

What is the definition of Standard Error of Measurement and can you provide an example?

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The Standard Error of Measurement (SEM) is a statistical measure that represents the amount of error present in a test or measurement. It is used to determine the level of precision and accuracy of a test by calculating the expected variability of scores that would occur if the test was administered multiple times. For example, if a student's test score is 85 and the SEM is 5, it means that the student's true score could range from 80 to 90 with 68% confidence. In other words, the SEM provides a range of values in which the true score is likely to fall. This measure is commonly used in educational and psychological testing to assess the reliability and consistency of test scores.

Standard Error of Measurement: Definition & Example

A standard error of measurement, often denoted SEm, estimates the variation around a "true" score for an individual when repeated measures are taken.

It is calculated as:

$$\text{SEm} = s\sqrt{1-R}$$

where:

s: The standard deviation of measurements
R: The reliability coefficient of a test

Note that α ranges from 0 to 1 and is calculated by administering a test to many individuals twice and calculating the correlation between their test scores.

The higher the reliability coefficient, the more often a

test produces consistent scores.

Example: Calculating a Standard Error of Measurement

Suppose an individual takes a certain test 10 times over the course of a week that aims to measure overall intelligence on a scale of 0 to 100. They receive the following scores:

Scores: 88, 90, 91, 94, 86, 88, 84, 90, 90, 94

The sample mean is 89.5 and the sample standard deviation is 3.17.

If the test is known to have a reliability coefficient of 0.88, then we would calculate the standard error of measurement as:

$$\text{SEm} = s\sqrt{1-R} = 3.17\sqrt{1-.88} = 1.098$$

How to Use SEm to Create Confidence Intervals

Using the standard error of measurement, we can create a confidence interval that is likely to contain the "true" score of an individual on a certain test with a certain degree of confidence.

If an individual receives a score of x on a test, we can use the following formulas to calculate various confidence intervals for this score:

68% Confidence Interval = 95% Confidence Interval =
99% Confidence Interval = 95% Confidence Interval = =

This means we are 95% confident that an individual's "true" score on this test is between 87 and 97.

Reliability & Standard Error of Measurement

There exists a simple relationship between the reliability coefficient of a test and the standard error of measurement:

The higher the reliability coefficient, the lower the standard error of measurement. The lower the reliability coefficient, the higher the standard error of measurement.

To illustrate this, consider an individual who takes a test 10 times and has a standard deviation of scores of 2.

If the test has a reliability coefficient of 0.9, then the

standard error of measurement would be calculated as:

$$\text{SEm} = s\sqrt{1-R} = 2\sqrt{1-.9} = 0.632$$

However, if the test has a reliability coefficient of 0.5, then the standard error of measurement would be calculated as:

$$\text{SEm} = s\sqrt{1-R} = 2\sqrt{1-.5} = 1.414$$

This should make sense intuitively: If the scores of a test are less reliable, then the error in the measurement of the "true" score will be higher.