



Standard Error of the Mean

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The standard error of the mean, also called the standard deviation of the mean, is a method used to estimate the standard deviation of a sampling distribution. To understand this, first we need to understand why a sampling distribution is required.

As an example, consider an experiment that measures the speed of sound in a material along the three directions (along x, y and z coordinates). By taking the mean of these values, we can get the average speed of sound in this medium.

However, there are so many external factors that can influence the speed of sound, like small temperature variations, the reaction time of the stopwatch, pressure changes in the laboratory, wind velocity changes, and other random errors. Thus instead of taking the mean with one measurement, we should instead take several measurements and take a mean each time. This is a sampling distribution. The standard error of the mean now refers to the change in mean with different experiments conducted each time.

Mathematically, the standard error of the mean formula is given by:

$$\sigma_M = \frac{\sigma}{\sqrt{N}}$$

σ_M = standard error of the mean

σ = the standard deviation of the original distribution

N = the sample size

\sqrt{N} = root of the sample size

It can be seen from the formula that the standard error of the mean decreases as N increases. This is expected because if the mean at each step is calculated using many data points, then a small deviation in one value will cause less effect on the final mean.

The standard error of the mean tells us how the mean varies with different experiments measuring the same quantity. Thus if the effect of random changes are significant, then the standard error of the mean will be higher. If there is no change in the data points as experiments are repeated, then the standard error of mean is zero.



The banner features a bright orange background. At the top center is a white icon of a flask with a flame, followed by the word "EXPLORABLE" in a bold, white, sans-serif font. Below this, the phrase "Quiz Time!" is written in a white, cursive script. Three white-bordered rectangular boxes are arranged horizontally. The first box shows a pair of red roller skates on a wooden deck, with the text "Quiz: Psychology 101 Part 2" below it. The second box shows a fan of colorful pens, also with the text "Quiz: Psychology 101 Part 2" below it. The third box shows a Ferris wheel at sunset, with the text "Quiz: Flags in Europe" below it. In the bottom right corner of the banner, the text "See all quizzes =>" is written in white.

Standard Error of the Estimate

A related and similar concept to standard error of the mean is the standard error of the estimate. This refers to the deviation of any estimate from the intended values.

For a sample, the formula for the standard error of the estimate is given by:

$$s_{est} = \sqrt{\frac{\sum(Y - Y')^2}{N - 2}}$$

where Y refers to individual data sets [1], Y' is the mean of the data and N is the sample size.

Note that this is similar to the standard deviation formula [2], but has an N - 2 in the denominator instead of N - 1 in case of sample standard deviation.

Source URL: <https://explorable.com/standard-error-of-the-mean?gid=1588>

Links

[1] <https://explorable.com/statistical-data-sets>

[2] <https://explorable.com/calculate-standard-deviation>