

T-Test Decision Rule



t test decision condition
my $t_{cal} = 2.06$ and $t_{tab} = 2.09$



In hypothesis testing, a t-test is used to determine if there is a significant difference between the means of two groups. The decision to reject or fail to reject the null hypothesis is based on the comparison between the calculated t-value (t_{cal}) and the critical t-value (t_{tab}) from the t-distribution table.

Here's how you make a decision:

1. State the Hypotheses:

- **Null Hypothesis (H_0):** There is no significant difference between the groups.
- **Alternative Hypothesis (H_1):** There is a significant difference between the groups.

2. Determine the Significance Level (α):

- This is the probability of rejecting the null hypothesis when it is true. Common values are 0.05, 0.01, or 0.10.

3. Calculate the Test Statistic (t_{cal}):

- You've calculated this as 2.06.

4. Find the Critical Value (t_{tab}):

- This is based on the chosen α , the degrees of freedom, and whether it's a one-tailed or two-tailed test. You've given this as 2.09.

5. Decision Rule:

- **If $|t_{cal}| > |t_{tab}|$, reject the null hypothesis (H_0).**
- **If $|t_{cal}| \leq |t_{tab}|$, fail to reject the null hypothesis (H_0).**

Applying to Your Example:

- $t_{cal} = 2.06$
- $t_{tab} = 2.09$

Since $|t_{cal}|$ (2.06) is **less than** $|t_{tab}|$ (2.09), you **fail to reject the null hypothesis**.

Conclusion:

- There is not enough evidence to say there is a significant difference between the groups at the chosen significance level.

This means that based on your data and the level of significance you set, the difference you observed could be due to random chance rather than a true difference between the groups.



$t_{cal} = -2$ and $t_{tab} = -1.71$ make decision



Let's evaluate the decision condition for your t-test using the given values:

- $t_{cal} = -2$
- $t_{tab} = -1.71$

Decision Rule:

- **For a Two-Tailed Test:**
 - If $|t_{cal}| > |t_{tab}|$, **reject** the null hypothesis (H_0).
 - If $|t_{cal}| \leq |t_{tab}|$, **fail to reject** the null hypothesis (H_0).
- **For a One-Tailed Test:**
 - **Left-tailed** (testing if the mean is less than a certain value):
 - If $t_{cal} < t_{tab}$, **reject** the null hypothesis (H_0).
 - If $t_{cal} \geq t_{tab}$, **fail to reject** the null hypothesis (H_0).
 - **Right-tailed** (testing if the mean is greater than a certain value):
 - If $t_{cal} > t_{tab}$, **reject** the null hypothesis (H_0).
 - If $t_{cal} \leq t_{tab}$, **fail to reject** the null hypothesis (H_0).

Applying to Your Example:

Since t_{cal} is negative, this is typically relevant for a left-tailed test, but let's consider both cases:

Two-Tailed Test:

- Calculate the absolute value of t:
 - $|t_{cal}| = |-2| = 2$
 - $|t_{tab}| = |-1.71| = 1.71$
- Since $|t_{cal}|$ (2) is **greater than** $|t_{tab}|$ (1.71), you **reject the null hypothesis** (H_0).

One-Tailed Test (Left-Tailed):

- Since t_{cal} (-2) is **less than** t_{tab} (-1.71), you **reject the null hypothesis** (H_0).

Conclusion:

- **Two-Tailed Test:** There is enough evidence to conclude that there is a significant difference between the means, implying that the observed effect is unlikely to be due to random chance.
- **One-Tailed Test (Left-Tailed):** There is enough evidence to conclude that the mean is significantly less than the value being tested against.

In both cases, the result suggests a statistically significant finding, allowing you to reject the null hypothesis at the chosen significance level.



list all conditions of z test and t test for decision making



When conducting hypothesis tests like the z-test and t-test, the decision-making process involves several conditions that must be met. These conditions guide whether to reject or fail to reject the null hypothesis (H_0). Let's list these conditions and discuss how to make decisions in both types of tests.

General Hypothesis Testing Steps

1. State the Hypotheses:

- **Null Hypothesis (H_0):** The statement being tested, usually implying no effect or no difference.
- **Alternative Hypothesis (H_1):** The statement you want to test for, indicating an effect or difference.

2. Select the Significance Level (α):

- Common values are 0.05, 0.01, or 0.10.

3. Choose the Appropriate Test:

- Decide whether to use a z-test or a t-test based on sample size and variance information.

4. Calculate the Test Statistic:

- Compute the z-value or t-value based on your sample data.

5. Determine the Critical Value:

- Obtain the critical value from the z-table or t-table corresponding to your α level and test type (one-tailed or two-tailed).

6. Make the Decision:

- Compare the calculated statistic with the critical value to decide whether to reject H_0 .

Conditions for Decision Making in Z-Test

The **z-test** is used when the sample size is large (typically $n \geq 30$), or the population variance is known. Here are the specific conditions for decision-making:

1. Z-Test for a Single Mean:

- **One-Tailed Test (Right-Tailed):**
 - Reject H_0 if $z_{cal} > z_{tab}$.
- **One-Tailed Test (Left-Tailed):**
 - Reject H_0 if $z_{cal} < -z_{tab}$.
- **Two-Tailed Test:**
 - Reject H_0 if $|z_{cal}| > z_{tab}$.

2. Z-Test for Comparing Two Means:

- Assume populations are normally distributed and have known variances.
- **Decision Rules:**
 - **Two-Tailed Test:** $|z_{cal}| > z_{tab}$
 - **One-Tailed Test:**
 - **Right-Tailed:** $z_{cal} > z_{tab}$
 - **Left-Tailed:** $z_{cal} < -z_{tab}$

3. Z-Test for Proportions:

- Used when testing hypotheses about population proportions.

- **Conditions:**
 - $np \geq 5$ and $n(1 - p) \geq 5$, where p is the sample proportion.
- **Decision Rules:**
 - **Two-Tailed Test:** $|z_{cal}| > z_{tab}$
 - **One-Tailed Test:**
 - **Right-Tailed:** $z_{cal} > z_{tab}$
 - **Left-Tailed:** $z_{cal} < -z_{tab}$

Conditions for Decision Making in T-Test

The **t-test** is used when the sample size is small ($n < 30$) and the population variance is unknown. Here are the specific conditions for decision-making:

1. T-Test for a Single Mean:

- The sample should be approximately normally distributed.
- **One-Tailed Test (Right-Tailed):**
 - Reject H_0 if $t_{cal} > t_{tab}$.
- **One-Tailed Test (Left-Tailed):**
 - Reject H_0 if $t_{cal} < -t_{tab}$.
- **Two-Tailed Test:**
 - Reject H_0 if $|t_{cal}| > t_{tab}$.

2. T-Test for Comparing Two Independent Means:

- The samples should be independent.
- Assume equal variances if using a pooled variance t-test.
- **Decision Rules:**
 - **Two-Tailed Test:** $|t_{cal}| > t_{tab}$
 - **One-Tailed Test:**
 - **Right-Tailed:** $t_{cal} > t_{tab}$
 - **Left-Tailed:** $t_{cal} < -t_{tab}$

3. Paired T-Test:

- Used for comparing two related samples (e.g., before and after measurements).
- Data should be paired and differences normally distributed.
- **Decision Rules:**
 - **Two-Tailed Test:** $|t_{cal}| > t_{tab}$
 - **One-Tailed Test:**
 - **Right-Tailed:** $t_{cal} > t_{tab}$
 - **Left-Tailed:** $t_{cal} < -t_{tab}$

Summary of Decision Conditions

- **Reject the Null Hypothesis (H_0) if:**
 - **Z-Test or T-Test, Two-Tailed:** $|\text{test statistic}| > \text{critical value}$
 - **One-Tailed, Right-Tailed:** $\text{test statistic} > \text{critical value}$
 - **One-Tailed, Left-Tailed:** $\text{test statistic} < -\text{critical value}$
- **Fail to Reject the Null Hypothesis (H_0) if:**
 - **Two-Tailed:** $|\text{test statistic}| \leq \text{critical value}$
 - **One-Tailed, Right-Tailed:** $\text{test statistic} \leq \text{critical value}$
 - **One-Tailed, Left-Tailed:** $\text{test statistic} \geq -\text{critical value}$

Example of Z-Test Decision

- **Example:**
 - $\alpha = 0.05$, two-tailed, critical value $z_{tab} = 1.96$
 - $z_{cal} = 2.5$
 - **Decision:** Since $|z_{cal}| = 2.5 > 1.96$, reject H_0 .

Example of T-Test Decision

- **Example:**
 - $\alpha = 0.05$, two-tailed, degrees of freedom = 10, critical value $t_{tab} = 2.228$
 - $t_{cal} = -2.5$
 - **Decision:** Since $|t_{cal}| = 2.5 > 2.228$, reject H_0 .

These conditions and rules help determine whether there is enough statistical evidence to support the alternative hypothesis, providing insights into the significance of your test results.

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