# t test sample problems with solution

**t test sample problems with solution** provide essential practice for understanding statistical hypothesis testing, particularly the application of the t test in real-world scenarios. This article explores various types of t tests, including one-sample, independent two-sample, and paired sample t tests, through detailed problems accompanied by step-by-step solutions. Understanding how to perform and interpret t tests is crucial for fields such as psychology, medicine, business, and any research involving sample mean comparisons. The article emphasizes clear methodology, formula usage, and critical thinking in hypothesis testing. Readers will gain insight into assumptions, calculation procedures, decision criteria, and interpretation of results, enhancing their competence in statistical analysis. The following sections systematically address t test sample problems with solution, ensuring comprehensive coverage of these fundamental statistical tools.



## Understanding the One-Sample t Test

The one-sample t test is used to determine whether the mean of a single sample differs significantly from a known or hypothesized population mean. This test is applicable when the population standard deviation is unknown and the sample size is relatively small. The t distribution accounts for extra uncertainty in estimating the population standard deviation from the sample. This section discusses the conceptual framework and walks through sample problems with detailed solutions to illustrate the application of the one-sample t test.

## Concept and Formula

The one-sample t test evaluates the null hypothesis that the population mean is equal to a specified value. The test statistic is calculated as:

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

where $\bar{x}$ is the sample mean, $\mu$ is the population mean under the null hypothesis, *s* is the sample standard deviation, and *n* is the sample size. The resulting t value is compared against critical values from the t distribution with *n-1* degrees of freedom.

## Sample Problem with Solution

**Problem:** A nutritionist claims that the average sodium content in a brand of canned soup is 500 mg. A sample of 15 cans reveals a mean sodium content of 520 mg with a standard deviation of 30 mg. Test the nutritionist's claim at the 0.05 significance level.

**Solution:**

1. **State hypotheses:** $H_0$: μ = 500 mg, $H_1$: μ $\neq$ 500 mg (two-tailed test)

2. **Calculate the test statistic:**

   $t = (520 - 500) / (30 / \sqrt{15}) = 20 / (30 / 3.873) = 20 / 7.746 = 2.58$

3. **Degrees of freedom:** df = 15 - 1 = 14

4. **Critical value:** For $\alpha = 0.05$ and df = 14, two-tailed t critical $\approx \pm 2.145$

5. **Decision:** Since 2.58 > 2.145, reject the null hypothesis.

6. **Interpretation:** There is sufficient evidence to conclude that the mean sodium content differs from 500 mg.

# Independent Two-Sample t Test Problems

The independent two-sample t test compares the means of two independent groups to determine if there is a statistically significant difference between them. This test is widely used in experiments where two distinct populations are compared. It requires assumptions such as independence of samples and normally distributed populations. This section presents problems involving independent samples with solutions demonstrating calculation of the test statistic, degrees of freedom, and decision-making process.

## Concept and Formula

The test statistic for two independent samples is given by:

$$t = (\bar{x}_1 - \bar{x}_2) / \sqrt{[(s_1^2/n_1) + (s_2^2/n_2)]}$$

where $\bar{x}_1$, $s_1^2$, and $n_1$ correspond to the first sample, and $\bar{x}_2$, $s_2^2$, and $n_2$ correspond to the second sample. The degrees of freedom can be approximated using the Welch-Satterthwaite equation when variances are unequal.

## Sample Problem with Solution

**Problem:** A researcher wants to compare the test scores of students taught by two different methods. Group A (n=12) has a mean score of 78 with a standard deviation of 8, while Group B (n=10) has a mean score of 85 with a standard deviation of 10. Test if the difference is significant at $\alpha = 0.05$.

**Solution:**

1. **State hypotheses:** $H_0: \mu_1 = \mu_2$, $H_1: \mu_1 \neq \mu_2$
2. **Calculate the test statistic:**

   $t = (78 - 85) / \sqrt{[(8^2/12) + (10^2/10)]} = (-7) / \sqrt{[(64/12) + (100/10)]} = (-7) / \sqrt{[5.33 + 10]} = (-7) / \sqrt{15.33} = (-7) / 3.916 = -1.79$

3. **Degrees of freedom (Welch's approximation):**

   $df \approx [(5.33 + 10)^2] / [(5.33^2 / (12-1)) + (10^2 / (10-1))] = (15.33^2) / [(28.4 / 11) + (100 / 9)] = 234.9 / (2.58 + 11.11) = 234.9 / 13.69 \approx 17.15$

4. **Critical value:** For $df \approx 17$ and $\alpha = 0.05$ two-tailed, t critical $\approx \pm 2.11$
5. **Decision:** Since $-1.79 > -2.11$, fail to reject the null hypothesis.
6. **Interpretation:** There is no significant difference in mean test scores between the two teaching methods.

## Paired Sample t Test Examples

The paired sample t test is designed for dependent samples, typically used when measurements are taken from the same subjects before and after an intervention. This test evaluates whether the mean difference between paired observations is significantly different from zero. This section explains the paired t test principles and provides sample problems with solutions to clarify the testing procedure.

## Concept and Formula

The paired t test statistic is calculated as:

*$t = \bar{d} / (s_d / \sqrt{n})$*

where $\bar{d}$ is the mean of the differences between paired observations, $s_d$ is the standard deviation of the differences, and $n$ is the number of pairs.

## Sample Problem with Solution

**Problem:** A group of 10 patients has their cholesterol levels measured before and after a dietary program. The mean difference (before - after) is 12 mg/dL with a standard deviation of 8 mg/dL. Test if the program significantly reduces cholesterol levels at the 0.01 significance level.

**Solution:**

1. **State hypotheses:** $H_0$: $\mu_d = 0$ (no difference), $H_1$: $\mu_d > 0$ (reduction in cholesterol)

2. **Calculate the test statistic:**

   $t = 12 / (8 / \sqrt{10}) = 12 / (8 / 3.162) = 12 / 2.53 = 4.74$

3. **Degrees of freedom:** df = n - 1 = 9

4. **Critical value:** For $\alpha = 0.01$ and df = 9, one-tailed t critical $\approx 2.821$

5. **Decision:** Since 4.74 > 2.821, reject the null hypothesis.

6. **Interpretation:** There is strong evidence that the dietary program reduces cholesterol levels.

## Common Mistakes in t Test Calculations

Accurate application of t tests requires attention to detail in data handling and formula use. Common errors can lead to incorrect conclusions and undermine research validity. This section outlines frequent mistakes encountered in t test sample problems with solution and provides guidance to avoid them.

### Typical Errors

- Misidentifying the type of t test needed, such as using an independent sample t test instead of a paired t test.
- Incorrect calculation of degrees of freedom, especially with unequal variances and sample sizes.
- Failing to check assumptions like normality and independence before applying the t test.
- Using population standard deviation instead of sample standard deviation when it is unknown.
- Misinterpreting p-values and critical values, leading to wrong hypothesis decisions.
- Neglecting to specify one-tailed or two-tailed tests according to research questions.

## Tips for Interpreting t Test Results

Interpreting t test outcomes accurately is essential for drawing valid conclusions from statistical analyses. This section discusses key considerations and best practices for understanding results from t test sample problems with solution, ensuring meaningful application in research contexts.

## Important Considerations

- **Significance Level:** Always confirm the alpha level set before testing to contextualize results.
- **Direction of Test:** Identify whether the hypothesis is one-tailed or two-tailed to interpret the p-value correctly.
- **Effect Size:** Beyond significance, assess the magnitude of differences to understand practical importance.
- **Confidence Intervals:** Utilize confidence intervals to estimate the range of plausible values for population parameters.
- **Assumptions Check:** Ensure that assumptions such as normality and independence are met to validate test results.
- **Contextualize Findings:** Interpret statistical results within the scope of the study's design and objectives.

# Frequently Asked Questions

## What is a t-test sample problem with solution for comparing two independent means?

A t-test sample problem for two independent means: Suppose we want to test if there is a significant difference in average test scores between two classes. Class A has 15 students with a mean score of 78 and standard deviation of 5, Class B has 12 students with a mean score of 74 and standard deviation of 6. Using a two-sample t-test, we calculate the t-statistic and compare it to the critical value for degrees of freedom to determine if the difference is significant.

## How do you solve a one-sample t-test problem with step-by-step solution?

Example: A sample of 10 students has an average height of 170 cm with a standard deviation of 8 cm. Test if the mean height is different from 165 cm at a 5% significance level. Solution steps: 1) State hypotheses H0: μ=165, H1: μ□165. 2) Calculate t = (170-165)/(8/□10) □ 1.98. 3) Degrees of freedom = 9. 4) Critical t-value □ ±2.262. 5) Since 1.98 < 2.262, fail to reject H0; no significant difference.

## What is an example of a paired t-test sample problem with solution?

Problem: A coach measures the running times of 8 athletes before and after a training program. Times (seconds) before: [12.1, 11.8, 12.5, 12.0, 11.9, 12.3, 12.4, 12.2], after: [11.8, 11.5, 12.2, 11.7, 11.6, 12.0, 12.1, 11.9]. Test if the training reduces running times at 5% significance. Solution: 1) Calculate differences, mean difference, and standard deviation. 2) Compute t-statistic using paired t-test formula. 3) Compare with critical t-value at 7 df. 4) If t is greater than critical value, reject H0 and conclude training is effective.

## How to interpret the results of a t-test sample problem with solution?

Interpretation involves comparing the calculated t-statistic to the critical value or using the p-value. For example, if a calculated t=2.5 with df=20 and critical t=2.086 at 5% significance, since 2.5 > 2.086, reject H0 and conclude a statistically significant difference exists. Alternatively, if p-value < 0.05, reject H0. The interpretation confirms whether the sample data provide enough evidence to support the alternative hypothesis.

## Can you provide a solved example of a two-tailed t-test sample problem?

Example: A machine produces bolts with mean length 5.1 cm, sample of 25 bolts has mean 5.3 cm and standard deviation 0.2 cm. Test if the mean length differs from 5.1 cm at 1% significance level.

Solution: H0: μ=5.1, H1: μ□5.1. Compute t = (5.3-5.1)/(0.2/□25) = 0.2/0.04 = 5. Critical t for df=24 at 1% two-tailed □ 2.797. Since 5 > 2.797, reject H0; the mean length differs significantly.

### What is a common mistake when solving t-test sample problems and how to avoid it?

A common mistake is confusing when to use a paired t-test versus an independent samples t-test. Paired t-test is used for dependent samples (e.g., before and after measurements on same subjects), while independent samples t-test is for two unrelated groups. To avoid this, carefully analyze the study design to select the correct test and apply the corresponding formula and assumptions.

### How do you solve a t-test problem involving unequal variances (Welch's t-test) with solution?

Example: Two samples with unequal variances: Sample 1 (n=10, mean=20, sd=4), Sample 2 (n=12, mean=22, sd=6). Test if means differ at 5% significance. Solution: Use Welch's t-test formula for t and approximate degrees of freedom. Calculate t = (20-22)/□($4^2$/10 + $6^2$/12) = (-2)/□(1.6 + 3) = -2/2.16 □ -0.93. Calculate df using Welch-Satterthwaite equation (~18). Critical t □ ±2.101. Since |-0.93| < 2.101, fail to reject H0; no significant difference.

## Additional Resources

1. *Mastering t-Tests: Sample Problems and Step-by-Step Solutions*
This book offers a comprehensive guide to understanding t-tests through numerous sample problems accompanied by detailed solutions. It covers one-sample, two-sample, and paired t-tests, making it ideal for beginners and intermediate learners. Each chapter focuses on practical examples to build confidence in hypothesis testing and data analysis.

2. *Applied Statistics: t-Test Examples and Solutions*
Designed for students and professionals, this book emphasizes real-world applications of t-tests. It provides a variety of sample problems with complete solutions, helping readers grasp the nuances of

statistical inference. The explanations are clear and supported by visual aids to enhance comprehension.

3. *Statistics Made Easy: Solving t-Test Sample Problems*
This user-friendly book simplifies the concepts behind t-tests by breaking down complex problems into manageable steps. It includes a wide range of sample problems with detailed solutions, focusing on interpretation and practical usage. Ideal for those new to statistics or anyone needing a refresher.

4. *t-Test Practice Workbook: Problems and Detailed Solutions*
A hands-on workbook filled with practice problems specifically designed to reinforce understanding of t-tests. Each problem is followed by a thorough explanation and solution, enabling self-study and mastery of key statistical techniques. The book also includes tips for avoiding common mistakes.

5. *Understanding t-Tests Through Sample Problems*
This book delves into the theoretical and practical aspects of t-tests, using sample problems to illustrate key concepts. It is well-suited for students seeking to deepen their knowledge of hypothesis testing. The solutions are clearly presented, fostering analytical thinking and problem-solving skills.

6. *Essential t-Test Problems with Complete Solutions*
Focusing on essential t-test scenarios, this book provides a curated selection of sample problems along with comprehensive solutions. It aids readers in developing a solid foundation in statistical testing and data analysis. The step-by-step approach makes complex ideas accessible to all levels.

7. *Practical t-Test Applications: Sample Problems and Solutions*
This book bridges the gap between theory and practice by presenting t-test problems drawn from various fields such as psychology, biology, and business. Each example is paired with a detailed solution, demonstrating how to apply statistical methods effectively. It is an excellent resource for applied researchers.

8. *Comprehensive Guide to t-Test Problems and Answers*
Offering an extensive collection of t-test problems, this guide serves as a valuable reference for

students and educators alike. Solutions are explained in depth, ensuring a clear understanding of each step. The book also includes tips for interpreting results and reporting findings accurately.

9. *Statistics Problem Solver: t-Test Sample Questions and Solutions*
Part of a larger series on statistics problem-solving, this book focuses specifically on t-test sample questions. It provides clear, concise solutions that emphasize understanding over memorization. Perfect for exam preparation and reinforcing statistical concepts in academic settings.

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