MEAN DEVIATION

A defect of the range is that it is based on only two values. The highest and the lowest, it doesn't take into consideration all of the values

The Mean Deviation does take into consideration all of the values.

The mean of the absolute deviations of observations from mean is called as Mean Deviation

$$M.D = \frac{\Sigma |X - \bar{X}|}{n}$$

Here;

X: Value of each observation

$\bar{X}$: is mean of values

n: is no: of obs in sample

| |: indicates the absolute value.

=> Merits of M.D:

- It is easy to calculate
- It is based on all the obs

=> Demerits of M.D:

- It ignores algebric sign(-)

Example:

45, 32, 37, 46, 39, 36, 41, 48, 36

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

$$= \frac{45+32+37+46+39+36+41+48+36}{9}$$

$$= 40$$

X	$X - \bar{X}$	$\lvert X - \bar{X} \rvert$
45	5	5
32	-8	8
37	-3	3
46	6	6
39	-1	1
36	-4	4
41	1	1
48	8	8
36	-4	4
		40

$$M.D = \frac{\Sigma |X - \bar{X}|}{n}$$

$$= \frac{40}{9}$$

$$M.D = 4.4$$

20, 40, 50, 60, 80

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

$$= \frac{20+40+50+60+80}{5}$$

$$= 50$$

X	$X-\bar{X}$	$\lvert X-\bar{X}\rvert$
20	-30	30
40	-10	10
50	0	0
60	10	10
80	30	30
		80

$$M.D = \frac{80}{5} \qquad M.D = 16$$

20, 49, 50, 51, 80

$$\bar{X} = \frac{20+49+50+51+80}{5}$$

$$= 50$$

X	$X-\bar{X}$	$\lvert X-\bar{X}\rvert$
20	-30	30
49	-1	1
50	0	0
51	1	1
80	30	30
		62

$$M.D = \frac{\lvert X-\bar{X}\rvert}{n}$$

$$= \frac{62}{5}$$

$$= 12.4$$

⇒ Example

88.03, 94.50, 94.90, 95.05, 84.60

$\bar{X} = \frac{663}{10}$

Example:

88.03, 94.50, 94.90, 95.05, 84.60

$\bar{X} = \frac{88.03 + 94.50 + 94.90 + 95.05 + 84.60}{5}$

$= 91.416$

X	$X - \bar{X}$	$\lvert X - \bar{X} \rvert$	
88.03	-3.386	3.386	$MD = \frac{\lvert X - \bar{X} \rvert}{n}$
94.50	3.084	3.084	
94.90	3.484	3.484	$= \frac{20.404}{5}$
95.05	3.634	3.634	
84.60	-6.816	6.816	$= 4.0808$
		20.404	

Example:

2, 5, 6, 6, 8, 9, 12, 13, 16, 23

$\bar{X} = \frac{\Sigma X}{10}$

$= 10$

X	$X - \bar{X}$	$\lvert X - \bar{X} \rvert$
2	-8	8
5	-5	5
6	-4	4
6	-4	4

8	-2	2
9	-1	1
12	2	2
13	3	3
16	6	6
23	13	13
		48

$$M.D = \frac{|x - \bar{x}|}{n}$$

$$= \frac{48}{10} \Rightarrow 4.8$$

Imp MCQ

measure of dispersion

Stardard deviation is best ↑ bcz M.D ignore (-ve sign) and in variance interpretation not right bcz answer came in square. unit even g in square

S.D take $\sqrt{}$ & not ignore signs

The Mean (or Average) Deviation:

The mean deviation of a set of data is defined as arithmetic mean of deviations measured either from mean or from median

- All deviations are counted as +ve

Reason:

Reason to count deviation as positive i.e to disregard the algebric signs (+ve & -ve) is to avoid the difficulty using from property that sum of deviations of obs from their mean is zero.

The symbolic defination of Mean deviation from mean is:

$$M.D = \frac{\Sigma |x_i - \bar{x}|}{n} \quad \text{for sample data}$$

$$M.D = \frac{\Sigma |x_i - \mu|}{N} \quad \text{for population data}$$

where $|x_i - \bar{x}|$ & $|x_i - \mu|$ pronounced "mod. deviations") indicate absolute deviations of obs from mean of sample & population respectively. It is more appropriate to call it mean absolute deviation (M.A.D)

For grouped data:

$$M.D = \frac{\Sigma f_i |x_i - \bar{x}|}{n}$$

The mean deviation is also defined in terms of absolute deviations from median in a similar way.
The mean deviation is least when deviation measured from median.
But in practice it generally calculated from arithmetic mean.
The mean deviation gives more info than range or quartile deviation as it is based on observed values.

→ Mean deviation is absolute measure of dispersion. Its relative measure known as coefficient of mean deviation, is obtained by dividing mean deviation by average used in calculation of observations. (Thus) *

Example:
Calculate mean deviation from i) the mean ii) the median, of following set of examination marks:
45, 32, 37, 46, 39, 36, 41, 48 & 36
Also calculate coefficient of M.D

Median: We first arrange given marks in ↑ing sequence.

32, 36, 36, 37, 39, 41, 45, 46, 48

Median - odd so (Not this formula for odd)

$$\frac{n+1}{2} \qquad \frac{9+1}{2} = 5.5$$

5^{th} ... 39

Mean:

$$\bar{X} = \frac{\Sigma X}{n} = \frac{32+36+36+37+39+41+45+46+48}{9}$$

$$= 40$$

Necessary calculations:

x_i	$x_i - \bar{x}$	$\lvert x_i - \bar{x} \rvert$	$\lvert x_i - \text{median} \rvert$
32	-8	8	7
36	-4	4	3
36	-4	4	3
37	-3	3	2
39	-1	1	0
41	1	1	2
45	5	5	6
46	6	6	7
48	8	8	9
		40	39

M.D(from mean) $= \frac{\Sigma|x_i - \bar{x}|}{n} = \frac{40}{9} = 4.4$ marks

M.D(from median) $= \frac{\Sigma(x_i - \text{median})}{n} = \frac{39}{9} = 4.3$

Coefficient of M.D $= \frac{\text{M.D}}{\bar{x}}$ or $\frac{\text{M.D}}{\text{median}}$

$= \frac{4.4}{40}$ or $\frac{4.3}{39}$

$= 0.11$ or 0.11

Example:

Calculate mean deviation of following freq distribution showing weight of apples:

Weight(grams)	65-84	85-104	105-124	125-144	145-164	165-184	185-204
	9	10	17	10	5	4	5

$\bar{x} = \frac{7350}{60} = 122.5$g

Weight	x_i	f_i	$f_i x_i$	$x_i - \bar{x}$	$f_i\|x_i - \bar{x}\|$	C.F
65-84	74.5	9	670.5	48	432	9
85-104	94.5	10	945	-28	280	9+10=19
105-124	114.5	17	1946.5	-8	136	19+17=36
125-144	134.5	10	1345	12	120	46
145-164	154.5	5	772.5	32	160	51
165-184	174.5	4	698	52	208	55
185-204	194.5	5	972.5	72	360	60
	941.5	60	7350	252	1696	

M·D from mean = $\frac{\Sigma f|X-\bar{X}|}{n}$ ___ = $\frac{\Sigma f|x-\bar{x}|}{n}$

M·D from median = $l + \frac{h}{f}\left(\frac{n}{2} - c\right) = \frac{\Sigma f|x-\text{median}|}{n}$

Weight	f	x_i	$\lvert x-\bar{x}\rvert$	$f\lvert x-\bar{x}\rvert$	fx_i	$\lvert x-\text{median}\rvert$	C.F
65-84	9	74.5	48	432	670.5	42.94	9
85-104	10	94.5	28	280	945	22.94	19
105-124	17	114.5	8	136	1946.5	2.9	36
125-144	10	134.5	12	120	1345	17.06	46
145-164	5	154.5	32	160	772.5	37.06	51
165-184	4	174.5	52	208	698	57.06	55
185-204	5	194.5	72	360	972.5	77.06	60
	60	941.5	252	1696	7350	257.02	

C·B

64.5 – 84.5
85.5 – 104.5
104.5 – 124.5
124.5 – 144.5
144.5 – 164.5
164.5 – 184.5
184.5 – 204.5

$f|x_i - \text{median}|$

386.46
229.4
49.98
170.6
185.3
228.3
385.3
1635.28

Mean = $\frac{\Sigma fX}{n}$

= $\frac{7350}{60}$

= 122.5

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

Median = $\frac{n}{2}$ = 30

= $104.5 + \frac{20}{17}(30-19)$

= $104.5 + 1.17647(11)$

= 117.44

M·D from mean

= $\frac{\Sigma f|x-\bar{x}|}{n}$

= $\frac{1696}{60}$

= 28.267

M·D from median

= $\frac{\Sigma f|x-\text{median}|}{n}$

= $\frac{1635.28}{60}$

= 27.25

Estimate Mean Deviation from A.M

Marks	No of Students
0 – 9	2
10 – 19	3
20 – 29	8
30 – 39	24
40 – 49	27
50 – 59	40
60 – 69	11
70 – 79	5

Marks	f	x_i	fx_i	$x_i - \bar{x}$	$f_i \lvert x_i - \bar{x} \rvert$
0 – 9	2	4.5	9	41.66	383.32
10 – 19	3	14.5	43.5	31.66	94.98
20 – 29	8	24.5	196	21.66	173.28
30 – 39	24	34.5	828	11.66	279.84
40 – 49	27	44.5	1201.5	1.66	44.82
50 – 59	40	54.5	2180	8.34	333.6
60 – 69	11	64.5	709.5	18.34	201.74
70 – 79	5	74.5	372.5	28.34	141.7
	316		5540	163.32	1353.28

$$M.D = \frac{\sum f_i |x_i - \bar{x}|}{n}$$

$$M.D = 11.27$$

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

$$= \frac{5540}{120}$$

$$= 46.16$$

MOTOWOTOFUS

Find Arithmetic mean & S.D of expenditure at both places

Range of expenditure in rupees per month	No of families Place A	Place B
30 — 60	28	39
60 — 90	292	284
90 — 120	389	401
120 — 150	212	202
150 — 180	59	48
180 — 210	18	31
210 — 240	2	5

Rupees	f	x_i	fx_i	fx_i^2
30-60	28	45	1260	56700
60-90	292	75	21900	1642500
90-120	389	105	40845	4288725
120-150	212	135	28620	3863700
150-180	59	165	9735	1606275
180-210	18	195	3510	684450
210-240	2	225	450	101250
	1000		106320	12243600

$$S = \frac{\Sigma f x_i^2}{n} - \left(\frac{\Sigma f x_i}{n}\right)^2 = 12243.6 - 11303.9 = 939.7$$

$$= \frac{12243600}{1000} - \left(\frac{106320}{1000}\right)^2 = 30.65$$

Rupees	f	x_i	fx_i	fx_i^2
30-60	39	45	1755	78975
60-90	284	75	21300	1597500
90-120	401	105	42105	4421025
120-150	202	135	27270	3681450
150-180	48	165	7920	1306800
180-210	31	195	6045	1178775
210-240	5	225	1125	253125
	1010		107520	12517650

$$S.D = \frac{\Sigma fx_i^2}{n} - \left(\frac{\Sigma fx_i}{n}\right)^2$$

$$= \frac{12517650}{1010} - \left(\frac{107520}{1010}\right)^2$$

$$= 12393.71 - 11332.76$$

$$= 1060.95$$

$$= 32.57$$

Mean Deviation for Grouped data

X	f	x_i	fx	$\lvert x_i - 6.57 \rvert$	$f\lvert x_i - \bar{x} \rvert$
2-4	2	3	6	3.57	7.14
4-6	3	5	15	1.57	4.71
6-8	6	7	42	0.43	2.58
8-10	2	9	18	2.43	4.86
10-12	1	11	11	4.43	4.43
	14		92		23.72

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

$$= \frac{92}{14} = 6.57$$

$$M.D = \frac{\Sigma f\lvert x_i - \bar{x} \rvert}{n}$$

$$= \frac{23.72}{14}$$

$$= 1.694$$

Compute M.D from X & M for given series:

X	C.B	f	C.F
5	2.5 — 7.5	3	3
10	7.5 — 12.5	4	7
15	12.5 — 17.5	8	15
20	17.5 — 22.5	12	27 ✓
25	22.5 — 27.5	~~7~~	34
30	27.5 — 32.5	2	36

(Jo C.F hum select kartai Us mein ki X ki value median ka hai)

Sol

X	f	x_i	fx	$\lvert x_i - 18.05 \rvert$	$f\lvert x_i - \bar{x} \rvert$	$\lvert x_i - \text{median} \rvert$
5	3	5	15	13.05	39.15	14
10	4	10	40	8.05	32.2	9
15	8	15	120	3.05	24.4	4
20	12	20	240	1.95	23.4	1
25	7	25	175	6.95	48.65	6
30	2	30	60	11.95	23.9	11
	36		650		191.7	45

$$\bar{X} = \frac{\Sigma fx}{n} = \frac{650}{36} = 18.05$$

$$M.D = \frac{f\lvert x_i - \bar{x} \rvert}{n} = \frac{191.7}{36} = 5.3$$

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

We mate C.B for median $= \frac{n}{2} = \frac{36}{2} = 18$

$$= 17.5 + \frac{5}{12}\left(\frac{2}{18 - 15}\right)$$

$$= 17.5 + 0.416(3)$$

$$= 18.75$$

M.D (from Median) $= \frac{\Sigma \lvert x_i - \text{median} \rvert}{n} = \frac{45}{36} = 1.25$

Q) Find S.D

X	X^2	Y	Y^2
58	3364	39	1521
49	2401	38	1444
76	5776	86	7396
80	6400	72	5184
47	2209	75	5625
72	5184	69	4761
61	3721	57	3249
59	3481	49	2401
77	5929	83	6889
48	2304	66	4356
627	40769	634	

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

$\bar{X} = \frac{627}{10}$

$= 62.7$

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

$\bar{Y} = \frac{634}{10}$

$= 63.4$

Have same Units so we don't find coefficient

$S_x = \sqrt{\frac{\Sigma X^2}{N} - \left(\frac{\Sigma X}{N}\right)^2}$

$S_x = \sqrt{\frac{40769}{10} - (62.7)^2}$

$S_x = \sqrt{4076.9 - 393129}$

$S_x = 12.06$

$S_y = \sqrt{\frac{\Sigma Y^2}{N} - \left(\frac{\Sigma Y}{N}\right)^2}$

$= \sqrt{\frac{42826}{10} - (63.4)^2}$

$S_y = \sqrt{4282.6 - 4019.56}$

$= \sqrt{263.04}$

$= 16.21$

Important

x is more

To measure uncertainty we use probability chances

Set → A well defined thing
(distinct way)

Members & element →
Set A = {a, b, x, y}

PROBABILITY

History:

The foundation of probability were laid by two French mathematicians of the 17th century- Blaise Pascal (1623-1662) and Pierre De Fermat (1601-1665)

Probability:

A numerical measure of the chance that an uncertain event will happen is called probability.

Example: toss a coin, draw a card, and throw a dice.

It is clear what we mean when we make a statements of the type that it is likely to rain today. Or I have a fair chances of passing annual examination.

MOTOWOTOFOS

Set:

A set is well defined collection or list of distinct objects and term distinct means that each object must appeas only once.

For example: a group of students, the book in library.

Members/Elements:

The objects that are in a set called members of elements of that set.

Set are usually denoted by capital letters such as A, B, C, Y. while 3 elements are represented by small letters such as a, b, c, d, y

A = {a, b, x, y} or B = {1, 2, 3, 4, 7} where A and B are two sets and a, b, x, y are elements / member of set A and 1, 2, 3, 4, 7 are elements of set B

The no: of a set A, written as n(A)

If A = {a, b, x, y} then the total elements of set A are 4 then n(A) = 4.

Kisi bhi cheez ki probability 0 – 1 kai darmiyan ho gi. As to toss coin how much chances to come head 50%. $\frac{50}{100} = 0.5$%

Sample space → All possible outcomes of an experiment said as sample space

like of dice is 6 so A {1, 2, 3, 4, 5, 6}

n(A) = probability
n(S) = Sample space

n = no of elements
So here n of A is (6)

S = 7
A = 16
B = 4

Random Experiment:

Experiment:

The term experiment means a planned activity or process whose results yield a set of data.

A single performance of an experiment is called a trial. The result obtained from experiment or trial called outcome.

Random Experiment:

An experiment which produces diff results even though it is repeated a large no: of times under essentially similar conditions, called a random experiment.

Example: tossing of fair coin, Throwing a balanced dice.

Sample Space:

A set consisting of all possible outcomes that can result from random experiment called sample space

1- If we throw a dice

A = {1, 2, 3, 4, 5, 6} sample space

All possible outcomes of our experiment.

2- If we toss a single coin there are 2 possible outcomes of experiment head or tail.

Probability of A = n(A) → Variable of interest / n(S) (Event kitni dafa aya)

(A) → Interest

Now we wanna see Head kitni dafa a sakta (Jesai ko coin S = {H, T}

A = {Head}

Probability of A = n(1) / n(2)

So its probability is 1/2

Assignment:

i) S = {ball, pen, table, coin, die, card, book}

n(S) = {7}

ii) A = {1, 3, 5, 7, 8, 9, 0, 4, 2, 12}

n(A) = {10}

iii) B = {book, city, clock, teacher}

n(B) = {4}