

GEOMETRIC MEAN

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Definition of Geometric Mean

Geometric mean formula, as the name suggests, is used to calculate the geometric mean of a set of numbers. To recall, the geometric mean (or GM) is a type of mean that indicates the central tendency of a set of numbers by using the product of their values. It is defined as the n th root of the product of n numbers. It should be noted that you cannot calculate the geometric mean from the arithmetic mean. In statistics, the geometric mean is well defined only for a positive set of real numbers.

Formula for Geometric Mean

For GM formula, multiply all the “ n ” numbers together and take the “ n th root of them. The formula for evaluating geometric mean is as follows if we have “ n ” number of observations.

$$\bar{X}_{geom} = \sqrt[n]{\prod_{i=1}^n X_i} = \sqrt[n]{X_1 \cdot X_2 \cdot \dots \cdot X_n}$$

Notation in the GM Formula

- \bar{X}_{geom} is the geometric mean
- “ n ” is the total number of observations
- $\sqrt[n]{\prod_{i=1}^n X_i}$ is the n^{th} square root of the product of the given numbers.

Properties of Geometric Means

- The logarithm of geometric mean is the arithmetic mean of the logarithms of given values
- If all the observations assumed by a variable are constants, say $K > 0$, then the G.M. of the observation is also K
- The geometric mean of the ratio of two variables is the ratio of the geometric means of the two variables
- The geometric mean of the product of two variables is the product of their geometric means

Advantages of Geometric Mean

- A geometric mean is based upon all the observations
- It is rigidly defined
- The fluctuations of the observations do not affect the geometric mean
- It gives more weight to small items

Disadvantages of Geometric Mean

- A geometric mean is not easily understandable by a non-mathematical person
- If any of the observations is zero, the geometric mean becomes zero
- If any of the observation is negative, the geometric mean becomes imaginary

Difference Between Arithmetic Mean and Geometric Mean

There is a difference between both the means like G.M and arithmetic mean for the given data set how they are calculations are done using G.M and arithmetic mean formula.

Arithmetic Mean	Geometric Mean
The arithmetic mean or mean can be found by adding all the numbers for the given data set divided by the number of data points in a set.	It can be found by multiplying all the numbers in the given data set and take the nth root for the obtained result.
For example, the given data sets are: 5, 10, 15 and 20 Here, the number of data points = 4 Arithmetic mean or mean = $(5+10+15+20)/4$ Mean = $50/4 = 12.5$	For example, consider the given data set, 4, 10, 16, 24 Here $n = 4$ Therefore, the G.M = 4th root of $(4 \times 10 \times 16 \times 24)$ = 4th root of 15360 G.M = 11.13

Some real-life uses of geometric mean:

1. Aspect Ratios:

The geometric mean has been used in film and video also to find the appropriate aspect ratios i.e. the proportion of the width to the height of a screen or image. It is used to find an appropriate balancing between the two aspect ratios as well as for distorting or cropping both ratios equally.

2. Computer Science:

Computers use mind-boggling amounts of large data which generally requires the summarization for many applications using various statistical measurements.

3. Medicine:

The Geometric Mean has many applications in the medical industry also. It is known as the “gold standard” for some measurements, including for the calculation of gastric emptying time.

4. Proportional Growth:

It is very useful in finding the growth rate. The geometric mean is used for calculating the proportional growth as well as demand growth.

Example Question Using Geometric Mean Formula

Question 1: Find the geometric mean of 4 and 3?

Solution: Using the formula for G.M., the geometric mean of 4 and 3 will be:

Geometric Mean will be $\sqrt{4 \times 3}$

$$= 2\sqrt{3}$$

So, GM = 3.46

Question 2: What is the geometric mean of 4, 8, 3, 9 and 17?

Solution:

Step 1: $n = 5$ is the total number of values. Now, find $1/n$.

$$1/5 = 0.2.$$

Step 2: Find geometric mean using the formula:

$$(4 \times 8 \times 3 \times 9 \times 17)^{0.2}$$

So, geometric mean = 6.81

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