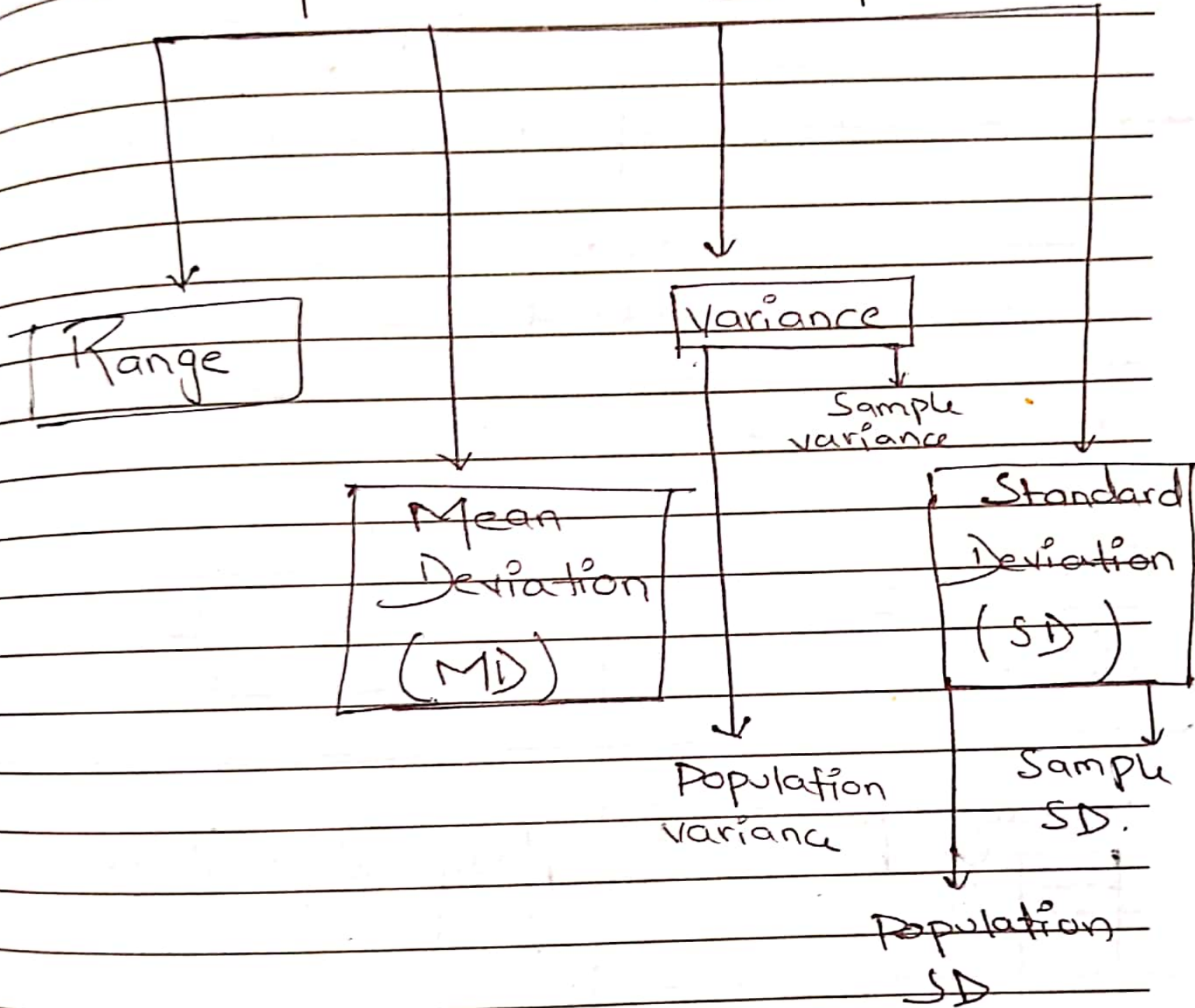


MEASURES OF VARIABILITY

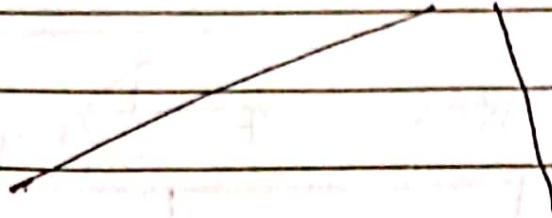
OR

MEASURES OF DISPERSION.



Dispersion:

Spread / Dispersion / variability
around the center of
dataset.



center of
dataset

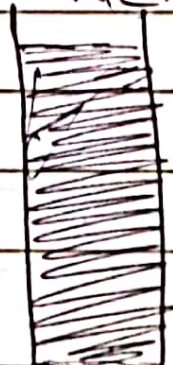
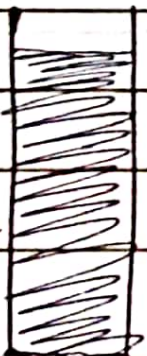
For Example there are two
Brands.

Brand I
(Pepsi)

Brand II
(Coca-Cola)

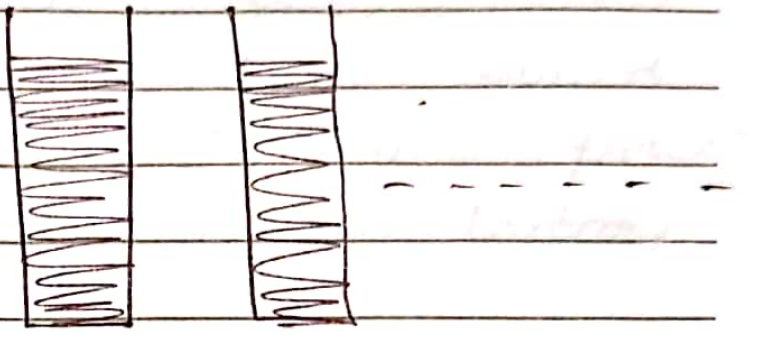
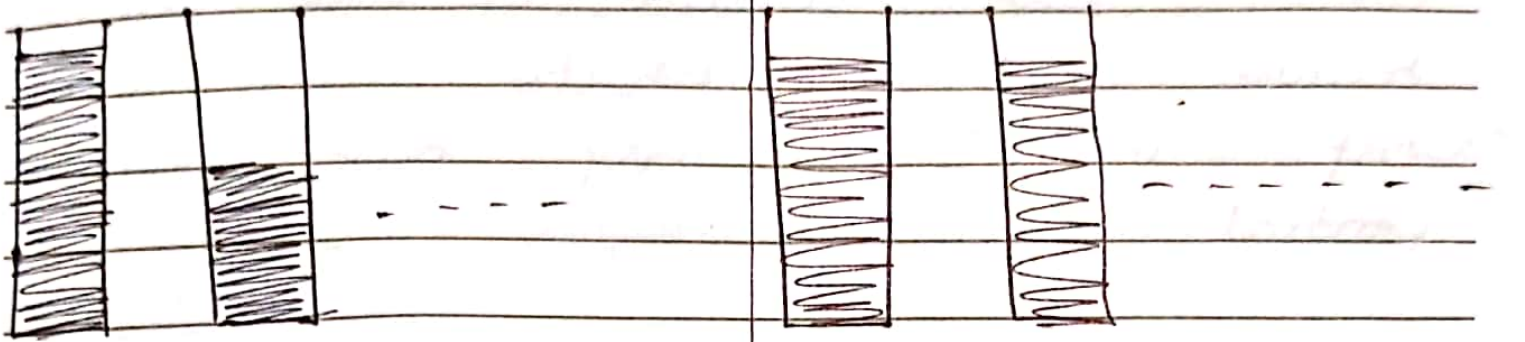
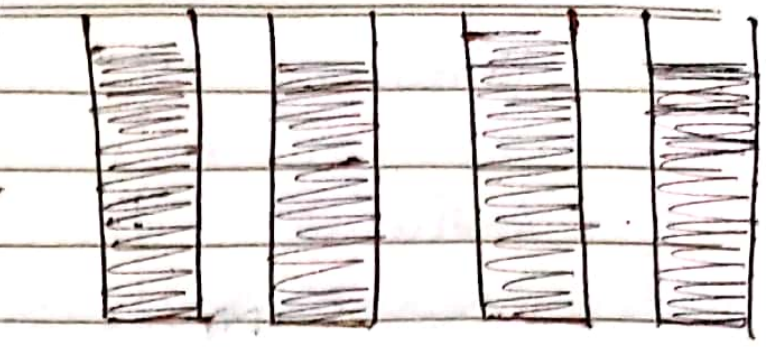
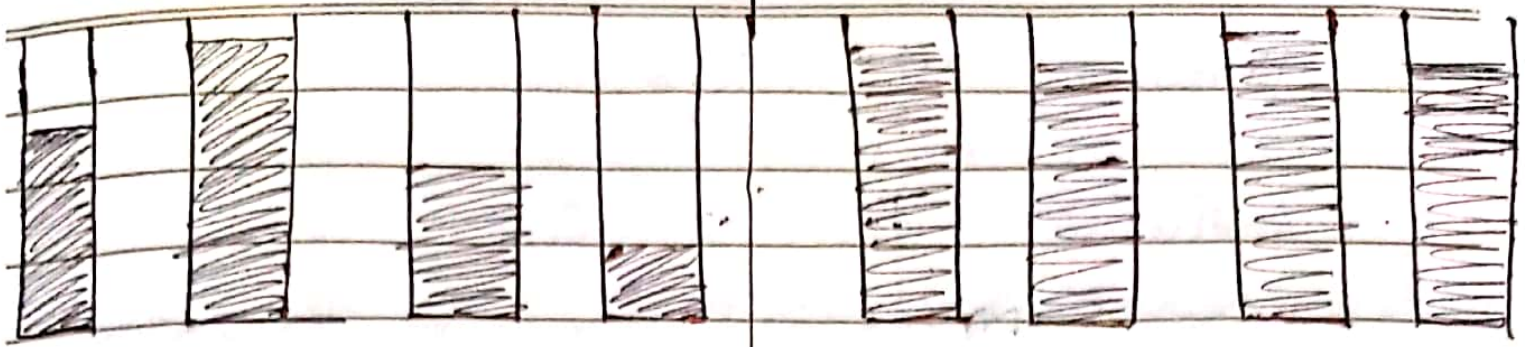
Average quantity = 1.5
Ltr

Average quantity = 1.5
Ltr



Pepsi
 Mo Tu We Th Fr Sa Su
 O O O O O O O

Coca Cola
 Memo no. _____
 Date / /



- High Dispersion / Spread - Low Dispersion / spread
 / variability in dataset | variability in dataset

- Customer find it low quality Product
 - Customer Buy this Brand More

⇒ Measures of Dispersion:

A measure of location only describes the center of the data. It does not tell us anything about the spread of the data, because any two datasets with different variability may have same central tendency. i.e.,

Dataset I



8, 7, 5, 8, 6



$$\bar{X} = 6.8$$



Less variation
or Dispersion

Dataset II



1, 4, 7, 10, 12



$$\bar{X} = 6.8$$



More variation
or dispersion

A numerical quantity that describes the spread of the values in a dataset is called a measure of Dispersion / ~~variation~~ variability.

⇒ Range :

It is the difference b/w the largest and the smallest value in a dataset.

Range = Largest value - Smallest value.

⇒ Merits of Range :

- It is easy to calculate.
- " " " " understand.

⇒ Demerits of Range :

- It is not based on all values.
- It depends only upon extreme values (i.e., largest & smallest)

→ Example:

DataSet I:

48, 49, 50, 51, 52

Range = Largest value - Smallest value

$$= 52 - 48$$

$$\boxed{\text{Range} = 4}$$

→ Example:

Data Set I:

40, 41, 42, 43, 44, 45, 46, 47,
48, 49, 50, 51, 52, 53, 54, 55,
56, 57, 58, 59, 60

$$\text{Range} = 60 - 40$$

$$\boxed{\text{Range} = 20}$$

⇒ Example :

Calculate range for the following observations (in cm).

X
84.2
87.5
80.7
92.4
91.9
86.5
85.4

$$R = 92.4 - 80.7$$

$$R = 11.7 \text{ cm}$$

⇒ Example :

The marks obtained by 9 students are given below.

X
45
32
37
46
39
36
41
48
36

$$R = 48 - 32$$

$$R = 16 \text{ marks}$$

→ Example:

X
12
6
7
-3
15
10
18
5
-24

$$R = 18 - (-24)$$

$$= 18 + 24$$

$$\boxed{R = 42}$$

⇒ Example :

X

19

3

→ Smallest

8

9

7

8

10

12

18

21

→ Largest

$$R = 21 - 3$$

→ Example :

X

4

4

4

4

4

4

4

4

4

4

4

4

4

$$R = 4 - 4$$

$$\boxed{R = 0}$$

Range of constant is zero.

Mean Deviation.

A defect of the range is that it is based on only two values, the highest & 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 Mean Deviation.

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

Here:

X : is the value of each observation

\bar{X} : is the mean of the values.

n : is the number of observations in the sample.

$| |$: indicates the absolute value.

⇒ Merits of MD:

- It is easy to calculate
- " " based on all the observations.

⇒ Demerits of MD:

- It ignores algebraic sign. (~~—~~)

⇒ Example :

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

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

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

$$= \frac{360}{9} = 40$$

X	$X - \bar{X}$	$ X - \bar{X} $
-----	---------------	-----------------

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
		<hr/>
		40

$$MD = \frac{\sum |x - \bar{x}|}{n}$$

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

$$MD = 4.4$$

→ Example :

20, 40, 50, 60, 80

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

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

$$= \frac{250}{5}$$

$$\boxed{\bar{x} = 50}$$

X	$x - \bar{x}$	$ x - \bar{x} $
---	---------------	-----------------

20	-30	30
----	-----	----

40	-10	10
----	-----	----

50	0	0
----	---	---

60	10	10
----	----	----

80	30	30
----	----	----

		<u>80</u>
--	--	-----------

$$MD = \frac{80}{5}$$

$$MD = 16$$

⇒ Example:

20, 49, 50, 51, 80

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

$$= \frac{250}{5}$$

$$\boxed{\bar{x} = 50}$$

x	$x - \bar{x}$	$ x - \bar{x} $
20	-30	30
49	-1	1
50	0	0
51	1	1
80	30	30
		<hr/>
		62

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

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

$$M.D = 12.4$$

→ Example:

88.03, 94.50, 94.90, 95.05, 84.60

$$\bar{x} = \frac{457.08}{5}$$

$$= 91.416$$

x	$x - \bar{x}$	$ x - \bar{x} $
-----	---------------	-----------------

88.03	-3.386	3.386
-------	--------	-------

94.50	3.084	3.084
-------	-------	-------

94.90	3.484	3.484
-------	-------	-------

95.05	3.634	3.634
-------	-------	-------

84.60	-6.816	6.816
-------	--------	-------

20.404

$$MD = \frac{\sum |x - \bar{x}|}{n}$$

$$= \frac{20.404}{5} = \boxed{4.0808}$$

⇒ Example :

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

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

$$= \frac{100}{10}$$

$$\boxed{\bar{X} = 10}$$

X	$X - \bar{X}$	$ X - \bar{X} $
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
		<hr/> 48

0101

$$MD = \frac{\sum |x - \bar{x}|}{n}$$

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

$$MD = 4.8$$