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Measures of Central tendency

In Statics, Various measures of Central tendency or averages are Studied. Three important Measures of Central tendency are :-

1. Airthmetic Mean (A.M) or Mean
2. Median
3. Mode

Airthmetic Mean → Airthmetic Mean, also Called average in general Sense, is the Most popular and widely used Measure of Central tendency.
Airthmetic Mean is of two types :-

1. Simple Arithmetic Mean
2. Weighted Airthmetic Mean

Simple Arithmetic Mean is are of two Method →
1. Direct Method
2. Short-Cut Method

Direct Method $= \frac{1}{N} \Sigma X$

Short-Cut Method $= A + \frac{\Sigma d}{N}$

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Ex 1: Calculate the Arithmetic mean of the following Marks in Statics obtained by ten Students in a Class.

Students No	1	2	3	4	5	6	7	8	9	10
Marks	15	20	25	19	12	11	13	17	18	20

Solⁿ →

Student No.	Marks (X)
1	15
2	20
3	25
4	19
5	12
6	11
7	13
8	17
9	18
10	20
$N=10$	$\Sigma X = 170$

Using Direct Method →

$$\bar{X} = \frac{1}{N} \Sigma X$$

$$\bar{X} = \frac{\Sigma X}{N} = \frac{170}{10} = 17 \text{ Marks}$$ Ans

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Ex2: Use Short-Cut Method to Calculate arithmetic mean for the data in Statitics

Student No.	1	2	3	4	5	6	7	8	9	10
Marks(s)	15	20	25	19	12	11	13	17	18	20

Sol^n

Student No.	Mark(s)	Deviation $(X-A)$
1	11	-3
2	12	$+2$
3	13	$+7$
4	15	$+1$
5	17	-6
6	18(A)	-7
7	19	-5
8	20	-1
9	20	0
10	25	$+2$
$N=10$		$\Sigma d=-10$

$$\bar{X} = A + \frac{\Sigma}{N}$$

$$= 18 + \left(\frac{-10}{10}\right)$$

$$= 18 - 1$$

$$= 17 \text{ Marks}$$ Ans

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Ex 3: Show that the arithmetic mean of the series.

$1, 2, 2^2, 2^3, 2^4, \ldots 2^n$ is $\frac{(2^{n+1}-1)}{(n+1)}$.

Sol^n →

S No.	X
1	1
2	2
3	2^2
4	2^3
5	2^4
n	2^n
$N = n+1$	$\Sigma X = (2^{n+1}-1)$

$$\bar{X} = \frac{1}{N} \cdot \Sigma X$$

$$= \frac{\Sigma X}{N}$$

$$= \frac{(2^{n+1}-1)}{(n+1)}$$ Ans.

Ex 4: The mean of n numbers of a series is $\bar{X}$ and the sum of first $(n-1)$ numbers is λ. Find the value of the last number.

Sol^n → Let n number is $x_1, x_2, x_3 \ldots x_{n-1}, x_n$

So $\bar{x} = \dfrac{x_1 + x_2 + x_3 - - - - - - x_{n-1} + x_n}{n}$

$x_1 + x_2 + x_3 + - - - - - - x_{n-1} + x_n = n\bar{x}$

also given

$$x_1 + x_2 + x_3 + - - - - x_{n-1} = \lambda$$

So from ①.

$$\lambda + x_n = n\bar{x}$$

$$x_n = n\bar{x} - \lambda$$

So, last number is $(n\bar{x} - \lambda)$ Ans

Ex5: Following table gives the wages paid to 125 workers in a factory. Calculate the Arithmetic Mean of the wages:

Wage (₹)	200	210	220	230	240	250	260
No. of Workers	5	15	32	42	15	12	4

Solⁿ →.

Wages (X)	No. of Workers (f)	fx
200	5	1000
210	15	3150
220	32	7040
230	42	9660
240	15	3600
250	12	3000
260	4	1040
Total	$N = \Sigma f = 125$	$fx = 28490$

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$$\bar{X} = \frac{\Sigma fx}{N} = \frac{28490}{125} = ₹227.92$$

Ex6: What is the arithmetic mean of the following?

Variate	0	1	2	---- n
Frequency	${}^nC_0$	${}^nC_1$	${}^nC_2$	---- ${}^nC_n$

Solⁿ →.

x	f	fx
0	${}^nC_0$	0
1	${}^nC_1$	$1 \cdot {}^nC_1$
2	${}^nC_2$	$2 \cdot {}^nC_2$
3	${}^nC_3$	$3 \cdot {}^nC_3$
4	${}^nC_4$	$4 \cdot {}^nC_4$
5	${}^nC_5$	$5 \cdot {}^nC_5$
n	${}^nC_n$	$n \cdot {}^nC_n$

We know that A.M Given by

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

$$\Rightarrow \frac{0 + 1 \cdot {}^nC_1 + 2 \cdot {}^nC_2 + 3 \cdot {}^nC_3 + \cdots n \cdot {}^nC_n}{{}^nC_0 + {}^nC_1 + {}^nC_2 + \cdots {}^nC_n}$$

$$= \frac{n + \cancel{2} \cdot \frac{n(n-1)}{\cancel{2}\angle 1} + \cancel{3} \cdot \frac{n(n-1)(n-2)}{\cancel{3}\angle 2} + \cdots n \cdot}{2^n}$$

So $\bar{x} = \dfrac{\dfrac{n[1+(n-1)+(n-1)(n-2)+ \cdots +1]}{\lfloor 2}}{2^n}$

$= \dfrac{n({}^{n-1}C_0 + {}^{n-1}C_1 + {}^{n-2}C_2 + \cdots {}^{n-1}C_n)}{2^n}$

$= \dfrac{n \cdot 2^{n-1}}{2^n} = \dfrac{n}{2}$

So $A.M = \dfrac{n}{2}$ Ans.

Ex7 If the arithmetic average of data given below be 165 Rupees, find the missing term.

Monthly Wages	100	150	200		300	500
Number of Labours	30	20	15	10	4	1

Sol^n → Let missing term is x_4 then

x	f	fx
100	30	3000
150	20	3000
200	15	3000
x_4	10	$10x_4$
300	4	1200
500	1	500
	80	$10700 + 10x_4$

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given $\bar{x} = 165$

$\Sigma f = 80$

$\Sigma f = 10700 + 10x_4$

So

$$165 = \frac{10700 + 10x_4}{80}$$

$$13200 = 10700 + 10x_4$$

$$10x_4 = 13200 - 10700$$

$$10x_4 = 2500$$

$$x_4 = 250 \quad \text{Ans.}$$

Ex 9: Use Step-deviation Method for Calculating arithmetic Mean for the data in following table gives the Wages paid to 125 workers in a factory

Wages	200	210	220	230	240	250	260
No. of Workers	5	15	32	42	15	12	4

Sol^n →

x	f	A	$d' = \frac{x-A}{h}$	fd'
200	5		-3	-15
210	15		-2	-30
220	32	230	-1	-32
230	42		0	0
240	15		1	15
250	12		2	24
260	4		3	12
	125			-26

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$$\bar{X} = A + \frac{\Sigma f d'}{\Sigma f} \times h$$

$$= 230 + \frac{-26}{125} \times 10$$

$$= 230 - 2.08$$

$$= 227.92 \text{ Ans.}$$

Ex10: Use direct Method to Calculate Arithmetic Mean from the following data

Class	20-25	25-30	30-35	35-40	40-45	45-50	50-55
Frequency	8	10	12	20	11	4	5

Sol^n →.

Class	frequency	Mid-Value(x)	fx
20-25	8	22.5	180
25-30	10	27.5	275
30-35	12	32.5	390
35-40	20	37.5	750
40-45	11	42.5	467.5
45-50	4	47.5	190
50-55	5	52.5	262.5
	70		2515

$$AM = \frac{\Sigma fx}{\Sigma f} = \frac{2515}{70} = 35.93 \text{ Ans}$$

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Ex 11: Use Short-Cut Method for Calculating Mean for the data given by:

Class	20-25	25-30	30-35	35-40	40-45	45-50	50-50
Frequency	8	10	12	20	11	4	5

Solⁿ

Class	frequency	Mid-value	$d = x - A$	fd
20-25	8	22.5	-15	-120
25-30	10	27.5	-10	-100
30-35	12	32.5	-5	-60
35-40	20	37.5 (A)	0	0
40-45	11	42.5	5	55
45-50	4	47.5	10	40
50-55	5	52.5	15	75
	70			-110

So by Short-Cut Method.

$$AM = A + \frac{\Sigma fd}{\Sigma f}$$

$$= 37.5 + \frac{-110}{70}$$

$$= 37.5 - 1.57$$

$$= 35.93 \text{ Ans.}$$

Ex 12: Obtain Aritmetic mean for the data in above example using Step-deviation Method.

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Class	frequency	Mid Value (X)	$d' = \frac{X-A}{h}$	fd'
20-25	8	22.5	-3	-24
25-30	10	27.5	-2	-20
30-35	12	32.5	-1	-12
35-40	20	37.5 (A)	0	0
40-45	11	42.5	1	11
45-50	4	47.5	2	8
50-55	5	52.5	3	15
	70			-22

So by Step divation Method.

$$AM = A + \frac{\Sigma fd}{\Sigma f} \times h$$

$$= 37.5 + \frac{-22}{70} \times 5$$

$$= 37.5 - 1.57$$

$$= 35.93 \text{ Ans}$$

Ex13: Find the average Marks of the Students from the following data:

Marks Below	10	20	30	40	50	60	70	80
No. of Stu	15	35	60	84	96	127	198	250

Marks (Below)	No. of Student	Class	f	M.V	d = x-A	fd
10	15	0-10	15	5	-30	-450
20	35	10-20	20	15	-20	-400
30	60	20-30	25	25	-10	-250
40	84	30-40	24	35(A)	0	0
50	96	40-50	12	45	10	120
60	127	50-60	31	55	20	620
70	198	60-70	71	65	30	2130
80	250	70-80	52	75	40	2080
			250			3850

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$$= 35 + \frac{3850}{250}$$

$$= 35 + 15.4$$

$$\bar{X} = 50.4 \text{ Ans.}$$

Ex 14: The following data related to the Marks of 70 Students in Statistics. Find the Mean:

Marks (More than)	20	30	40	50	60	70
No. of Student	70	63	40	30	18	7

Sol^n:

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Marks (Mark Class)	No. of Student	Class	f	M.V(X)	d	fd
20	70	20-30	7	25	-20	-140
30	63	30-40	23	35	-10	-230
40	40	40-50	10	45(A)	0	0
50	30	50-60	12	55	10	120
60	18	60-70	11	65	20	220
70	7	70-80	7	75	30	210
			70			180

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$$= 45 + \frac{180}{70}$$

$$= 45 + 2.57$$

$$= 47.57 \text{ Ans.}$$

Ex15 Calculate A.M from the following distribution:

Classes	10-19	20-29	30-39	40-49	50-59	60-69
frequency	5	12	17	20	18	8

Sol^n:

Classes	frequency	M.V(X)	d = X-A	fd
10-19	5	14.5	-20	-100
20-29	12	24.5	-10	-120
30-39	17	34.5(A)	0	0
40-49	20	44.5	10	200
50-59	18	54.5	20	360
60-69	8	64.5	30	240
	80			580

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$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$$\bar{X} = 34.5 + \frac{58\cancel{0}}{8\cancel{0}}$$

$$\bar{X} = 34.5 + 7.25$$
$$\bar{X} = 41.75 \text{ Ans}$$

Ex 17: The mean wage of 100 workers in a factory running two shifts of 60 & 40 workers is 38. The mean wage of 60 workers in the morning shift is 40 ₹. Find the mean wage of 40 workers in the evening shift.

Solⁿ → $\bar{x}_{12} = 38$, $N_1 = 60$, $N_2 = 40$, $\bar{x}_1 = 40$
$\bar{x}_2 = ?$

We know combined mean is given by

$$\bar{x}_{12} = \frac{N_1 \bar{x}_1 + N_2 \bar{x}_2}{N_1 + N_2}$$

$$38 = \frac{60 \times 40 + 40 \times \bar{x}_2}{60 + 40}$$

$$3800 = 2400 + 40 \bar{x}_2$$
$$40 \bar{x}_2 = 3800 - 2400$$
$$\bar{x}_2 = \frac{1400}{40}$$
$$\bar{x}_2 = 35 \text{ Ans}$$

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Ex18: Find the Combined mean from the following data:

Groups	1	2	3
Numbers	200	250	300
Mean	25	20	15

Sol^n→ Given

$N_1 = 200, \; N_2 = 250, \; N_3 = 300$

$N = N_1 + N_2 + N_3 = 200 + 250 + 300$

$N = 750$

$\overline{X}_{123} = ?$

We know Combined Mean is given by

$$\overline{X}_{123} = \frac{N_1 \overline{x}_1 + N_2 \overline{x}_2 + N_3 \overline{x}_3}{N_1 + N_2 + N_3}$$

$$= \frac{200 \times 25 + 250 \times 20 + 300 \times 15}{750}$$

$$= \frac{5000 + 5000 + 4500}{750}$$

$$= \frac{14500}{750}$$

$\overline{x}_{123} = 19.33$ Ans

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Ex 20: The weight of 150 students in a certain class is 60 kilograms. The mean weight of boys in the class is 70 kilograms & that of the girls is 55 kilograms find the number of boys and girls in the class.

Sol^n → Let N_1 boys & N_2 Girls in the Class

then $N_1 + N_2 = 150$ — ①

& given

$$\overline{N_{12}} = 60$$
$$\overline{x_1} = 75$$
$$\overline{x_2} = 55$$

We know Combined Mean is given by

$$\overline{x_{12}} = \frac{N_1 \overline{x_1} + N_2 \overline{x_2}}{N_1 + N_2}$$

$$60 = \frac{70 N_1 + 55 N_2}{150}$$

$$9000 = 70 N_1 + 55 N_2$$

$$14 N_1 + 11 N_2 = 1800 \quad \text{— ②.}$$
$$\underline{11 N_1 + 11 N_2 = 1650}$$

$$3 N_1 = 150$$
$$N_1 = 50$$

from ①.

$$50 + N_2 = 150$$
$$N_2 = 100 \quad \text{Ans.}$$

Ex21: A person makes a trip which entire travelling 900 Kms by train at an average speed of 60 K/h, 300 Kms by bus at an average speed 25 K/h, 400 Kms by plane at 350 K/h and finally 15 Kms by taxi at 25 K/h. What is the average speed of the entire distance.

Sol⇒

Journey by	Distance (Kms)	Average Speed (K/h)	Time Taken (Hrs)
Train	900	60	15
Bus	300	25	12
Plane	400	350	$8/7$
Taxi	15	25	$3/5$
Total	1615		$\frac{1006}{35}$

Now Average Speed $= \frac{\text{Total distance}}{\text{Total Time}}$

$= \frac{1615}{\frac{1006}{35}} = \frac{1615 \times 35}{1006} = \frac{56525}{1006}$

$= 56.19$ Km/h Ans.

Ex22: A person travels n equal distances with velocities $V_1, V_2 --- V_n$. Show that his average velocity $V_1, V_2, V_3 ----V_n$. Show that his average velocity cannot exceed $\frac{(V_1 + V_2 + --- V_n)}{n}$ when it when it will be equal to this value?

Sol⇒ Total distance = $n \cdot$ equal distance

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Velocity per distance be $V_1, V_2, V_3 ---- V_3$

Per Units distance time $= \frac{\text{Speed}}{\text{distance}}$

$= \frac{V_1 + V_2 + ---V_n}{n}$

The Max Speed $= \frac{V_1 + V_2 + ---V_n}{n} \leq$ Total time

Maximum Average Speed $= \frac{V_1 + V_2 + ---V_n}{n}$ Ans

Ex 23: In a Class of 50 Students, 10 have failed and their average of Marks is 2.5 The Total of Marks Secured by the entire class was 285. Find the average Marks of those Who have passed.

Sol^n → Total Students = 50
Fail Students = 10
Passed Students = 50 − 10 = 40

Total Marks = 285
Total Marks of fail students = 10 × 2.5
= 25

Total Marks of passed Students = 285 − 25
= 260

So, average Marks of Passed Students
$= \frac{\Sigma X}{N} = \frac{260}{40} = 6.5$ Ans

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Ex24: In the examination, the average grade of all Students in Class A ~~and B be N_1 and N_2 respectively.~~ ~~the~~ is 68.4 and that for Students in Class B is 71.2 if there average of both the Class Combined is 70, find the Number of Students in Class A to the Number in Class B.

Sol^n → Given $\bar{x}_1 = 68.4$, $\bar{x}_2 = 71.2$
$\bar{x}_{12} = 70$

Let Number of Students in Class A be N_1 & Number of Student in Class B be N_2 then We know.

$$\bar{x}_{12} = \frac{N_1 \bar{x}_1 + N_2 \bar{x}_2}{N_1 + N_2}$$

$$70 = \frac{68.4 N_1 + 71.2 N_2}{N_1 + N_2}$$

$$70 N_1 + 70 N_2 = 68.4 N_1 + 71.2 N_2$$

$$70 N_1 - 68.4 N_1 = 71.2 N_2 - 70 N_2$$
$$1.6 N_1 = 1.2 N_2$$

$$\frac{N_1}{N_2} = \frac{1.2}{1.6} = \frac{3}{4}$$

$N_1 : N_2 = 3 : 4$ Ans

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Ex25 : The Average Marks of 80 students were found to be 40. Later, it was discovered that a Score of 54 was misread as 84. Find the Correct Mean of the 80 Students

Sol^n → Given, $N = 80$
Incorrect Mean $= 40$
Correct Value $= 54$
Incorrect Value $= 84$

We know $\bar{x} = \frac{\Sigma X}{N}$

Incorrect $\Sigma X = \bar{X} \cdot N$
$= 40 \times 80$
$= 3200$

Correct $\Sigma X = 3200 - 84 + 54$
$= 3170$

So Correct Mean $= \frac{\text{Correct } \Sigma X}{N}$

$= \frac{3170}{80}$

$= 39.625$ Ans.

Ex26: Mean of 100 items is found to be 30. if at the time collection, two items are wrongly taken as 32 & 12 instead of 23 and 11, find the Correct Mean.

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Sol^n: $N = 100$, $\bar{x} = 40$
Correct item = 23 & 11
incorrect item = 32 & 12

$$\bar{X} = \frac{\Sigma X}{N}$$

Now $\Sigma X = \bar{X} \cdot A$
$= 30 \times 100$
$= 3000$

So, Correct $\Sigma X = 3000 - 32 - 12 + 23 + 11$
$= 2990$

So, Correct Mean $= \frac{\text{Correct } \Sigma X}{N}$

$= \frac{2990}{100} = 29.9$ Ans

Ex28: The average Monthly wages of all workers in a factory is 444 ₹. if the average wages paid to Male and female Workers are 480 ₹ and 360 ₹ respectively, find the persentage of Male and female workers employed by the factory.

Sol^n: Let No. of Male Workers = N_1
Let No. of Female Workers = N_2

$\bar{X}_{12} = 444$, $\bar{x}_1 = 480$, $\bar{x}_2 = 360$

We Know $\bar{x}_{12} = \dfrac{N_1 \bar{x}_1 + N_2 \bar{x}_2}{N_1 + N_2}$

$$444 = \frac{480 N_1 + 360 N_2}{N_1 + N_2}$$

$$444 N_1 + 444 N_2 = 480 N_1 + 360 N_2$$
$$444 N_2 - 360 N_2 = 480 N_1 - 444 N_1$$
$$84 N_2 = 36 N_1$$
$$\frac{N_1}{N_2} = \frac{\cancel{84}\,7}{\cancel{36}\,3} = \frac{7}{3}$$

$$N_1 = \frac{7}{3} N_2 \quad \& \quad N_2 = \frac{3}{7} N_1$$

Now male % $= \dfrac{N_1}{N_1 + N_2} \times 100$

$$= \frac{N_1}{N_1 + \frac{3}{7} N_1} \times 100$$

$$= \frac{\cancel{N_1}}{\frac{10}{7} \times \cancel{N_1}} \times 100$$

$$= \frac{7}{\cancel{10}} \times 10\cancel{0}$$

$$= 70$$

So % of Male Workers = 70 %
& % of Female Workers = 100 − 70
= 30 % Ans.

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Ex29: Average rainfall of a City from Monday to Saturday is 0.3 inch. Due to heavy rainfall on Sunday, the average rainfall increased to 0.5 inches. What was the rainfall on Sunday?

Sol^n → Let rainfall in Sunday to x & given average Rainfall Monday to Saturday is 0.3 inch. So

$$0.3 = \frac{\text{Monday to Saturday}}{6}$$

Monday to Saturday total Rainfall

$= 0.3 \times 6$

$= 1.8$ inch

Now average Rainfall from Monday to Saturday $= 0.5$ inch

$$\Rightarrow 0.5 = \frac{1.8 + x}{7}$$

$$3.5 = 1.8 + x$$

$$x = 3.5 - 1.8$$

$$x = 1.7 \text{ inch}$$ Ans

Ex31: The daily wages of there person are 6, 9 and 13.5 ₹. Find the geometric mean

Sol^n → Given $x_1 = 6$, $x_2 = 9$, $x_3 = 13.5$

We know

$$G.M = (x_1 \cdot x_2 \cdot x_3)^{1/3}$$

$$= (6 \times 9 \times 13.5)^{1/3}$$

$$= (3 \times 9 \times 27)^{1/3}$$

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$= (3\times3\times3 \times 3\times3\times3)^{1/3}$

$= 3\times3$

$\Rightarrow GM = 9$ Ans.

Ex32: Calculate the geometric Mean of the following 2574, 475, 75, 5, 0.8, 0.08, 0.005, 0.0009.

Sol^n:

Value (x)	Logarithm ($\log x$)
2574	3.4106
475	2.6767
75	1.8751
5	0.6999
0.8	$\bar{1}.9031$
0.08	$\bar{2}.9031$
0.005	$\bar{3}.6990$
0.0009	$\bar{4}.9545$
$N=8$	Total $= 2.1208$

So, $N=8$, $\Sigma \log x = 2.1208$

$$G.M = \text{Antilog}\left(\frac{\Sigma \log x}{N}\right)$$

$$= \text{Antilog}\left(\frac{2.1208}{8}\right)$$

$= \text{Antilog}(0.2651)$

$= 1.841$

$GM = 1.841$ Ans

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Ex 33: Find the geometric Mean for the following data.

Class	100-200	200-300	300-400	400-500	500-600
Frequency	15	18	30	20	17

Sol^n:

Class	frequency	Mid Value	log x	f log x
100-200	15	150	2.1761	32.6415
200-300	18	250	2.3979	43.1622
300-400	30	350	2.5441	76.3230
400-500	20	450	2.6532	53.0640
500-600	17	550	2.7407	46.5919
	100			251.7826

We know $G.M = \text{Antilog}\left(\frac{\Sigma f \log x_i}{\Sigma f}\right)$

$= \text{Antilog}\left(\frac{251.7826}{100}\right) = \text{Antilog}(2.517826)$

$= (329.5) = GM$ Ans.

Ex 35: Find the harmonic mean of 12, 8, 6 and 24.

Sol^n: $x_1 = 12,\ x_2 = 8,\ x_3 = 6,\ x_4 = 24$

We know H.M is given by

$$\frac{1}{H} = \frac{1}{N}\left(\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3} + \frac{1}{x_4}\right)$$

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$$= \frac{1}{4}\left(\frac{1}{12} + \frac{1}{8} + \frac{1}{6} + \frac{1}{4}\right.$$

$$= \frac{1}{4}(0.833 + 0.1250 + 0.1167 + 0.0417)$$

$$= \frac{1}{4}(0.4167) = 0.104175$$

So $H = \frac{1}{0.104175}$

$H = 9.5992$ Ans.

Ex 36: Find the Harmonic Mean for the following table of Marks obtained in Class test:

Marks obtained	11	12	13	14	15
No. of Students	3	7	8	5	2

Soln →

x	f	$\frac{1}{x}$	$f \cdot \frac{1}{x}$
11	3	0.0909	0.2727
12	7	0.0833	0.5831
13	8	0.0769	0.6152
14	5	0.0714	0.3570
15	2	0.667	0.1334
	25		1.9614

Now H.M is given by

$$\frac{1}{H} = \frac{\Sigma f \cdot \frac{1}{x}}{\Sigma f} = \frac{1.9614}{25}$$

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$= 0.078456$

$$H = \frac{1}{0.078456} = 12.746 \text{ Ans.}$$

Ex.37: A Variate takes Values $a, ar, ar^2 \cdots ar^{n-1}$ each with frequency one. Show that the

$$A.M = \frac{a(1-r^n)}{n(1-r)}$$

Sol^n: Given $x_1 = a$, $x_2 = ar$, $x_3 = ar^2 \cdots x_n = ar^{n-1}$

Now $AM = \frac{x_1 + x_2 + x_3 + \cdots x_n}{n}$

$$A = \frac{a + ar + ar^2 + \cdots ar^{n-1}}{n}$$

$$AM = \frac{a(1-r^n)}{n(1-r)}$$

$= [a \cdot ar \cdot ar^2 \cdots ar^{n-1}]^{1/n}$

$G = a^n \cdot r^{1+2+3+\cdots n-1}]^{1/n}$

Put formula.

$= \frac{n-1}{2}[2a - ((n-1)-1)d]$

$= a^n \cdot r^{\frac{n-1}{2}[2\times 1 + (n-1-1)]}]^{1/n}$

$= [a^n \cdot r^{\frac{n-1 \cdot n}{2}}]^{1/n}$

$G = a \cdot r^{\frac{n-1}{2}}$ Ans.

$$H.M = \frac{N}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3} - - - \frac{1}{x_n}}$$

$$= \frac{n}{\frac{1}{a} + \frac{1}{ar} + \frac{1}{ar^2} + - - - - \frac{1}{ar^{n-1}}}$$

$$= \frac{n}{\frac{\frac{1}{a}\left[\frac{1}{r}\right]^{n-1}}{\frac{1}{r} - 1}}$$

$$H = \frac{n}{\frac{\frac{1}{a}\left(\frac{1-r^n}{r^n}\right)}{\frac{1-r}{r}}}$$

$$= \frac{n}{\frac{-r^n}{ar^n} \times \frac{r}{1-r}}$$

$$H = \frac{n a r^{n-1}(1-r}{1-r^n}$$ Ans.

Ex 38: Find the average rate of

(a) Motion in the case of a person who rides the first mile at 10 m.p.h, the next mile at 8 m.p.h and the third mile at 6 m.p.h

(b) Increase in population which in the first decade has increase 20% in the next 25% and in the third 44%.

Sol 3: $x_1 = 10$, $x_2 = 8$, $x_3 = 6$ & $n = 3$

So average speed $= \frac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3}}$

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$$= \frac{3}{0.1 + 0.125 + 0.1667}$$

$$= \frac{3}{0.3917}$$

Average Speed = 7.6589 m.p.h.

(b) $x_1 = 20$, $x_2 = 25$, $x_3 = 44$ & $n = 3$

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

$$G.M = (20 \times 25 \times 44)^{1/3}$$

Taking log on both side

$$\log G = (\log 20 \times \log 25 \times \log 44)^{1/3}$$

$$\log G = \frac{1}{3}(1.3010 + 1.3979 + 1.6435)$$

$$\log G = \frac{1}{3} \times 4.3424$$

$$\log G = \frac{4.3424}{3}$$

$$\log G = 1.4475$$

$$G = \log 28.02$$

$$G = 28.02$$ Ans.

Ex39: A Motor When traveling from rest travels the first twentieth of a Mile at 6 Miles per hours and the next three twentieth of the mile at 8, 12, 24 m.p.h respectively. But its average speed over the first one-fifth of a Mile is not 12.5 m.p.h but 9.6 m.p.h. Explain the apparent paradox.

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Let A&H be A.M & H.M of speeds

$$A.M = \frac{6+8+12+24}{4} = \frac{50}{4} = 12.5$$

$$\&M = \frac{4}{\frac{1}{6}+\frac{1}{8}+\frac{1}{12}+\frac{1}{24}}$$

$$= \frac{4 \times 24}{4+3+2+1} = \frac{4 \times 24}{10}$$

$$= 9.6$$

Now average speed $= \frac{\text{Total distance}}{\text{Total Time}}$

$$= \frac{20+20+20+20}{20/6 + 20/8 + 20/12 + 20/24} = \frac{80}{\frac{20(4+3+2+1)}{24}}$$

$$= \frac{\cancel{80}^{4} \times 24}{\cancel{20} \times 10} = \frac{96}{10} = 9.6 \text{ HM}$$

Then the average speed is given by H.M But Now A.M Ans.

Ex 41: If the price of a commodity doubles is period of 4 years from 1997 to 2001. What is the average persentage increase per year?

Sol:→ Let $P = P_0$, $A = 2P_0$, $n = 4$

We know $A = P\left(1 + \frac{r}{100}\right)^n$

$$2P_0 = P_0\left(1 + \frac{r}{100}\right)^4$$

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$\frac{r}{100} + 1 = 2^{\frac{1}{4}}$

$= r = 100(2^{\frac{1}{4}} - 1)$

let $2^{\frac{1}{4}} = x$

$= \log x = \frac{1}{4} \log 2$

$= \frac{1}{4} \times 0.3010$

$\log x = 0.07525$

$x = \text{antilog}(0.07525)$

$x = 1.190$

So from 1 $r = 100(1.190 - 1)$

$r = 19\%$ Ans.

Ex 42: The geometric Mean of a Number is x & that of b numbers it is y, obtain the G.M of those $a+b$ numbers Combined.

Sol:→ Given,

GM of a Number $= x$

$(\text{Product of a Number})^{\frac{1}{a}} = x$

Product of a Number $= x^a$

& GM of b number $= y$

$(\text{Product of } b \text{ number})^{\frac{1}{b}} = y$

Product of b Number $= y^b$

New product of $(a+b)$ number $= x^a \cdot y^b$

So G.M of $(a+b)$ number $= (\text{Product of } (a+b) \text{ number})^{\frac{1}{a+b}}$

$= (x^a \cdot y^b)^{\frac{1}{a+b}}$

$= x^{\frac{a}{a+b}} \cdot y^{\frac{b}{a+b}}$ Ans.

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Ex 43: Find the geometric Mean of the series $1, 2, 4, 8, 16, \ldots 2^n$

Sol^n →

$1, 2, 4, 8, 16 \ldots 2^n$

$2^0, 2^1, 2^2, 2^3, 2^4 \ldots 2^n$

Then Number of term $= n+1$

So $G.M = (\text{Product of Number})^{\frac{1}{n+1}}$

$= (2^0 \cdot 2^1 \cdot 2^2 \cdot 2^3 \cdot 2^4 \ldots 2^n)^{\frac{1}{n+1}}$

$= 2^{0+1+2+3+4 \ldots n)\frac{1}{n+1}}$

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

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

$G.M = 2^{\frac{n}{2}}$ Ans.

Ex 44. The rise in price of a Certain Commodity was 5% in 1994, 8% in 1995 and 77% in 1996. It is said that the average price rise between 1994 was 26% and net was 30%.

Sol^n → Let price in 1993 be $= 100$

So price in 1994 $= 105$

price in 1995 $= 108$

price in 1996 $= 177$

Now average price $= G.M$ of $105, 108, 177$

$G = (105 \times 108 \times 177)^{\frac{1}{3}}$

$\log G = \frac{1}{3}(\log 105 + \log 108 + \log 177)$

$= \frac{1}{3}[2.0212 + 2.0334 + 2.2480$

$= \frac{1}{3}[6.3026]$

$\Rightarrow \log G = 2.1009$

$G = \text{Antilog}(2.1009)$

$= 125.09 = 126$

So Average price rise $= 126 - 100 = 26\%$.

Ans

Ex 46 The following data relate to the height of nine students in a class. Compute the Median height.

S. No	1	2	3	4	5	6	7	8	9
Heights	153	142	151	144	149	146	147	150	154

Sol^n → First Arrange in Assending order.

142, 144, 146, 147, 149, 150, 151, 153, 154,

Here $N = 9$

So, Median $= \left(\frac{N+1}{2}\right)^{th}$ observation

$= \left(\frac{9+1}{2}\right)^{th}$ observation

$= \frac{10}{2} = 5^{th}$ observation

So Median is 149 Ans

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Ex 47: Calculate Median from the following data:

S. No.	1	2	3	4	5	6	7	8	9	10
Marks	17	32	35	33	15	21	41	32	11	18

Determine the Median.

Sol^n → First arrange in assending order.

11, 15, 17, 18, 21, 32, 33, 35, 41

Here $N = 10$

So, Median $= \left(\frac{N+1}{2}\right)^{th}$ observation

$= \left(\frac{10+1}{2}\right)^{th}$ observation

$= \frac{11}{2} = 5.5^{th}$ observation

Median $= \frac{\text{Value of } 5^{th} + \text{Value of } 6^{th}}{2} = \frac{21+32}{2} = \frac{53}{2}$

$= 26.5$ Ans

Ex 48: The following table represent the Marks obtained by a batch of 20 Students in Certain Class tests in Statistics & Accountancy:

Serial No	1	2	3	4	5	6	7	8	9	10
Marks (Statistics)	53	54	52	32	30	60	47	46	35	28
Marks (Accountancy)	58	55	25	32	56	85	44	80	33	72

Serial No	11	12	13	14	15	16	17	18	19	20
Statistics	25	42	33	48	72	51	45	33	65	29
Accountancy	10	42	15	46	50	64	39	38	30	36

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Sol ⇒. Here $N=20$

For Statics →

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

$$= \left(\frac{21}{2}\right)^{th} \text{ observation} = 10.5^{th} \text{ observation}$$

$$\text{Median} = \frac{\text{Value of } 10th + \text{Value of } 11}{2} = \frac{45+46}{2} = 45.5$$

For Account

$$\text{Median} = \frac{10th \text{ Value} + 11 \text{ Value}}{2} = \frac{39+42}{2} = 40.5$$

Since Median of Statics > Median of Accountency
= Knowledge is higher in Statics Ans.

Ex 49: Find the Median Size of the following Series:

Size	4	5	6	7	8	9	10
Frequency	6	12	15	28	20	14	5

Sol ⇒

x	f	cf
6	6	6
12	12	18
15	15	33
28	28	61
20	20	81
14	14	95
5	5	100

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Here $N = 100$

Median $= \left(\frac{N+1}{2}\right)^{th}$ observation

$= \left(\frac{100+1}{2}\right)^{th}$ observation $= 50.5^{th}$ observation

$=$ 50.5 lies in 61 frequency

So, Median is 7 Ans.

Ex 50: From the following table find the value of Median:

Measurements	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-
Frequency	7	10	13	26	35	22	11	6

Sol^n →

Measurement	Frequency	Class-Boundries	C.f
11-15	7	10.5 - 15.5	7
16-20	10	15.5 - 20.5	17
21-25	13	20.5 - 25.5	30
26-30	26	25.5 - 30.5	56
31-35	35	30.5 - 35.5	91
36-40	22	35.5 - 40.5	113
41-45	11	40.5 - 45.5	124
46-50	6	45.5 - 50.5	130

Here $N = 130$, So $\frac{N}{2} = \frac{130}{2} = 65$

Which lies is 91, So Median Class is 30.5-35

So here $l_1 = 30.5$, $l_2 = 35.5$, $f = 35$, $c = 56$

Median → $l_1 + \frac{\frac{N}{2} - c}{f} (l_2 - l_1)$

$$= 30.5 + \frac{\frac{130}{2} - 56}{35} (35.5 - 30.5)$$

$$= 30.5 + \frac{65 - 56}{35} (5)$$

$$= 30.5 + \frac{9}{7} = 30.5 + 1.29 = 31.79$$

Median = 31.79 Ans.

Ex 51: Calculate the Median for the following:

Marks Below	10	20	30	40	50	60	70	80
No. of Students	15	35	60	84	96	127	198	250

Sol^n:

Class	f	C.f
0 - 10	15	15
10 - 20	20	35
20 - 30	25	60
30 - 40	24	84
40 - 50	12	96
50 - 60	31	127
60 - 70	71	198
70 - 80	52	250
	N = 250	

Here $N = 250$, So $\frac{N}{2} = 125$

So this lies in 127 so Median Class is 50-60

Here. $l_1 = 50$, $l_2 = 60$, $C = 96$, $f = 31$

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$$\text{Median} = l_1 + \frac{\frac{N}{2} - C}{f}(l_2 - l_1)$$

$$= 50 + \frac{125 - 96}{31}(60 - 50)$$

$$= 50 + \frac{29}{31} \times 10$$

$$= 50 + 0.935 \times 10$$

$$= 50 + 9.35$$

Median = 59.35 Ans.

Ex 52: Following is the distribution of Marks of 50 students in a Class:

Marks (More than)	0	10	20	30	40	50
No. of students	50	46	40	20	10	3

Sol^n →

Class	f	Cf
0-10	4	4
10-20	6	10
20-30	20	30
30-40	10	40
40-50	7	47
50-60	3	50
	N=50	

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Here $N = 50$, so $\frac{N}{2} = 25$

$\therefore$ Median Class $20 - 30$

So $l_1 = 20$, $l_2 = 30$, $f = 20$, $C = 10$

$$\text{Median} = l_1 + \frac{\frac{N}{2} - C}{f}(l_2 - l_1)$$

$$= 20 + \frac{25-10}{20}(30-20)$$

$$= 20 + \frac{15}{2\cancel{0}} \times 1\cancel{0}$$

$$= 20 + 7.5$$

$$= 27.5 \text{ Ans}$$

Ex 55: Determine Mode from the following distribution:

x	10	12	14	16	18	20	22
f	4	6	10	11	21	10	5

Sol^n ⇒

~~Class~~ Here Max frequency is 21, So mode is above distribution is 18.

Ex 56 The following table gives the measurement of Collar size of 230 students in a University. Determine the Modal size of the Collar:

Collar-Size	32	33	34	35	36	37	38	39	40	41
No. of Students	7	14	30	28	35	34	16	14	36	16

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Sol 27

x	f	I	II	III	IV	V
32	7	21				
33	14		44	51		
34	30	58			72	
35	28		63			83
36	35	69		87		
37	34		50		85	
38	16	30				64
39	14		50	66		
40	36	52			66	
41	16					

x	32	33	34	35	36	37	38	39	40	41
f										
I					✓	✓				
II				✓	✓					
III				✓	✓	✓				
IV					✓	✓	✓			
V			✓	✓	✓					
	0	0	1	3	5	3	1	0	0	0

Since 36 Repeated highest Number of time
So

Mode = 36 Ans

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Ex57 Determine the Modal Value in the following Series.

Value	10	12	14	16	18	20	22	24	26	28	30	32
Frequency	7	15	21	38	34	34	11	19	10	38	5	2

Sol^n →

Value	f	I	II	III	IV	V
10	7	22				
12	15		36	43		
14	21	59			74	
16	38		72			93
18	34	68		106		
20	34		45		79	
22	11	30				64
24	19		29	40		
26	10	48			67	
28	38		43			53
30	5	7		45		
32	2					

X	10	12	14	16	18	20	22	24	26	28	30	32
f				✓						✓		
I					✓	✓						
II				✓	✓							
III				✓	✓	✓						
IV					✓	✓	✓					
V			✓		✓							
	0	0	1	3	5	3	1	0	0	0	0	0

Since 18 repeated Max of times So Mode of given distribution is 18 Ans.

Ex 58: Obtain Mode of the following distribution:

Classes	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	8	12	25	45	11	9

Solⁿ:- Here Max frequency = 45
So Mode Class is 40-50

$l_1 = 40,\ f_1 = 45,\ f_0 = 25,\ f_1 = 11,\ h = 10$

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

$$= 40 + \frac{45-25}{2\times 45 - 25 - 11} \times 10$$

$$= 40 + \frac{20}{90-36} \times 10$$

$$= 40 + \frac{200}{54}$$

$$= 40 + 3.7$$

$$= 43.7 \text{ Ans}$$

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Ex59: Locate Mode from the following data:

Mid-Value	30	40	50	60	70	80	90
Frequency	7	12	17	29	31	5	3

Sol^n:

Mid Value	Class	f	I	II	III	IV	V
30	25-35	7	19				
40	35-45	12		29			
50	45-55	17	46		36		
60	55-65	29		60		58	
70	65-75	31	36				77
80	75-85	5		8	65		
90	85-95	3				39	

Class	25-35	35-45	45-55	55-65	65-75	75-85	85-95
f					✓		
I			✓	✓			
II				✓	✓		
III				✓	✓	✓	
IV		✓	✓	✓			
V			✓	✓	✓		
	0	1	3	5	4	1	0

Since 55-65 repeated Max 5 times so Mode Class 55-65

So $l_1 = 55$, $f_1 = 29$, $f_0 = 17$, $f_2 = 31$, $h = 10$

So $\text{Mode} = l_1 + \frac{f_1 - f_2}{2f_1 - f_0 - f_2} \times h$

$= 55 + \frac{29 - 17}{2 \times 29 - 17 - 31} \times 10$

$= 55 + \frac{12 \times 10}{10}$

$= 67$

Since 67 not lies in 55 - 65
So 67 is not Mode.

So again
$\text{Mode} = l_1 + \frac{|f_1 - f_0|}{|f_1 - f_0| + |f_1 - f_2|} \times h$

$= 55 + \frac{|29 - 17|}{|f_1 - f_0| + |f_1 - f_2|} \times h$

$= 55 + \frac{12}{|29 - 17| + |29 - 31|} \times 10$

$= 55 + \frac{120}{14}$

$= 55 + 8.57$

$= 63.57$ Ans

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Ex 60: Find the Mode for the following distribution:

Class	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	5	10	20	22	24	6	2

Sol^n:

Class	f	I	II	III	IV	V
0-10	5	15				
10-20	10		30	35		
20-30	20	42			52	
30-40	22		46			66
40-50	24	30		52		
50-60	6		8		32	
60-70	2					

Class	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f					✓		
I			✓	✓			
II				✓	✓		
III				✓	✓	✓	
IV		✓	✓	✓			
V			✓	✓	✓		
	0	1	3	5	4	1	0

Since 5 Repeated Max times of Class 30-40
So Mode Class is 30-40

So $l_1 = 30$, $f_1 = 22$, $f_0 = 20$, $f_2 = 24$, $h = 10$

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

$$= 30 + \frac{22-20}{44-20-24} \times 10$$

$$= 30 + \frac{20}{0}$$

$$= 30 + \infty = \infty$$

Which is Not possible So again :-

$$\text{Mode} = l_1 + \frac{|f_1 - f_0|}{|f_1 - f_0| + |f_1 - f_2|} \times h$$

$$= 30 + \frac{|22-20|}{|22-20| + |22-24|} \times 10$$

$$= 30 + \frac{2}{2+2} \times 10$$

$$= 30 + \frac{\cancel{20}\,5}{\cancel{4}}$$

$$= 30 + 5$$

Mode = 35 Ans.

Ex 65: A distribution $x_1, x_2, \ldots, x_n$ Which frequencies $f_1, f_2, \ldots f_n$ is transformed into the distribution $x_1, x_2, \ldots x_n$ With the Same corresponding frequincies of the relation

$$x_i = ax_i + b, \quad i = 1, 2, 3 \ldots n$$

Where a & b are Constants. Show that the means mode and Median of the New distribution are

given in terms of those of the first distribution are given in terms of those of the first distribution by the Same transformation.

Sol^n:- Given $x_i = ax_i + b$

Let $\bar{x}$ be the mean of initial distribution & $\bar{x}$ be the mean of New distribution by Some transformation

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{\Sigma f_i (a x_i + b)}{\Sigma f_i}$$

$$= \frac{a \Sigma f_i x_i}{\Sigma f_i} + \frac{b \Sigma f_i}{\Sigma f_i}$$

$$\boxed{\bar{x} = a\bar{x} + b}$$ Mean

& Let Median of initial distribution is Md & New distribution is Md' then.

$$Md = L_0 + \frac{\frac{N}{2} - C}{f} \times h$$

So $L_0' = aL_0 + b$

So $Md' = L_0' + \frac{\frac{N}{2} - C}{f} \times ah$

$$= aL_0 + b + \frac{\frac{N}{2} - C}{f} \times ah$$

$$= a\left(L_0 + \frac{\frac{N}{2} - C}{f} \cdot h\right) + b$$

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$\boxed{M_d' = a M_d + b}$ Median

Let Mode of initial distribution is M_o & New distribution is M_o' then

$$M_o = L_o + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$x_1 = a x_1 + b$$

$$\text{So } M_o' = (a L_o + b) + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times ah$$

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

$\boxed{M_o' = a M_o + b}$ Mode Ans.

Ex 67: The Monthly incomes of 10 families are given by the following table:

A	B	C	D	E	F	G	H	I	J	Total
85	70	25	75	500	20	45	250	40	36	1136

Compute the airthmetic Mean, geometric Mean & Harmonic Mean of the above incomes. Which of the above three means represents the data Most Suitable? Give reasons.

Sol^n → Here $N = 10$

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Arithmetic Mean

$$A = \frac{\Sigma X_i}{n} = \frac{1136}{10} = \boxed{113.6}$$ Arithmetic Mean

Geometric Mean

$$G = (85 \times 70 \times 15 \times 75 \times 500 \times 20 \times 40 \times 250 \times 40 \times 36)^{1/10}$$

$$\log G = \frac{1}{10}[\log 85 + \log 70 + \log 15 + \log 75 + \log 500 + \log 20 + \log 40 + \log 250 + \log 40 + \log 36]$$

$$= \frac{1}{10}[1.9294 + 1.8451 + 1.1761 + 1.8751 + 2.6980 + 1.3010 + 1.6532 + 2.3979 + 1.6021 + 1.5563]$$

$$= \frac{1}{10} \times 18.0342 = 1.80342 = \log 63.59$$

$$\boxed{\text{So } G = 63.59 \text{ ₹}}$$ Geometric Mean

$$\text{Harmonic Mean} = \frac{N}{\frac{1}{x_1} + \frac{1}{x_2} - - - - - - - - - - - \frac{1}{x_{10}}}$$

$$= \frac{10}{\frac{1}{85} + \frac{1}{70} + \frac{1}{15} + \frac{1}{75} + \frac{1}{500} + \frac{1}{20} + \frac{1}{75} + \frac{1}{250} + \frac{1}{40} + \frac{1}{56}}$$

$$= \frac{10}{0.01176 + 0.0143 + 0.0667 + 0.0133 + 0.002 + 0.05 + 0.0222 + 0.004 + 0.025 + 0.0278}$$

$$= \frac{10}{0.23706} = \boxed{42.18}$$ Harmonic Mean

Ans

The Geometric Mean Representation the data Most Suitable. Since out of 10 families, 8 families has their income less than A.M & H.M is represent the lower income Group only Ans.

Ex 68: The Expenditure of 100 families are given by

Expenses in Ruppies	0-10	10-20	20-30	30-40	40-50
No. of families	14	2	27	?	15

The Mode for the distribution is 24. Find the Missing frequencies.

Sol^n →

Class	f	Cf
0-10	14	14
10-20	f_1	$14 + f_1$
20-30	27	$41 + f_1$
30-40	f_2	$41 + f_1 + f_2$
40-50	15	$56 + f_1 + f_2$

$N = 100 = 56 + f_1 + f_2$

$56 + f_1 + f_2 = 100$

$f_1 + f_2 = 100 - 56$

$f_1 + f_2 = 44$ — (1)

& Mode = 24

Mode Class is 20-30

$l_1 = 20$, $f_1 = 27$, f_0, $f_2 = f_2$

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

$$24 = 20 + \frac{27 - f_1}{54 - f_1 - f_2} \times 10$$

$$24 = \frac{27 - f_1}{54 - f_1 - f_2} \times 10$$

$$108 - 2f_1 - 2f_2 = 135 - 5f_1$$
$$5f_1 - 2f_1 - 2f_2 = 135 - 108$$

$$3f_1 - 2f_2 = 27$$
$$f_1 + f_2 = 44 \quad \times 2$$
$$5f_1 = 27 + 88$$

$$5f_1 = 115$$
$$f_1 = 23$$

from ① $23 + f_2 = 44$
$$f_2 = 44 - 23$$
$$f_2 = 21$$

So $f_1 = 23$, & $f_2 = 21$ Ans

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Ex 75: The Mean of the following frequency distribution is 62.8 and the Sum of all frequencies is 50. Compute the Missing frequency f_1 & f_2

Class	0-20	20-40	40-60	60-80	80-100	100-120	Total
Frequency	5	f_1	10	f_2	7	8	50

Sol^n:

Given $\bar{x} = 62.8$

$\Sigma f = 50$

Class	x	f	fx
0-20	10	5	50
20-40	30	f_1	$30f_1$
40-60	50	10	500
60-80	70	f_2	$70f_2$
80-100	90	7	630
100-120	110	8	880
		$30+f_1+f_2$	$2060+30f_1+70f_2$

Since $\Sigma f = 50$

$30 + f_1 + f_2 = 50$

$f_1 + f_2 = 20$ — (1)

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

$$62.8 = \frac{2060 + 30f_1 + 70f_2}{50}$$

$$3140 = 2060 + 30f_1 + 70f_2$$

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$$3f_1 + 7f_2 = 108$$
$$-\ 3f_1 \pm 3f_2 = 60$$

$$4f_2 = 48$$
$$f_2 = 12$$

From (1) :-

$$f_1 + 12 = 20$$
$$f_1 = 8$$

So $f_1 = 8$ & $f_2 = 12$ Ans