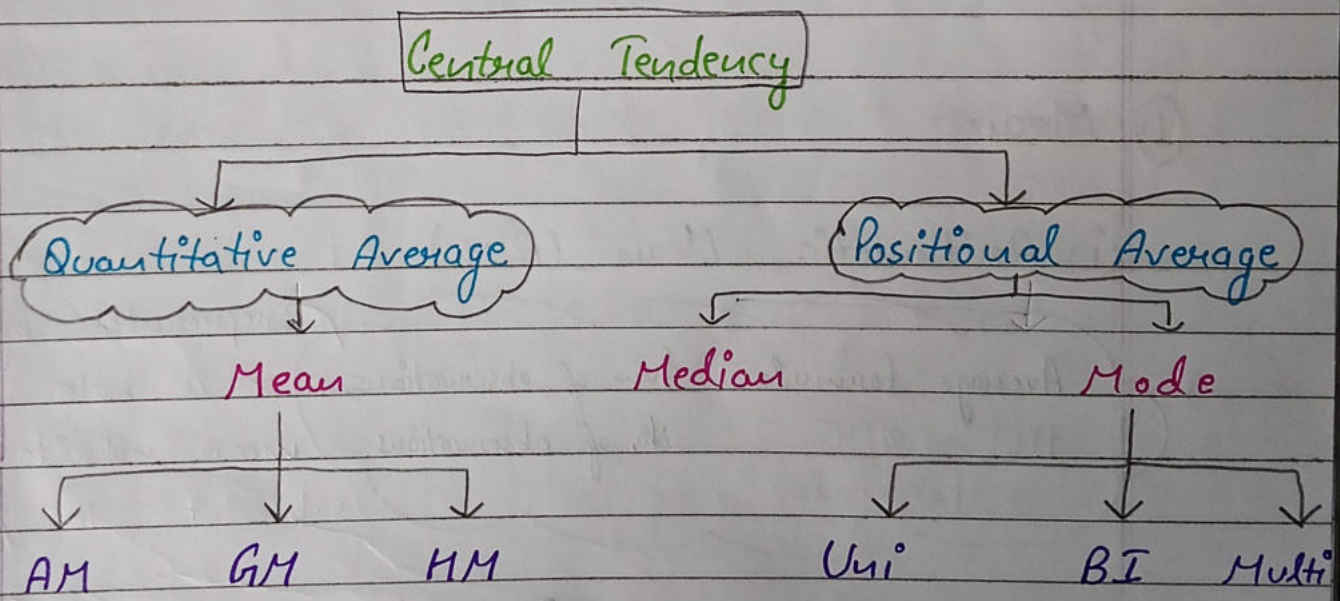
CH-14
Measures of Central Tendency and Dispersion

Basics

This chapter demonstrates that the frequency of variable is highest in the centre.
It is the tendency of the variable to lie in the centre, hence the name of the chapter is called central tendency.

Chapter Overview



Mean → Statistics
Average → Mathematics

✓ **Quantitative average:** Numbers / Quantities / Numerical Values

Mean

H	R	J	S
2	4	6	8

$\text{Average} = \frac{2+4+6+8}{4} = 5$

It makes use of values of observation to calculate average.

✓ **Positional average:** Based on Position

Median
Mode

It makes use of central position of the organisation to calculate the average.
For eg. finding the centre point of a building

① Mean

(i) Arithmetic Mean (A.M.)

Average formula = $\frac{\text{Sum of observations}}{\text{No. of observations}}$

Formula

→ represented by x_c, or vo hota hai jiska mean nikalta ho, baki sab f ho jata hai.

A.M. (represented by $\bar{x}$)

Individual	Discrete	Continuous
$\bar{x} = \frac{\Sigma x}{n}$	$\bar{x} = \frac{\Sigma fx}{\Sigma f}$	$\bar{x} = \frac{\Sigma fm}{\Sigma f}$
		$m = \frac{HV + LV}{2}$

✓ Why do we have 3 different series?

Particular	Marks (x)	Students (f)	e.g.
Individual	—	Very less	x: 2, 4, 6, 8
Discrete	Very Less	High	x: 2, 4, 6, 8 F: 1, 5, 9, 7
Continuous	High	High	x: 0-10, 10-20, 20-30 F: 5, 10, 11

Eg. 1 Calculate Mean

x: 10, 9, 8, 17, 16, 4, 8

$$\bar{x} = \frac{\Sigma x}{n} = \frac{10 + 9 + 8 + 17 + 16 + 4 + 8}{7}$$

$$\boxed{\bar{x} = 10.28 \quad \text{Ans}}$$

Eg.2 Calculate mean marks of the class.

Cal. –

D.O.C.	→ Students (f)	fx	Marks (x)
10 × 1 M+	10	10	1
20 × 2 M+	20	40	2
35 × 3 M+	35	105	3
40 × 4 M+	40	160	4
10 × 5 M+	10	50	5
MRC	115	365 → Σfx	
÷ 115			
= 3.17			

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{365}{115} = 3.17$$

Eg.3 Calculate mean from the following data:

x	$m = \frac{HV + LV}{2}$	f	fm
0 – 10	5	10	50
10 – 20	15	20	300
20 – 30	25	25	625
30 – 40	35	10	350
40 – 50	45	05	225
		70	1550

$$\bar{x} = \frac{\Sigma fm}{\Sigma f} = \frac{1550}{70} = 22.14$$

Series

- Ungrouped
  - Individual
  - Discrete
- Grouped
  - Inclusive
  - Exclusive

x
2
4
6
8

x	f
2	10
4	15
6	8

x	f
0-9	10
10-19	15
20-29	8

Inc.

Class Limits

x	f
0-10	10
10-20	15
20-30	8

Inc.

Class Boundaries

Important Note : All the formulas of statistics are made for continuous series therefore we will have to convert discontinuous series to continuous series

Q. How to convert inclusive type series to exclusive type series?

Lower class Boundary = Lower class Limit $-\frac{1}{2}$ diff.

Upper class Boundary = Upper class Limit $+\frac{1}{2}$ diff.

$x \longrightarrow x$	
0 - 8	1-9
10 -18	9-19
20 -28	19-29

$x \longrightarrow x$	
0-9	0.5-9.5
10-19	9.5-19.5
20-29	19.5-29.5

$x \longrightarrow x$	
3-10	1.5-11.5
13-20	11.5-21.5
23-30	21.5-31.5

Properties of A.M.

(i) A.M. is the most popular measure of central tendency.
Because it is easy to use. (Reels 😂)

(ii) Sum of deviations from A.M. is always 0

Deviation = Actual value − Expected value

$$\Sigma (x - \bar{x}) = 0 = (\bar{x} - x)\Sigma$$

x	$x - \bar{x}$
2	-3
4	-1
6	+1
8	+3
	0

$\bar{x} = 5$ → Expected Value

x	$x - \bar{x}$
1	-4.5
5	-0.5
7	+1.5
9	+3.5
	0

$\bar{x} = 5.5$ → Expected Value

(iii) Assumed mean $= \bar{x} = A + \frac{\Sigma d}{n}$

Eg.

x	$d = x - A$
2	-2
4	0
6	+2
8	+4
	4

Σd = Sum of deviations from Assumed mean

A = Assumed Mean

A = 4

$\bar{x} = A + \frac{\Sigma d}{n}$

$\bar{x} = 4 + \frac{4}{4} = 4 + 1 = 5$

Eg.

x	$d = x - A$
10	-25
20	-15
30	-5
40	5
	-40

A = 35

$\bar{x} = A + \frac{\Sigma d}{n}$

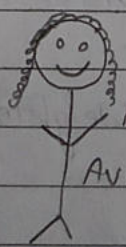
$\bar{x} = 35 + \left(\frac{-40}{4}\right)$

$\bar{x} = 25$

(iv) A.M. has **desirable** mathematical properties.

Combined A.M. can be calculated. (2 groups ko combine kia ja skta hai)

Salman Bhai
No. of Movies = 200
Average Collection = 100 Cr.



Vivek Oberoi
No. of Movies = 50
Average Collection = 25 Cr.

$\frac{\Sigma x}{n} = \bar{x} \Rightarrow \bar{x} \times n = \Sigma x$

No. × mean = Sum

$\bar{x}_{12} = \frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2}$

$= \frac{250 \text{ movies ka total}}{250} = \bar{x}_{12}$

$= \frac{200 \times 100 + 50 \times 25}{200 + 50} = \frac{20000 + 1250}{250}$

$= \frac{21250}{250} = 85$ Cr.

Eg. Calculate combined A.M. from the following data.

	CAF	CSEET
Students = n	1000	700
avg. marks = x	70	50

$$\bar{x}_{12} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

$$\bar{x}_{12} = \frac{1000 \times 70 + 700 \times 50}{1000 + 700}$$

$$\bar{x}_{12} = 61.76$$

D.O.C.
1000×70 M_1
700×50 M_2
MRC $\div$ 1700 = 61.76

Note : Pure C.T. me kahi par bhi weighted average nikalne ke liye hamesa Discrete series ka formula istemal karenge. $F = W$

(V) Formula of weighted A.M. :—> is same as discrete series

Discrete Series : x f $\frac{\Sigma fx}{\Sigma f} = \bar{x}$

Weighted A.M. : x W $\frac{\Sigma Wx}{\Sigma W} = \bar{x}$

★ AM of First n Natural No. = $\frac{\text{Sum of first } n \text{ Natural No.}}{n}$

$$= \frac{\frac{n(n+1)}{2}}{n}$$

(vi) Sum of squares of deviation from mean is minimum. $\Sigma(x-\bar{x})^2$

x	$x-\bar{x}$	$(x-\bar{x})^2$
2	-3	9
4	-1	1
6	+1	1
8	+3	9
		20

$\bar{x} = 5$ → minimum

x	$x-7$	$(x-7)^2$
2	-5	25
4	-3	9
6	-1	1
8	+1	1
		36

x	$x-4$	$(x-4)^2$
2	-2	4
4	0	0
6	+2	4
8	+4	16
		24

$x_1 + x_2 + x_3 \ldots + x_{10}$

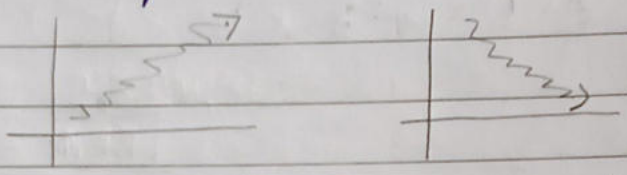
$$\sum_{n=1}^{6} x_n = x_1 + x_2 + x_3 + x_4 + x_5 + x_6$$

$$\sum_{n=3}^{5} x_n = x_3 + x_4 + x_5$$

(ii) Geometric Mean (G.M.)

Why do we need G.M. & its usage?

- It incorporates trends unlike A.M.



- Best measure of Central Tendency for Rates & Ratios & Percentage → always & always use G.M. (पुछ के ही)

G.M.

Individual	Discrete	Continuous
$GM = (x_1 \times x_2 \times \dots x_n)^{1/n}$	$GM = (x_1^{f_1} \times x_2^{f_2} \times \dots x_n^{f_n})^{1/\Sigma f}$	$GM = (m_1^{f_1} \times m_2^{f_2} \times \dots m_n^{f_n})^{1/\Sigma f}$

e.g. x_i: 2, 4, 6, 8
Calculate G.M.

$G.M. = (x_1 \times x_2 \times \dots x_n)^{1/n}$
$G.M. = (2 \times 4 \times 6 \times 8)^{1/4}$
$G.M. = (384)^{1/4}$
$G.M. = 4.426$

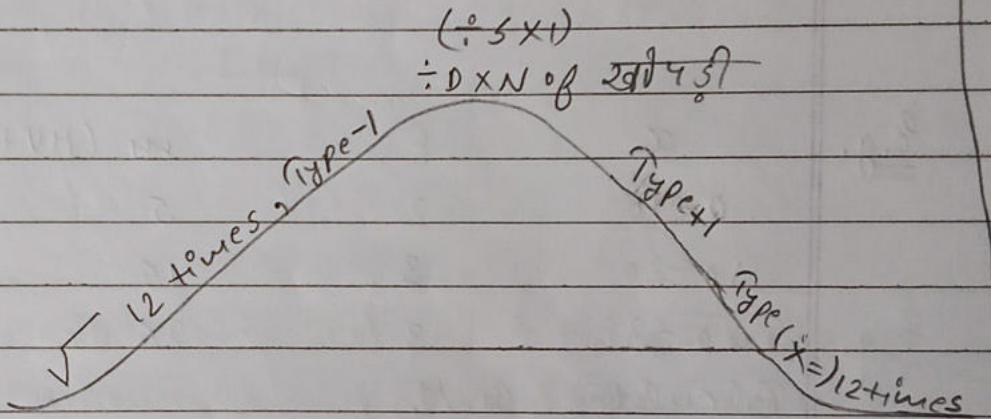
D.O.C. - 4384 ✓✓

e.g. $x: 2, 4, 6, 8, 10$
Calculate G.M.

$$G.M. = (x_1 \times x_2 \times \dots \times x_n)^{1/n}$$
$$G.M. = (2 \times 4 \times 6 \times 8 \times 10)^{1/5}$$
$$G.M. = (3840)^{1/5}$$
$$\boxed{G.M. = 5.2172}$$

D.O.C. → 4

Type no. 3840



e.g. $x: 2, 4, 6$
Calculate G.M.

$$G.M. = (x_1 \times x_2 \times x_3)^{1/n}$$
$$G.M. = (2 \times 4 \times 6)^{1/3}$$
$$G.M. = (48)^{1/3}$$
$$\boxed{G.M. = 3.6357}$$

Combined GM $= (x_1^{n_1} \times x_2^{n_2})^{\frac{1}{n_1+n_2}}$

e.g.

x	2	4	6	8
f	1	2	3	4

Calculate G.M.

$$G.M. = (x_1^{f_1} \times x_2^{f_2} \times \dots x_n^{f_n})^{1/\Sigma f}$$

$$G.M. = (2^1 \times 4^2 \times 6^3 \times 8^4)^{1/10}$$

$$G.M. = 2,83,11,552$$

$$\boxed{G.M. = 5.57}$$

e.g.

x	f	m (HV + LV / 2)
0–10	2	5
10–20	3	15
20–30	3	25

Calculate G.M.

$$G.M. = (m_1^{f_1} \times m_2^{f_2} \times m_3^{f_3})^{1/\Sigma f}$$

$$G.M. = (5^2 \times 15^3 \times 25^3)^{1/8}$$

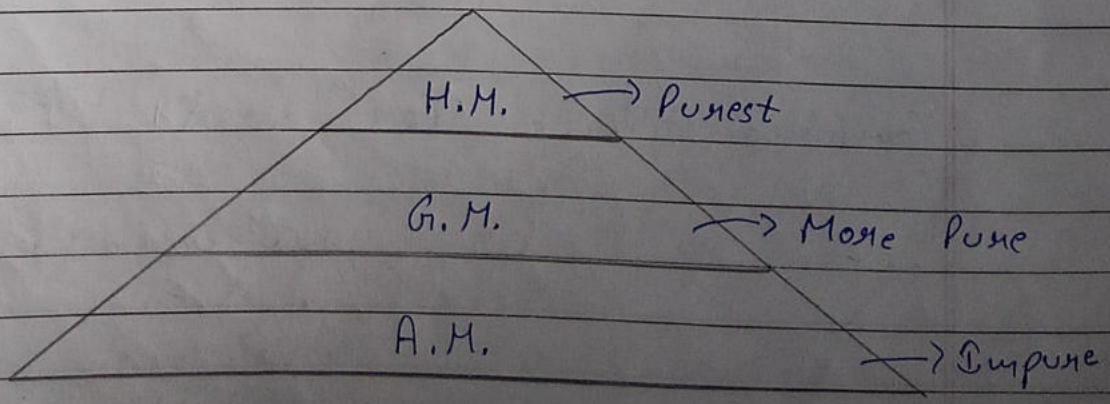
$$G.M. = (1,31,83,59,375)^{1/8}$$

$$\boxed{G.M. = 13.80}$$

$2^3 = 8$ $\quad 27 = 3^3$

$2 = 8^{1/3}$ $\quad (27)^{1/3} = 3$

✓ G.M. is the purest measure of Central Tendency after H.M.



Q. Weighted Mean

(11) The average salary of a group of unskilled workers is 10,000 and that of a group of skilled workers is ₹ 15,000. If the combined salary is ₹12,000, then what is the % of skilled workers?

(a) 40% n_2 (b) 50% n_2 (c) 60% n_2 (d) none of these
60% n_1 50% n_1 40% n_1

Method-1 Traditional

$$\bar{x}_{12} = \frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2}$$

$$12,000 = \frac{60 \times 10,000 + 40 \times 15,000}{60 + 40}$$

$$12,000 = 12,000$$

M.P.

; $\bar{x}_1 = 10,000$
$\bar{x}_2 = 15,000$
$\bar{x}_{12} = 12,000$
$n_2 = ?$

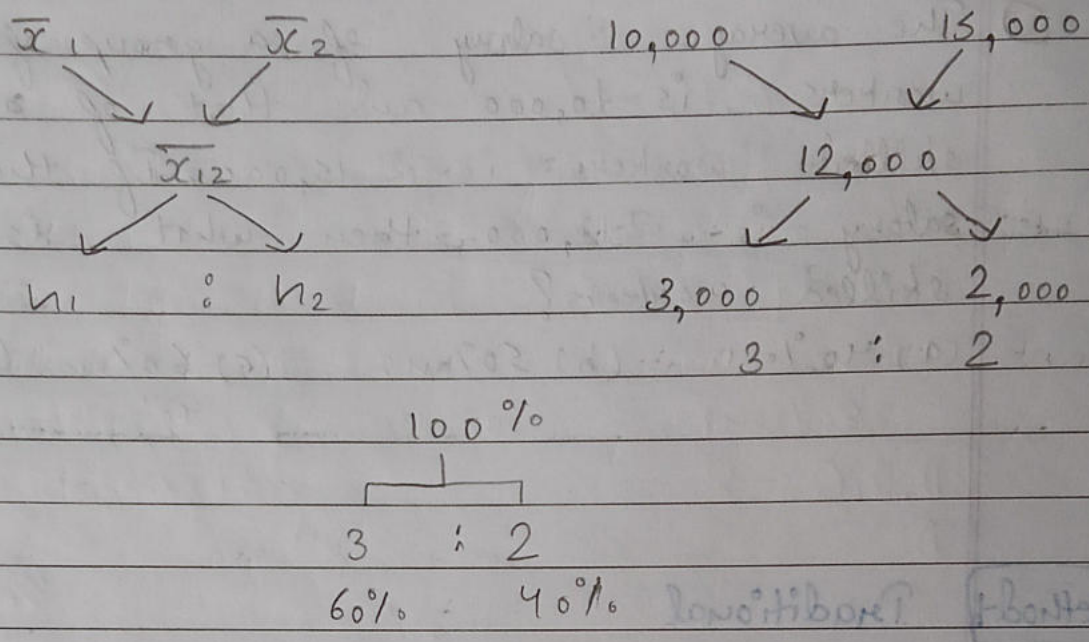
Method-2 निचर वजन उचर भजन

Eg.1 No. of Boys = 100
Avg. Marks = 50
No. of girls = 300
Avg. Marks = 90
$\bar{x}_{12}$ = 80 marks

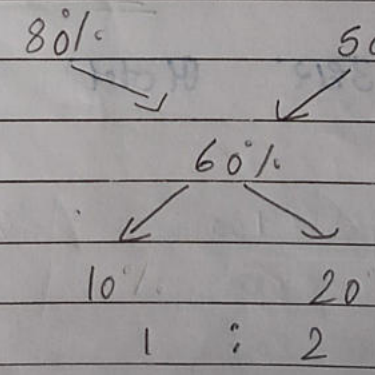
Eg.2 No. of Boys = 300
Avg. Marks = 50
No. of Girls = 100
Avg. Marks = 90
$\bar{x}_{12}$ = 60 marks

In above ques :- C. avg. is closed to 10,000 so, % of n_1 is more than of n_2

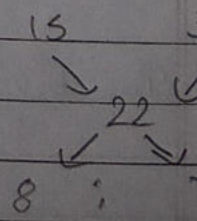
Method-3 चौकड़ी → Caution: use only when either n_1/n_2 or both are missing



e.g. In Solution 1, % of water is 80%
In Solution 2, % of water is 50%
In what ratio, these two solutions should be mixed to have water of 60%



e.g. Invt. 1 15% → 53,333
Invt. 2 30% → 46,667
Combined return = 22%
Total Invest. = 1,00,000



Q. Mean of 'n' terms is $\bar{x}$. If first no. is inc. by 1, second no. is inc. by 2 and third number is inc. by 3 and so on then, the new average is

(A) $\bar{x} + n = 5 + 4 = 9$ ✗

(B) $\bar{x} + n + 1 = 5 + 4 + 1 = 10$ ✗

(C) $\bar{x} + \frac{n+1}{2} = 5 + \frac{4+1}{2} = 7.5$ ✓

(D) $\bar{x} + \frac{n}{2} = 5 + \frac{4}{2} = 7$ ✗

2	3
4	6
6	9
8	12

$\bar{x} = 5$ New avg. = 7.5

Q. If G is GM between a (→1) and b (→4) then $1/(G^2-a^2) + 1/(G^2-b^2)$ is

$G = \sqrt{1 \times 4} = 2$

(A) G^2

(B) $1/G^2$

(C) $1/G$

(D) G

$$\frac{1}{2^2-1^2} + \frac{1}{2^2-4^2}$$

$$\frac{1}{3} - \frac{1}{12} = \frac{1}{4}$$

(iii) Harmonic Mean (H.M.)

Q. Why do we need H.M.?

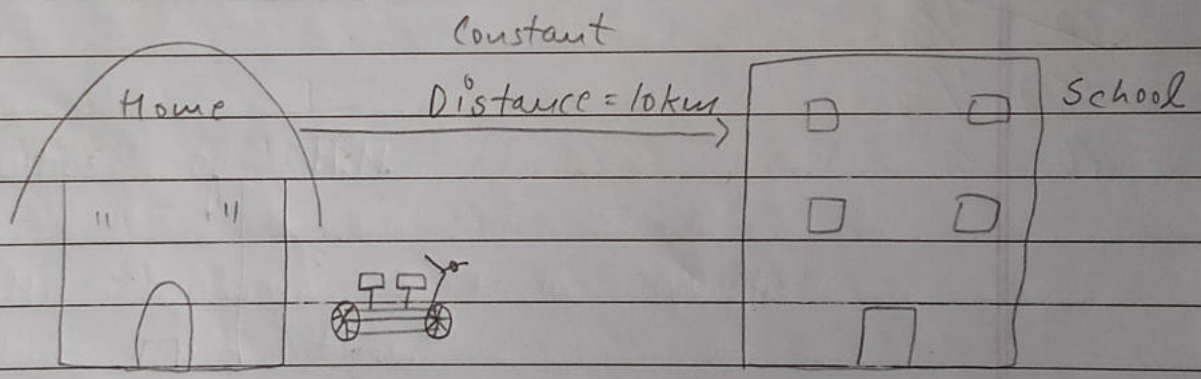
There are two reasons for using HM:

(a) It is used when observations are expressed in different denominations.

(b) When 1 variable is constant & other two variables have a reciprocal relationship.

constant

E.g. Speed, distance & time — Reciprocal Relationships



Rakshabhandan Fun.

Case 1 Aug. Speed = 2km/hrs Time = 5hours

Valentine Fun.

Case 2 Feb. Speed = 20km/hr Time = 0.5 hours

Speed ↑ Time ↓

Speed ↓ Time ↑

H.M.

(weights)

Individual	Discrete	Continuous
$H.M. = \frac{n}{\frac{1}{x_1}+\frac{1}{x_2}+\cdots\frac{1}{x_n}}$	$H.M. = \frac{\Sigma f}{\frac{f_1}{x_1}+\frac{f_2}{x_2}+\cdots\frac{f_n}{x_n}}$	$H.M. = \frac{\Sigma f}{\frac{f_1}{m_1}+\frac{f_2}{m_2}+\cdots\frac{f_n}{m_n}}$

E.g. $x : 2, 4, 6$

Calculate H.M.

$$HM = \frac{n}{\frac{1}{x_1}+\frac{1}{x_2}+\frac{1}{x_3}} = \frac{3}{\frac{1}{2}+\frac{1}{4}+\frac{1}{6}} = 3.27$$

D.O.C. →

$2 \div = M+$

$4 \div = M+$

$6 \div = M+$

$MRC \div = \times 3$

E.g. $x : 2, 4, 6, 8$ Calculate H.M.

$f : 1, 2, 3, 4$

$$HM = \frac{\Sigma f}{\frac{f_1}{x_1}+\frac{f_2}{x_2}\cdots\frac{f_n}{x_n}} = \frac{10}{\frac{1}{2}+\frac{2}{4}+\frac{3}{6}+\frac{4}{8}} = 5$$

Eg.

x	f	m
0 – 10	1	5
10 – 20	2	15
20 – 30	3	25

$$HM = \frac{\Sigma f}{\frac{f_1}{m_1} + \frac{f_2}{m_2} + \frac{f_3}{m_3}} = \frac{6}{\frac{1}{5} + \frac{2}{15} + \frac{3}{25}} = 13.23$$

D.O.C. →

1 ÷ 5 M+

2 ÷ 15 M+

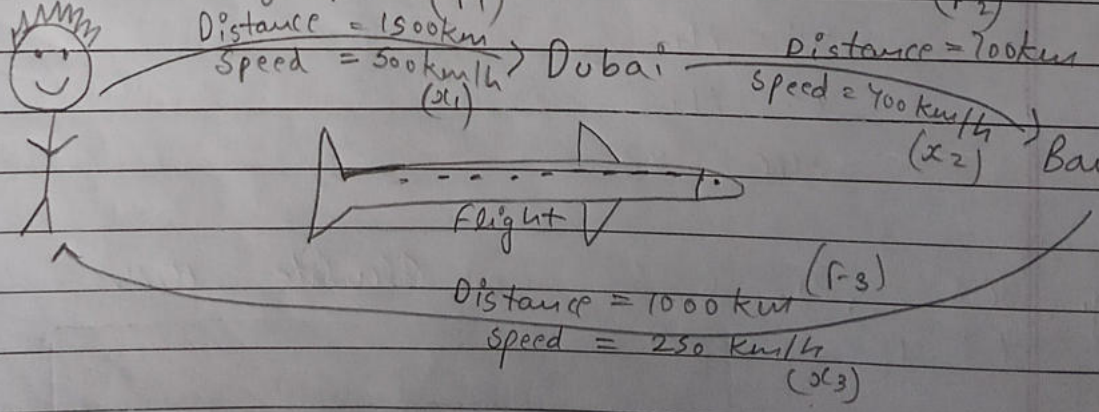
3 ÷ 25 M+

MRC ÷ = × 6

Properties of H.M.

(i) H.M. is always used in questions of speed, distance and time.

Eg. Calculate avg. speed

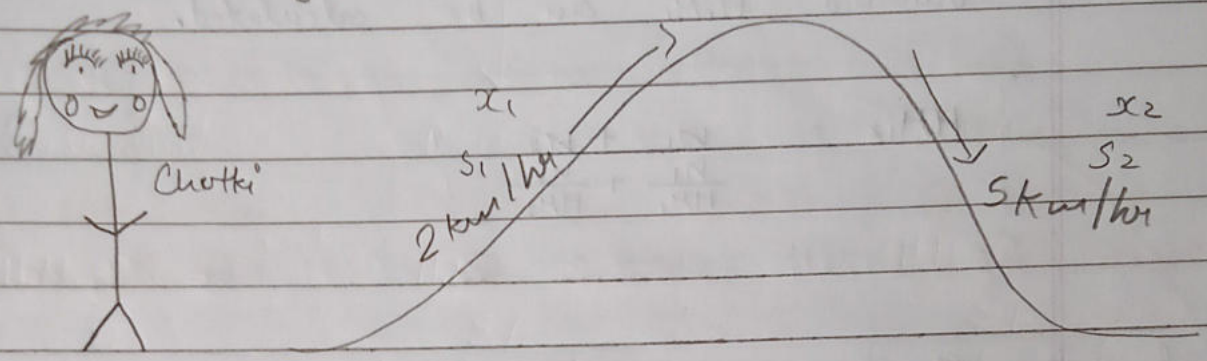


Sol.

$$HM = \frac{\Sigma f}{\frac{f_1}{x_1} + \frac{f_2}{x_2} + \frac{f_3}{x_3}}, \quad HM = \frac{\Sigma \text{ distance}}{\frac{d_1}{s_1} + \frac{d_2}{s_2} + \frac{d_3}{s_3}}$$

$$HM = \frac{3200}{\frac{1500}{500} + \frac{700}{400} + \frac{1000}{250}} = 365.71 \text{ km/h}$$

Eg. Calculate average speed.



$$HM = \frac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \cdots \frac{1}{x_n}}$$

$$HM = \frac{2}{\frac{1}{2} + \frac{1}{5}} = 2.85 \text{ km/hr}$$

(ii) H.M. is the reciprocal of A.M. of reciprocals. (Theoretical)

2 , 4 , 6 , 8

reciprocal

$\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$

A.M.

$$\frac{\frac{1}{2} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8}}{4}$$

Reciprocal

$$\frac{4}{\frac{1}{2} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8}}$$

यह तो H.M. है।

(iii) H.M. has desirable mathematical properties. It means combined H.M. can be calculated.

$$HM_{12} = \frac{n_1 + n_2}{\frac{n_1}{HM_1} + \frac{n_2}{HM_2}}$$

e.g.

Class A	Class B	
10	20	← HM
50	70	← n

Calculate combined H.M.

$$HM_{12} = \frac{n_1 + n_2}{\frac{n_1}{HM_1} + \frac{n_2}{HM_2}} = \frac{50 + 70}{\frac{50}{10} + \frac{70}{20}} = 14.1176$$

D.O.C. →

50 ÷ 10 M+, 70 ÷ 20 M+

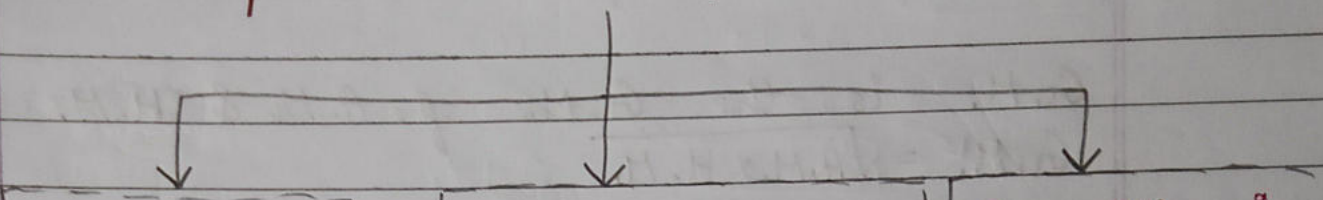
MRR ÷ = × 120

$$HM_{12} = \frac{n_1 + n_2}{\frac{n_1}{H_1} + \frac{n_2}{H_2}}$$

$$HM_{12} = \frac{n_1 + n_2}{\frac{n_1 H_2 + n_2 H_1}{H_1 H_2}}$$

$$\boxed{HM_{12} = \frac{(n_1 + n_2) H_1 H_2}{n_1 H_2 + n_2 H_1}}$$

✓ Relationship between A.M., G.M. & H.M.



$AM > GM > HM$ $\quad$ $AM = GM = HM$

$AM \geq GM \geq HM$

e.g. 2, 4, 6, 8. Demonstrate the relationship. (Distinct)

$$AM = \frac{2+4+6+8}{4} = 5$$

$$GM = (2 \times 4 \times 6 \times 8)^{1/4} = 4.42$$

$$HM = \frac{4}{\frac{1}{2}+\frac{1}{4}+\frac{1}{6}+\frac{1}{8}} = 3.84$$

AM & HM ka

$GM = \sqrt{5 \times 3.84}$

$= 4.42$

e.g. 2, 2, 2, 2. Demonstrate the relationship. (same)

$$AM = \frac{2+2+2+2}{4} = 2$$

$$GM = (2 \times 2 \times 2 \times 2)^{1/4} = 2$$

$$HM = \frac{4}{\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}} = 2$$

✓ Other relationships

G.M. is the G.M. of A.M. & H.M.

$$G.M. = \sqrt{A.M. \times H.M.}$$

e.g. If G.M. is 3.20 & A.M. is 4, calculate H.M.

$$G.M. = \sqrt{A.M. \times H.M.}$$

$$3.20 = \sqrt{4 \times H.M.}$$

$$3.20^2 = 4 \times H.M.$$

$$H.M. = \frac{(3.20)^2}{4}$$

$$H.M. = \frac{10.24}{4}$$

$$\boxed{H.M. = 2.56}$$

e.g. If HM of A,B,C is 3 and HM of D,E is 4. What is the HM of A,B,C,D,E

$A,B,C = n_1 = 3$

$2 = H_1$

$D,E = n_2 = 2$

$4 = H_2$

$$H_{12} = \frac{n_1 + n_2}{\frac{n_1}{H_1} + \frac{n_2}{H_2}} = \frac{3+2}{\frac{3}{2} + \frac{2}{4}}$$

$$HM_{12} = 2.50$$

② Mode

Why do we need mode?

Where frequency is more important than the value, we calculate mode.
For e.g. Deciding the winner in India v/s Pak.

MODE

Individual	~~No.~~ Discrete	Continuous
Most repeated no. is called mode	No. with highest frequency is called mode	Step 01 → Find out modal class. {Class with highest frequency}
x: 2, 4, 6, 10, 8, 4, 2, 9, 7, 2, 8, 10	x f 2 10 ④ ← 15 6 12 8 8	Step 02 → $m = l_1 + \left\{\frac{F_1 - F_0}{2f_1 - f_0 - f_2}\right\} \times h$ l_1 → lowest frequency of f_1
Mode = 2		

For eg.

x	f
0 - 10	10
10 - 20	20 → f_0
20 - 30 ← l_1	(30) f_1
30 - 40	20 - f_2
40 - 50	10

$h = 30 - 20 = 10$

Sol.

$$m_0 = l_1 + \left\{\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right\} \times h$$

$$m_0 = 20 + \left\{\frac{30 - 20}{2 \times 30 - 20 - 20}\right\} \times 10$$

$$m_0 = 20 + \left\{\frac{10}{60 - 40}\right\} \times 10$$

$$m_0 = 20 + \frac{10}{20} \times 10$$

$$m_0 = 25$$

For eg.

x	0-10	(10)-20	20-30	30-4
f	7 (f_0)	8 (f_1)	6 (f_2)	5

(l = 10)

$h = 20 - 10 = 10$

$$m_0 = l_1 + \left\{\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right\} \times h$$

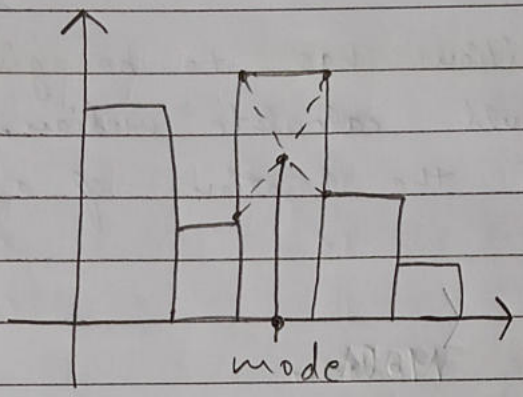
$$m_0 = 10 + \left\{\frac{8 - 7}{2 \times 8 - 7 - 6}\right\} \times 10$$

$$m_0 = 10 + \frac{1}{3} \times 10$$

$$m_0 = 13.33$$

Properties of Mode

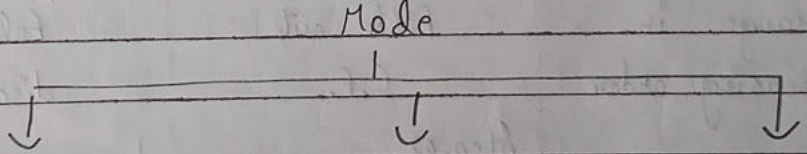
(i) Mode is calculated using Histogram. (theoretical)



Left to Left
Right to Right

fig: Histogram

(ii) Mode is not uniquely defined. (Mean is uniquely defined)



Unimodal
1 mode

Bimodal
2 modes

Multimodal
more than
2 modes

x: 2, 7, 9, 10, 7, 8, 2, 2, 7
mode = 2, 7

(iii) Mode is not based on all the values.

x: 2, 7, 9, 10, 7, 8, 2, 2, 7, 2
mode = 2

x: 2, 17, 19, 0.10, 0.7, 18, 2, 2, 17, 2
mode = 2

③ Median

Position → Importance

Why do we need median?

Many often, position has to be given importance therefore, we should calculate median.
For e.g.; Deciding the location of a bus-stop.

Median

Individual	Discreate	Continuous
Step.01 Arrange in increasing order Step.02 Idhar se kato, Udhar se kato, Beech me jo bach jaaye vo median.	Step.01 Find out C.f. Step.02 Calculate $\frac{N}{2}$ $N = \Sigma f$ N = last C.f. Step.03 Locate $N/2$ in Cf table. Badi Cf ke samne wali khidki me md rehta hai	Step.01 Follow steps of discrete series Step.02 Apply Formula: $md = l_1 + \left\{\frac{\frac{N}{2} - C}{f}\right\} \times h$

Individual

For e.g. 2, 8, 9, 7, 16, 24 Calculate median

Sol. Increasing Order : ~~2, 7~~, 8, 9, ~~16, 24~~

$$\frac{8+9}{2} = 8.50 \text{ Ans}$$

For e.g. 2, 8, 7, 5, 6, 4, 1 Calculate median

Sol. Increasing Order : ~~1, 2, 4~~, 5, ~~6, 7, 8~~

5 Median Ans

Discrete

median

For e.g. x	2	(4)	6	8	
F	10	12	08	06	Calculate median
CF	10	22	30	36 → N	

$$\frac{N}{2} = \frac{36}{2} = 18$$

Locate 18 in CF table

median = 4

Continuous

e.g. Calculate Median

Class x	Frequency f	C.f.
0-10	10	10
10-20	12	22 → C
l₁ → 20-30	18-f	40
30-40	15	55
40-50	10	65
	65	

$\frac{N}{2} = \frac{65}{2} = 32.5$

$l_1 = 20$

$f = 18$

C = md class ke phele wali class ki CF

$C = 22$

$h = 30 - 20 = 10$

$$md = l_1 + \left\{\frac{\frac{N}{2} - C}{f}\right\} \times h$$

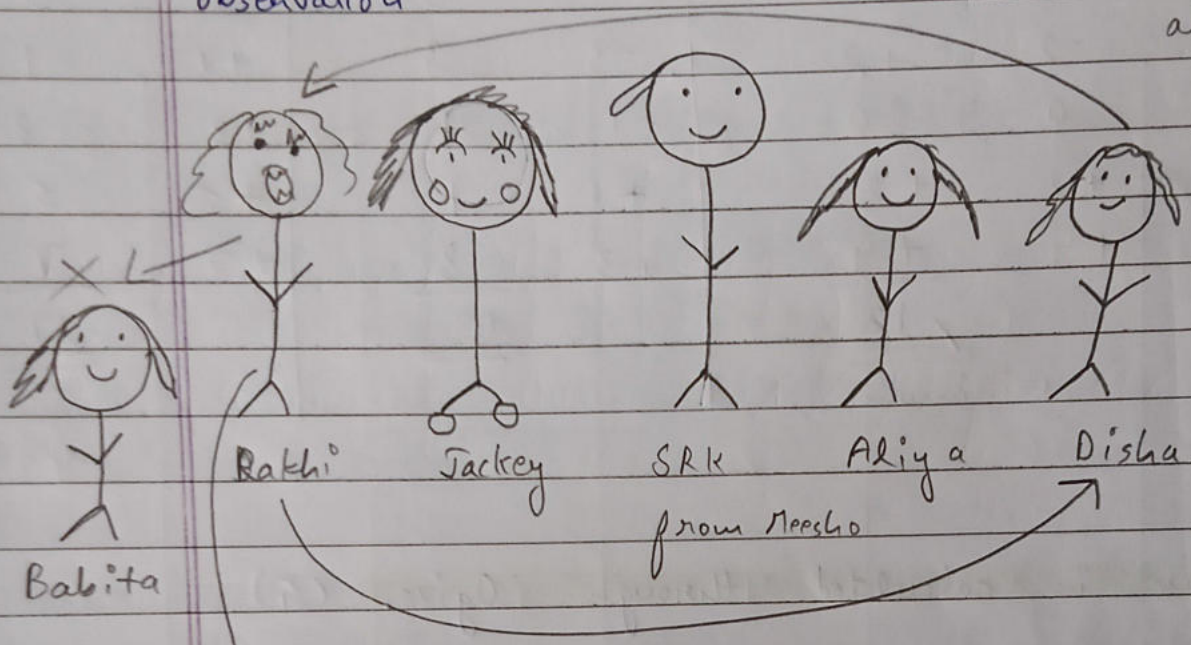
$$md = 20 + \left\{\frac{32.5 - 22}{18}\right\} \times 10$$

$$md = 20 + \frac{10.5}{18} \times 10$$

$$\boxed{md = 25.8333} \quad \text{Ans}$$

Properties of Median:

(i) Median is not affected by the extremities of the observation (not based on all the values)



Batmeezi kar rhi thi toh uski phele jagah badli phir hta dia and me

For e.g. $x = 2, 4, 6, 8, 10$
$md = 6$

For e.g. $x = 0.2, 0.4, 6, 800, 100$
$md = 6$

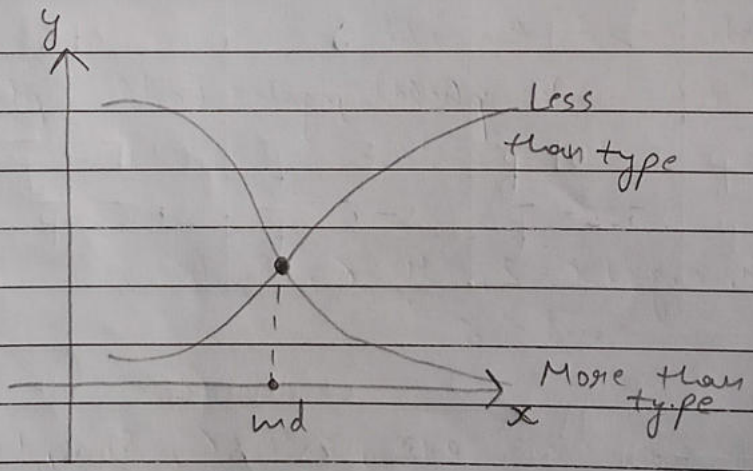
(Theoretical)

(ii) Sum of absolute deviation from median and is min.
↳ mod ke baad → 1 | मीडियन

x	$x-md$	$\lvert x-md\rvert$	$x-7$	$\lvert x-7\rvert$	$x-3$	$\lvert x-3\rvert$
2	−4	+4	−5	5	−1	1
4	−2	+2	−3	3	+1	1
6	0	0	−1	1	+3	3
8	+2	+2	+1	1	+5	5
10	+4	+4	+3	3	+7	7
$md=6$		12		13		17

minimum

(iii) Median is calculated through Ogive. (T)



* Mean can not be represented graphically

Mode → Histogram
Median → Ogive
Mean → N.A.

For Asymmetrical & Skewed Distribution

✓ Relationship b/w mean, mode & median.

$$\text{Mode} = 3 \text{ median} - 2 \text{mean}$$

e.g. Calculate mode if md = 9 & mean = 8

$$\text{mode} = 3\,\text{md} - 2\,\bar{x}$$
$$\text{mode} = 3 \times 9 - 2 \times 8$$
$$\text{mode} = 27 - 16$$
$$\boxed{\text{mode} = 11}$$

e.g. The difference b/w mean & median is 70. What is the difference b/w mode & mean?

$$\boxed{\text{Mode} = 3\,\text{md} - 2\,\bar{x}}$$

-& Subtracting mean from both sides

$$m_o - \bar{x} = 3\,\text{md} - 2\bar{x} - \bar{x}$$
$$m_o - \bar{x} = 3\,\text{md} - 3\,\bar{x}$$
$$\boxed{m_o - \bar{x} = 3\,(\text{md} - \bar{x})}$$ ——— One more way of writing the formula

$$m_o - \bar{x} = 3\,(70)$$
$$m_o - \bar{x} = 210 \quad \underline{\text{Ans}}$$

$$\boxed{\bar{x} - m_o = 3(\bar{x} - \text{md})}$$ ———)

11

✓ लावारिस Property → It is applicable on all the measures of central tendency.

e.g.

	Δ of origin		Δ of scale		Δ of sign
x	$y = x+2$	$y = x-2$	$y = 2x$	$y = \frac{x}{2}$	$y = -x$
2	4	0	4	1	-2
4	6	2	8	2	-4
6	8	4	12	3	-6
8	10	6	16	4	-8
$\bar{x} = 5$	$\bar{y} = 7$ $\bar{y} = \bar{x}+2$	$\bar{y} = 3$ $\bar{y} = \bar{x}-2$	$\bar{y} = 10$ $\bar{y} = 2\bar{x}$	$\bar{y} = 2.5$ $\bar{y} = \bar{x}/2$	$\bar{y} = -5$ $\bar{y} = -\bar{x}$

If all the observations are affected by Δ of origin, Δ of scale & Δ of sign then AM/GM/HM/Mode/Median are similarly affected.

Step 01 :- Jiski value nikalni ho vo ek taraf baki duniya ek taraf.

Step 02 :- Put the given value.

e.g. A.M. of x is 8. What is A.M. of $y = 3x + 2$?

→ $y = 3x + 2$

$\bar{y} = 3\bar{x} + 2$

$\bar{y} = 3 \times 8 + 2$

$\bar{y} = 26$ Ans

e.g. Md of series x is 9. What is the md of $2x + 3y = 10$?

→ $3y = -2x + 10$

$y = \frac{-2x + 10}{3}$

$Md_y = \frac{-2\, Md_x + 10}{3}$

$Md_y = \frac{-2 \times 9 + 10}{3}$

$Md_y = -2.666$ Ans