

NDA 1 2025

LIVE

MATHS

STATISTICS

CLASS 1

NAVJYOTI SIR

SSBCrack
EXAMS

Crack
EXAMS

STATISTICS

→ involves collection, representations, analysing of data.

DATA

→ raw form collected as to draw insights.

TYPES OF DATA

(1) On the basis of source :

a) Primary - collected by oneself.

b) Secondary - collected from some other source. —

TYPES OF DATA

→ Grouped

2	→	16
4	→	15
6	→	11
7	→	10
8	→	6
10	→	2

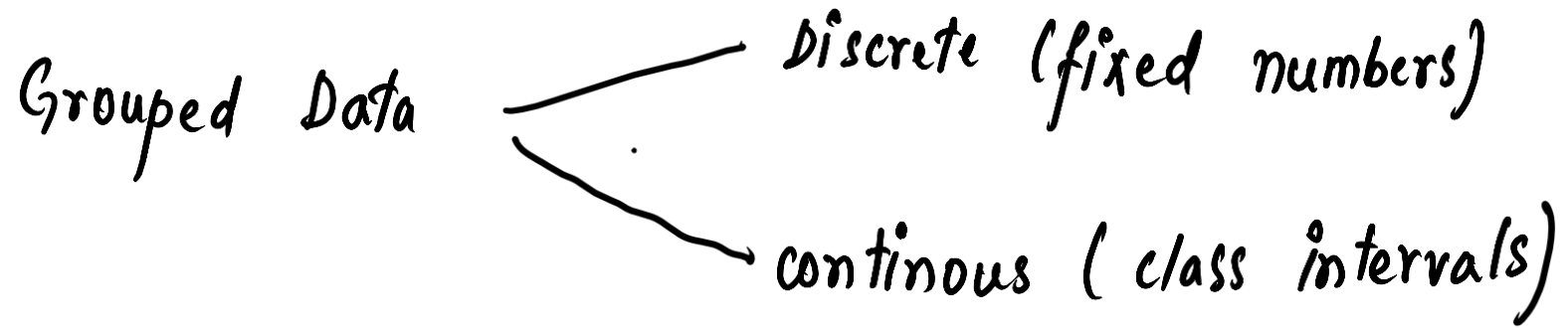
frequency

how many times a particular observation in the data has occurred.

→ Ungrouped

2, 4, 6, 6, 6, 7, 4, 2 - - - -

(Marks obtained by students in a class test)



2	→	16	freq
4	→	15	
✓6	→	11	
✓7	→	10	
✓8	→	6	
✓10	→	2	

(Discrete)

Marks	→	Number of students
0 - 5	→	$16 + 15 = \underline{31}$
5 - 10	→	$11 + 10 + 6 + 2 = \underline{29}$

class intervals

class width

Continuous data,

$0 - 5$
 $5 - 10$

upper - class limit (UCL)

Lower class limit (LCL)

$$\frac{UCL + LCL}{2} = \text{class mark}$$

$$\text{class width} = UCL - LCL$$

* A single number to represent a class interval is class mark.

DATA REPRESENTATION

→ Frequency distribution table

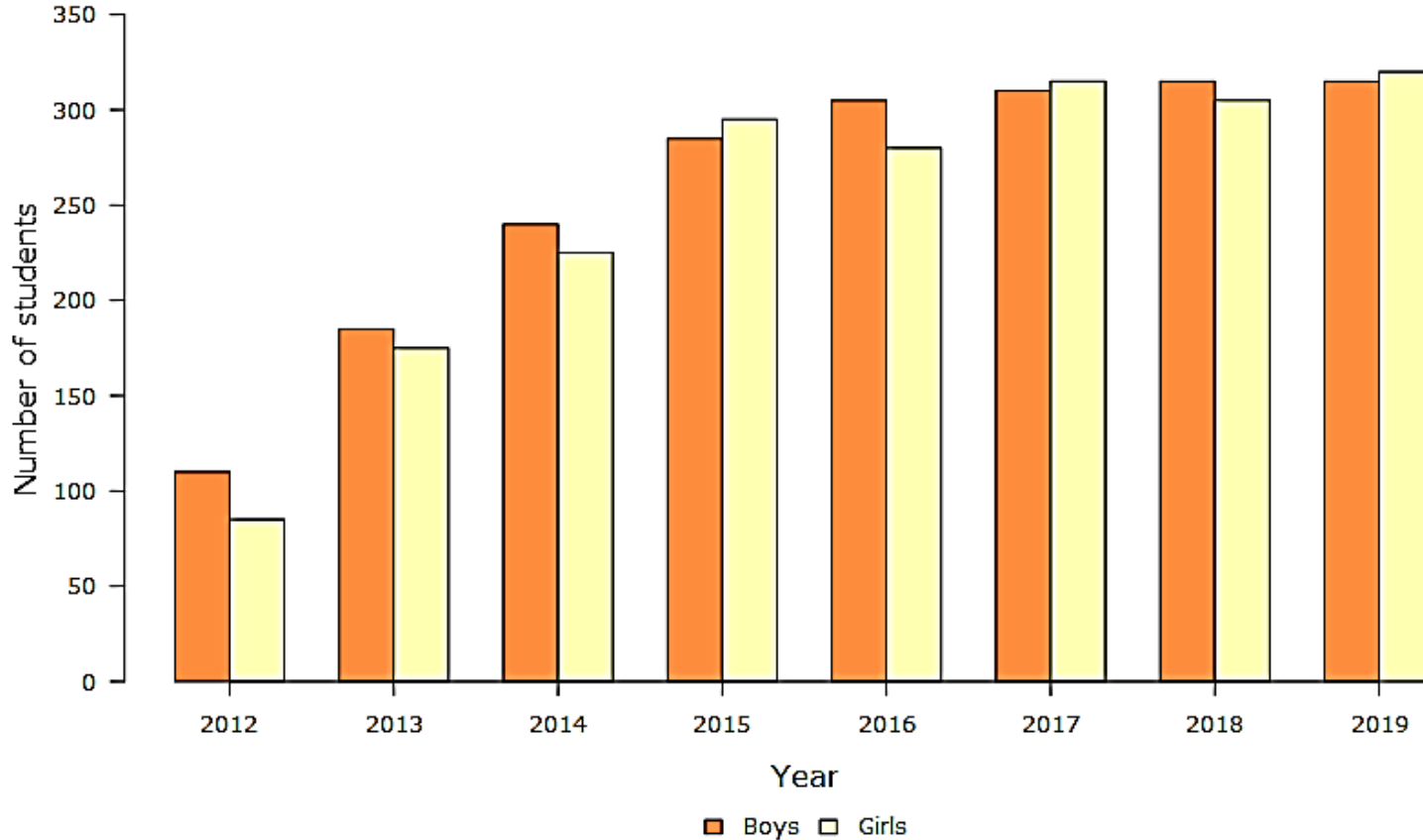
→ Bar Graph

→ Pie chart / Circle Graph

→ Histogram

→ Frequency Polygon

BAR GRAPH

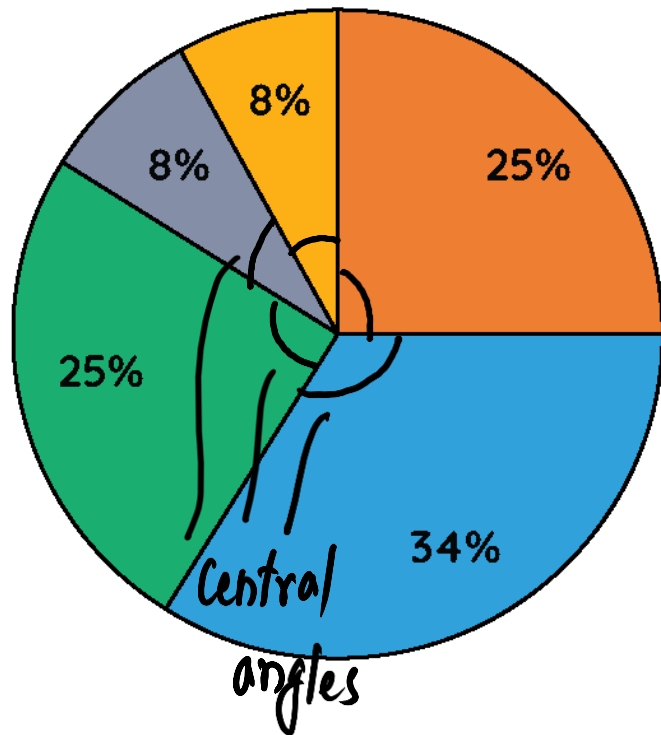


→ Height of rectangle is related with frequency.

→ Its best for comparison.

PIE CHART

Activities



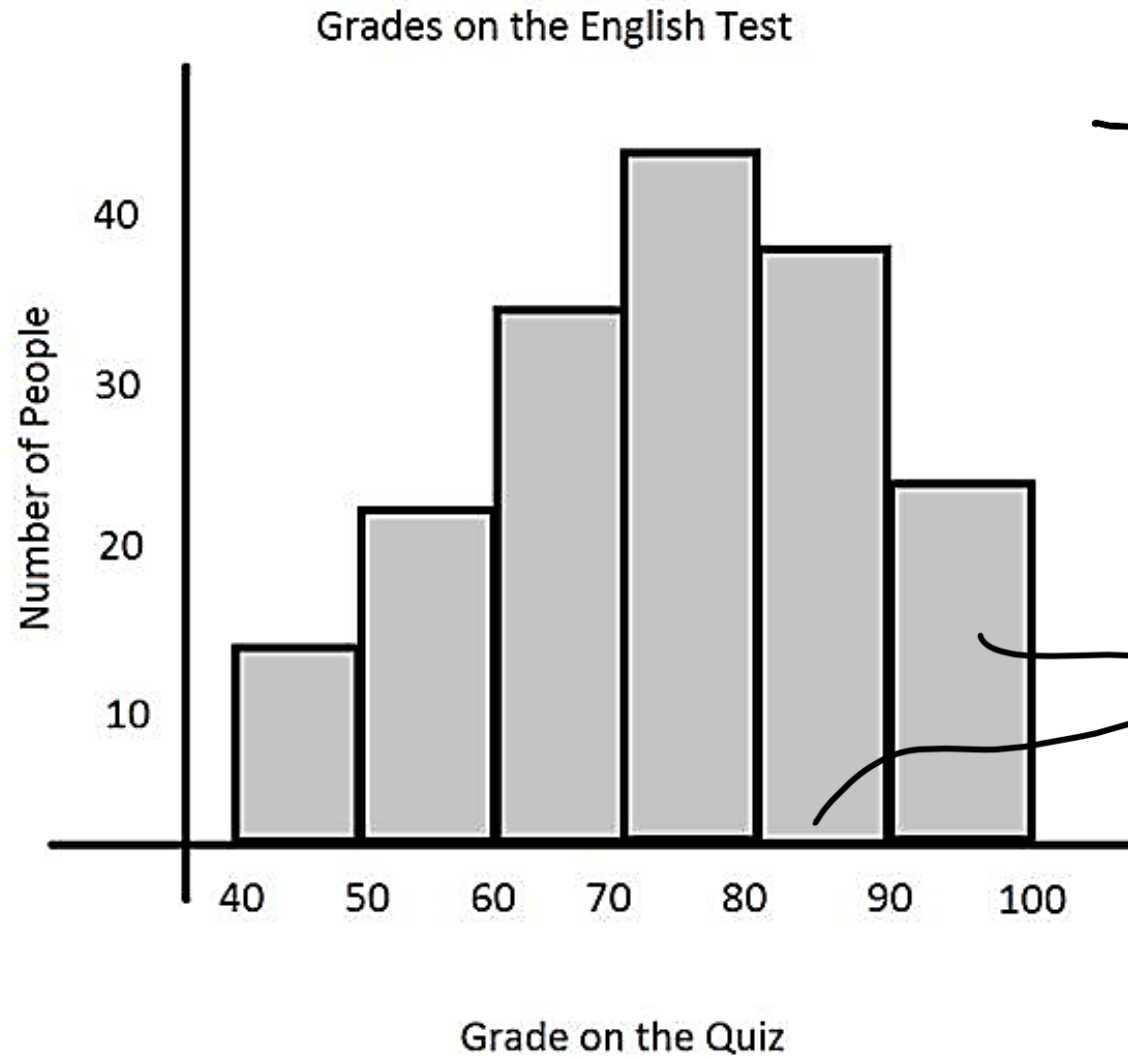
- sleeping ■ school ■ playing
- tv ■ music

→ Used to know how much a part is contributing to total.

$$\text{central angle of part} = \frac{\text{part}}{\text{Total}} \times 360^\circ$$

(0)

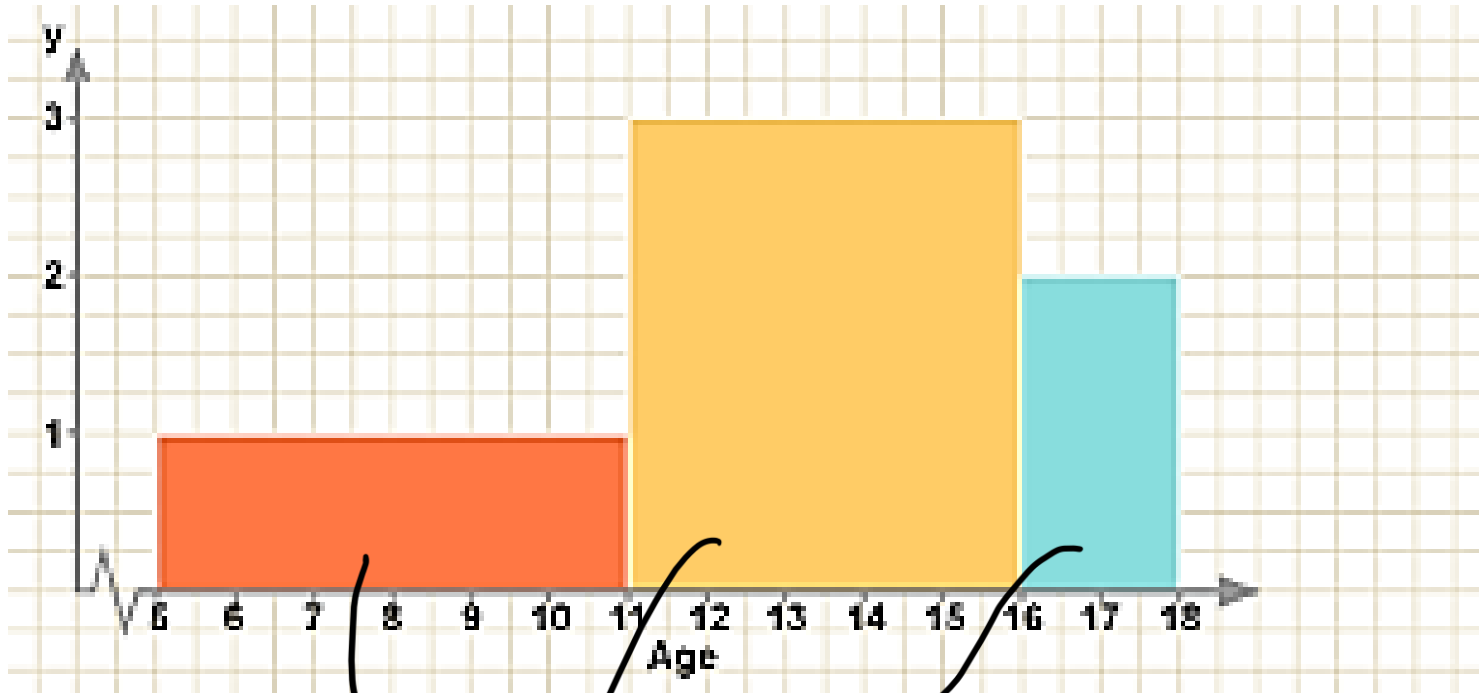
HISTOGRAM



→ Represents class intervals.

equal class widths = 10,

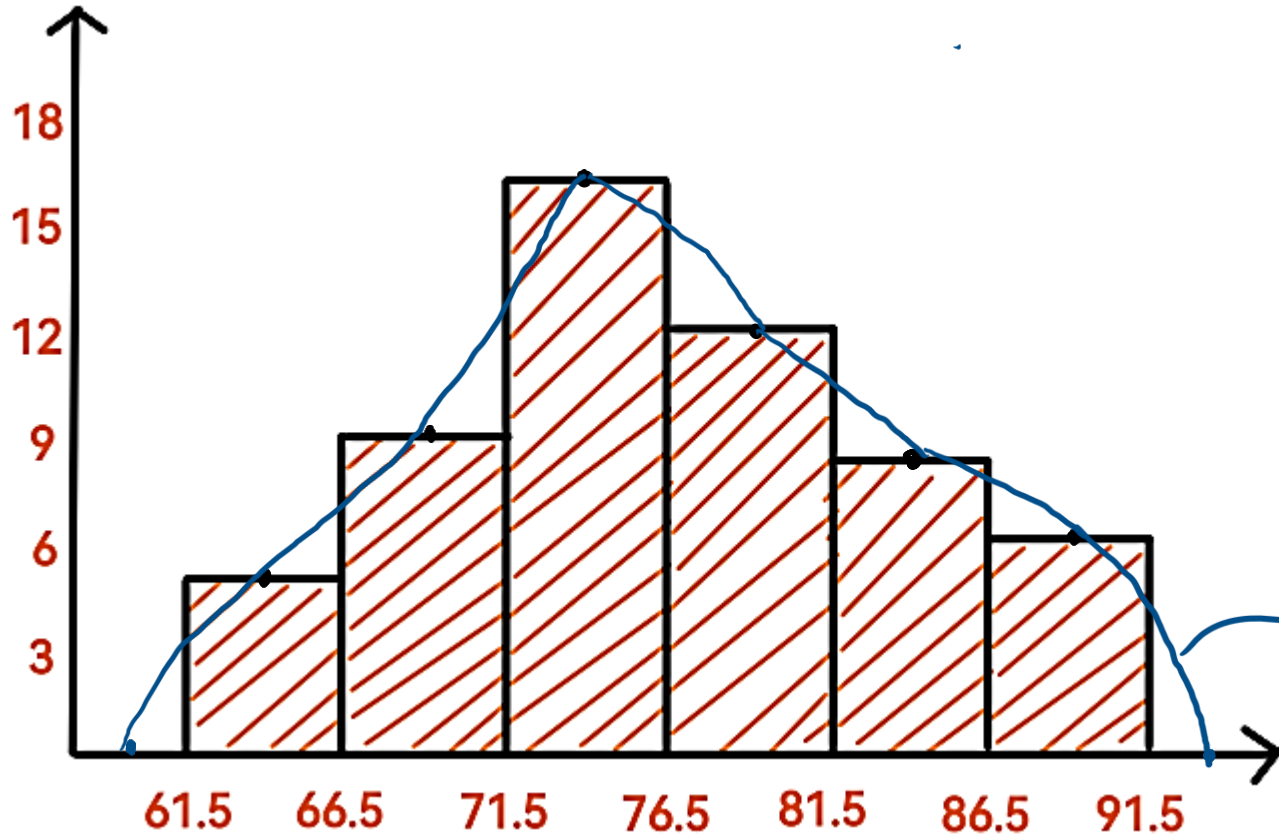
HISTOGRAM



unequal
class widths

Area of
rectangle is related to
frequency.

FREQUENCY POLYGON



joining class marks of each class interval,

MEASURES OF CENTRAL TENDENCY

The number used to represent the center or middle of a set of data values.

→ Mean, Median and mode,

MEAN

* For ungrouped data, $x_1, x_2, x_3, \dots, x_n$

$$\text{Mean, } \bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \frac{\sum_{i=1}^n x_i}{n}$$

Mean for discrete data,

x	f
x_1	f_1
x_2	f_2
x_3	f_3
\vdots	
x_n	f_n

$$\text{Mean, } \bar{x} = \frac{x_1 f_1 + x_2 f_2 + \dots + x_n f_n}{f_1 + f_2 + f_3 + \dots + f_n}$$

$$\bar{x} = \frac{\sum_{i=1}^n x_i f_i}{\sum_{i=1}^n f_i}$$

Mean for continuous data (class intervals)

→ obtain class mark of each interval. This is x_i .

$$\bar{x} = \frac{\sum_{i=1}^n x_i f_i}{\sum_{i=1}^n f_i} = \left(A + \frac{\sum_{i=1}^n u_i f_i}{\sum_{i=1}^n f_i} \times h \right)$$

assumed mean

$$u_i = \frac{x_i - A}{h}$$

works also for
unequal class
widths.

EXAMPLE

The mean for following distribution is

- (a) 22.33 (b) 23.24 (c) 24.56 (d) 25.56

Class Interval	Frequency	x_i (class marks)
0-10	22	5
10-20	38	15
20-30	46	25
30-40	35	35
40-50	20	45

$\sum f_i$

$22 + 38 + 46 + 35 + 20$

$= 161$

(HCF of $x_i - A$ values)

$(h = 10)$

$\frac{x_i}{f_i}$
5 — 22

$\frac{x_i - A}{u_i = (x_i - A)/h}$
-20 — -2

$\frac{u_i \cdot f_i}{-2 \times 22 = -44}$

15 — 38

-10 — -1

$-1 \times 38 = -38$

25 — 46

0 — 0

$0 \times 46 = 0$

35 — 35

10 — 1

$1 \times 35 = 35$

45 — 20

20 — 2

$2 \times 20 = 40$

$\sum u_i \cdot f_i = (-44) + (-38) + 0 + 35 + 40$

$= -7$

A

$$\text{Mean} = A + \frac{\sum u_i f_i}{\sum f_i} \times h$$

$$= 25 + \frac{(-7)}{161} \times 10$$

$$= 25 - \frac{70}{161}$$

$$= 24.56 \text{ (from options)}$$

EXAMPLE

The mean for following distribution is

- (a) 22.33 (b) 23.24 (c) 24.56 (d) 25.56

Class Interval	Frequency
0–10	22
10–20	38
20–30	46
30–40	35
40–50	20

Ans: (c)

MODE

→ observation occurring maximum no. of times,

→ Ungrouped data —

→ Discrete — observation having frequency,

For class intervals,

f (frequencies)

$a - b$

f_1

$b - c$

f_2

$c - d$

f_3

f_0

$d - e$

f_4

f_1

$e - f$

f_5

f_2

Lower limit

modal class

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

class width

Let f_4 be highest among f_1, f_2, f_3, f_4 and f_5 .

MODE

Mode of the grouped data can be calculated by using the formula

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

EXAMPLE

The mode of the following distribution is

Class Interval	Frequency
0-20	17
20-40	28
40-60	32
60-80	24
80-100	19

- (a) 40 (b) 42.67 (c) 46.67 (d) 7

40-60 ⇒ modal class

$l = 40$; $h = 20$

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

$$= 40 + \left(\frac{32 - 28}{2 \times 32 - 28 - 24} \right) \times 20$$

$$= 40 + \left(\frac{4}{64 - 52} \right) \times 20$$

$$= 40 + \left(\frac{1}{3} \times 20 \right) = 40 + \frac{20}{3}$$

46.67

EXAMPLE

The mode of the following distribution is

Class Interval	Frequency
0–20	17
20–40	28
40–60	32
60–80	24
80–100	19

- (a) 40 (b) 42.67 (c) 46.67 (d) 7

Ans: (c)

MEDIAN

→ middle value when data is arranged in an order.

↓
ascending order

→ for ungrouped data,

number of observations (n) = odd

or $n = \text{even}$

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

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

MEDIAN

Median of the grouped data can be calculated by using the formula :

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

l - lower limit of median class
 cf - just above of median class cf ,
 f - frequency of median class

$$\rightarrow \sum f = n$$

$\rightarrow \frac{n}{2}$. check which cf is just bigger than $\frac{n}{2}$.
 h - class width

corresponding to this cf , is median class,

EXAMPLE

The median for the following distribution is

Class Interval	Frequency
0-10	22
10-20	38
20-30	46
30-40	35
40-50	20

cf (cumulative frequency)

22
 22 + 38 = 60
 60 + 46 = 106
 106 + 35 = 141
 141 + 20 = 161

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

$$20 + \left(\frac{80.5 - 60}{46} \right) \times 10$$

- (a) 20 (b) 22.46 (c) 24.46 (d) 25

$$\sum f = 161 = n$$

$$\frac{n}{2} = \frac{161}{2} = 80.5$$

$$h = 10$$

20 - 30 (median class)
 l

$$= 20 + \left(\frac{80.5 - 60}{46} \right) \times 10$$

$$= 24.46$$

EXAMPLE

The median for the following distribution is

Class Interval	Frequency
0–10	22
10–20	38
20–30	46
30–40	35
40–50	20

- (a) 20 (b) 22.46 (c) 24.46 (d) 25

Ans: (c)

CUMULATIVE FREQUENCY DISTRIBUTION

<u>Class intervals</u>	<u>frequencies</u>
0 - 10	6
10 - 20	5
20 - 30	7
30 - 40	10
40 - 50	11

Less than

More than

<u>Less than (x_i)</u>	<u>frequency (f_i)</u>
less than 10	6
less than 20	$6 + 5 = 11$
less than 30	$11 + 7 = 18$
less than 40	28
less than 50	39

Less than every
class interval's
upper limit

<u>Class intervals</u>	<u>frequencies</u>	<u>More than (x_i)</u>	<u>frequency</u>
0 - 10	6	More than 0 →	39
10 - 20	5	More than 10 →	33
20 - 30	7	u u 20 →	28
30 - 40	10	u u 30 →	21
40 - 50	11	u u 40 →	11

More than lower class
limit of
 each interval,

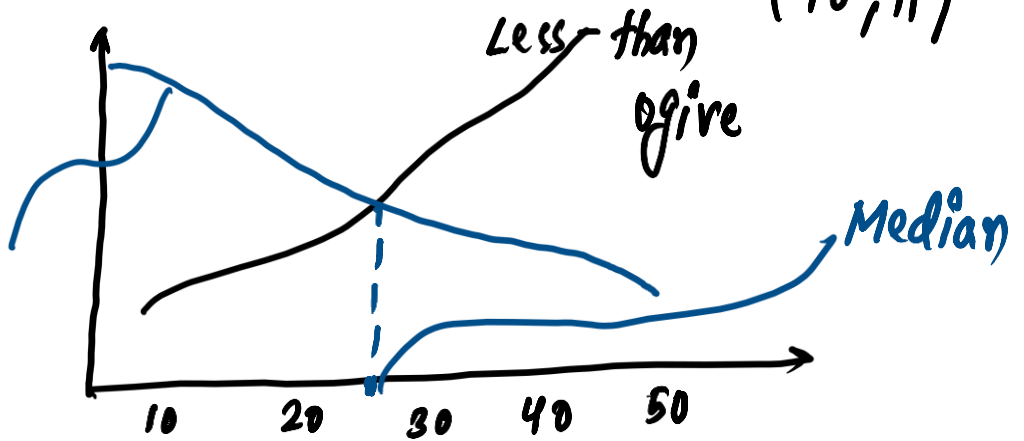
OGIVE — curves of cumulative frequency distribution

<u>less than (x_i)</u>	<u>frequency (f_i)</u>
less than <u>10</u> →	<u>6</u>
less than <u>20</u> →	$6 + 5 = 11$
less than <u>30</u> →	$11 + 7 = 18$
less than <u>40</u> →	<u>28</u>
less than <u>50</u> →	<u>39</u>

<u>More than (x_i)</u>	<u>frequency</u>
More than 0 →	39
More than 10 →	33
" " 20 →	28
" " 30 →	21
" " 40 →	11

$(10, \underline{6}), (20, \underline{11}), (30, \underline{18}), (40, \underline{28}), (50, \underline{39})$
 (x_i, f_i)

(more than ogive)



DISPERSION

There is also a need to measure the variation in the observations about the middle value.

→ Range

→ Mean deviation about Mean / Median

→ Variance and standard deviation

RANGE

Highest observation - lowest observation

MEAN DEVIATION

x_i	f_i
x_1	f_1
x_2	f_2
x_3	f_3
\vdots	\vdots
x_n	f_n

$$d_i = |x_i - M|$$

M can be mean or median (\bar{x})
 only difference is taken, (modulus is put)

$$\text{Mean deviation} = \frac{\sum_{i=1}^n d_i f_i}{\sum_{i=1}^n f_i} = \frac{\sum_{i=1}^n f_i |x_i - M|}{\sum f_i}$$

VARIANCE

$$\text{Variance} = \frac{\sum f_i (x_i - \bar{x})^2}{\sum f_i}$$

(σ^2)

Where σ is standard deviation.

STANDARD DEVIATION

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^n f_i (x_i - \bar{x})^2, \quad \sigma = \frac{1}{N} \sqrt{N \sum_{i=1}^n f_i x_i^2 - \left(\sum_{i=1}^n f_i x_i \right)^2}$$

$N = \sum f_i$

Standard deviation

EXAMPLE

Calculate variance of the following data :

Class interval	x_i	Frequency (f_i)
4 - 8	6	3
8 - 12	10	6
12 - 16	14	4
16 - 20	18	7

$\sum f_i = 20$

$$\bar{x} = \frac{\sum x_i f_i}{\sum f_i} = \frac{18 + 60 + 56 + 126}{20}$$

$$= \frac{134 + 126}{20} = \frac{260}{20} = \textcircled{13}$$

$(x_i - \bar{x})^2$	f_i	$f_i (x_i - \bar{x})^2$
49	3	147
9	6	54
1	4	4
25	7	175

$$\frac{\sum f_i (x_i - \bar{x})^2}{\sum f_i} = \frac{380}{20} = \textcircled{19} \text{ (Variance)}$$

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