

Is there a difference in variance between the groups being compared in a t-test?

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The question "Is there a difference in variance between the groups being compared in a t-test?" refers to the statistical analysis method of comparing two groups to determine if there is a significant difference between their means. Specifically, it addresses the variability or spread of data within each group. A t-test is used to calculate the probability of the observed differences in means being due to chance or if they are significant. By examining the variance between the groups, this question seeks to understand if there is a meaningful difference between the two groups being compared.

Determine Equal or Unequal Variance in t-tests

When we want to compare the means of two independent groups, we can choose between two different tests:

Assumes that both groups of data are sampled from populations that follow a normal distribution and that both populations have the same variance.

Assumes that both groups of data are sampled from populations that follow a normal distribution, but it does not assume that those two populations have the same variance.

So, if the two samples do not have equal variance then it's best to use the Welch's t-test.

But how do we determine if the two samples have equal variance?

There are two ways to do so:

1. Use the Variance Rule of Thumb.

As a rule of thumb, if the ratio of the larger variance to the smaller variance is less than 4 then we can assume the variances are approximately equal and use the Student's t-test.

For example, suppose we have the following two samples:

Sample 1	Sample 2
8	10
12	12
12	12
13	14
13	14
14	15
16	17
17	18
17	18
19	19
21	20
24	20
25	24

Sample 1 has a variance of 24.86 and sample 2 has a variance of 15.76.

The ratio of the larger sample variance to the smaller sample variance would be calculated as:

$$\text{Ratio} = 24.86 / 15.76 = 1.577$$

Since this ratio is less than 4, we could assume that the variances between the two groups are approximately equal.

Thus, we could proceed to perform Student's t-test to determine if the two groups have the same mean.

2. Perform an F-test.

An F-test is a formal statistical test that uses the following null and alternative hypotheses:

H_A : The samples do not have equal variances.

The test statistic is calculated as follows:

$$F = s_{12} / s_{22}$$

where s_{12} and s_{22} are the sample variances.

If the p-value that corresponds to the test statistic is less than some significance level (like 0.05), then we

have sufficient evidence to say that the samples do not have equal variances.

Once again suppose we have the following two samples:

Sample 1	Sample 2
8	10
12	12
12	12
13	14
13	14
14	15
16	17
17	18
17	18
19	19
21	20
24	20
25	24

To perform an F-test on these two samples, we can calculate the F test statistic as:

$$F = s_1^2 / s_2^2 = 24.86 / 15.76 = 1.577$$

According to the , an F-value of 1.577 with numerator df = $n_1 - 1 = 12$ and denominator df = $n_2 - 1 = 12$ has a corresponding p-value of 0.22079.

Since this p-value is not less than .05, we fail to reject the null hypothesis. In other words, we can assume the sample variances are equal.

Thus, we could proceed to perform Student's t-test to determine if the two groups have the same mean.

If you decide to perform the Student's t-test, you can use the following tutorials as references:

And if you decide to perform the Welch's t-test, you can use the following tutorials as references: