 + 30 / 2	X	+ $30 f_1$
40 - 60	30 + 50 / 2	X	+ 500
60 - 80	50 + 70 / 2	X	+ $70 f_2$
80 - 100	70 + 90 / 2	X	+ 630
100 - 120	90 + 100 / 2	X	+ 880
Total	--	$\Sigma f_i = 30 + f_1 + f_2$	$\Sigma f_i x_i = 2060 + 30f_1 + 70f_2$

$$\text{Mean } (\bar{x}) = \frac{\sum f_i x_i}{\sum f_i} = \frac{2060 + 30f_1 + 70f_2}{30 + f_1 + f_2}$$

$$\therefore 62.8 = \frac{2060 + 30f_1 + 70f_2}{\text{Lower limit} + \text{upper limit}}$$

$$\text{Class mark} = \frac{j_1 + j_2}{2}$$

Q.

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

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

Sol.

$$\text{Mean } (\bar{x}) = \frac{\sum f_i x_i}{\sum f_i}$$

$$\begin{aligned} 30 + f_1 + f_2 &= 50 \\ \therefore f_1 + f_2 &= 50 - 30 \\ \therefore f_1 + f_2 &= 20 \\ \therefore f_2 &= 20 - f_1 \end{aligned}$$

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

$$\therefore 62.8 = \frac{2060 + 30f_1 + 70(20 - f_1)}{30 + f_1 + 20 - f_1}$$

$$\therefore 62.8 = \frac{2060 + 30f_1 + 1400 - 70f_1}{50}$$

$$\therefore 62.8 \times 50 = 2060 + 30f_1 + 1400 - 70f_1$$

$$\begin{aligned} +3140 &= 3460 - 400 + f_1 + f_2 = 50 \\ 40f_1 &= 3460 - 3140 = 320 \\ f_1 &= \frac{320}{40} = 8 \quad \therefore f_1 + f_2 = 20 \\ f_2 &= 20 - 8 = 12 \quad f_2 = 20 - f_1 \end{aligned}$$

The missing frequencies are 8 and 12 respectively.

Thank You

Lecture_02

Module_07

Assumed Mean Method

$$\bar{x} = a + \left(\frac{\sum f_i d_i}{\sum f_i} \right)$$

\bar{x} = Mean

a = Assumed Mean

f_i = Frequency

d_i = Deviation

Q. The measurements (in mm) of the diameters of the head of screws are given below :

Diameter (in mm)	33 - 35	36 - 38	39 - 41	42 - 44	45 - 47
Number of screws	10	19	23		

Sol. Calculate the mean diameter of the screws
 Width of the class (h) = 3 Assumed Mean (a) = 40

In 5th column we calculate $f_i \times d_i$

class	33 - 35	36 - 38	39 - 41	42 - 44	45 - 47
	10	19	23		

There is an easy way to find d_i

Add all +ve value
 $(i.e., \text{Assumed mean})$

By adding

Adding all f_i

Adding all $f_i d_i$
 one middle value

$$\sum f_i =$$

$$\sum f_i a_i = 108$$

$$225$$

$$\text{Mean} = 41.08 \text{ mm.}$$

$$a + \frac{\sum f_i a_i}{\sum f_i}$$

$$41.08 = 40 + \frac{108}{100}$$

$$= 40 + 1.08$$

$$= 41.08$$

Module_08

Q. A class teacher has the following absentee record of 40 students of a class for the whole term. Find the mean number of days a student was absent.

No. of days	0 - 6	6 - 10	10 - 14	14 - 20	20 - 28	28 - 38	38 - 40
No. of students	11	10	7	4	4	3	1

Sol:

class interval	class mark (x_i)	No. of students (f_i)	$f_i \times x_i$
0 - 6	3	11	33
6 - 10	8	10	80
10 - 14	12	7	84
14 - 20	17	4	68
20 - 28	24	4	96
28 - 38	33	3	99
38 - 40	39	1	39
Total	--	$\sum f_i = 40$	$\sum f_i x_i = 181$

Assume mean, $a = 17$ By assumed mean method,

$$a + \frac{\sum f_i d_i}{\sum f_i}$$

$$17 + \left[\frac{-181}{40} \right]^{4.525}$$

$$= 17.000 - 4.525$$

We assume any one value from x_i column as ' a ' (a = assumed mean)

Adding all f_i

Adding all $f_i d_i$

middle value
 $39 - 17$

Mean = 12.48 days

Module_09

Q.

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

(3 marks)

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

Sol.

Class width = 8

Assumed Mean (A) = 20

Class interval	Class Mark (x_i)	$d_i = x_i - A$ $= x_i - 20$	Frequency (f_i)	$f_i d_i$
0 - 8	4	4 - 20	5	-80
8 - 16	12	12 - 20	6	-48
16 - 24	20	20 - 20	4	0
24 - 32	28	28 - 20	3	24
32 - 40	36	36 - 20	2	32
Total	--	--	$\sum f_i = 20$	$\sum f_i d_i = -72$

Class mark = $\frac{\text{Lower limit} + \text{upper limit}}{2}$
 $\bar{d} = \frac{2 \sum f_i d_i}{\sum f_i}$

Mean (\bar{x}) = $A + \bar{d}$

56

Q.

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

(3 marks)

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

Sol.

$$\bar{d} = \frac{\sum f_i d_i}{\sum f_i}$$

$$= \frac{-72}{20}$$

$$= -3.6$$

$$\therefore \bar{d} = -3.6$$

$$\text{Mean } (\bar{x}) = A + \bar{d}$$

$$= 20 + (-3.6)$$

$$= 20 - 3.6$$

$$= 16.4$$

$$\therefore \text{Mean } (\bar{x}) = 16.4$$

$$\sum f_i = 20$$

$$\sum f_i d_i = -72$$

$$\text{Assumed Mean (A)} = 20$$

Module_10

Q.

Find the mean of each of the following frequency distributions (5 – 14) (4 marks)

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

Sol. Class width(h) = 20 Assumed Mean (A) = 60

Class interval	Class Mark (x_i)	$d_i = x_i - A$ $= x_i - 60$	Frequency (f_i)	$f_i d_i$
10 - 30	20	20 - 40	X	-200
30 - 50	40	40 - 60	X	-160
50 - 70	60	60 - 80	X	0
70 - 90	80	80 - 100	X	400
90 - 110	100	100 - 120	X	120
110 - 130	120	120 - 140	X	120
Total	--	--	$\sum f_i = 50$	$\sum f_i u_i = 280$

Class mark = $\frac{\text{Lower limit} + \text{Upper limit}}{2}$

Mean (\bar{x}) = $A + g \bar{u}$

$\left. \right\} 640$

Q.

Find the mean of each of the following frequency distributions (5 – 14) (4 marks)

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

Sol.

$$\bar{d} = \frac{\sum f_i d_i}{\sum f_i}$$

$$= \frac{280}{50}$$

$$\therefore \bar{d} =$$

$$\sum f_i = 50 \quad \sum f_i d_i = 280$$

$$\begin{aligned} \text{Mean } (\bar{x}) &= A + \bar{d} \\ &= 60 + 5.6 \\ &= 65.6 \end{aligned}$$

$$\therefore \text{Mean } (\bar{x}) = 65.6$$

$$\text{Assumed Mean (A)} = 60$$

$$\begin{array}{r} 5.6 \\ - 60 \\ \hline 56 \\ - 50 \\ \hline 6 \\ - 5 \\ \hline 1 \end{array}$$

Module_11

Q.

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

(3 marks)

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

Sol.

Class width = 8

Assumed Mean (A) = 20

Class interval	Class Mark (x_i)	$d_i = x_i - A$ $= x_i - 20$	Frequency (f_i)	$f_i d_i$
0 - 8	4	4 - 20	5	-80
8 - 16	12	12 - 20	9	-72
16 - 24	20	20 - 20	10	0
24 - 32	28	28 - 20	8	64
32 - 40	36	36 - 20	8	128
Total	--	--	$\sum f_i = 40$	$\sum f_i d_i = 40$

$$\bar{d} = \frac{\sum f_i d_i}{\sum f_i}$$

$$\text{Mean } (\bar{x}) = A + \bar{d}$$

Q.

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

(3 marks)

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

Sol.

$$\bar{d} = \frac{\sum f_i d_i}{\sum f_i}$$

$$= \frac{40}{40}$$

$$\text{Mean } (\bar{x}) = A + \bar{d}$$

$$= 20 + 1$$

$$= 21$$

$$\therefore \text{Mean } (\bar{x}) = 21$$

$$\therefore \bar{d} = 1$$

$$\sum f_i = 40$$

$$\sum f_i d_i = 40$$

$$\text{Assumed Mean } (A) = 20$$

Thank You

Lecture_03

Module_12

Step Deviation Method

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

\bar{x} = Mean

a= Assumed Mean

f_i = Frequency

u_i = Deviation / h

Ex.14.1) 2) Consider the following distribution of daily wages of 50 workers of a factory

Daily wages in(Rs)	100 - 120	120 - 140	140 - 160	160 - 180	180 - 200
No. of workers	12	14	8	6	10

Find the mean daily wages of the workers of the factory by using an appropriate method

Sol: Class width(h) = 20

class interval	freq	mid value	Deviation (u_i)	frequency (f_i)	$f_i u_i$
100 - 120	12	110	-4	12	-48
120 - 140	14	130	-2	14	-28
140 - 160	8	150	0	8	0
160 - 180	6	170	+2	6	+12
180 - 200	10	190	+4	10	+40
Total	$\Sigma f_i = 50$			20	$\Sigma f_i u_i = -12$

By step deviation method

assume any one value

Preferably the middle value

Adding all f_i

Adding all $f_i u_i$

$$\frac{-4}{5}$$

$$= 150 - 4.8$$

Mean = Rs.145.20

Module_13

Ex.14.1) 5) In a retail market , fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

No. of mangoes	50 - 52	53 - 55	56 - 58	59 - 61	62 - 64
No. of boxes	12	14	8	6	10

Find the daily mean of mangoes kept in a packaging box. Which method of finding the mean did you choose ?

Sol:

Class width(h) = 3

class interval	freq
50 - 52	15
53 - 55	110
56 - 58	
59 - 61	
62 - 64	25
Total	$\Sigma f_i = 400$

50

110

25

Adding all $f_i u_i$

50

$\Sigma f_i u_i = 25$

mean, $a = 57$.

We

f

By

W

W

W

W

W

W

W

Mean = 57 (approx)mangoes

51 - 57

54 - 57

57 - 57

60 - 57

63 - 57

66 - 57

69 - 57

72 - 57

75 - 57

78 - 57

81 - 57

$= 57 + 0.1875$

Step deviation method

any one value

column as 'a'

ed mean)

3

100

4

3

We used step deviation method because the values of f_i and x_i are big numbers

Module_14

Q. Consider the following distribution of daily wages of 50 workers of a factory

Daily expenditure in(Rs)	100 - 150	150 - 200	200 - 250	250 - 300	300 - 350
No. of households	4	5	12	2	2

Find the mean daily expenditure on food by a suitable method.

Sol: Class width(h) = 50 | med mean, $a = 225$ | ~~Deviation method~~

class interval	class mark (x_i)
100 - 150	125
150 - 200	175
200 - 250	225 $\leftrightarrow a$
250 - 300	275
300 - 350	325
Total	--

By subtracting two consecutive lower limits

Adding all f_i

Adding all $f_i u_i$

Preferably the middle value

$$\frac{100 + 150}{2}$$

$$125 - 225$$

$$50$$

$$50$$

$$50$$

$$50$$

$$50$$

$$50$$

$$50$$

$$(x) = \text{one value in column as 'a' (med mean)}$$

$$225 - 14$$

$$225 - 14$$

$$225 - 14$$

$$225 - 14$$

$$h = 50$$

$$50$$

$$50$$

$$50$$

$$50$$

$$225 - 14$$

$$225 - 14$$

Module_15

6

Find the mean of each of the following frequency distributions (5 – 14) (4 marks)

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

Sol. Class width(h) = 20 Assumed Mean (A) = 100

Class interval	Class Mark (x_i)	$d_i = x_i - A$ $= x_i - 100$	$u_i = \frac{d_i}{g} = \frac{d_i}{20}$	No. of items (f _i)	f _i u _i
50 - 70	60	-40	-2	18	-72
70 - 90	80	-20	-1	12	-24
90 - 110	100	-10	0	13	0
110 - 130	120	20	1	27	27
130 - 150	140	40	2	8	16
150 - 170	160	60	3	22	66
Total	--	--	--	$\sum f_i = 100$	$\sum f_i u_i = 61$

g is the G.C.D. of all values of d_i

Mean (\bar{x}) = A + g \bar{u}

} 109

6

Find the mean of each of the following frequency distributions (5 – 14) (4 marks)

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

Sol.

$$\sum f_i = 100 \quad \sum f_i u_i = 61$$

$$\bar{u} = \frac{\sum f_i u_i}{\sum f_i}$$

$$= \frac{61}{100}$$

$$\therefore \bar{u} = 0.61$$

$$\begin{aligned}\text{Mean } (\bar{x}) &= A + g \times \bar{u} \\ &= 100 + 20(0.61) \\ &= 100 + 12.2\end{aligned}$$

$$\therefore \text{Mean } (\bar{x}) = 112.2$$

$$\begin{aligned}\text{Assumed Mean (A)} &= 100 \\ \text{G.C.D of all } d_i(g) &= 20\end{aligned}$$

Module_16

6

Find the mean of each of the following frequency distributions (5 – 14) (4 marks)

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

Sol. Class width(h) = 4 Assumed Mean (A) = 35

Class interval	Class Mark (x_i)	$d_i = x_i - A$ $= x_i - 35$	$u_i = \frac{d_i}{g} = \frac{d_i}{4}$	No. of workers (f_i)	$f_i u_i$
25 - 29	27	27 - 35	- 2	14	- 28
30 - 34	31	31 - 35	- 1	22	- 22
35 - 39	35	35 - 35	0	16	0
40 - 44	39	39 - 45	1	6	6
45 - 49	43	43 - 35	2	5	10
50 - 54	47	47 - 35	3	3	9
55 - 59	51	51 - 35	4	16	16
Total	--	--	--	$\sum f_i = 70$	$\sum f_i u_i = -91$

$-\bar{x} = \frac{\sum f_i u_i}{\sum f_i}$
 $\text{Mean } (\bar{x}) = A + g \bar{u}$
 41

6

Find the mean of each of the following frequency distributions (5 – 14) (4 marks)

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

Sol.

$$\sum f_i = 100 \quad \sum f_i u_i = 61$$

$$\bar{u} = \frac{\sum f_i u_i}{\sum f_i}$$

$$= \frac{-91}{70}$$

$$\therefore \bar{u} = 0.61$$

$$\begin{aligned}\text{Mean } (\bar{x}) &= A + g \times \bar{u} \\ &= 100 + 20(0.61) \\ &= 100 + 12.2\end{aligned}$$

$$\therefore \text{Mean } (\bar{x}) = 112.2$$

Assumed Mean (A) = 100
G.C.D of all d_i (g) = 20

Thank You

Lecture_04

Module_17

Mode

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

Classes must be continuous

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

l = Lower limit of modal class

f_1 = Maximum frequency

f_0 = Frequency of class preceding modal class

f_2 = Frequency of class succeeding the modal class

h = Width of the class

The class having a maximum frequency is termed as Modal class.

Ex.14.2) 2) The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:

Lifetime (in hours)	0 - 20	20 - 40	40 - 60	60 - 80	80 - 100	100 - 120
frequency	10	35	52	61	38	29

Determine the modal lifetimes of the components

Sol:

$$\text{Class width}(h) = 20$$

class interval	Frequency (f)
0 - 20	10
20 - 40	
40 - 60	
60 - 80	
80 - 100	
100 - 120	29

Modal Class

Class width (h) is found by subtracting upper limit of one class from lower limit of another class.

Frequency of the modal class

Frequency of the class succeeding the Modal class

$$l = 60, h = 20, f_1 = 61, f_0 = 52, f_2 = 38,$$

$$\therefore \text{Mode} = l + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right] \times h$$

$$= 60 + \left[\frac{61 - 52}{2(61) - 52 - 38} \right] \times 20$$

$$= 60 + \left[\frac{9}{62} \right] \times 20$$

$$= 60 + 1.45 = 65.625$$

$$\therefore \text{Mode} = 65.625 \text{ hours}$$

Maximum frequency is 61

The corresponding class 60 - 80 is mode

Module_18

Ex. 14.2) 5) The given distribution shows the number of runs scored by some top batsmen of the world in one-day international cricket matches.

Runs scored	3000 – 4000	4000 – 5000	5000 – 6000	6000 – 7000	7000 – 8000	8000 – 9000	9000 – 10000	10000 – 11000
No. of batsmen	4	18	9	7	6	3	1	1

Find the mode of the data.

Sol:

$$\text{Class width}(h) = 1000$$

class interval	frequency (f_i)
3000 - 4000	4
4000 - 5000	18
5000 - 6000	9
6000 - 7000	7
7000 - 8000	6
8000 - 9000	3
9000 - 10000	1
10000 - 11000	1

Maximum frequency is 18

The corresponding class 4000 – 5000 is modal class.

$$l = 4000, h = 1000, f_1 = 18, f_0 = 4, f_2 = 9,$$

$$\therefore \text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$\text{Mode} = 4000 + \frac{18 - 4}{2(18) - 4 - 9} \times 1000$$

$$= 4000 + \frac{14}{36 - 13} \times 1000$$

$$= 4000 + \frac{14}{23} \times 1000$$

$$= 4000 + \frac{14000}{23}$$

$$= 4608.7$$

$$\therefore \text{Mode} = 4608.7 \text{ runs}$$

Modal Class

Class width (h) is found by subtracting two limits or two

Frequency of the class preceding the mode class
 $\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$

Frequency of the class succeeding the mode class
 $\text{Mode} = l + \frac{f_0 - f_2}{2f_1 - f_0 - f_2} \times h$

Module_19

Q. A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below.

Find the mode of the data :

No. of cars	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
Frequency	7	14	13	12	20	11	15	8

Sol:

$$\text{Class width}(h) = 10$$

Maximum frequency is 20

The corresponding class 40 – 50 is modal class.

Class	Frequency (f_i)
0 - 10	7
10 - 20	14
20 - 30	13
30 - 40	12
40 - 50	20
50 - 60	11
60 - 70	15
70 - 80	8

Modal Class

Class width
subtracting
lower limit or
upper limit
 $\times 10$

For finding mode classes
must be continuous

What is the
Maximum
frequency?

Mode class
Modal class

∴ Mode

Module_20

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

Age (in years)	5 - 15	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65
Number of patients	6	11	21	23	14	5

Find the mode and the mean of the data given above.

Sol:

$$\text{Class width}(h) = 10$$

Age in years No. of patients
 f_1

5 - 15

Class width (h) is

6

subtracting two consecutive lower limits or two consecutive upper limits

$$l = 35, h = 10, f_1 = 23, f_0 = 21, f_2 = 14,$$

\therefore

For finding mode, classes must be continuous

Modal Class

15 - 25

25 - 35

35 - 45

45 - 55

55 - 65

Maximum frequency is 23

The corresponding class 35 - 45 is modal class

years

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

Age (in years)	5 - 15	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65
Number of patients	6	11	21	23	14	5

Find the mode and the mean of the data given above.

Sol: Class width(h) = $15 - 5 = 10$ Assumed mean, $a = 14$ By step deviation method

class interval	frequency
5 - 15	10
15 - 25	20
25 - 35	30
35 - 45	40 ↔ a
45 - 55	50
55 - 65	60
Total	--

5 ± 15 Assumed mean, $a = 40$ By step deviation method

6 x -

By adding h to x_i we get
next x_i

Adding all fu

Preferably the middle value ~~B~~
 $40 - 4.63$
can = 35.37 yrs

Module_21

Q. The following data gives the distribution of total monthly household expenditure of 200 families of a village. **Find the modal monthly expenditure of the families.** Also, find the mean monthly expenditure :

Expenditure (in Rs.)	1000 - 1500	1500 - 2000	2000 - 2500	2500 - 3000	3000 - 3500	3500 - 4000	4000 - 4500	4500 - 5000
No. of families	24	40	33	28	30	22	16	7

Sol:

$$\text{Class width}(h) = 500$$

Maximum frequency is 40

The corresponding class 1500 – 2000 is modal class.

$$l = 1500, h = 500, f_1 = 40, f_0 = 24, f_2 = 33$$

Modal Class

Expenditure (in Rs.)	No. of families (Frequency, f_i)
1000 - 1500	24
1500 - 2000	40
2000 - 2500	33
2500 - 3000	28
3000 - 3500	30
3500 - 4000	22
4000 - 4500	16
4500 - 5000	7

Class width
subtracting
limits or
open classes

For finding mode, classes must be continuous

What is
the formula

Frequency of the class Preceeding the Modal class

$$\therefore \text{Mode} = \text{Rs. } 1841.67$$

Q. The following data gives the distribution of total monthly household expenditure of 200 families of a village. Find the modal monthly expenditure of the families. Also, find the mean monthly expenditure :

Expenditure (in Rs.)	1000 - 1500	1500 - 2000	2000 - 2500	2500 - 3000	3000 - 3500	3500 - 4000	4000 - 4500	4500 - 5000
No. of families	24	40	33	28	30	22	16	7

Sol: Class width(h) = 500 Mean, $a = 2750$, Deviation method

class interval	class mark (x_i)	$\frac{1000 + 1500}{2}$	4×-3	$x_i - 2500$	$f_i u_i$	$\sum f_i u_i$
1000 - 1500	1250	1250	-12	-1250	-30	-30
1500 - 2000	1750	1750	-8	-1750	-32	-32
2000 - 2500	2250	2250	-4	-2250	-33	-33
2500 - 3000	2750 $\leftrightarrow a$	2750	0	-2750	-34	-34
3000 - 3500	3250	3250	4	-3250	-35	-35
3500 - 4000	3750	3750	8	-3750	-36	-36
4000 - 4500	4250	4250	12	-4250	-37	-37
4500 - 5000	4750	4750	16	-4750	-38	-38
Total	--	$\sum f_i = 200$			$\sum f_i u_i = -35$	= 2662.50

Module_22

Q. The following distribution gives the state-wise teacher-student ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two measures.

No. of students per teacher	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50	50 - 55
No. of states/U.T.	3	8	9	10	3	0	0	2

Sol:

$$\text{Class width}(h) = 5$$

Maximum frequency is 10

The corresponding class 30 – 35 is modal class.

$$l = 30, h = 5, f_1 = 10, f_2 = 9, f_0 = 3$$

Class	No. of states/U.T.
15 - 20	3
20 - 25	8
25 - 30	9
30 - 35	10
35 - 40	3
40 - 45	0
45 - 50	0
50 - 55	2

Modal Class

For finding mode classes subtracting limits or two

What is the Maximum frequency?

class
modal class

It represents that most of the states/U.T have a teacher-student ratio as 30.6

Q. The following distribution gives the state-wise teacher-student ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two measures.

No. of students per teacher	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50	50 - 55
No. of states/U.T.	3	8	9	10	3	0	0	2

Sol: Class width(h) = 5. Assumed mean, $a = 32.5$. deviation method

Class	Class mark (x_i)	Frequency (f_i)	$f_i u_i$
15 - 20	17.5	3	52.5
20 - 25	22.5	8	180.0
25 - 30	27.5	9	247.5
30 - 35	32.5 $\rightarrow a$	10	325.0
35 - 40	37.5	3	112.5
40 - 45	42.5	0	0.0
45 - 50	47.5	0	0.0
50 - 55	52.5	2	105.0
Total	--	$\Sigma f_i = 35$	$\Sigma f_i u_i = 23$

By substituting consecutive values of x_i in the formula $f_i u_i = f_i \times (x_i - a)$, we get:

We assume any one value from x_i column as 'a' (i.e. Assumed mean)

Mean = $a + \frac{\sum f_i u_i}{\sum f_i}$

Mean = $32.5 + \frac{23}{35}$

Mean = $32.5 + 0.657$

Mean = $32.5 + 3.3$

Mean = 35.8

It represents that on an average, teacher-student ratio was 29.2

Thank You

Lecture_05

Module_23

Classes must be continuous.

**M
E
D
I
A**

N

$$= l + \left[\frac{\frac{n}{2} - c.f}{f} \right] \times h$$

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

l = Lower limit of median class

n = Total frequency

$c.f.$ = Cumulative frequency of class preceding the median class

f = Frequency of median class

h = Width of the class

Steps :

- (i) Find the value of $\frac{\text{Total frequency (N)}}{2} = x$
- (ii) Check the ‘Cumulative frequency less than type’ column for the value x
- (iii) The cumulative frequency less than type which is just greater than or equal to x . The corresponding class is the median class.

14.3(5) The following table gives the distribution of the life time of 400 neon lamps :

Life time (hours)	1500 - 2000	2000 - 2500	2500 – 3000	3000 - 3500	3500 - 4000	4000 - 4500	4500 - 5000
No. of lamps	14	56	60	86	74	62	48

Find the median life time of a lamp.

Sol:

Changing the data in continuous form

Class	Frequency	c. f.
1500 - 2000	14	14
2000 - 2500	5	7
2500 - 3000	6	13
3000 - 3500	8	21
3500 - 4000	7	29
4000 - 4500	4	35
4500 - 5000	2	40
Total	n = 400	0

$$\text{Here } \frac{n}{2} = \frac{400}{2} = 200$$

Which lies in the class 3000 - 3500

∴ Median class is 3000-3500.

$$h = 500, f = 86, c.f. = 130$$

$$l = 3000,$$

$$70 + 60 = 130$$

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

$$= 3000 + \frac{200 - 130}{86}$$

$$= 3000 + \frac{17500}{43}$$

$$= 3000 + 406.98$$

Which c.f is greater than or equal to 200

$$\therefore \text{Median} = 3406.98 \text{ hrs.}$$

Module_24

14.3(4) The lengths of 40 leaves of plant are measured correct to the nearest millimeter, and the data obtained is represented in the following table

Length (in mm)	Number of leaves
118 - 126	3
127 - 135	5
136 – 144	9
145 – 153	12
154 - 162	5
163 - 171	4
172 - 180	2

(Hint: The data needs to be converted to continuous classes for finding the median , since the formula assumes continuous classes . The classes then change to 117.5 – 126.5,126.5 – 135.5,.....171.5 – 180.5.)

Find the median length of the leaves.

Sol:

Let us change the data in
Is it a continuous class ?

Sol:

Class	f	c. f.
117.5 – 126.5	3	3
126.5 – 135.5	5	8
135.5 – 144.5	9	17 ← c. f.
144.5 – 153.5	12	29
153.5 – 162.5	5	34
162.5 – 171.5	4	38
171.5 – 180.5	2	40
Total	$n = 40$	

$$8 + 9 = 17$$

$$\text{Here } \frac{n}{2} = \frac{40}{2} = 20 \text{ Which is greater than or equal to 20}$$

\therefore Median class is 144.5 – 153.5

$$l = 144.5, h = 9, f = 12, c.f. = 29$$

$$\text{Median} = l + \frac{\frac{n}{2} - \text{c.f.}}{f} \times h$$

Now identify the cumulative frequency which is greater than or equal to 20

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

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

$$= 144.5 + \frac{9}{4} \times 2.25$$

$$= 144.5 + 2.25$$

$\therefore \boxed{\text{Median} = 146.75 \text{ mm}}$

Module_25

14.3(3)A life insurance agent found the following data for distribution of age of 100 policy holders. Calculate median age, if policies are given only to the persons having age 18 years onwards but less than 60 years.

Age (in years)	Below 20	Below 25	Below 30	Below 35	Below 40	Below 45	Below 50	Below 55	Below 60
Frequency	2	6	24	45	78	89	92	98	100

Age (in years)	Class	Cuml. frequency	Frequency
Below 20	15 - 20	2	2
Below 25	20 - 25	6	$6 - 2 = 4$
Below 30	25 - 30	24	$24 - 6 = 18$
Below 35	30 - 35	45	$45 - 24 = 21$
Below 40	35 - 40	78	$78 - 45 = 33 \rightarrow f$
Below 45	40 - 45	89	$89 - 78 = 11$
Below 50	45 - 50	92	$92 - 89 = 3$
Below 55	50 - 55	98	$98 - 92 = 6$
Below 60	55 - 60	100	$100 - 98 = 2$

Class	frequency	Cum. frequency
15 - 20	2	2
20 - 25	$6 - 2 = 4$	6
25 - 30	$24 - 6 = 18$	24
30 - 35	$45 - 24 = 21$	45 ← c.f.
35 - 40	$78 - 45 = 33 \rightarrow f$	78
40 - 45	$89 - 78 = 11$	89
45 - 50	$92 - 89 = 3$	92
50 - 55	$98 - 92 = 6$	98
55 - 60	$100 - 98 = 2$	100

Cumulative frequency of the class preceding the median class (c.f.)

$$\begin{aligned}
 &= 35 + \frac{25}{33} \times 5 \\
 &= 35 + 0.76
 \end{aligned}$$

Median = 35.76

Here $\frac{n}{2} = \frac{100}{2} = 50$ which lies in the class 35 - 40

Median class is 35 - 40

$$l = 35, h = 5, f = 33, c.f. = 45,$$

Module_26

12

If the median of the following frequency distribution is 28.5 find the missing frequencies:

(4 marks)

Class interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	Total
Frequency	5	f_1	20	15	f_2	5	60

Sol.

Class intervals (Daily working hours)	Frequency (No. of workers)	Cumulative frequency (less than type)
0 - 10	5	5
10 - 20	f_1	$5 + f_1$
20 - 30	20	$5 + f_1 + 20 = 25 + f_1$
30 - 40	15	$25 + f_1 + 15 = 40 + f_1$
40 - 50	f_2	$40 + f_1 + f_2$
50 - 60	5	$40 + f_1 + f_2 + 5 = 45 + f_1 + f_2$
Total	$N = 60$	

12

If the median of the following frequency distribution is 28.5 find the missing frequencies:

(4 marks)

Class interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	Total
Frequency	5	f_1	20	15	f_2	5	60

Sol.

Class intervals (Daily working hours)	Frequency (No. of workers)	Cumulative frequency (less than type)
0 - 10	5	5
10 - 20	f_1	$5 + f_1$ \longleftrightarrow c.f
20 - 30	20	$25 + f_1$
30 - 40	15	$40 + f_1$
40 - 50	f_2	$40 + f_1 + f_2$
50 - 60	5	$45 + f_1 + f_2$
Total	$N = 60$	

Here $N = 60 \quad \therefore \frac{N}{2} = \frac{60}{2} = 30$

Median = 28.5 Which is lies in the class 20-30

$\therefore l = 20, c.f. = 5 + f_1, f = 20, h = 10$

$$\text{Median} = l + \left(\frac{\frac{N}{2} - c.f.}{f} \right) h$$

$$28.5 = 20 + \frac{30 - (5 + f_1)}{20} \times 10$$

12

If the median of the following frequency distribution is 28.5 find the missing frequencies:

(4 marks)

Class interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	Total
Frequency	5	f_1	20	15	f_2	5	60

$$\text{Sol. } 28.5 = 20 + \frac{30 - (5 + f_1)}{20} \times 10$$

$$\therefore 28.5 = 20 + \frac{30 - 5 - f_1}{2}$$

$$\therefore 28.5 = 20 + \frac{25 - f_1}{2}$$

$$\therefore 28.5 - 20 = \frac{25 - f_1}{2}$$

$$\therefore 8.5 \times 2 = 25 - f_1$$

$$\therefore 17 = 25 - f_1$$

$$\therefore f_1 = 25 - 17$$

$$\therefore f_1 = 8$$

$$\therefore f_2 = 15 - f_1 \\ = 15 - 8 = 7$$

$$\therefore 45 + f_1 + f_2 = 60$$

$$\therefore f_1 + f_2 = 60 - 45$$

$$\therefore f_1 + f_2 = 15$$

\therefore Hence missing frequencies are 8 and 7.

Class intervals (Daily working hours)	Frequency (No. of workers)	Cumulative frequency (less than type)
0 - 10	5	5
10 - 20	f_1	$5 + f_1$
20 - 30	20	$25 + f_1$
30 - 40	15	$40 + f_1$
40 - 50	f_2	$40 + f_1 + f_2$
50 - 60	5	$45 + f_1 + f_2$
Total		$N = 60$

Module_27

14

If the median of the following data is 32.5, find the missing frequencies:
(4 marks)

Class interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	Total
Frequency	f_1	5	9	12	f_2	3	2	40

Sol.

Class intervals (Daily working hours)	Frequency (No. of workers)	Cumulative frequency (less than type)
0 - 10	f_1	f_1
10 - 20	5	$5 + f_1$
20 - 30	9	$5 + f_1 + 9 = 14 + f_1$
30 - 40	12	$14 + f_1 + 12 = 26 + f_1$
40 - 50	f_2	$26 + f_1 + f_2$
50 - 60	3	$26 + f_1 + f_2 + 3$
60 - 70	2	$29 + f_1 + f_2 + 2 = 31 + f_1 + f_2$
Total	$N = 40$	

14

If the median of the following data is 32.5, find the missing frequencies:
(4 marks)

Class interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	Total
Frequency	f_1	5	9	12	f_2	3	2	40

Sol.

Class intervals (Daily working hours)	Frequency (No. of workers)	Cumulative frequency (less than type)
0 - 10	f_1	f_1
10 - 20	5	$5 + f_1$
20 - 30	9	$14 + f_1$ ← c.f
30 - 40	12	$26 + f_1$
40 - 50	f_2	$26 + f_1 + f_2$
50 - 60	3	$29 + f_1 + f_2$
60 - 70	2	$31 + f_1 + f_2$
Total	$N = 40$	

Here $N = 40 \therefore \frac{N}{2} = \frac{40}{2} = 20$

Median = 32.5 Which is lies in the class 30-40

$\therefore l = 30, c.f. = 14 + f_1, f = 12, h = 10$

$$\text{Median} = l + \left(\frac{\frac{N}{2} - c.f.}{f} \right) h$$

$$32.5 = 30 + \frac{20 - (14 + f_1)}{12} \times 10$$

14 If the median of the following data is 32.5, find the missing frequencies:
(4 marks)

Class interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	Total
Frequency	f_1	5	9	12	f_2	3	2	40

Sol. $32.5 = 30 + \frac{20 - (14 + f_1)}{12} \times 10$

$$\therefore 32.5 - 30 = \frac{20 - 14 - f_1}{12} \times 10$$

$$\therefore 2.5 = \frac{6 - f_1}{12} \times 10$$

$$\therefore 2.5 \times 12 = 60 - 10f_1$$

$$\therefore 30 = 60 - 10f_1$$

$$\therefore 10f_1 = 60 - 30$$

$$\therefore 10f_1 = 30$$

$$\therefore f_1 = \frac{30}{10} = 3$$

$$\therefore f_2 = 9 - f_1 \\ = 9 - 3 = 6$$

Hence missing frequencies are 3 and 6.

$$\therefore f_1 + f_2 = 40 - 31$$

$$\therefore f_1 + f_2 = 9$$

$$\therefore f_2 = 9 - f_1$$

Class intervals (Daily working hours)	Frequency (No. of workers)	Cumulative frequency (less than type)
0 - 10	f_1	f_1
10 - 20	5	$5 + f_1$
20 - 30	9	$14 + f_1$
30 - 40	12	$26 + f_1$
40 - 50	f_2	$26 + f_1 + f_2$
50 - 60	3	$29 + f_1 + f_2$
60 - 70	2	$31 + f_1 + f_2$
Total		$N = 40$

Thank You

Lecture_06

Module_28

Q. The distribution below gives the weights of 30 students of a class.
Find the median weight of the students.

Weight (in kg)	40 - 45	45 - 50	50 - 55	55 - 60	60 - 65	65 - 70	70 - 75
Number of students	2	3	8	6	6	3	2

Sol:

class	frequency	c.f
40 - 45	2	2
45 - 50	3	5
50 - 55	8	13
55 - 60	6 ← f	19
60 - 65	6	25
65 - 70	3	28
70 - 75	2	30

Here $\frac{n}{2} = \frac{30}{2} = 15$ which lies in the class 55 - 60

Which c.f is greater than

Cumulative frequency of the class preceding the median class (c.f)

$$= 55 + \frac{10}{6}$$

$$= 55 + 1.67$$

∴ Median = 56.67 kg

Module_29

Ex14.3-2) If the median of the distribution given below is 28.5, find the values of x and y

Class interval	Frequency
0 - 10	5
10 - 20	x
20 - 30	20
30 - 40	15
40 - 50	y
50 - 60	5
Total	60

∴ Median class is $20 - 30$.

$$n = 60, l = 20, h = 10, f = 20, c.f. = (5 + x)$$

$$\text{Median} = l + \left[\frac{\frac{n}{2} - \text{c.f.}}{f} \right] \times h$$

$$\therefore 28.5 = 20 + \left[\frac{30 - (5+x)}{20} \right] \times 10$$

$$\therefore 28.5 - 20 = \frac{(30 - 5 - x)}{2}$$

$$\therefore 2(8.5) = 25 - x$$

$$\therefore 17 = 25 - x$$

$$\therefore x = 8 \text{ units}$$

Substituting $x = 8$ in (1)

$$\Rightarrow 8 + y = 15$$

$$\Rightarrow y = 7$$

Hence, $x = 8$ and $y = 7$

Soln.

class	frequency	c.f
0 - 10	5	5
10 - 20	x	$5 + x$
20 - 30	20	$25 + x$
30 - 40	15	$40 + x$
40 - 50	y	$40 + x + y$
50 - 60	5	$45 + x + y$
Total	$n = 60$	

$$\text{Here, } 45 + x + y = 60$$

$$\therefore x + y = 15 \quad \dots (1)$$

Since the median is 28.5 which lies in the class $20 - 30$

Module_30

Ex14.3-(1) The following frequency distribution gives the monthly consumption of electricity of 68 consumers of a locality. Find the median, mean and mode of the data and compare them.

Monthly electricity consumption (in units)	No. of consumers of electricity
65 - 85	4
85 - 105	5
105 - 125	13
125 - 145	20
145 - 165	14
165 - 185	8
185 - 205	4

Soln.

class	frequency	c.f
65 - 85	4	4
85 - 105	5	9
105 - 125	13	22
125 - 145	20	42
145 - 165	14	56
165 - 185	8	64
185 - 205	4	68

$$\text{Here } \frac{n}{2} = \frac{68}{2} = 34$$

which lies in the class 125 - 145

∴ Median class is 125 - 145

$$l = 125, h = 20, f = 20, c.f. = 22,$$

$$\text{Median} = l + \frac{\frac{n}{2} - c.f.}{f} \times h$$

$$9 + 13 = 22$$

$$= 125 + 12$$

∴ Median = 137 units.

Determination of mean and mode

$h = 20$ Let assumed mean, $a = 135$.

class	Class $\frac{65 + 85}{2}$	frequency f_i	$u_i = \frac{x_i - 135}{20}$	$f_i u_i$
65 - 85	75	4	-3	-12
85 - 105	95	5	-2	-10
105 - 125	115	13	-1	-13
125 - 145	135 $\leftrightarrow a$	20	0	0
145 - 165	155	14	1	14
165 - 185	175	8	2	16
185 - 205	195	4	3	12
	$\sum f_i = 68$			$\sum f_i u_i = 7$

By step deviation method,

$$\begin{aligned}\bar{x} &= a + \frac{\sum f_i u_i}{\sum f_i} \times h \\ &= 135 + \frac{7}{68} \times \cancel{20}^5 \\ &= 135 + \frac{7}{68} \times 20\end{aligned}$$

$$\begin{aligned}&= 135 + \frac{35}{17}^{2.05} \\ &= 135 + 2.05 \\ \therefore &\text{Mean} = 137.05 \text{ units}\end{aligned}$$

Maximum frequency is 20 which lies in the class 125 - 145

∴ Modal class is 125 - 145

class	Class Mark x_i	Frequency f_i	$u_i = \frac{x_i - 135}{20}$	$f_i u_i$
65 - 85	75	4	-3	-12
85 - 105	95	5	-2	-10
105 - 125	115	13	-1	-13
125 - 145	135	20	0	0
145 - 165	155	14	1	14
165 - 185	175	8	2	16
185 - 205	195	4	3	12
$\sum f_i = 68$				

$$l = 125, h = 20, f_1 = 20, f_0 = 13, f_2 = 14$$

$$\therefore \text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$= 125 + \frac{20 - 13}{2(20) - 13 - 14} \times 20$$

Frequency of the class
preceding the Modal class
Frequency of the class
succeeding the Modal class

$$= 125 + \frac{7}{40 - 27} \times 20$$

$$= 125 + \frac{140}{13} \times 20$$

$$= 125 + 10.76$$

$$\therefore \text{Mode} = 135.76 \text{ units}$$

Module_31

Q. 100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabets in the surnames was obtained as follows :

No. of letters	1 - 4	4 - 7	7 - 10	10 - 13	13 - 16	16 - 19
No. of surnames	6	30	40	16	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames ? Also, find the modal size of the surnames.

Sol: Determination of median

class	frequency	c.f
1 - 4	6	6
4 - 7	30	36
7 - 10	40 ← f	76
10 - 13	16	92
13 - 16	4	96
16 - 19	4	100

Which c.f is greater than

Cumulative frequency of the class preceding the median class (c.f)

$$= 7 + \frac{42}{40} 1.05$$

Here $\frac{n}{2} = \frac{100}{2} = 50$ which lies in the class 7 - 10
 \therefore Median = 8.05 letters

Q. 100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabets in the surnames was obtained as follows :

No. of letters	1 - 4	4 - 7	7 - 10	10 - 13	13 - 16	16 - 19
No. of surnames	6	30	40	16	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames ? Also, find the modal size of the surnames.

Sol: Class width, $h = \frac{1 + 4}{2} = 2.5$

class interval	class mark (x_i)	f _i
1 - 4	2.5	6
4 - 7	5.5	30
7 - 10	8.5	40
10 - 13	11.5	16
13 - 16	14.5	4
16 - 19	17.5	4
Total	5	$\sum f_i = 832$

$$\text{Mean, } (\bar{x}) = \frac{\sum f_i x_i}{\sum f_i}$$

$$= \frac{832}{100}$$

8.32 letters

By adding h to x_i we get
next x_i

Adding all f_i

Adding all $f_i x_i$

$$\sum f_i x_i = 832$$

Exercise 14.3

Q.6. 100 surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabets in the surnames was obtained as follows :

No. of letters	1 - 4	4 - 7	7 - 10	10 - 13	13 - 16	16 - 19
No. of surnames	6	30	40	16	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames ? Also, find the modal size of the surnames.

Sol:

Class width(h) = 3 Maximum frequency is 40. The corresponding class 7–10 is modal class.

class interval	class mark (x_i)	frequency (f_i)	$f_i x_i$
1 - 4	5	6	15
4 - 7	5	30	f_0 165
7 - 10	8.5	40	$\leftarrow f_1$ 340
10 - 13	11.5	16	f_2 184
13 - 16	14.5	4	58
16 - 19	17.5	4	70
Total		$\sum f_i = 100$	$\sum f_i x_i = 832$

$$l = 7, h = 3, f_1 = 40, f_0 = 30, f_2 = 16$$

$$\therefore \text{Mode} = l + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right] \times h$$

$$\therefore \text{Mode} = 7 + \left[\frac{40 - 30}{2(40) - 30 - 16} \right] \times 3$$

$$\therefore \text{Mode} = 7 + \frac{30 - 0.88}{34}$$

$$\therefore \text{Mode} = 7 + 0.88$$

$$\therefore \text{Mode} = 7.88 \text{ letters}$$

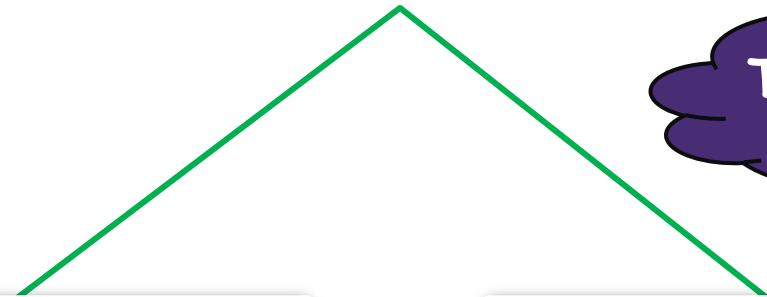
Thank You

Lecture_07

Module_32

INTRODUCTION

Ogive curve



There are two types
Of curve

More than type
frequency curve

Less than type
frequency curve

EX 14.4 (1)The following distribution gives the daily income of 50 workers of a factory.

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

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

Sol.

Daily income
(in Rs)

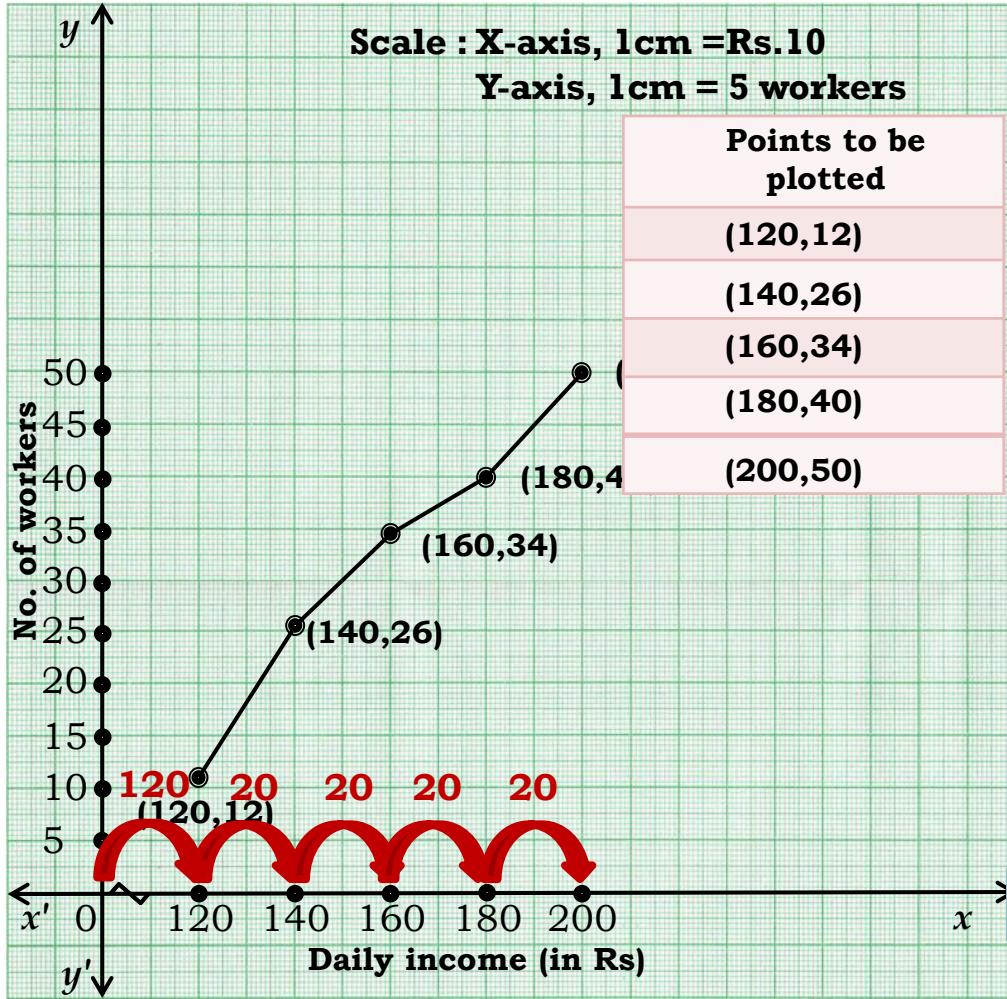
Numbers of

Cumulative

Upper limit, cumulative
frequency

I will prepare less than
cumulative frequency
distribution table.

100 - 120	40	(100,40)
120 - 140	50	(120,50)



Leaving 2 cm from bottom we draw horizontal X-axis and leaving 2cm from left we draw vertical Y-axis

On X-axis if classes are not starting from '0' leaving 2cm from X-axis we start putting limits .

The difference between origin and lower limit of first class is not same as the width of classes hence we put a Krink mark

Looking at the biggest Y-co ordinate we select the scale on Y - axis

We plot the points one after the other and write the co-ordinate

Join all points with smooth curve

Module_33

EX.14.4(3) The following table gives production yield per hectare of wheat of 100 farms of a village.

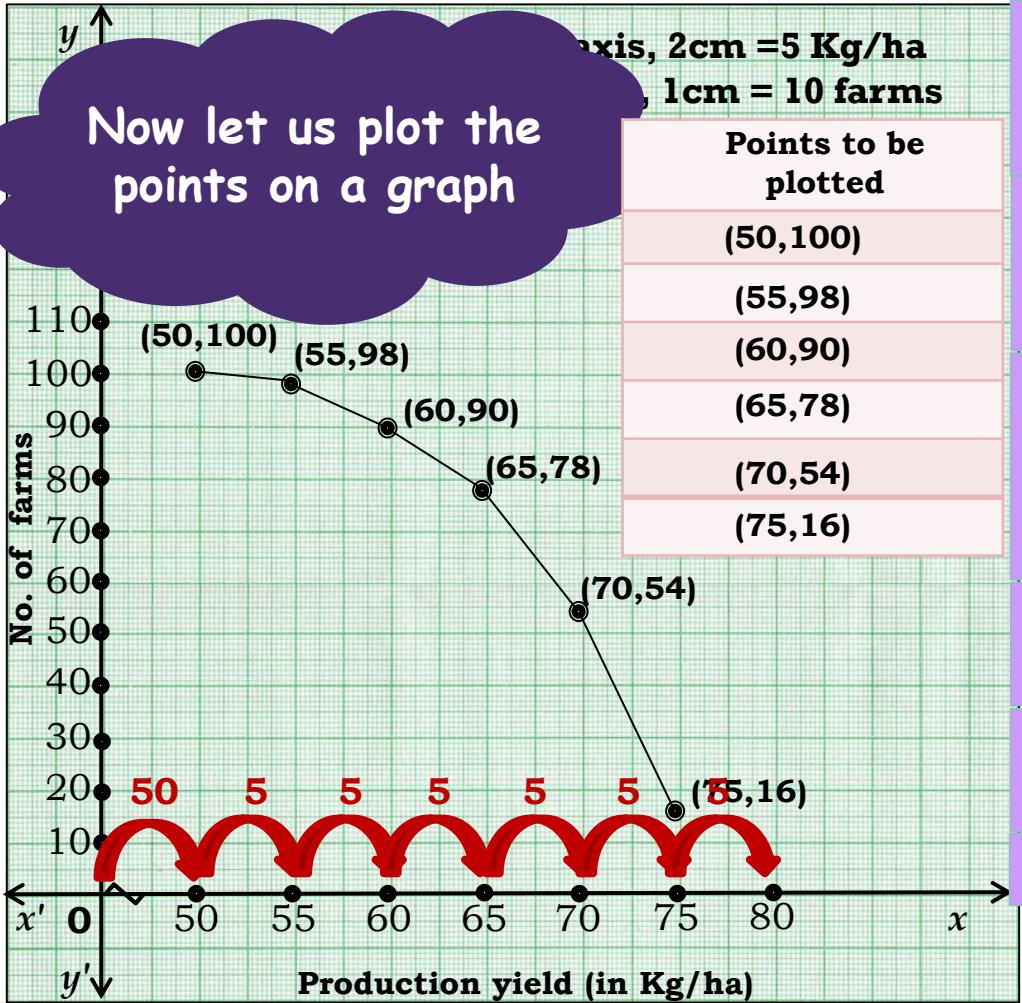
Production yield (in Kg/Ha)	50 - 55	55 - 60	60 - 65	65 - 70	70 - 75	75 - 80
Numbers of Farms	8	12	20	25	30	20
Cumulative Frequency	8	20	40	65	95	100
Points to be plotted	52.5	57.5	62.5	67.5	72.5	77.5

Second column will be frequency. In this sum it is

Third column will be more than type cumulative frequency. In this we add the frequency from Down to Up

Fourth column will be points to be plotted lower limit,cumulative frequency

are more than 100. Fifth column will be continuous classes in this sum it is Production yield(in Kg/Ha)



Leaving 2 cm from bottom we draw horizontal X-axis and leaving 2cm from left we draw vertical Y-axis

On X-axis if classes are not starting from '0' leaving 2cm from X-axis we start putting limits .

The difference between origin and lower limit of first class is not same as the width of classes hence we put a Krink mark

Looking at the biggest Y-co ordinate we select the scale on Y - axis

We plot the points one after the other and write the co-ordinate

Join all points with smooth curve

Module_34

EX 14.4(2) During the medical check-up of 35 students of a class, their weight were recorded as, follows :

Weight (in Kg)	Less than 38	Less than 40	Less than 42	Less than 44	Less than 46	Less than 48	Less than 50	Less than 52
Numbers of students	0	3	5	9	14	28	32	35

Draw a less than type ogive for the given data.Hence obtain the median weight from graph and verify the result by using the formula.

Weight (in Kg)	Numbers of students	Cumulative Frequency	Point to be plotted
36 - 38	0	0	(38,0)
38 - 40	$3 - 0 = 3$	3	(40,3)
40 - 42	$5 - 3 = 2$	5	(42,5)
42 - 44	$9 - 4 = 5$	9	(44,9)
44 - 46	$14 - 9 = 6$	14	(46,14)
46 - 48	$28 - 14 = 14$	28	(48,28)
48 - 50	$32 - 28 = 4$	32	(50,32)
50 - 52	$35 - 32 = 3$	35	(52,35)

$$\text{Now, } \frac{N}{2} = \frac{35}{2} = 17.5.$$

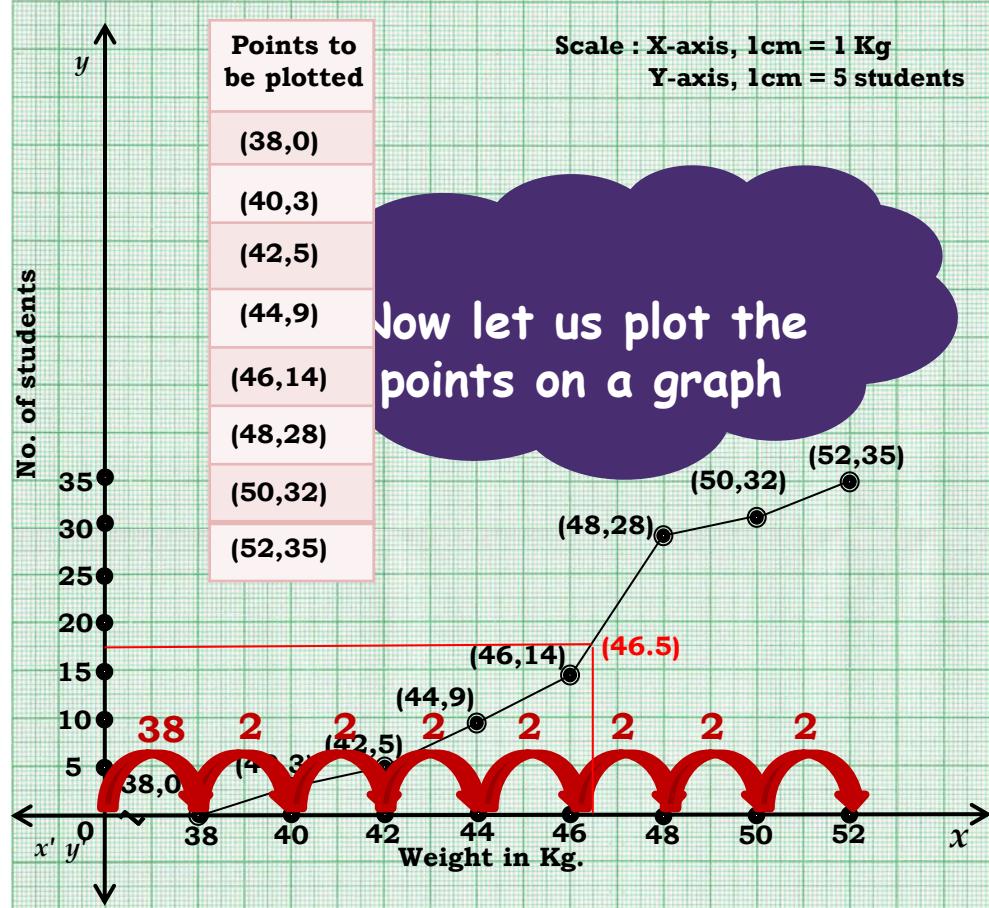
Which lies in the class 46 - 48

∴ Median class is 46 - 48.

∴ L = 46, f = 14, cf = 14 and h = 2

Median from graph is 46.5 kg

Soln.



Leaving 2 cm from bottom we draw horizontal X-axis and leaving 2cm from left we draw vertical Y-axis

On X-axis if classes are not starting from '0' leaving 2cm from X-axis we start putting limits .

The difference between origin and lower limit of first class is not same as the width of classes hence we put a Krink mark

Looking at the biggest Y-co ordinate we select the scale on Y - axis

We plot the points one after the other and write the co-ordinate

Join all points with smooth curve

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

$$= 46 + \frac{17.5 - 14}{7} \times 2$$

$$= 46 + \frac{3.5}{7}^{0.5}$$

$$= 46 + 0.5$$

$$\therefore \text{Median} = 46.5$$

Hence the median is same as obtained from graph.

Module_35

Q. Construct a frequency distribution table for following distribution :

Age in year (less than)	10	20	30	40	50	60	
Cumulative frequency				37	53		
Soln. The cumulative frequency							
Age in years	Class interval	frequency					
Less than 10	0 - 10	10	0	10	17	0 - 17	
Less than 20	10 - 20	20	10	17	32	32 - 17 = 15	
Less than 30	20 - 30	30	32	10	37	37 - 32 = 5	
Less than 40	30 - 40	40	37	30	53	53 - 37 = 16	
Less than 50	40 - 50	50	53	37	58	58 - 53 = 5	
Less than 60	50 - 60	60	58	53	65	65 - 58 = 7	
Less than 70	60 - 70	70	65	58	58	5	

Since class width is 10 we get lower limit by subtracting 10 from each upper limit

Similarly all upper limits are given to us

For getting c.f. we add frequencies.
Similarly, for getting frequencies we subtract consecutive c.f.

that class

Module_36

Q. Draw an ogive to represent

Class Mark	12.5
Frequency	12
Sol:	
Class interval	Frequency
5 - 10	0
10 - 15	12
15 - 20	17
20 - 25	22
25 - 30	27
30 - 35	31
35 - 40	30

From
to get
to go

Class mark &
frequency is given

Class mark is mid
point of classes

140
139

Scale : 2 cm = 5 units on x-axis

1 cm = 10 units on y-axis

(40, 139)

Let us find class
interval using
given class marks

Divide class width by 2

Join these points
with smooth curve

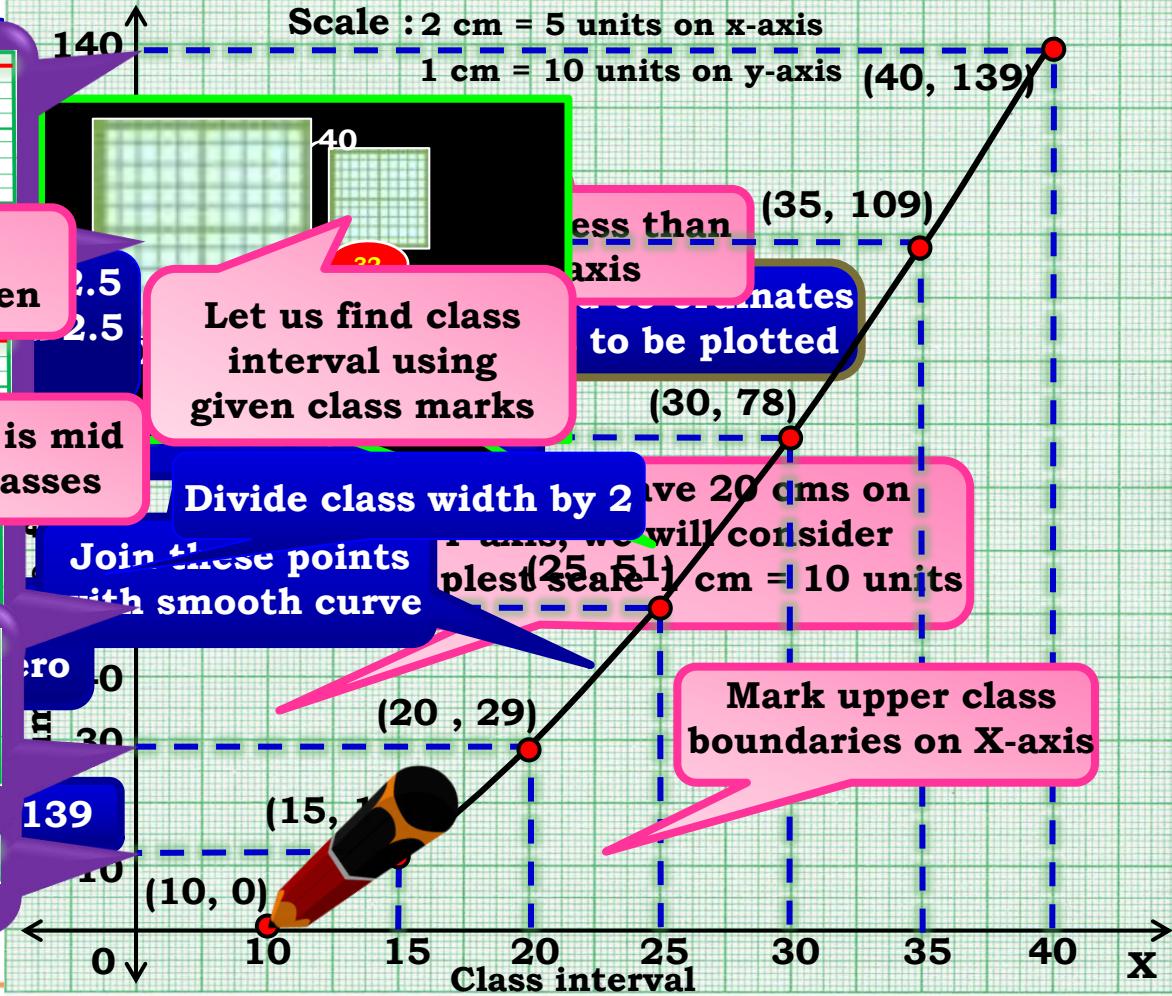
Coordinates
to be plotted

(30, 78)

(25, 51)

cm = 10 units

Mark upper class
boundaries on X-axis



Thank You