

What is the difference between an F-Test and a T-Test?

Authored by
stats writer

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The F-Test and T-Test are statistical tests used to analyze the difference between two or more groups of data. The main difference between the two is that the F-Test is used to compare the variances of two or more groups, while the T-Test is used to compare the means of two groups. In other words, the F-Test is used to determine if the variances of the groups are significantly different, while the T-Test is used to determine if the means of the groups are significantly different. Additionally, the F-Test is typically used for larger sample sizes and when the data follows a normal distribution, while the T-Test is more appropriate for smaller sample sizes and non-normal distributions. Both tests are useful in different scenarios and can provide valuable insights in statistical analysis.

F-Test vs. T-Test: What's the Difference?

Two statistical tests that students often get mixed up are the F-Test and the T-Test. This tutorial explains the difference between the two tests.

F-Test: The Basics

An F-test is used to test whether two population variances are equal. The null and alternative hypotheses for the test are as follows:

$H_0: \sigma_1^2 = \sigma_2^2$ (the population variances are equal)

$H_1: \sigma_1^2 \neq \sigma_2^2$ (the population variances are *not* equal)

The F test statistic is calculated as s_1^2 / s_2^2 .

If the p-value of the test statistic is less than some significance level (common choices are 0.10, 0.05, and

0.01), then the null hypothesis is rejected.

Example: F-Test for Equal Variances

A researcher wants to know if the variance in height between two species of plants is the same. To test this, she collects a random sample of 20 plants from each population and calculates the sample variance for each sample.

The F test statistic turns out to be 4.38712 and the corresponding p-value is 0.0191. Since this p-value is less than .05, she rejects the null hypothesis of the F-Test. This means she has sufficient evidence to say that the variance in height between the two plant species is *not* equal.

T-Test: The Basics

A two sample t-test is used to test whether or not the means of two populations are equal.

A two-sample t-test always uses the following null hypothesis:

H₀: $\mu_1 = \mu_2$ (the two population means are equal)

The alternative hypothesis can be either two-tailed, left-tailed, or right-tailed:

H1 (two-tailed): $\mu_1 \neq \mu_2$ (the two population means are not equal)
H1 (left-tailed): $\mu_1 < \mu_2$ (population 1 mean is less than population 2 mean)
H1 (right-tailed): $\mu_1 > \mu_2$ (population 1 mean is greater than population 2 mean)

The test statistic is calculated as:

where \bar{x}_1 and \bar{x}_2 are the sample means, n_1 and n_2 are the sample sizes, and where s_p is calculated as:

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

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

If the p-value that corresponds to the test statistic t with (n_1+n_2-1) degrees of freedom is less than your chosen significance level (common choices are 0.10, 0.05, and 0.01) then you can reject the null hypothesis.

Example: Two Sample t-test

A researcher wants to know if the mean height between two species of plants is equal. To test this, she collects

a random sample of 20 plants from each population and calculates the sample mean for each sample.

The t test statistic turns out to be 1.251 and the corresponding p-value is 0.2148. Since this p-value is not less than .05, she fails to reject the null hypothesis of the T-Test. This means she does not have sufficient evidence to say that the mean heights between these two plant species is different.

F-Test vs. T-Test: When to Use Each

We typically use an F-test to answer the following questions:

Do two samples come from populations with equal variances? Does a new treatment or process reduce the variability of some current treatment or process?

And we typically use a T-test to answer the following questions:

Are two population means equal? (We use a two sample t-test to answer this) Is one population mean equal to a certain value? (We use a one sample t-test to answer this)

Introduction to Hypothesis Testing

One Sample t-test Calculator

Two Sample t-test Calculator

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