

When do you reject the null hypothesis?

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In summary, the null hypothesis is rejected when the p-value is less than the significance level, when the test statistic falls outside the critical region, or when there is strong evidence against the null hypothesis. These criteria are used to determine if the observed results are statistically significant and differ significantly from what would be expected under the null hypothesis. Rejecting the null hypothesis implies that there is a relationship or difference between the variables being compared, and further investigation and analysis may be needed to understand this relationship.

When Do You Reject the Null Hypothesis? (3 Examples)

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

We always use the following steps to perform a hypothesis test:

Step 1: State the null and alternative hypotheses.

The null hypothesis, denoted as H_0 , is the hypothesis that the sample data occurs purely from chance.

The alternative hypothesis, denoted as H_A , is the hypothesis that the sample data is influenced by some non-random cause.

2. Determine a significance level to use.

Decide on a significance level. Common choices are .01, .05, and .1.

3. Calculate the test statistic and p-value.

Use the sample data to calculate a test statistic and a corresponding .

4. Reject or fail to reject the null hypothesis.

If the p-value is less than the significance level, then you reject the null hypothesis.

If the p-value is not less than the significance level, then you fail to reject the null hypothesis.

You can use the following clever line to remember this rule:

"If the p is low, the null must go."

In other words, if the p-value is low enough then we must reject the null hypothesis.

The following examples show when to reject (or fail to reject) the null hypothesis for the most common types of hypothesis tests.

Example 1: One Sample t-test

For example, suppose we want to know whether or not the mean weight of a certain species of turtle is equal to

310 pounds.

We go out and collect a simple random sample of 40 turtles with the following information:

Sample size $n = 40$

Sample mean weight $\bar{x} = 300$

Sample standard deviation $s = 18.5$

We can use the following steps to perform a one sample t-test:

Step 1: State the Null and Alternative Hypotheses

We will perform the one sample t-test with the following hypotheses:

$H_0: \mu = 310$ (population mean is equal to 310 pounds)

$H_A: \mu \neq 310$ (population mean is not equal to 310 pounds)

2. Determine a significance level to use.

We will choose to use a significance level of 0.05.

3. Calculate the test statistic and p-value.

We can plug in the numbers for the sample size, sample mean, and sample standard deviation into this to calculate the test statistic and p-value:

t test statistic: -3.4187

two-tailed p-value: 0.0015

4. Reject or fail to reject the null hypothesis.

Since the p-value (0.0015) is less than the significance level (0.05) we reject the null hypothesis.

We conclude that there is sufficient evidence to say that the mean weight of turtles in this population is not equal to 310 pounds.

Example 2: Two Sample t-test

A is used to test whether or not two population means are equal.

For example, suppose we want to know whether or not the mean weight between two different species of turtles is equal.

We go out and collect a simple random sample from each population with the following information:

Sample 1:

Sample size $n_1 = 40$

Sample mean weight $x_1 = 300$

Sample standard deviation $s_1 = 18.5$

Sample 2:

Sample size $n_2 = 38$

Sample mean weight $x_2 = 305$

Sample standard deviation $s_2 = 16.7$

We can use the following steps to perform a two sample t-test:

Step 1: State the Null and Alternative Hypotheses

We will perform the two sample t-test with the following hypotheses:

$H_0: \mu_1 = \mu_2$ (the two population means are equal)

$H_1: \mu_1 \neq \mu_2$ (the two population means are not equal)

2. Determine a significance level to use.

We will choose to use a significance level of 0.10.

3. Calculate the test statistic and p-value.

We can plug in the numbers for the sample sizes, sample means, and sample standard deviations into this to calculate the test statistic and p-value:

t test statistic: -1.2508

two-tailed p-value: 0.2149

4. Reject or fail to reject the null hypothesis.

Since the p-value (0.2149) is not less than the significance level (0.10) we fail to reject the null hypothesis.

We do not have sufficient evidence to say that the mean weight of turtles between these two populations is different.

Example 3: Paired Samples t-test

A is used to compare the means of two samples when each observation in one sample can be paired with an observation in the other sample.

For example, suppose we want to know whether or not a certain training program is able to increase the max

vertical jump of college basketball players.

To test this, we may recruit a of 20 college basketball players and measure each of their max vertical jumps. Then, we may have each player use the training program for one month and then measure their max vertical jump again at the end of the month:

Player	Max Vertical Jump Before Training Program	Max Vertical Jump After Training Program
Player 1	22	24
Player 2	20	22
Player 3	19	19
Player 4	24	22
Player 5	25	28
Player 6	25	26
Player 7	28	28
Player 8	22	24
Player 9	30	30
Player 10	27	29
Player 11	24	25
Player 12	18	20
Player 13	16	17
Player 14	19	18
Player 15	19	18
Player 16	28	28
Player 17	24	26
Player 18	25	27
Player 19	25	27
Player 20	23	24

We can use the following steps to perform a paired samples t-test:

Step 1: State the Null and Alternative Hypotheses

We will perform the paired samples t-test with the following hypotheses:

H0: $\mu_{\text{before}} = \mu_{\text{after}}$ (the two population means are equal)

H1: $\mu_{\text{before}} \neq \mu_{\text{after}}$ (the two population means are not equal)

2. Determine a significance level to use.

We will choose to use a significance level of 0.01.

3. Calculate the test statistic and p-value.

We can plug in the raw data for each sample into this to calculate the test statistic and p-value:

t test statistic: -3.226

two-tailed p-value: 0.0045

4. Reject or fail to reject the null hypothesis.

Since the p-value (0.0045) is less than the significance level (0.01) we reject the null hypothesis.

We have sufficient evidence to say that the mean vertical jump before and after participating in the training program is not equal.

Bonus: Decision Rule Calculator

You can use this to automatically determine whether you should reject or fail to reject a null hypothesis for a hypothesis test based on the value of the test statistic.

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