جامعة المستقبل

كلية التقنيات الطبية والصحية

قسم تقنيات البصريات

محاضرات التطبيقات الإحصائية 1

الكورس الأول

المحاضرة الثالثة

المرحلة الثانية

2024-2023

م.د. ايناس رضا علي

Properties of Mean

1. It requires at least the interval scale.
2. All values are used.
3. It is unique.
4. It is easy to calculate and allow easy mathematical treatment.
5. The sum of the deviations from the mean is 0.
6. The arithmetic mean is the only measure of central tendency where the sum of the deviations of each value from the mean is zero.
7. It is easily affected by extremes, such as very big or small numbers in the set (non-robust).

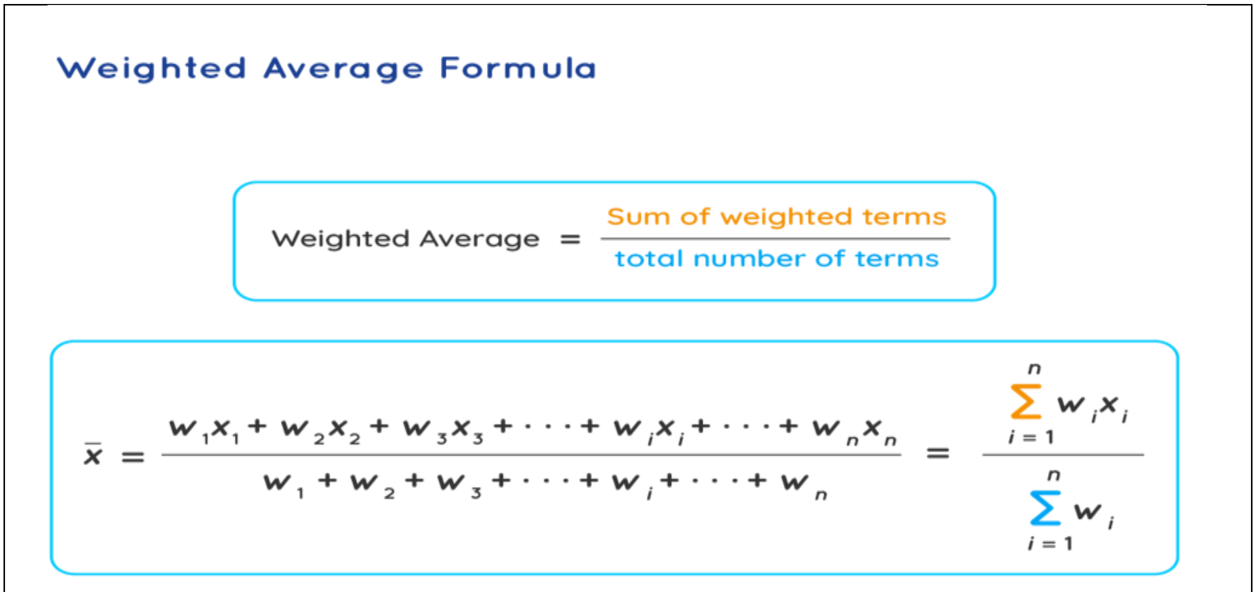
How Extremes Affect the Mean?

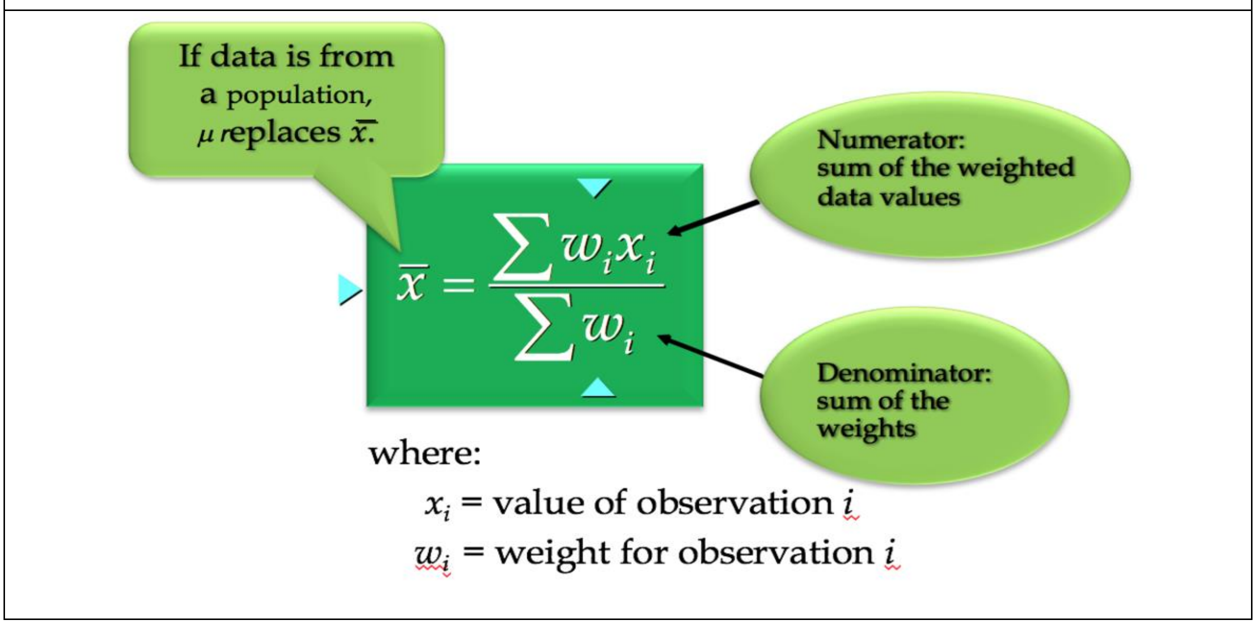
1. The mean of the values 1,1,1,1,100 is 20.8.
2. However, 20.8 does not represent the typical behavior of this data set!
3. Extreme numbers relative to the rest of the data are called outliers!
4. Examination of data for possible outliers serves many useful purposes, including
    - Identifying strong skew in the distribution.
    - Identifying data collection or entry errors.
    - Providing insight into interesting properties of the data.

Weighted Mean

What is the Weighted Mean?

The weighted mean is a type of mean that is calculated by multiplying the weight (or probability) associated with a particular event or outcome with its associated quantitative outcome and then summing all the products together. It is very useful when calculating a theoretically expected outcome where each outcome has a different probability of occurring, which is the key feature that distinguishes the weighted mean from the arithmetic mean.





NOTE: When we use the simple mean or simple average, we are giving equal weight (1/n) to each observation or data point and the sum of the weights is equal to 1.

The weighted mean is used in:

a. Construction of index numbers.

b. Comparison of results of two or more universities where the number of students differs.

c. Computation of standardized death and birth rates.

Example

Find the mean of the following data set.

1	1	1	1		
10	10	10	10	10	
5	5	5	5	5	5

Solution.

Use the Weighted Mean formula.

The w terms are the weights.

$$\text{Weighted Average} = \frac{\text{Sum of weighted terms}}{\text{total number of terms}} = \frac{w_1 \bullet x_1 + w_2 \bullet x_2 + \cdots + w_n \bullet x_n}{w_1 + w_2 \cdots + w_n}$$

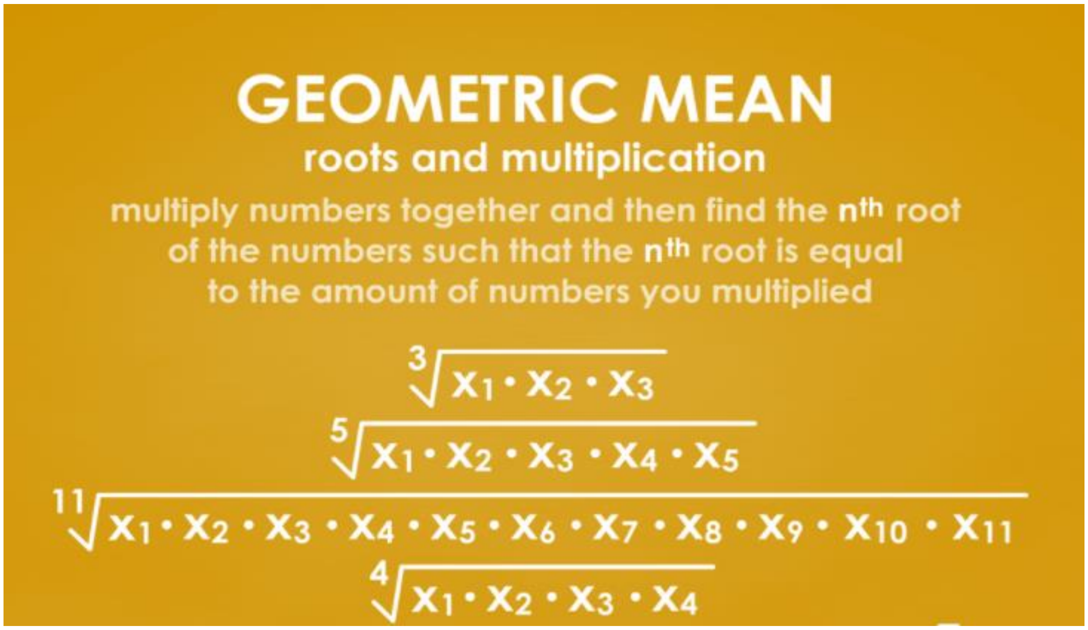
$$\text{Weighted Mean} = \frac{4 \bullet 1 + 5 \bullet 10 + 6 \bullet 5}{15} = \frac{4 + 50 + 30}{15} = \frac{84}{15} = 5.6$$

The numbers in red are the weights.

Geometric mean

In mathematics, the geometric mean is a mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). The geometric mean is defined as the nth root of the product of n numbers, i.e., for a set of numbers $x_1, x_2, \ldots, x_n$, the geometric mean is defined as

$$Geometric\ mean = \sqrt[n]{x_1 \cdot x_2 \cdot \ldots\ldots \cdot\ x_n}$$



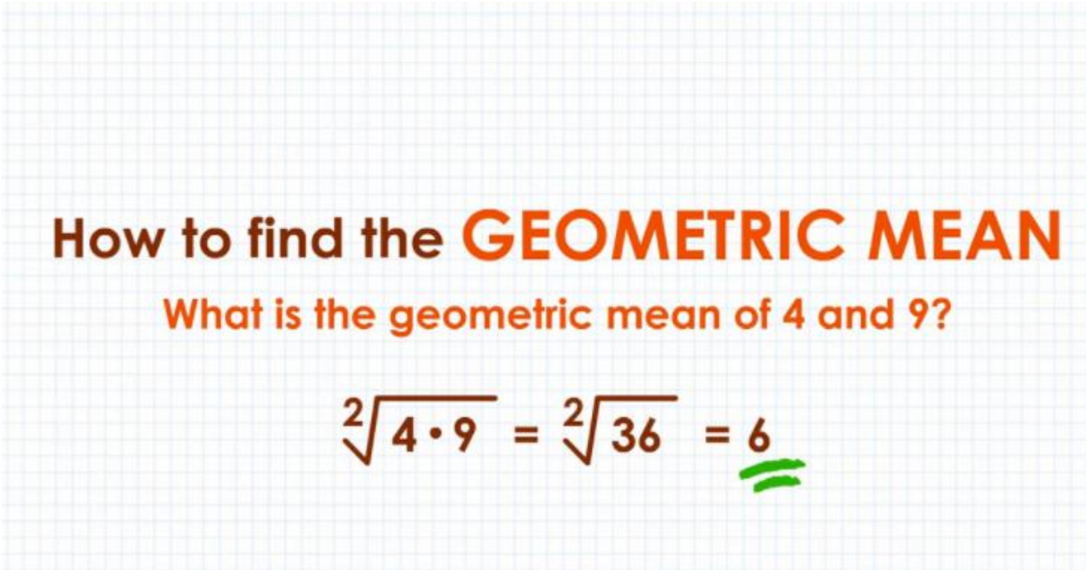
For example, if you multiply three numbers, the geometric mean is the third root of the product of those three numbers. The geometric mean of five numbers is the fifth root of their product. Suppose we said we found the geometric mean using the 11th root of the numbers. That tells you that 11 numbers were multiplied together. To find the geometric mean of four numbers, what root would we take? The fourth root, of course.

How to Find the Geometric Mean

We will start with an easy example using only two numbers, 4 and 9. What is the geometric mean of 4 and 9?

Multiply $4 \cdot 9$

Then find the square root of their product (because you only multiplied two numbers):



Uses for the Geometric Mean

Anytime we are trying to calculate average rates of growth where growth is determined by multiplication, not addition, we need the geometric mean. This connects geometric mean to economics, financial transactions between banks and countries, interest rates, and personal finances.

Harmonic mean

The harmonic mean can be expressed as the reciprocal of the arithmetic mean of the reciprocals of the given set of observations.

$$Harmonic\ mean = \frac{n}{\sum \frac{1}{x_i}}$$

Where:

n : the number of the values in a dataset

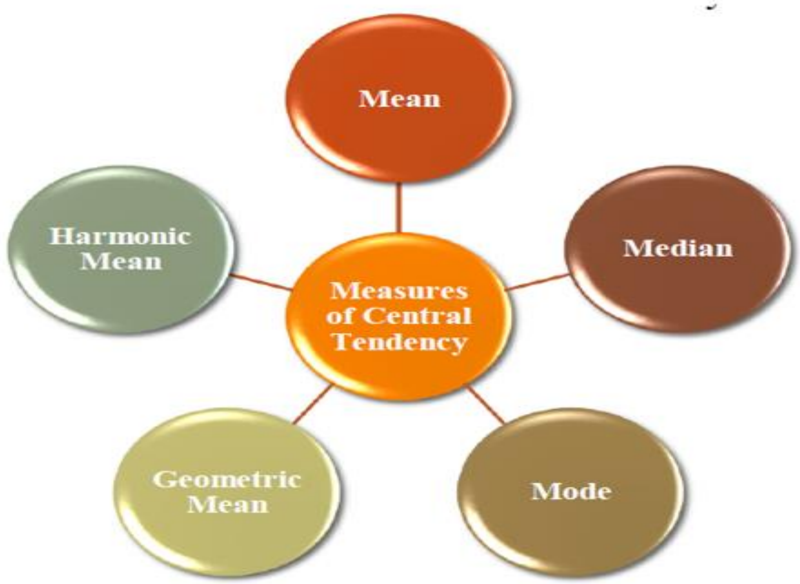
x_i : the point in a dataset

Example

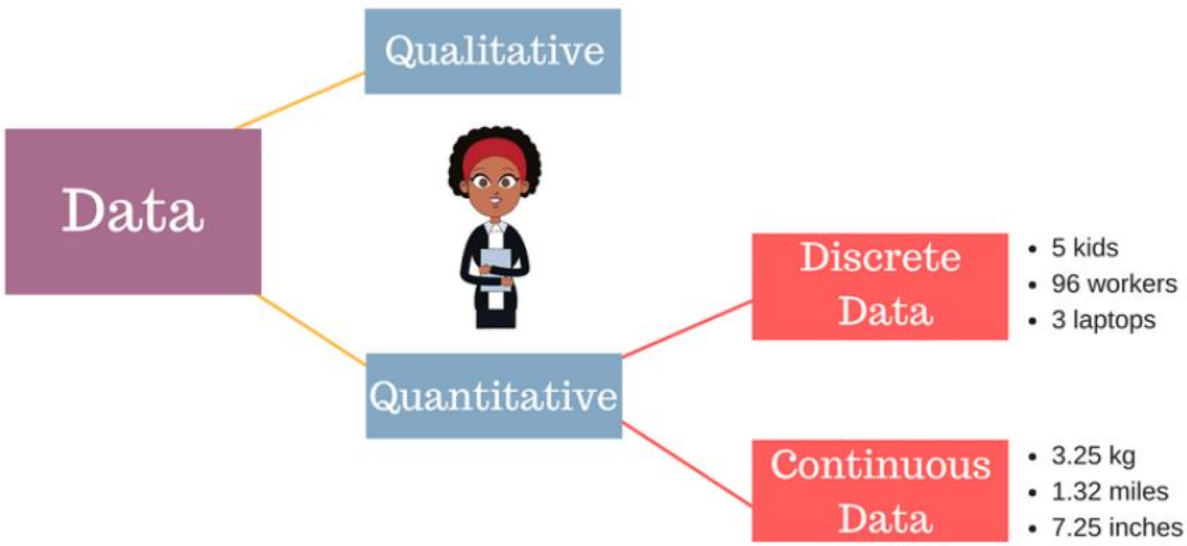
consider 2, 3, 5, 7, and 60 with a number of observations as 5 find Harmonic mean.

$$\text{mean} = \frac{2+3+5+7+60}{5} = \frac{77}{5} = 15.4$$

$$\text{Harmonic Mean} = \frac{n}{\left(\frac{1}{x_1}+\frac{1}{x_2}+\ldots+\frac{1}{x_n}\right)} = \frac{5}{\left(\frac{1}{2}+\frac{1}{3}+\frac{1}{5}+\frac{1}{7}+\frac{1}{60}\right)} = \frac{5}{(0.5+0.33+0.2+0.14+0.017)} = \frac{5}{1.187} = 4.21$$



شكل توضيحي ل أنواع البيانات في المحاضرة الاولى



Examples of discrete data:	**Examples of continuous data:**
1. The number of students in a class. 2. The number of workers in a company. 3. The number of parts damaged during transportation. 4. Shoe sizes. 5. Number of languages an individual speaks. 6. The number of home runs in a baseball game. 7. The number of test questions you answered correctly. 8. Instruments in a shelf. 9. The number of siblings a randomly selected individual has.	1. The amount of time required to complete a project. 2. The height of children. 3. The amount of time it takes to sell shoes. 4. The amount of rain, in inches, that falls in a storm. 5. The square footage of a two-bedroom house. 6. The weight of a truck. 7. The speed of cars. 8. Time to wake up.