Standard Error

- Stat Trek: What is the Standard Error?

Standard Error of Sample Estimates

Sadly, the values of population parameters are often unknown, making it impossible to compute the standard deviation of a statistic. When this occurs, use the standard error.

The standard error is computed from known sample statistics. The table below shows how to compute the standard error for simple random samples, assuming the population size is at least 20 times larger than the sample size.

Statistic	Standard Error
Sample mean, $\bar{x}$	$SE_{\bar{x}} = s / sqrt(n)$
Sample proportion, p	$SE_p = sqrt [p(1 - p) / n]$
Difference between means, $\bar{x}_1 - \bar{x}_2$	$SE_{\bar{x}_1-\bar{x}_2} = sqrt [s^2_1 / n_1 + s^2_2 / n_2]$
Difference between proportions, $\bar{p}_1 - \bar{p}_2$	$SE_{p_1-p_2} = sqrt [p_1(1-p_1) / n_1 + p_2(1-p_2) / n_2]$

The equations for the standard error are identical to the equations for the standard deviation, except for one thing - the standard error equations use statistics where the standard deviation equations use parameters. Specifically, the standard error equations use *p* in place of *P*, and *s* in place of σ.

Standard Deviation of Sample Estimates

Statisticians use sample statistics to estimate population parameters. Naturally, the value of a statistic may vary from one sample to the next.

The variability of a statistic is measured by its standard deviation. The table below shows formulas for computing the standard deviation of statistics from simple random samples. These formulas are valid when the population size is much larger (at least 20 times larger) than the sample size.

Statistic	Standard Deviation
Sample mean, $\bar{x}$	$\sigma_{\bar{x}} = \sigma / sqrt(n)$
Sample proportion, p	$\sigma_p = sqrt [P(1 - P) / n]$
Difference between means, $\bar{x}_1 - \bar{x}_2$	$\sigma_{\bar{x}_1-\bar{x}_2} = sqrt [\sigma^2_1 / n_1 + \sigma^2_2 / n_2]$
Difference between proportions, $\bar{p}_1 - \bar{p}_2$	$\sigma_{p_1-p_2} = sqrt [P_1(1-P_1) / n_1 + P_2(1-P_2) / n_2]$

Note: In order to compute the standard deviation of a sample statistic, you must know the value of one or more population parameters. For example, to compute the standard deviation of the sample mean ($\sigma_{\bar{x}}$), you need to know the variance of the population (σ).

Multiplier Number (z*)	Level of Confidence
3.0	99.7%
2.58 (2.576)	99%
2.0 (more precisely 1.96)	95%
1.645	90%
1.282	80%
1.15	75%
1.0	68%

Questions

Test Your Understanding

Problem 1

Which of the following statements is true.

I. The standard error is computed solely from sample attributes.
II. The standard deviation is computed solely from sample attributes.
III. The standard error is a measure of central tendency.

(A) I only
(B) II only
(C) III only
(D) All of the above.
(E) None of the above.

Solution

The correct answer is (A). The standard error can be computed from a knowledge of sample attributes - sample size and sample statistics. The standard deviation *cannot* be computed solely from sample attributes; it requires a knowledge of one or more population parameters. The standard error is a measure of variability, *not* a measure of central tendency.