MEASURES OF CENTRAL TENDENCY (location):

- A *measure of central tendency* is a descriptive statistic that describes the average, or typical value of a set of scores
- There are three common measures of central tendency:

✓ Arithmetic mean (A.M.): it is the ratio between the sum of variables and total number of observations.
✓ Mode
✓ Median

Other measures of central tendency are

1. Geometric Mean (G.M.)

2. Harmonic Mean (H.M.)

3. Weighted Mean (W.M.)

The most important types of mean are:

✓ Arithmetic mean ($\bar{X}$)

- For ungrouped data:

Sample: $\bar{X} = (\Sigma x_i)/n = x_1+x_2+x_3+\ldots\ldots x_n/n$

Population: $\mu = (\Sigma x_i)/N = x_1+x_2+x_3+\ldots\ldots x_n/N$

- Grouped data:

Sample: $\bar{X} = \Sigma f i\ xi/n$

Population: $\mu = \Sigma f i\ xi/N$ $N=\Sigma f$

Example: from the following information calculate the mean of marks for (5) students in statistic.

Students	*1*	*2*	*3*	*4*	*5*
Marks (xi)	*95*	*70*	*75*	*90*	*82*

$\bar{X} = (\Sigma x_i)/n = x_1+x_2+x_3+\ldots\ldots x_n/n$

=(95+70+75+90+82/5=82.4

Averages from Grouped Data

Frequency Distribution

No. of plants (X)	*1*	*2*	*3*	*4*	*5*
No. of flowers (f)	*11*	*10*	*5*	*3*	*1*

X	*f*	*fX*
1	11	11
2	10	20
3	5	15
4	3	12
5	1	5

$\Sigma fi = 30$ $\Sigma f\,xi$=63 ⟹ $\bar{X}$ = $\Sigma f\,xi/n$=63/30=2.1

Grouped Frequency Distribution

The lengths of 32 leaves were measured correct to the nearest mm. Find the mean length.

Length (mm)	*20–22*	*23–25*	*26–28*	*29–31*	*32-34*
Frequency	*3*	*6*	*12*	*9*	*2*

Length (mm)	Class mark (X_i)	f	f_iX_i
20–22	21	3	63
23–25	24	6	144
26–28	27	12	324
29–31	30	9	270
32–34	33	2	66

$\Sigma fi = 32$ $\Sigma f_i\,x_i$=867

$\bar{X}$ = $\Sigma fixi/n$=867/32=27.1 mm

✓ Mode (Mo): it is a datum which repeated more than others.
The mode may be:
- One datum
- More than one datum
- No mode

Example: The following data are the random height of 6 plants (cm):
1. 60, 65, 80,70, 80, 80
2. 69, 50, 73, 54, 69, 73
3. 60, 63, 80, 70, 65, 50

✓ Median (Me): is the value of datum which location at the middle of data after arranging them.
For calculating median we must:
1. Arrange the data from the lower value to the upper value or from upper to lower.
2. Limiting the Median value by one of these equations :
A/Median series = (n+1)/2 (in case of odd numbers)

Example: If the $CaCO_3$ % off (11) soil samples of were{20,23,30,24,25,26,27,29,30,21 and 20} , calculate median value.

1-Sample size =11
2-Data after arrangement: 20, 20, 21, 23, 24, 25, 26, 27, 29,30, 30.
3-Median series is (11+1)/2 =6
4-The Median value (Me) =25
B/ Median series =n/2 and (n/2)+1 ,(in case of even number)
Example: If the number of apple /tree for 10 trees are :
30, 24, 34, 29, 40, 38, 50, 46, 52 and 52

Find the Median.
24,29,30, 34, 38, 40, 46, 50, 52, 52
Median series are : n/2 = 10/2 =5
And (n/2)+1 =(10/2) +1=6
Median value = (38+40)/2 =39

- Geometric Mean (G.M.)

G.M=$\sqrt[n]{x_1 x_2 x_3 \ldots\ldots\ldots\ldots\ldots\ldots x_n}$

- It is useful for averaging ratios and percentages rates are increase or decrease.

Example: The average person's monthly salary in a company jumped from $2,500 to $5,000 over the course of ten years. Using the geometric mean, what is the average yearly increase?

G.M=$\sqrt[n]{x_1 x_2 x_3 \ldots\ldots\ldots\ldots\ldots\ldots x_n}$

=$\sqrt[2]{2500 * 5000}$=3535.53/10=353.53 is average increase over ten years (according to the G.M).

- Harmonic Mean (H.M.)
  - The harmonic mean is a very specific type of average
  - It's generally used when dealing with averages of units, like speed, time or other rates such as km/hour, km/litre, etc.
  - It can be computed when one or more items are zero

H.M=$\frac{n}{\sum 1/xi}$

Example: Ali drives a car at 20 mph for the first hour and 30 mph for the second. What's his average speed?

$$\text{H.M} = \frac{n}{\sum 1/xi} = 2/(1/20) + (1/30) = 2/(0.05+0.033)$$

$$= 24.09 \text{ mph or miles/hour}$$

- Weighted Mean:

$$\bar{X}w = \frac{\sum X_i w_i}{\sum w_i}$$

Example: the following data represent a student marks of the first course:

Subject	marks (X_i)	unit(w_i)	$X_i w_i$
Statistics	93	3	93*3=279
Computer	90	2	90*2=180
English	87	2	87*2=154
		$\sum wi = 7$	$\sum x_i w_i = 613$

$$\bar{X}w = \frac{\sum X_i w_i}{\sum w_i} = 613/7 = 87.57$$