

# What is the difference between Sample Variance and Population Variance?

Authored by  
**stats writer**

May 11, 2024

## RECOMMENDED CITATION

stats writer (2024). *What is the difference between Sample Variance and Population Variance?*. PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=143633>

Sample variance and population variance are two measures of variability used in statistics to describe the spread or dispersion of a set of data. The main difference between them lies in the type of data they represent.

Sample variance is calculated using a subset of the data, known as a sample, while population variance is calculated using all of the data in a population. In other words, sample variance is an estimate of the population variance based on a smaller portion of the data.

This difference in data used to calculate the variances can lead to slight variations in the results. Sample variance tends to be slightly higher than population variance due to the fact that it is based on a smaller sample.

Furthermore, sample variance is used to make inferences about the population, while population variance is used to describe the entire population. This means that sample variance is more commonly used in statistical analyses and hypothesis testing, while population variance is used for descriptive purposes.

In summary, the main difference between sample variance and population variance is the type of data used to calculate them and their respective purposes. Both measures provide valuable information about the variability of a set of data, but they serve different purposes in statistical analysis.

## Sample Variance vs. Population Variance: What's the Difference?

**The variance is a way to measure of values in a dataset.**

**The formula to calculate population variance is:**

$$\sigma^2 = \frac{\sum (x_i - \mu)^2}{N}$$

**where:**

**$\Sigma$ : A symbol that means "sum"  $\mu$ : Population mean  $x_i$ :**

**The  $i$ th element from the population  $N$ : Population size**

**The formula to calculate sample variance is:**

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{(n-1)}$$

**where:**

**$\bar{x}$ : Sample mean**  
 **$x_i$ : The  $i$ th element from the sample**  
 **$n$ : Sample size**

**Notice that there's only one tiny difference between the two formulas:**

**When we calculate population variance, we divide by  $N$  (the population size).**

**When we calculate sample variance, we divide by  $n-1$  (the sample size - 1).**

**When calculating the sample variance, we apply something known as  $Bessel's$  correction - which is the act of dividing by  $n-1$ .**

**Without getting bogged down in the mathematical details, dividing by  $n-1$  can be shown to provide an unbiased estimate of the population variance, which is**

**the value we're usually interested in anyway.**

**When to Calculate Sample Variance vs. Population Variance**

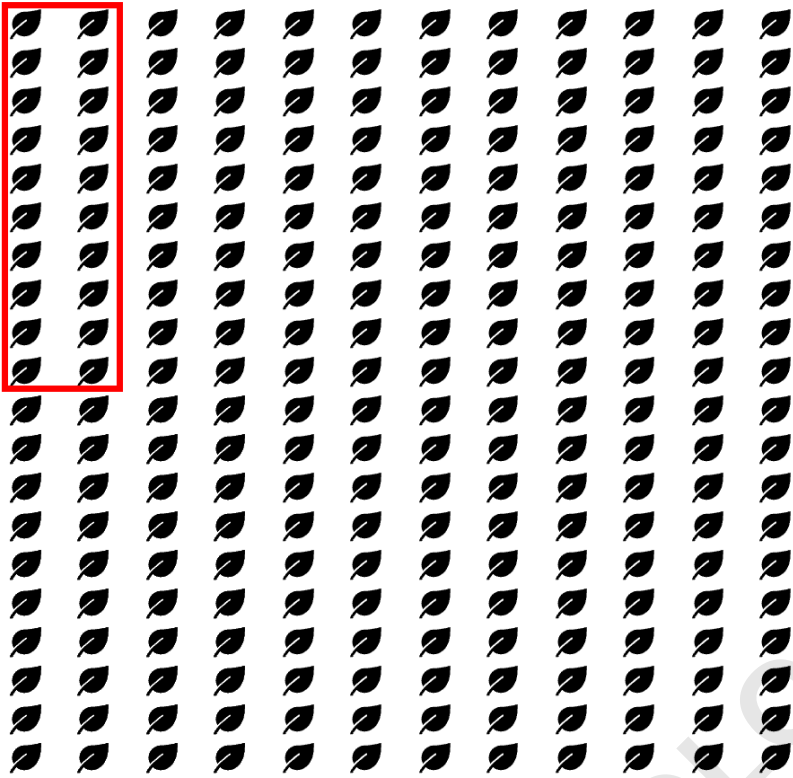
**If you're unsure of whether you should calculate the sample variance or the population variance, keep this rule of thumb in mind:**

**You should calculate the sample variance when the dataset you're working with represents a sample taken from a larger population of interest.**

**The following examples show different scenarios of when to calculate the sample variance vs. the population variance.**

**Example: Calculating Sample Variance**

**Suppose a botanist wants to calculate the variance in height of a certain species of plants. Because there are thousands of individual plants in one region, she decides to take a simple random sample of 20 plants and measure each of their heights.**



In this scenario, the botanist should calculate the sample variance because she is interested in the variance of the entire population of plants but is simply using this sample to estimate the true population variance.

**Example: Calculating Population Variance**

Suppose a teacher wants to calculate the variance of exam scores for the 20 students in her class.



In this scenario, the teacher should calculate the population variance because the dataset she's working with (the 20 exam scores) represent the entire population that she is interested in.

The following tutorials explain how to calculate sample variance and population variance in different statistical software: