

How to Perform a One-Sample t-Test on Your TI-84 Calculator

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Perform a One Sample t-test on a TI-84 Calculator

The **One Sample t-test** is a fundamental tool within the realm of **inferential statistics**, designed to evaluate whether the **mean** of a specific sample significantly deviates from a predetermined or hypothesized **population mean**. This statistical procedure is indispensable for researchers who need to validate whether a single set of observations aligns with a known standard or if there is sufficient evidence to suggest a meaningful difference. By utilizing the **TI-84 Plus** family of calculators, students and professionals can bypass complex manual calculations, allowing the device to handle the heavy mathematical lifting involved in determining **statistical significance**.

In practice, the **One Sample t-test** relies on the **t-distribution**, which is particularly useful when the population **standard deviation** is unknown and the sample size is relatively small. The **TI-84 Plus** streamlines this process by providing a dedicated "TESTS" menu where users can input either raw data or summary statistics. Once the data is entered, the calculator provides critical outputs, including the **t-statistic** and the **p-value**, which are essential for deciding whether to reject or fail to reject the **null hypothesis**.

This comprehensive tutorial is designed to walk you through the entire process of conducting a **One Sample t-test** on your **TI-84 Plus** calculator. We will cover the theoretical underpinnings of the test, the necessary **statistical assumptions** that must be met for the results to be valid, and a detailed, step-by-step example. By the end of this guide, you will have a thorough understanding of how to interpret the results generated by your calculator and how to apply these findings to real-world research scenarios.

Foundational Concepts and Statistical Assumptions

Before diving into the technical steps on the **TI-84 Plus**, it is crucial to understand the logic behind the **One Sample t-test**. The test functions by comparing the difference between the **sample mean** and the hypothesized **population mean** relative to the variability in the data. This variability is captured by the **standard error**, which accounts for both the **standard deviation** and the **sample size**. When the **t-statistic** is large, it indicates that the observed **sample mean** is far from the **null hypothesis** value, potentially suggesting a significant effect.

For the results of a **One Sample t-test** to be reliable, several **statistical assumptions** must be satisfied. First, the data must be collected through **random sampling** to ensure that the sample is representative of the population. Second, the observations must be independent of one another. Third, the data should follow a **normal distribution**, especially if the sample size is small (typically $n < 30$). However, due to the **Central Limit Theorem**, the t-test is relatively robust to violations of normality when the sample size is sufficiently large.

Another vital component is the formulation of hypotheses. The **null hypothesis** (H_0) generally

states that there is no difference between the **sample mean** and the population **mean**. Conversely, the **alternative hypothesis** (H_1 or H_a) posits that a difference does exist. This difference can be non-directional (a **two-tailed test**) or directional (a **one-tailed test**). Properly identifying these hypotheses is the first step in ensuring your **TI-84 Plus** analysis yields meaningful conclusions.

Example: Evaluating Fuel Efficiency Standards

To illustrate the application of this test, let us consider a practical example involving automotive engineering and fuel economy. Suppose a team of researchers is investigating whether a specific model of a compact car achieves an average fuel efficiency of 20 miles per gallon (mpg). This 20 mpg figure represents our hypothesized **population mean** (μ_0). The researchers aim to determine if the actual performance of the car fleet differs significantly from this benchmark.

To conduct their investigation, the researchers collect a **random sample** of 74 cars ($n = 74$). After rigorous testing, they calculate a **sample mean** (\bar{x}) of 21.29 mpg and a **standard deviation** (s_x) of 5.78 mpg. Although the **sample mean** is higher than the hypothesized 20 mpg, we must determine if this difference is **statistically significant** or if it could have occurred simply by **random chance**.

Using this data, we will perform a **two-tailed One Sample t-test** on the **TI-84 Plus**. The **null hypothesis** is $H_0: \mu = 20$, and the **alternative hypothesis** is $H_a: \mu \neq 20$. We will set our **significance level** (α) at 0.05, a standard threshold in scientific research. If the resulting **p-value** is less than 0.05, we will reject the **null hypothesis** and conclude that the true mean mpg is different from 20.

Step 1: Navigating to the T-Test Menu

The first step in performing the analysis on your **TI-84 Plus** is to locate the correct statistical function. Begin by pressing the **STAT** key, which is located in the center of the keypad. This button opens the primary statistics interface, where you can manage lists, perform calculations, and conduct various **hypothesis tests**.

Once the STAT menu is open, use the right arrow key to scroll over to the **TESTS** tab. This section contains a comprehensive list of inferential procedures, including z-tests, t-tests, and **ANOVA**. Scroll down using the down arrow key until you highlight **2: T-Test...**. This is the specific function required for a **One Sample t-test** when the population **standard deviation** is unknown.

Press the **ENTER** key to select the T-Test option. You will be presented with a screen that requires you to choose your input method and provide the necessary parameters for the calculation. Ensuring that you have selected the correct test is vital, as selecting the Z-Test instead would lead

to incorrect results by assuming a known population variance.

```
EDIT CALC TESTS
1:Z-Test...
2:T-Test...
3:2-SampZTest...
4:2-SampTTest...
5:1-PropZTest...
6:2-PropZTest...
7:ZInterval...
```

Step 2: Inputting Data and Summary Statistics

After selecting the T-Test function, the **TI-84 Plus** will prompt you to choose between two input modes: **Data** or **Stats**. The **Data** mode is used when you have a complete list of raw observations stored in a list (such as L1). However, in our current example, we already possess the calculated summary statistics. Therefore, you should highlight **Stats** and press **ENTER** to proceed with the summary-based input.

Next, you must fill in the specific values required for the test. For **μ_0** , which represents the null hypothesis value, enter **20** and press **ENTER**. For **\bar{x}** , the sample mean, enter **21.29**. For **s_x** , the standard deviation of the sample, input **5.78**. Finally, for **n** , the sample size, enter **74**. Accuracy during this stage is critical, as a single typo can drastically alter the final t-statistic.

The final input line, labeled **μ** , allows you to define the alternative hypothesis. You have three choices: **$\neq \mu_0$** (two-tailed), **$< \mu_0$** (left-tailed), or **$> \mu_0$** (right-tailed). Since our researchers want to know if the mpg is simply "not 20," highlight **$\neq \mu_0$** and press **ENTER**. This selection ensures that the calculator computes a p-value based on both tails of the t-distribution. Once all fields are populated, highlight **Calculate** and press **ENTER**.

```

T-Test
Inpt:Data Stats
μ₀:20
x̄:21.29
Sx:5.78
n:74
μ:≠μ₀ <μ₀ >μ₀
Color: BLACK
Calculate Draw

```

Step 3: Interpreting the Calculator Output

Once you press Calculate, the **TI-84 Plus** will immediately generate a results screen. This screen contains all the necessary metrics to draw a statistical conclusion. The top line confirms the **alternative hypothesis** used for the test ($\mu \neq 20$). Below that, you will find the calculated **t-statistic**, which in this case is $t = 1.919896124$. This value represents how many **standard errors** the **sample mean** is away from the **null hypothesis**.

The most critical value for decision-making is the **p-value**, listed as $p = 0.0587785895$. The **p-value** represents the probability of obtaining a result as extreme as ours, assuming the **null hypothesis** is true. In this example, since our p-value of approximately 0.0588 is greater than our **significance level** of 0.05, we fail to reject the **null hypothesis**. This means there is not enough evidence to conclude that the true mean fuel efficiency is different from 20 mpg.

Finally, the calculator reiterates the input values, such as the **sample mean** ($\bar{x} = 21.29$), the **standard deviation** ($s_x = 5.78$), and the **sample size** ($n = 74$). It is always a good practice to double-check these values against your original data to ensure that no input errors occurred. While the **t-statistic** was relatively high, the large amount of variation in the sample prevented the result from reaching the 0.05 threshold for **statistical significance**.

```

T-Test
μ≠20
t=1.919896124
p=0.0587785895
x̄=21.29
Sx=5.78
n=74

```

Advanced Considerations: Degrees of Freedom and Effect Size

While the **TI-84 Plus** provides the primary outputs needed for a basic analysis, advanced researchers often look deeper into the **degrees of freedom** (df). In a **One Sample t-test**, the **degrees of freedom** are calculated as $n - 1$. For our example, $df = 73$. The **degrees of freedom** are essential because they define the shape of the **t-distribution** used to determine the **p-value**. As df increases, the t-distribution begins to closely resemble the **standard normal distribution**.

It is also important to distinguish between **statistical significance** and practical significance. Even if our **p-value** had been below 0.05, we would still need to evaluate the **effect size**, such as **Cohen's d**. The **effect size** quantifies the magnitude of the difference between the means. A small p-value indicates that a difference is likely not due to chance, but the **effect size** tells us if that difference is large enough to matter in a real-world context, such as automotive engineering or environmental policy.

Lastly, when reporting your results, it is standard practice to include the **t-statistic**, the **degrees of freedom**, and the **p-value**. For our example, the formal reporting might look like this: "A one-sample t-test was conducted to compare car fuel efficiency to a hypothesized mean of 20 mpg. The results indicated that the mean fuel efficiency ($M=21.29$, $SD=5.78$) did not differ significantly from 20 mpg, $t(73) = 1.92$, $p = .059$." Utilizing the **TI-84 Plus** ensures these values are calculated with high precision, aiding in the accurate communication of scientific findings.

Summary of Key Terms

Null Hypothesis (H_0): The assumption that no significant difference exists between the sample and population means.

Alternative Hypothesis (H_a): The claim that a significant difference does exist, which can be directional or non-directional.

T-statistic: A measure of the difference between the **sample mean** and the population **mean**, expressed in units of **standard error**.

P-value: The **probability** of observing the data given that the **null hypothesis** is true.

Degrees of Freedom: A parameter ($n-1$) that helps define the **t-distribution** for a specific sample size.