NDA 1 2025

LIVE

MATHS

STATISTICS

CLASS 1

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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

→ Ungrouped

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

(Marks obtained by students in a class test)

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

frequency

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

Grouped Data → Discrete (fixed numbers)

Grouped Data → continous (class intervals)

4	16
5	15
6	11
7	10
8	6
10	2

freq

(Discrete)

Marks	Number of students
0 – 5	16 + 15 = 31
5 – 10	11 + 10 + 6 + 2 = 29

Class intervals

Class width

Continous data,

0 – 5

5 – 10

upper - class limit (UCL)

Lower class limit (LCL)

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

class width = UCL - LCL

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

DATA REPRESENTATION

→ Frequency distribution table

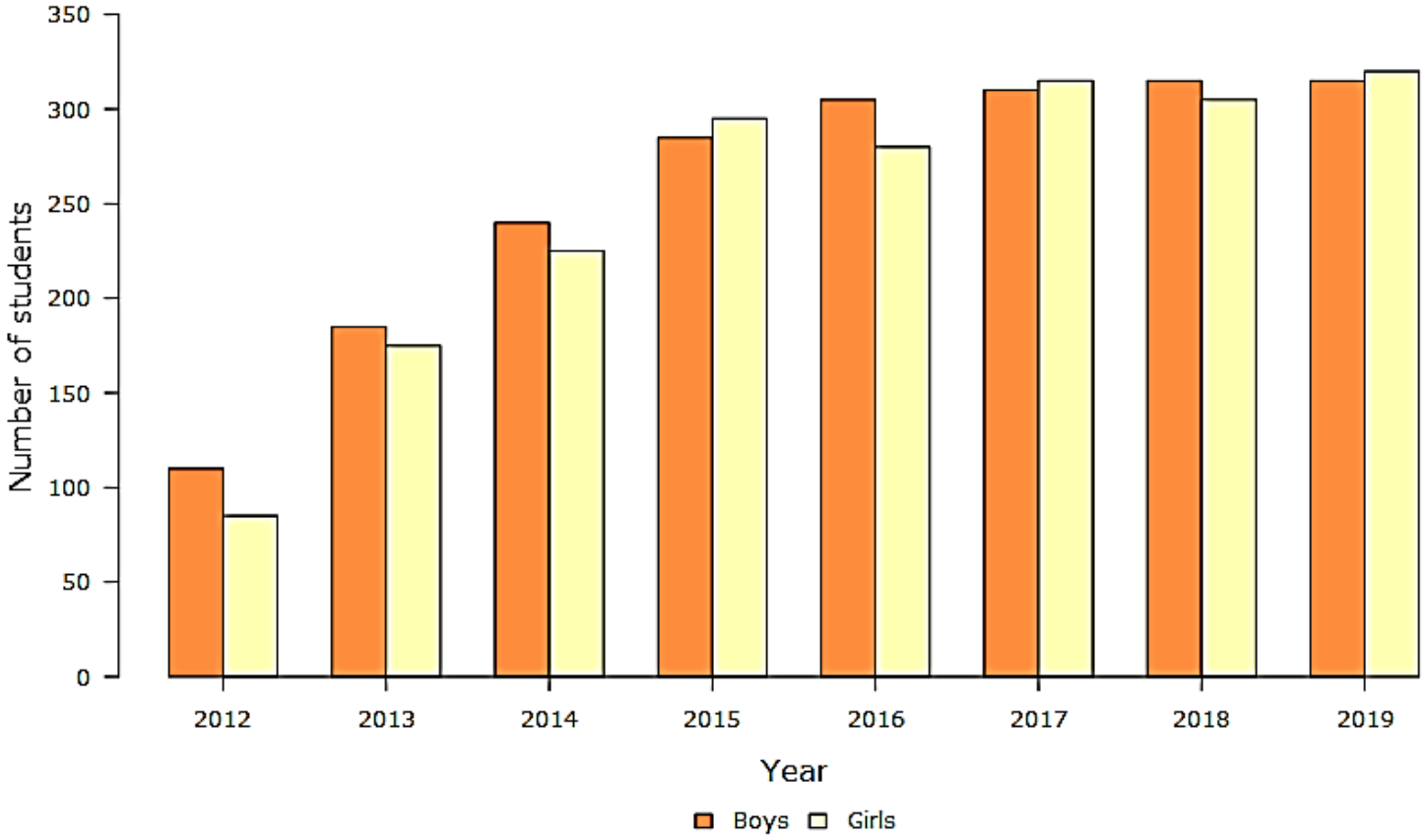
→ Bar Graph

→ Pie chart / Circle Graph

→ Histogram

→ Frequency Polygon

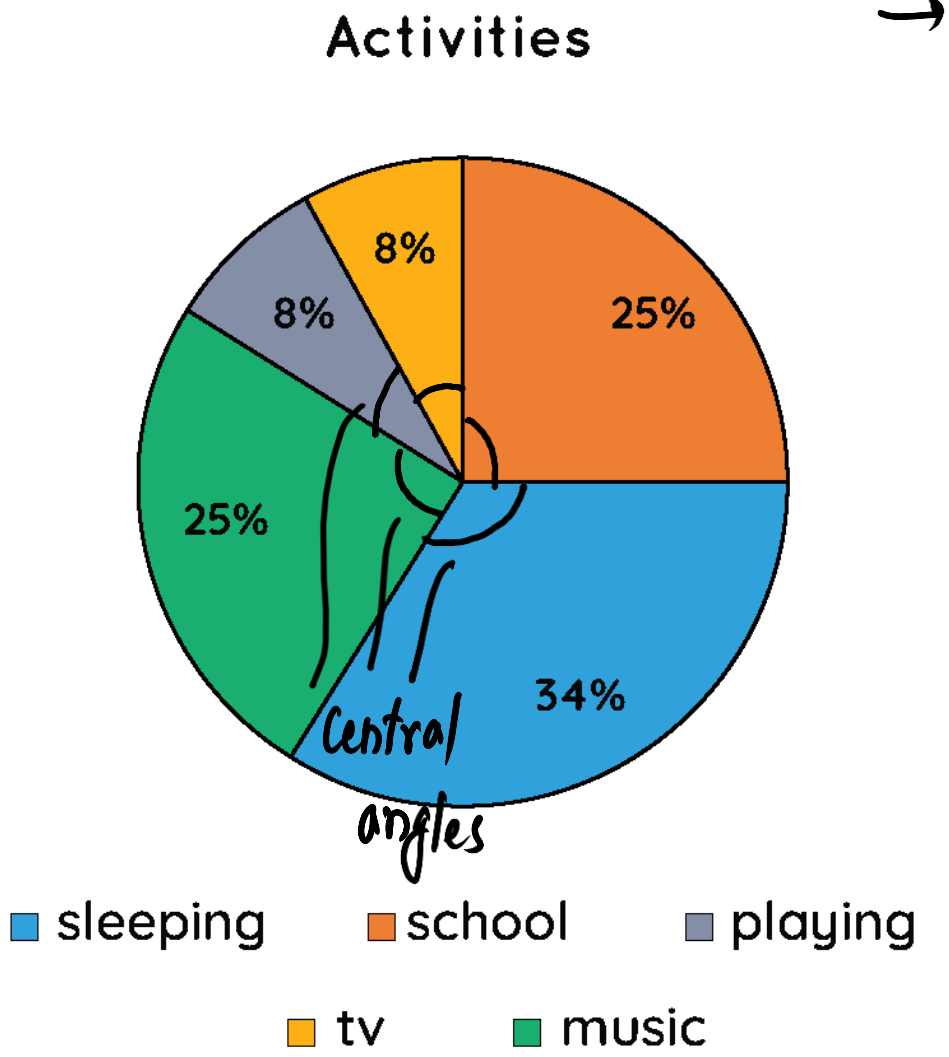
BAR GRAPH



→ Height of rectange is related with frequency.

→ Its best for comparison.

PIE CHART

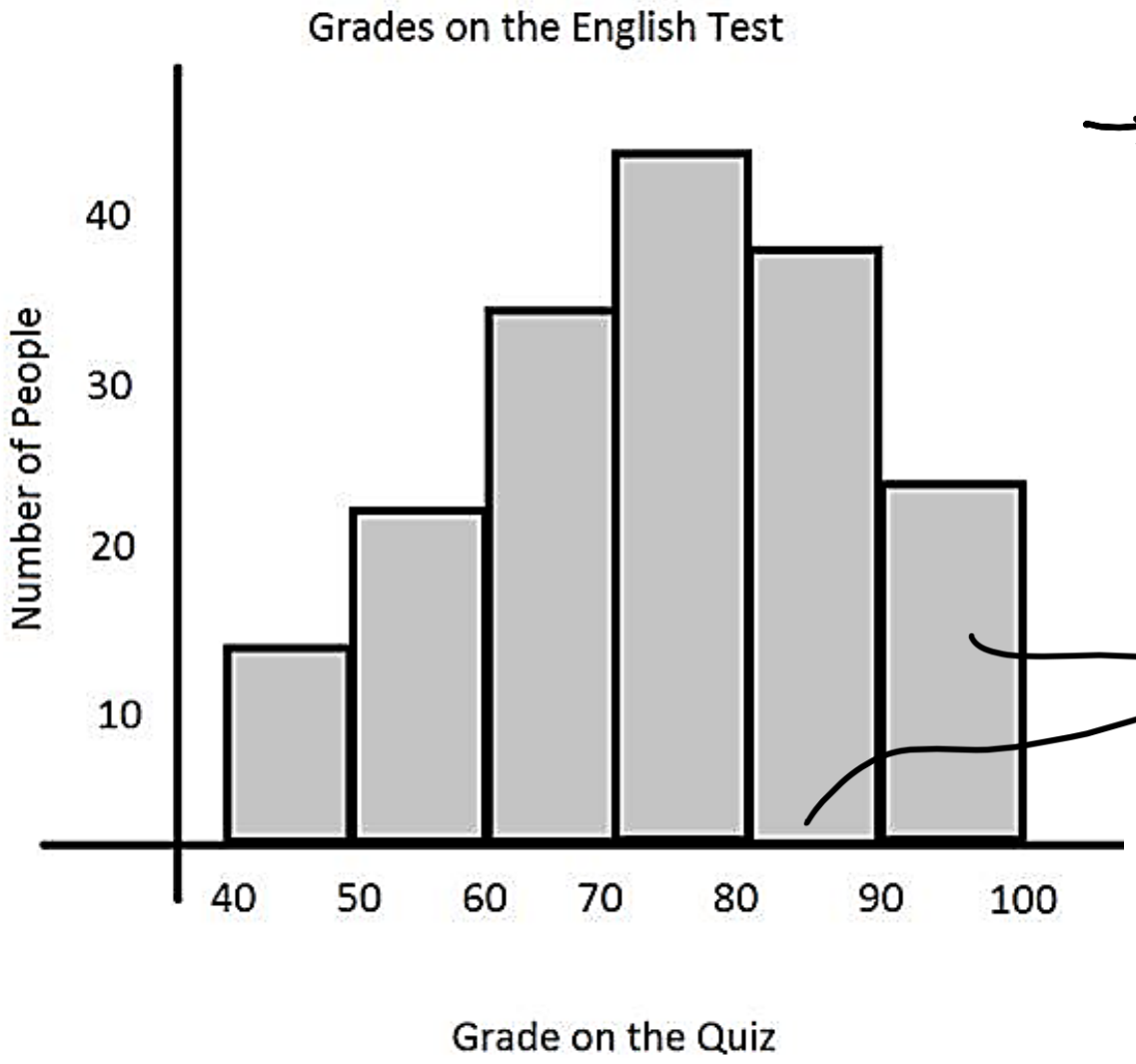


→ Used to know how much a part is contributing to total.

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

(0)

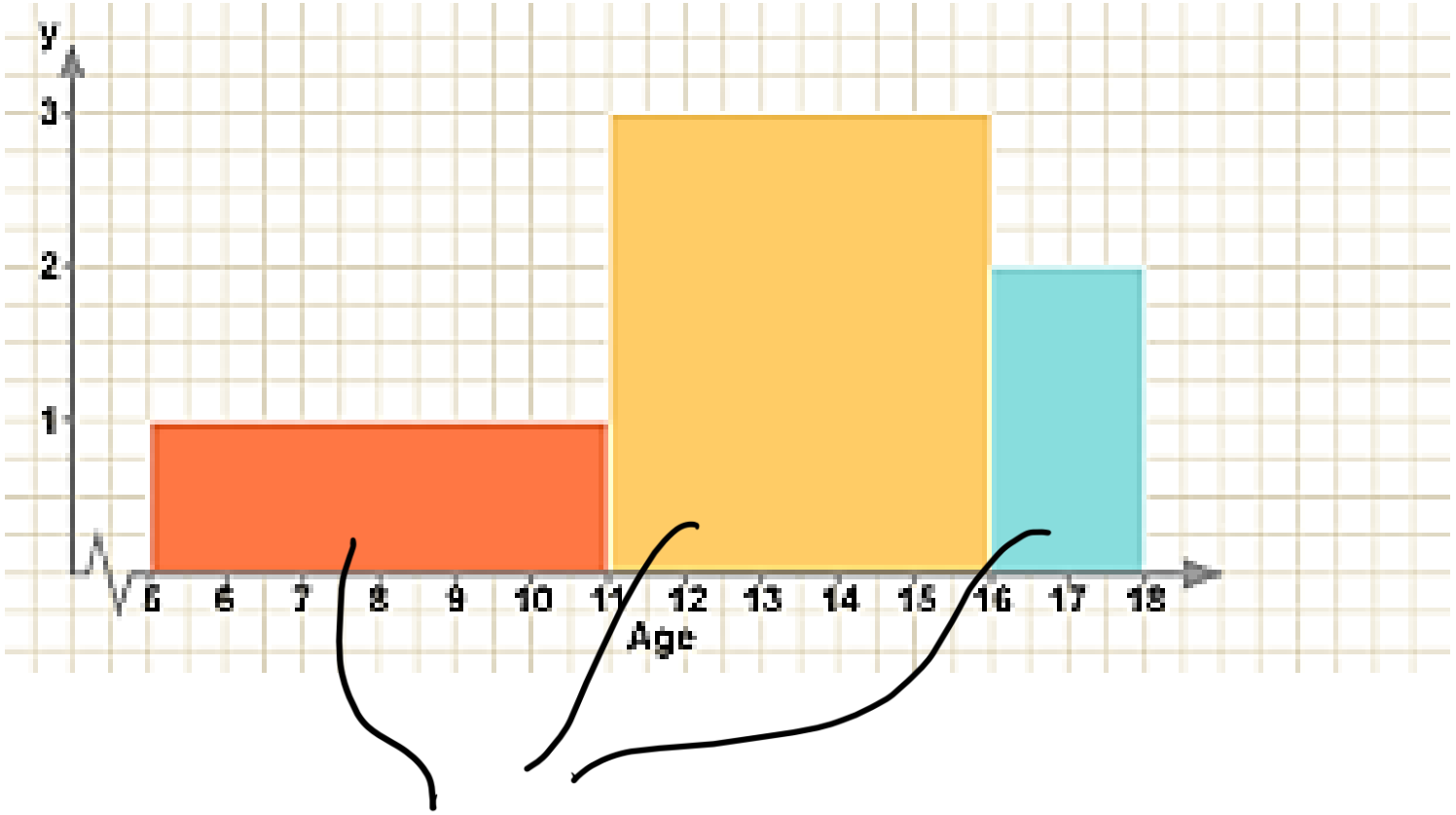
HISTOGRAM



→ Represents class intervals.

equal class widths = 10,

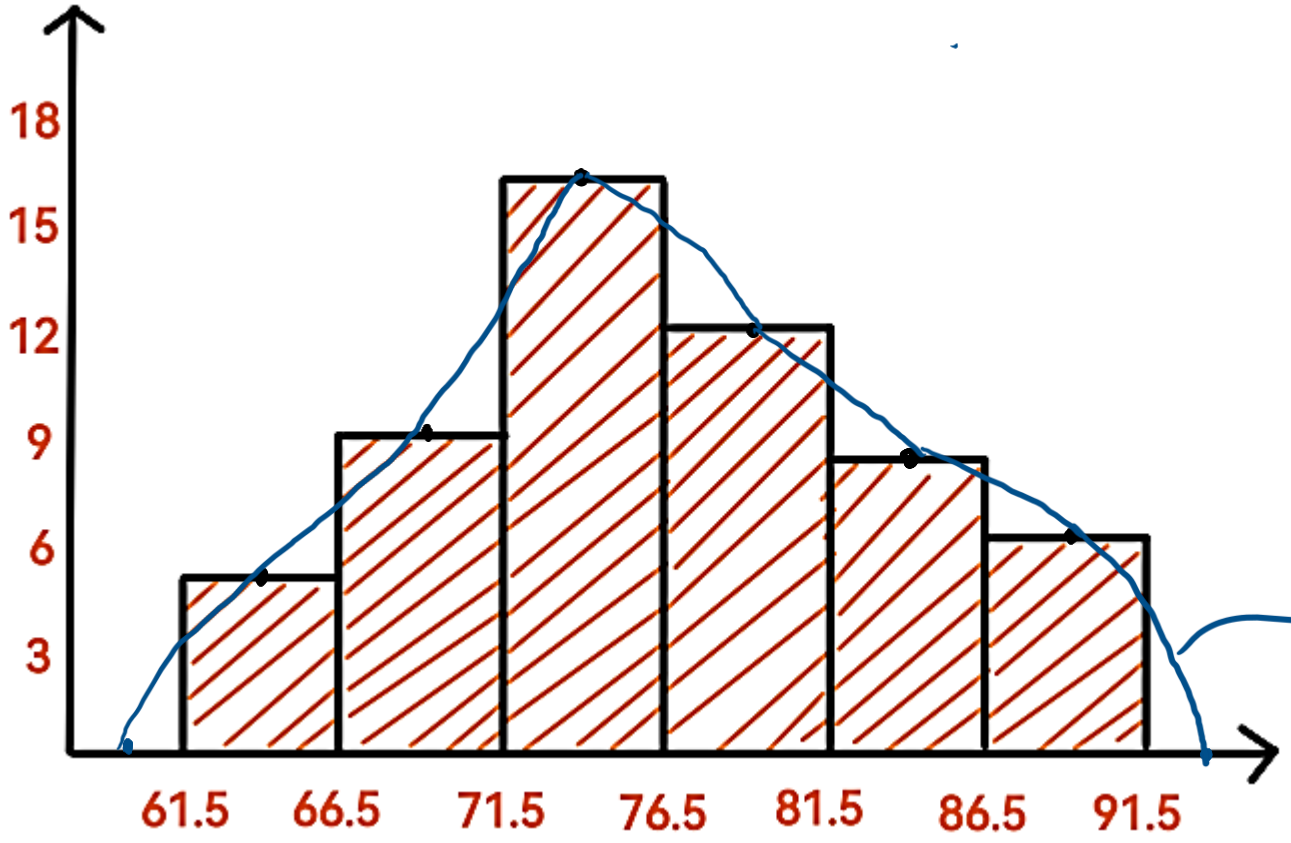
HISTOGRAM



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

* 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
⋮	⋮
x_n	f_n

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

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

Mean for continous data (class intervals)

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

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

works also for unequal class widths.

assumed mean

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

SSBCrack EXAMS

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

x_i (class marks): 5, 15, 25, 35, 45

$\sum f_i$

$22 + 38 + 46 + 35 + 20$

$= 161$

x_i	f_i	$x_i - A$	$u_i = (x_i - A)/h$	$u_i f_i$
5	22	−20	−2	$-2 \times 22 = -44$
15	38	−10	−1	$-1 \times 38 = -38$
A → 25	46	0	0	$0 \times 46 = 0$
35	35	10	1	$1 \times 35 = 35$
45	20	20	2	$2 \times 20 = 40$

(HCF of $x_i - A$ values) $(h = 10)$

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

$= (-7)$

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

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

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

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

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 occuring maximum no. of times,

→ Ungrouped data —

→ Discrete — observation highing 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

f_0 = 28, f_1 = 32, f_2 = 24

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

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

or n = even

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

MEDIAN

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

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

l – lower limit of median class

cf – just above of median class cf,

f – frequency of median class

h – class width

→ $\Sigma f = n$

→ $\frac{n}{2}$. check which cf is just bigger than $\frac{n}{2}$.

corresponding to this cf, is median class,

SSBCrack EXAMS

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

cf (cumulative frequency)

22

22 + 38 = 60

60 + 46 = 106

106 + 35 = 141

141 + 20 = 161

$\Sigma f = 161 = n$

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

$h = 10$

20 – 30 (median class)

l

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

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

$= 20 + \left(\frac{20.5}{46}\right) \times 10$

$= 24.46$

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

Less than

More than

Class intervals	frequencies
0 – 10	6
10 – 20	5
20 – 30	7
30 – 40	10
40 – 50	11

Less than (x_i)	frequency (f_i)
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

Class intervals	frequencies
0 – 10	6
10 – 20	5
20 – 30	7
30 – 40	10
40 – 50	11

More than lower class limit of each interval,

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

OGIVE — curves of cumulative frequency distribution

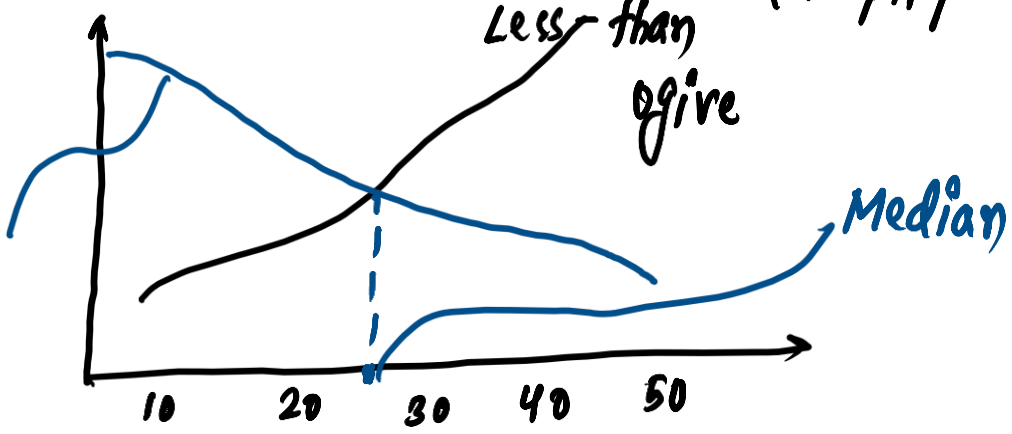
Less than (x_i)	frequency (f_i)
less than 10	6
Less than 20	6 + 5 = 11
Less than 30	11 + 7 = 18
Less than 40	28
Less than 50	39

(x_i, f_i)

(10, 6), (20, 11), (30, 18), (40, 28), (50, 39)

More than (x_i)	frequency
More than 0	39
More than 10	33
" " 20	28
" " 30	21
" " 40	11

(0, 39)
(10, 33)
(20, 28)
(30, 21)
(40, 11)



(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

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

where σ is standard deviation.

STANDARD DEVIATION

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

$N = \Sigma f_i$

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

$\Sigma f_i = 20$

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

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

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

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

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