

# What is a Standardized Test Statistic?

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A standardized test statistic is a numerical value that is used to measure and compare an individual's performance on a standardized test to that of a larger group of individuals who have taken the same test. This statistic is calculated by converting an individual's raw score on the test into a standardized value, using a formula that takes into account the mean and standard deviation of the larger group's scores. This enables a fair and accurate comparison of an individual's performance on the test to others who have taken it, regardless of any variations in test versions or administrations.

## What is a Standardized Test Statistic?

**A statistical hypothesis is an assumption about a population parameter.** For example, we may assume that the mean height of a male in the U.S. is 70 inches. The assumption about the height is the *statistical hypothesis* and the true mean height of a male in the U.S. is the *population parameter*.

**A hypothesis test is a formal statistical test we use to reject or fail to reject some statistical hypothesis.**

**The basic process for performing a hypothesis test is as follows:**

- 1. Collect sample data.**
- 2. Calculate the standardized test statistic for the sample data.**
- 3. Compare the standardized test statistic to some**

**critical value. If it's more extreme than the critical value, reject the null hypothesis. Otherwise, fail to reject the null hypothesis test.**

**The formula that we use to calculate the standardized test statistic varies depending on the type of hypothesis test we perform.**

**The following table shows the formula to use to calculate the standardized test statistic for each of the four major types of hypothesis tests:**

Hypothesis Test	Purpose	Standardized Test Statistic
Hypothesis Test for One Mean	Test whether or not the mean of a population is equal to some value.	$t = (\bar{x} - \mu) / (s/\sqrt{n})$
Hypothesis Test for a Difference in Means	Test whether or not the means of two populations are equal.	$t = (\bar{x}_1 - \bar{x}_2) / s_p(\sqrt{1/n_1 + 1/n_2})$
Hypothesis Test for One Proportion	Compare an observed proportion to a theoretical one.	$z = (p - p_0) / \sqrt{p_0(1-p_0)/n}$
Hypothesis Test for a Difference in Proportions	Test for a difference between two population proportions.	$z = (p_1 - p_2) / \sqrt{p(1-p)(1/n_1 + 1/n_2)}$

### **Hypothesis Test for One Mean**

**A one sample t-test is used to test whether or not the mean of a population is equal to some value.**

**The standardized test statistic for this type of test is**

calculated as follows:

$$t = (x - \mu) / (s/\sqrt{n})$$

where:

**x:** sample mean

**$\mu_0$ :** hypothesized population mean

**s:** sample standard deviation

**n:** sample size

Refer to [this tutorial](#) for an example of how to calculate this standardized test statistic.

Hypothesis Test for a Difference in Means

The standardized test statistic for this type of test is calculated as follows:

$$t = (x_1 - x_2) / sp(\sqrt{1/n_1 + 1/n_2})$$

where  $x_1$  and  $x_2$  are the sample means,  $n_1$  and  $n_2$  are the sample sizes, and where  $sp$  is calculated as:

$$sp = \sqrt{(n_1-1)s_1^2 + (n_2-1)s_2^2 / (n_1+n_2-2)}$$

where  $s_1^2$  and  $s_2^2$  are the sample variances.

Refer to [this tutorial](#) for an example of how to calculate this standardized test statistic.

### Hypothesis Test for One Proportion

A one proportion z-test is used to compare an observed proportion to a theoretical one.

The standardized test statistic for this type of test is calculated as follows:

$$z = (p - p_0) / \sqrt{p_0(1 - p_0)/n}$$

where:

p: observed sample proportion

p<sub>0</sub>: hypothesized population proportion

n: sample size

Refer to [this tutorial](#) for an example of how to calculate this standardized test statistic.

### Hypothesis Test for a Difference in Proportions

A two proportion z-test is used to test for a difference between two population proportions.

The standardized test statistic for this type of test is

calculated as follows:

$$z = (p_1 - p_2) / \sqrt{p(1-p)(1/n_1 + 1/n_2)}$$

where  $p_1$  and  $p_2$  are the sample proportions,  $n_1$  and  $n_2$  are the sample sizes, and where  $p$  is the total pooled proportion calculated as:

$$p = (p_1 n_1 + p_2 n_2) / (n_1 + n_2)$$

Refer to [this tutorial](#) for an example of how to calculate this standardized test statistic.