

CH-14

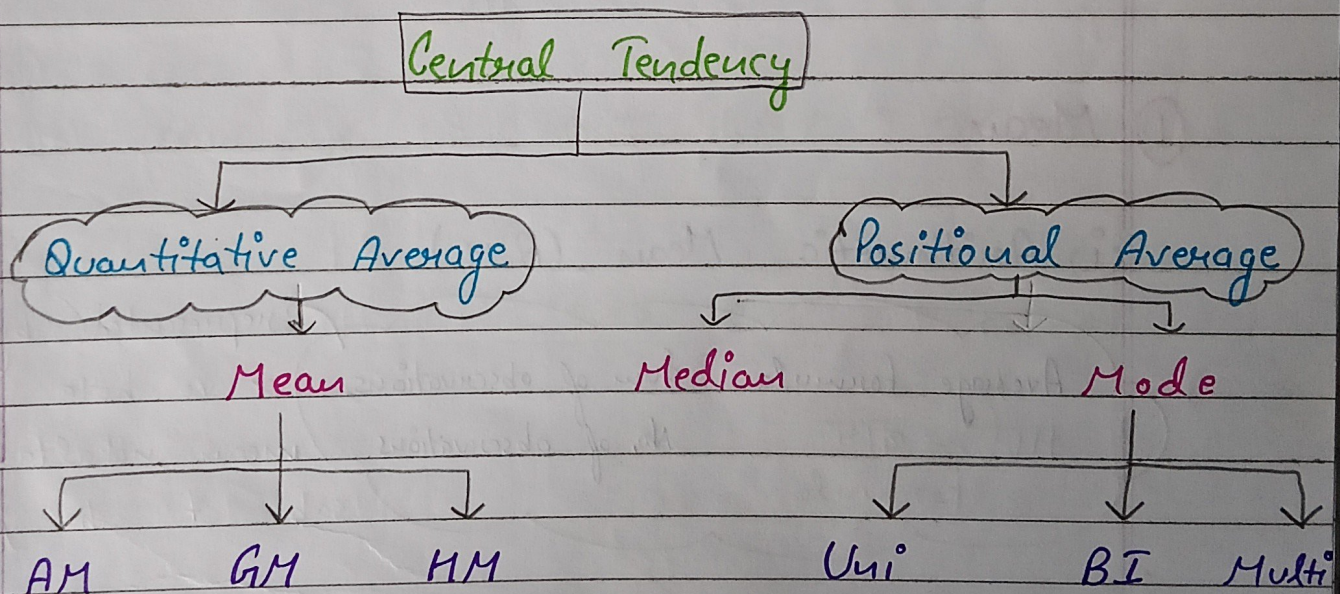
Measures of Central Tendency and Dispersion

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 = $\frac{\text{Sum of observations}}{\text{No. of observations}}$
HIS - 119
Formula

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

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

Individual

Discrete

Continuous

$$\bar{x} = \frac{\sum x}{n}$$

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$$\bar{x} = \frac{\sum fm}{\sum f}$$

$$m = \frac{HV + LV}{2}$$

✓ 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

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

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

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

eg.2 Calculate mean marks of the class.

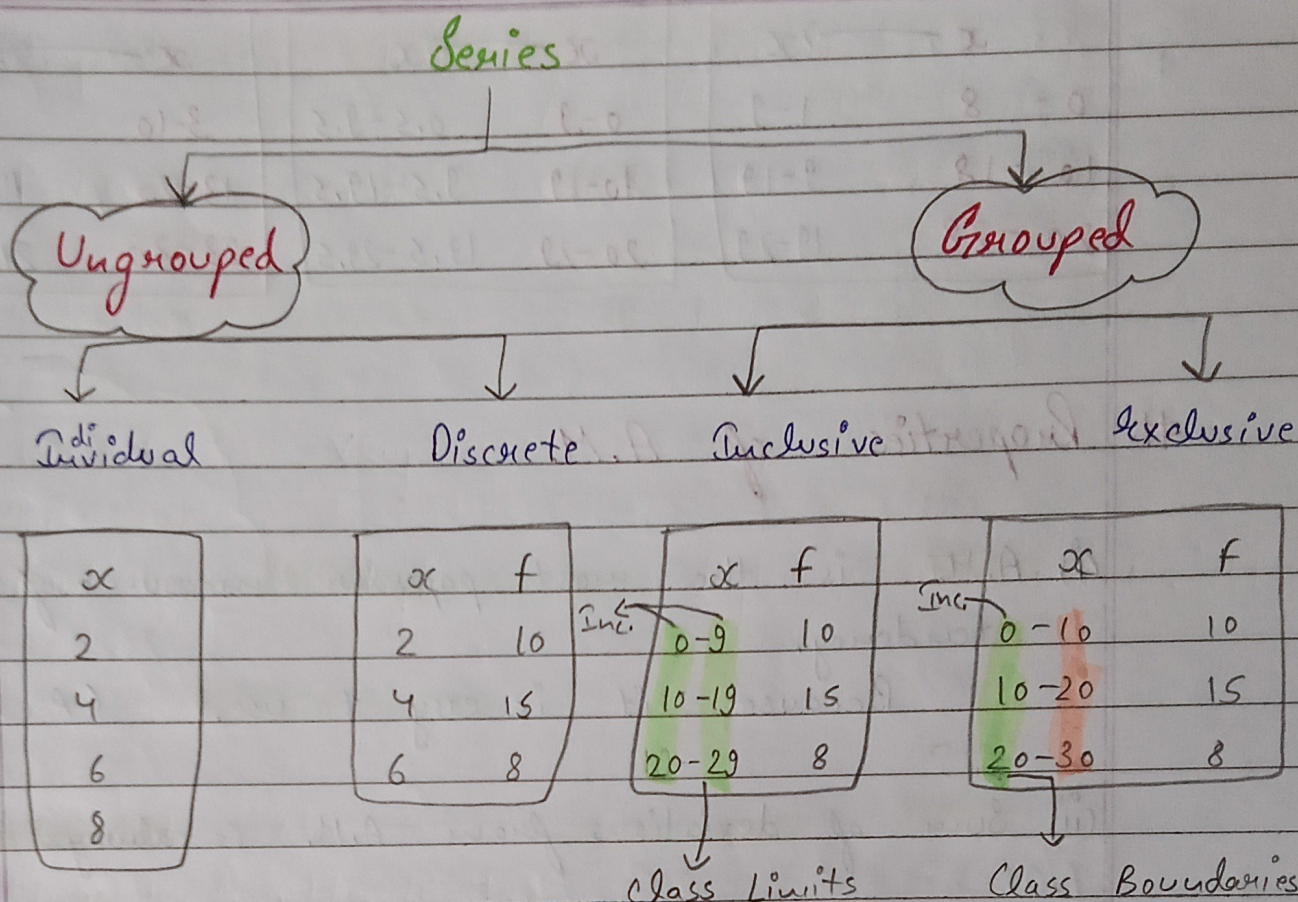
Cal.	D.O.C.	→ Students (f)	Fx	Marks (x)
	10x1 M+	10	10	1
	20x2 M+	20	40	2
	35x3 M+	35	105	3
	40x4 M+	40	160	4
	10x5 M+	10	50	5
	MRC	115	365 → $\sum fx$	
	÷ 115			
	= 3.17			

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

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

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



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

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

x	$\rightarrow x$
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. (Recall 35)

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

Deviation = Actual value - Expected value

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

x	$x - \bar{x}$
2	-3
4	-1
6	+1
8	+3
	<u>0</u>
	<u><u>0</u></u>

$\bar{x} = 5 \rightarrow$ Expected Value

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

$\bar{x} = 5.5 \rightarrow$ Expected Value

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

eg.

x $d = x - A$

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

2 -2

4 0

6 +2

8 +4

4

— $\sum d$ = Sum of deviations

A = Assumed Mean

from Assumed

A = 4

mean

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

eg.

x $d = x - A$

10 -25

20 -15

30 -5

40 5

-40

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

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

$\bar{x} = 25$

A = 35

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

Combined A.M. can be calculated.

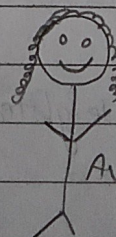
2 groups ko combine kia ja skta hai



Salmon Bhai

No. of Movies = 200

Average Collection = 100 Cr.



Vivek Oberoi

No. of Movies = 50

Average Collection = 25 Cr.

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

No. $\times$ mean = Sum

$\bar{x}_2 \geq n_1 \bar{x}_1 + n_2 \bar{x}_2$
 $n_1 + n_2$



250 movies avg. coll.

250 movies ka total = $\bar{x}_2$

$= 200 \times 100 + 50 \times 25 = 20000 + 1250$

$= 21250 = 85 \text{ Cr.}$

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.

$$1000 \times 70 \quad M_1$$

$$700 \times 50 \quad M_2$$

$$MRC \div 1700 = 61.76$$

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

(v) Formula of weighted A.M. $\rightarrow$ is same as discrete Series

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

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

* AM of first n Natural No. = Sum of first n Natural No.

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

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

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

$$\bar{x} = 5$$

20
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

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

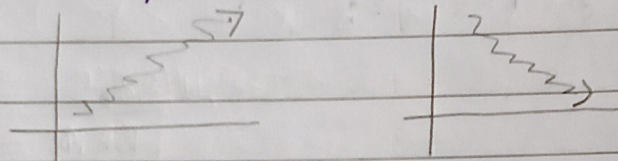
$$\sum_{n=1}^6 x_n = x_1 + x_2 + x_3 + x_4 + x_5 + x_6$$

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

(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. (यदि)

G.M.

Individual

Discrete

Continuous

$$GM = (x_1 \times x_2 \times \dots \times x_n)^{1/n}$$

$$GM = (x_1^{f_1} \times x_2^{f_2} \times \dots \times x_n^{f_n})^{1/\sum f}$$

$$GM = (m_1^{f_1} \times m_2^{f_2} \times \dots \times m_n^{f_n})^{1/\sum f}$$

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

$$G.M. = (x_1 \times x_2 \times \dots \times x_n)^{1/n}$$

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

$$G.M. = (384)^{1/4}$$

$$G.M. = 4.426$$

D.O.C. - 938455

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

$$G.M. = (x_1 \times x_2 \times \dots \times x_n)^{1/n}$$

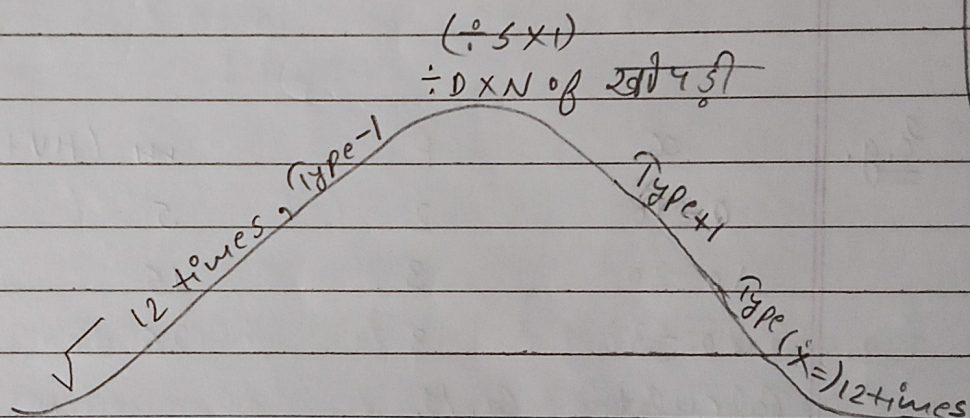
$$G.M. = (2 \times 4 \times 6 \times 8 \times 10)^{1/5}$$

$$G.M. = (3840)^{1/5}$$

$$G.M. = 5.2172$$

D.O.C. - 8

Type no. 3840



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

$$G.M. = (x_1 \times x_2 \times x_3)^{1/n}$$

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

$$G.M. = (48)^{1/3}$$

$$G.M. = 3.6357$$

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

E.g.

x	2	4	6	8
f	1	2	3	4

Calculate G.M.

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

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

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

$$G.M. = 5.57$$

E.g.

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

Calculate G.M.

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

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

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

$$G.M. = 13.80$$

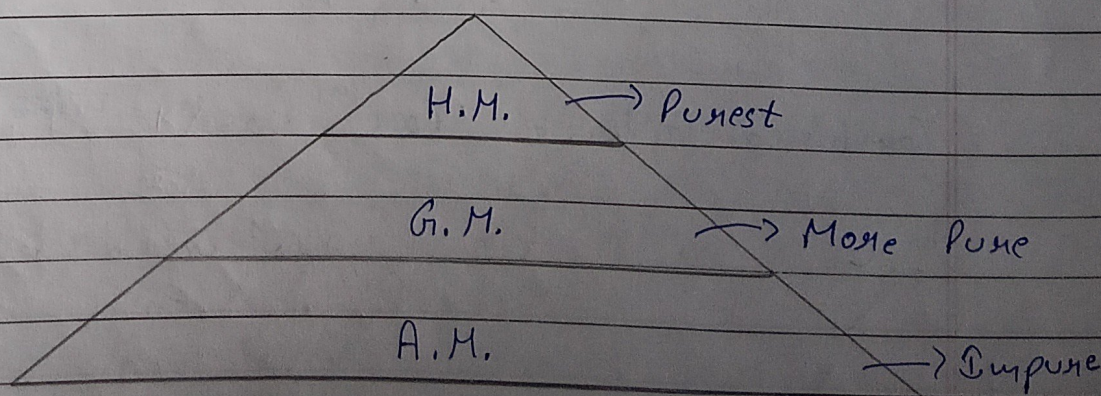
$$2^3 = 8$$

$$27 = 3^3$$

$$2 = 8^{1/3}$$

$$(27)^{1/3} = 3$$

✓ 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_3 (d) none of these
60% n_1 50% n_1 40% n_1

Method-1 Traditional

$$\bar{x}_{12} = \frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2} \quad ; \quad \bar{x}_1 = 10,000$$
$$\bar{x}_2 = 15,000$$
$$\bar{x}_{12} = 12,000$$
$$12,000 = \frac{60 \times 10,000 + 40 \times 15,000}{60 + 40}$$
$$12,000 = 12,000$$

$n_2 = ?$

M.P.

Method-2

निम्न वजन उच्च भजन

e.g. 1 No. of Boys = 100

Avg. Marks = 50

No. of girls = 300

Avg. Marks = 90

$\bar{x}_{12} = 80$ marks

e.g. 2 No. of Boys = 300

Avg. Marks = 50

No. of Girls = 100

Avg. Marks = 90

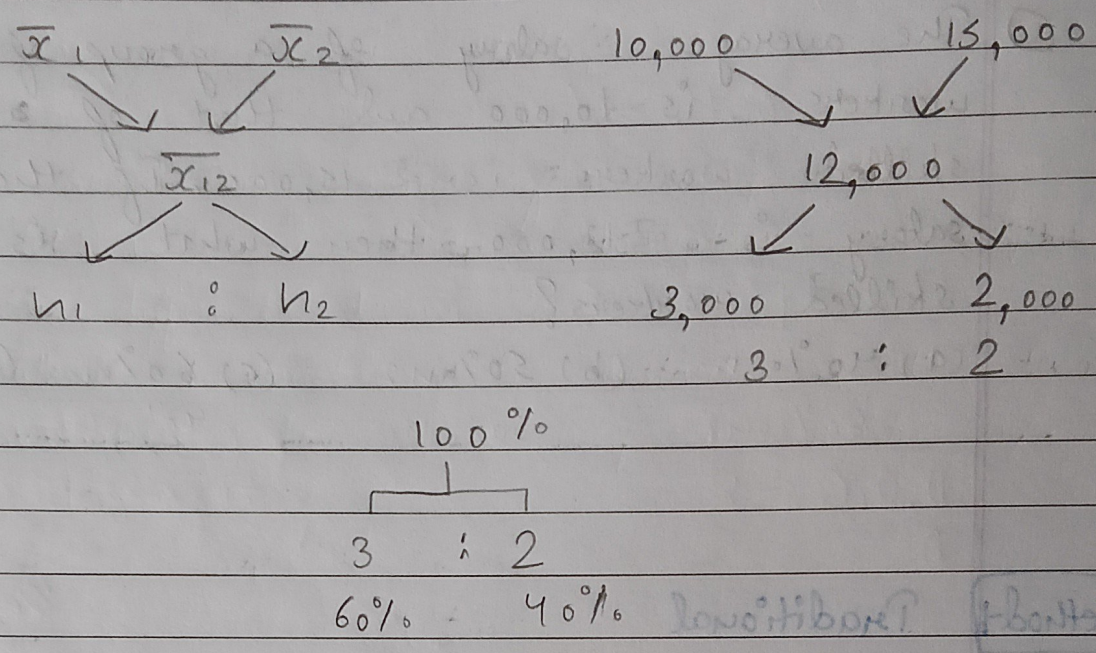
$\bar{x}_{12} = 60$ marks

In above ques 3-C. avg. is closer to 10,000 so,
% of n_1 is more than of n_2

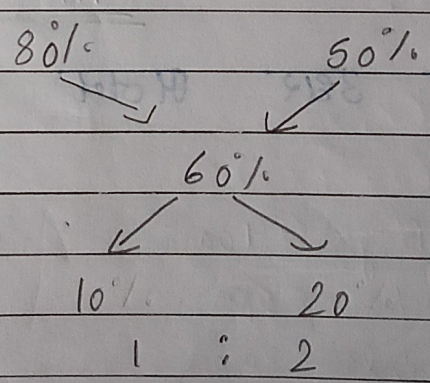
Method-3

चुकी

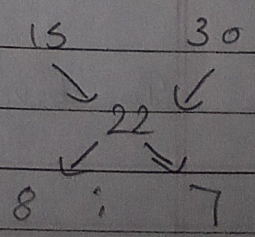
Caution: use only when either n_1/n_2 or both are missing



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. Invst. 1 15% $\rightarrow$ 53,333
 Invst. 2 30% $\rightarrow$ 46,667
 Combined returns = 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) $\bar{x} + n = 5 + 4 = 9$ X 2 3

(B) $\bar{x} + n + 1 = 5 + 4 + 1 = 10$ X 4 6

☒ (C) $\bar{x} + \frac{n+1}{2} = 5 + \frac{4+1}{2} = 7.5$ ✓ 6 9
2 2 8 12

(D) $\bar{x} + \frac{n}{2} = 5 + \frac{4}{2} = 7$ X $\bar{x} = 5$ New avg. = 7.5

Q. If G is GM between a and b then $\frac{1}{1/G^2 - a^2} + \frac{1}{1/G^2 - b^2}$ is

(A) G^2

☒ (B) $1/G^2$

(C) $1/G$

(D) G

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

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

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

(iii) Harmonic Mean (H.M.)

Q. Why do we need H.M.?

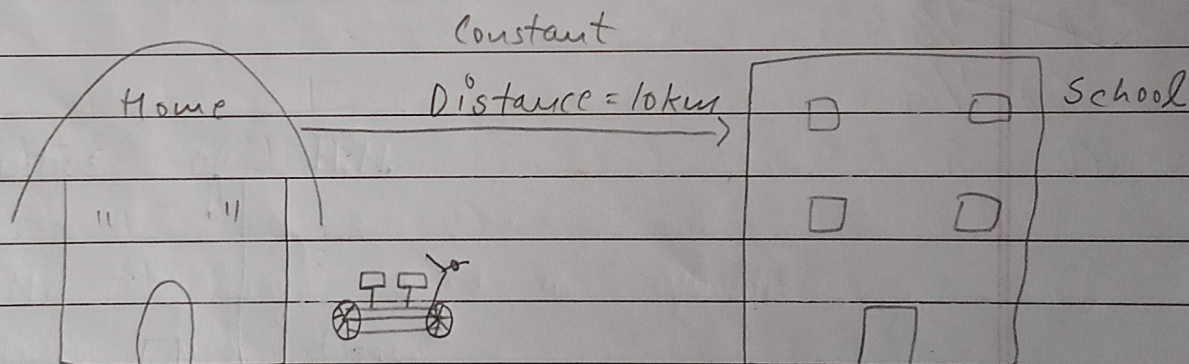
There are two reasons for using H.M.:

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

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

E.g. Speed, distance & time

Reciprocal Relationships



Rakshabandhan Fun.

Case 1

Aug.

Speed = 2 km/hrs

Time = 5 hours

Valentine Fun.

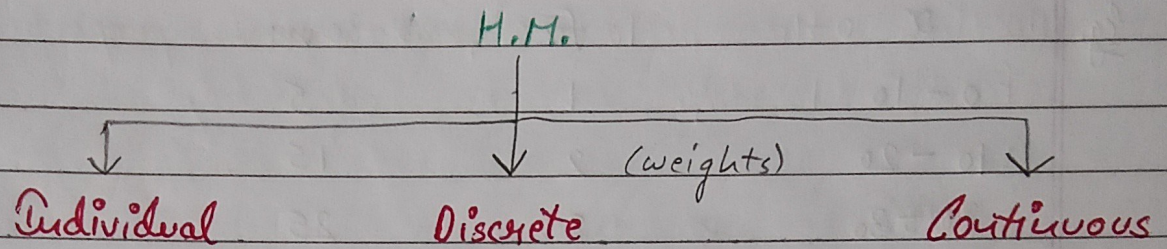
Case 2

Feb.

Speed = 20 km/hr

Time = 0.5 hours

Speed $\uparrow$ Time $\downarrow$
Speed $\downarrow$ Time $\uparrow$



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

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

$$H.M. = \frac{1}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3}} = \frac{H.M.3}{\frac{1}{2} + \frac{1}{4} + \frac{1}{6}} = 3.27$$

D.O.C. →

$$2 \div = M+$$

$$4 \div = M+$$

$$6 \div = M+$$

$$MRC \div = \times 3$$

E.g. $x : 2, 4, 6, 8$
 $f : 1, 2, 3, 4$

Calculate H.M.

$$H.M. = \frac{\sum f}{\frac{f_1}{x_1} + \frac{f_2}{x_2} + \frac{f_3}{x_3} + \frac{f_4}{x_4}} = \frac{10}{\frac{1}{2} + \frac{2}{4} + \frac{3}{6} + \frac{4}{8}} = 5$$

eg.

α	f	m
0-10	1	5
10-20	2	15
20-30	3	25

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

D.O.C. →

$$1 \div 5 \quad M+$$

$$2 \div 15 \quad M+$$

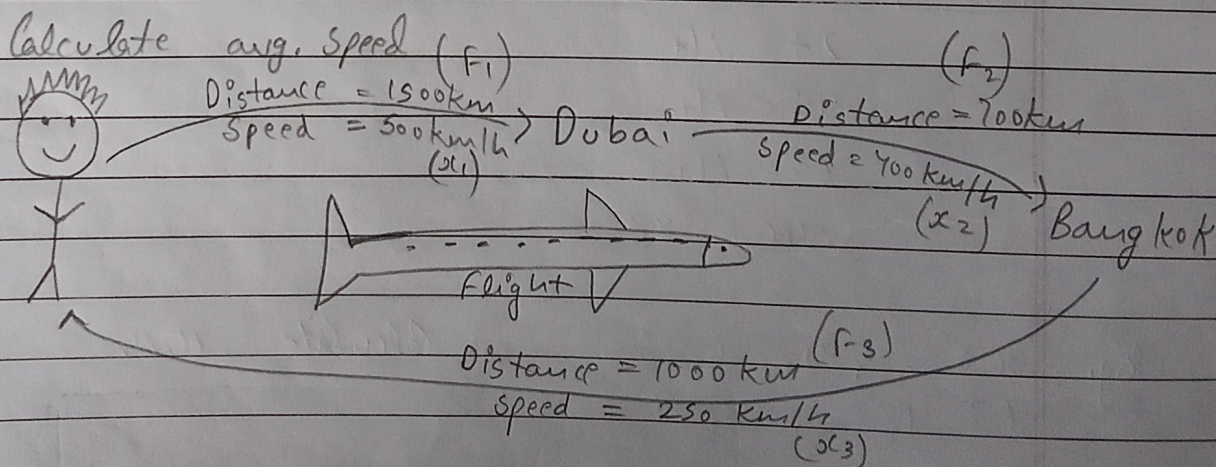
$$3 \div 25 \quad M+$$

$$MRC \div = \times 6$$

Properties of H.M.

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

eg.

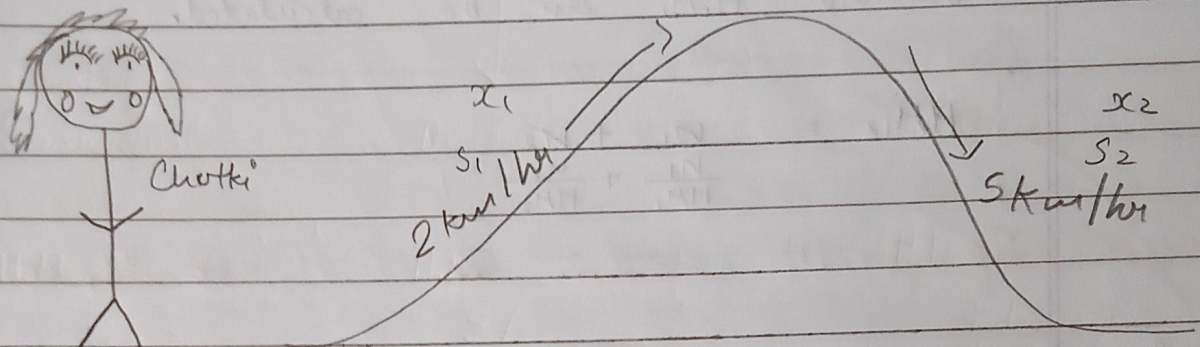


Sol.

$$HM = \frac{\sum F_i}{\frac{F_1}{x_1} + \frac{F_2}{x_2} + \frac{F_3}{x_3}} \quad , \quad HM = \frac{\sum \text{distance}}{\frac{d_1}{s_1} + \frac{d_2}{s_2} + \frac{d_3}{s_3}}$$

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

E.g. Calculate average speed.



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

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

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

2, 4, 6, 8

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

reciprocal

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

A.M.

4

Reciprocal

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

∴ H.M. = 2.85

(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

← M

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. →

$$50 \div 10 \text{ M+}, 70 \div 20 \text{ M+}$$

$$MRR \div = \times 120$$

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

$$HM_{12}^2 = \frac{n_1 + n_2}{\frac{n_1 H_2 + n_2 H_1}{H_1 H_2}}$$

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

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

If observation
are distinct

$$AM > GM > HM$$

If all the observations
are same

$$AM = GM = HM$$

If nothing is
specified about
observation

$$AM \geq GM \geq HM$$

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

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

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

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

$$\begin{aligned} &AM \& HM \text{ ka} \\ &GM = \sqrt{5 \times 3.84} \\ &= 4.42 \end{aligned}$$

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.

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

Ex. 9. If G.M. is 3.20 & A.M. is 4, calculate H.M.

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

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

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

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

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

$$H.M. = 2.56$$

Ex. 9. 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

$$A, B, C = n_1 = 3$$

$$3 = H_1$$

$$D, E = n_2 = 2$$

$$4 = H_2$$

$$H_{1,2} = \frac{n_1 + n_2}{\frac{n_1}{H_1} + \frac{n_2}{H_2}} = \frac{3+2}{\frac{3}{3} + \frac{2}{4}}$$

$$H_{1,2} = 2.50$$

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

x: 2, 4, 6, 10,

8, 4, 2, 9, 7,

2, 8, 10

✓

Mode = 2

No. with
highest
frequency
is called
mode

x f

2 10

④ ← 15

6 12

8 8

Step 01 -> Find out
modal class.

{ Class with highest
frequency }

Step 02 ->

$$m = l_1 + \frac{F_1 - F_0}{2f_1 - f_0 - f_2} \times h$$

lowest
of F_1 frequency

For eg.

x	f
0-10	10
10-20	20 $\rightarrow f_0$
20-30	30 f_1
30-40	20 f_2
40-50	10

$h = 30 - 20 = 10$

Sol.

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

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

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

$$m_0 = 20 + \frac{105}{126} \times 10$$

$$m_0 = 25$$

For eg.

x	0-10	10-20	20-30	30-40
f	7	8	6	5
	f_0	f_1	f_2	

$$h = 20 - 10 = 10$$

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

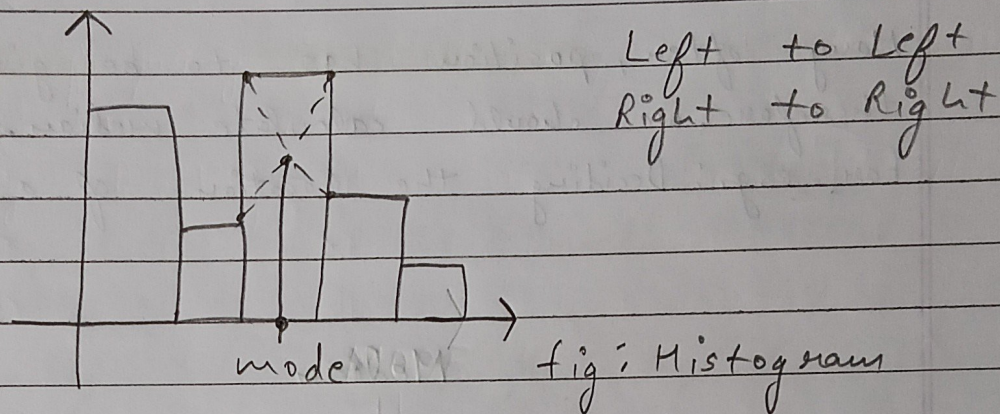
$$m_0 = 10 + \frac{8 - 7}{2 \times 8 - 7 - 6} \times 10$$

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

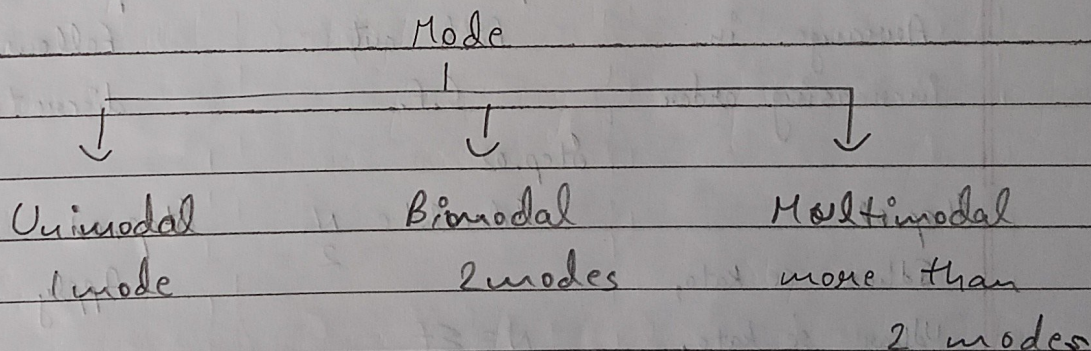
$$m_0 = 13.33$$

Properties of Mode

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



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



$x: 2, 7, 9, 10, 7, 8, 2, 2, 7$
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

Discrete

Continuous

Step. 01

Arrange in increasing order

Step. 01

Find out C.F.

Step. 01

Follow steps of discrete series

Step. 02

Idhar se kato,
Udhar se kato,
Beech me jo
bach jaaye vo
median.

Step. 02

Calculate $\frac{N}{2}$

$N = \sum f$

$N = \text{last C.F.}$

Step. 02

Apply Formula:

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

Step. 03

Locate $\frac{N}{2}$ in C.F. table.

Badi CF ke

Sanne wali

Khidki me

md rehta hai

Individual

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

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

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

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

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

$\downarrow$
5 Median Ans

Discrete

For e.g.

x	2	4	6	8
F	10	12	08	06
CF	10	22	30	36 $\rightarrow N$

Calculate median

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

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 $\rightarrow C$
20-30	18 $\rightarrow f$	40
30-40	15	55
40-50	10	65
	<u>65</u>	

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

$$l_1 = 20$$

$$F = 18$$

C = mid class ke phele wali class ki CF

$$C = 22$$

$$h = 30 - 20 = 10$$

$$\text{mid} = l_1 + \left\{ \frac{\frac{N}{2} - C}{F} \right\} \times h$$

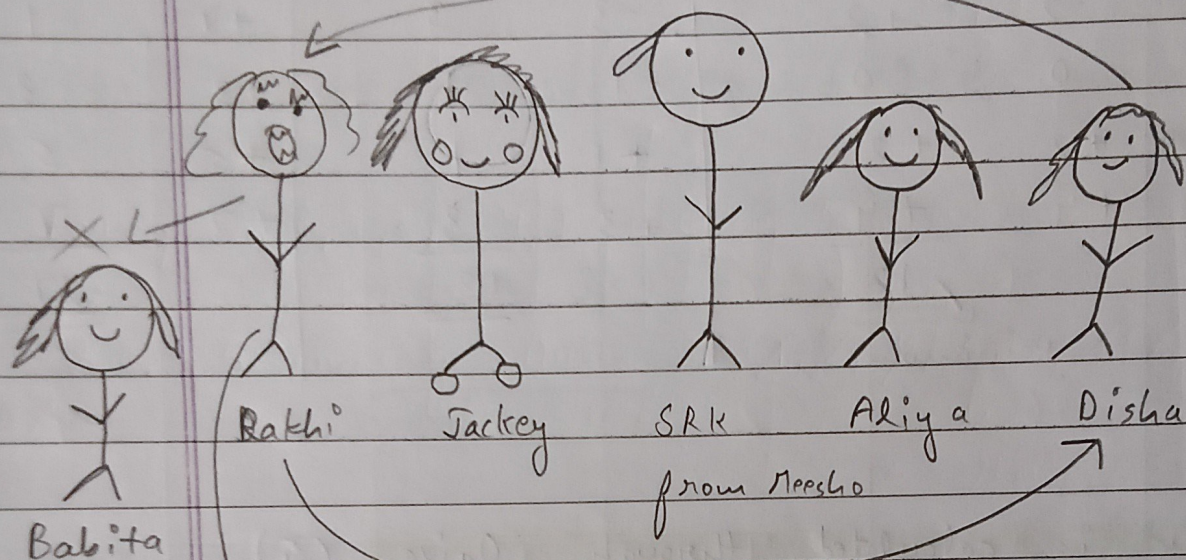
$$\text{mid} = 20 + \left\{ \frac{32.5 - 22}{18} \right\} \times 10$$

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

$$\boxed{\text{mid} = 25.8333} \quad \underline{\text{Ans}}$$

Properties of Median:

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



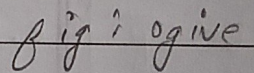
For e.g. $x = 2, 4, 8, 8, 10$
mid = 6

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

$\rightarrow$ mod ke baad $-21 \mid 1$

minim

(iii) Median is calculated through Ogive. (1)



- * Mean can not be represented graphically

Mode $\rightarrow$ Histogram

Median $\rightarrow$ Ogive

Mean $\rightarrow$ 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

$$m_0 - \bar{x} = 3 \text{ md} - 2 \bar{x} - \bar{x}$$

$$m_0 - \bar{x} = 3 \text{ md} - 3 \bar{x}$$

$$\boxed{m_0 - \bar{x} = 3 (\text{md} - \bar{x})}$$

One more way of writing the formula

$$m_0 - \bar{x} = 3 (70)$$

$$m_0 - \bar{x} = 210 \quad \underline{\text{Ans}}$$

$$\boxed{\bar{x} - m_0 = 3 (\bar{x} - \text{md})}$$

✓ लावारिस Property $\rightarrow$ 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/MM/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 $2x + 3y = 10$?

→

$$3y = -2x + 10$$

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

$$Mdy = \frac{-2 Mdx + 10}{3}$$

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

$$Mdy = -2.666 \quad \underline{\text{Ans}}$$