

How to Perform a One Sample t-Test in Excel: A Step-by-Step Guide

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Analyzing statistical hypotheses often requires specialized software, but for many common tests, Microsoft Excel offers powerful, accessible tools. This guide provides an in-depth, step-by-step tutorial on executing a One Sample t-Test directly within Excel, a method crucial for determining if a population mean significantly differs from a specified target value.

While Excel's Data Analysis toolPak technically lacks a dedicated "One Sample t-Test" function, we will demonstrate a highly reliable method that uses basic statistical functions and manual calculations to achieve the exact same statistical rigor and output required for academic or professional analysis. Understanding this manual procedure is vital for complex statistical applications.

Mastering this process involves several key phases: data preparation, calculating descriptive statistics, determining the required test statistic, finding the associated p-value, and finally, interpreting the results against the chosen significance level (α). This method ensures you can reliably test whether your sample data supports a statistically significant difference from the hypothesized population mean.

Understanding the One Sample t-Test

A One Sample t-Test is a fundamental statistical procedure used to evaluate whether the unknown mean of a population is statistically equal to a specific, hypothesized value (μ). This test is indispensable in fields ranging from quality control to biological research, whenever you need to compare empirical sample evidence against a predefined theoretical standard.

This tutorial explains, through a practical example, the exact methodology required to conduct a robust One Sample t-Test using the native capabilities of Excel. Since Excel does not provide a direct one-click option for this specific test, we rely on core statistical functions to manually derive the necessary components needed for the analysis.

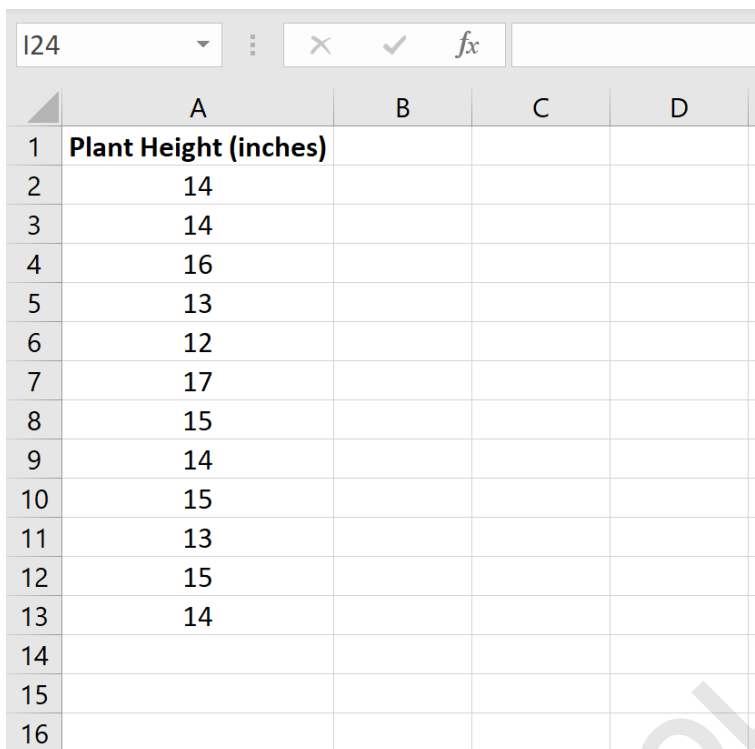
Case Study: Setting Up the Data (The Botanist Example)

To illustrate the analytical process, let us consider a practical scenario involving a botanist who is studying a specific species of plant. The botanist wants to rigorously test the historical claim that the average height of this entire plant population is exactly 15 inches. This 15-inch measurement represents the hypothesized population mean (μ).

To gather the necessary empirical evidence, she collects a random sample of 12 plants from the population and meticulously records each of their heights in inches. This sample data serves as the critical evidence base for evaluating the null hypothesis ($H_0: \mu = 15$).

The following image displays the recorded height measurements for each of the 12 plants included

in the sample, organized within a structured Excel worksheet:



	A	B	C	D
1	Plant Height (inches)			
2	14			
3	14			
4	16			
5	13			
6	12			
7	17			
8	15			
9	14			
10	15			
11	13			
12	15			
13	14			
14				
15				
16				

Using this raw data set, we can now proceed through the sequential steps required to conduct the one sample t-test and statistically determine if the mean height for this plant species is, in fact, different from the hypothesized value of 15 inches, using a predetermined significance level.

Step 1: Calculating Core Descriptive Statistics

The first essential step involves calculating the core descriptive statistics from our sample data. These values--specifically the **sample size** (n), the **sample mean** (\bar{x}), and the **sample standard deviation** (s)--are fundamental inputs for accurately calculating the test statistic t in the subsequent step.

Using Excel's powerful built-in functions, these calculations are streamlined and reliable. We utilize the `COUNT` function to find the sample size, the `AVERAGE` function for the sample mean, and the `STDEV.S` function (which correctly calculates the standard deviation based on a sample rather than a population) for the sample standard deviation.

The following image shows the formulas we can use to calculate these necessary values efficiently within the Excel environment:

	A	B	C	D	E
1	Plant Height (inches)				
2	14		Sample size	12	=COUNT(A2:A13)
3	14		Sample mean	14.3333	=AVERAGE(A2:A13)
4	16		Sample standard deviation	1.3707	=STDEV.S(A2:A13)
5	13				
6	12				
7	17				
8	15				
9	14				
10	15				
11	13				
12	15				
13	14				
14					
15					
16					
17					
18					

Step 2: Determining the Test Statistic (t-value)

Next, we must calculate the test statistic, denoted as t . The t-statistic serves as the primary measure of effect size in this context; it quantifies how many standard errors the calculated sample mean (\bar{x}) is located away from the hypothesized population mean (μ). A larger magnitude of t indicates stronger evidence against the null hypothesis.

The mathematical formula used for calculating the t-statistic in a one sample test is as follows:

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

The components of this formula are defined by the statistical parameters we have already established:

\bar{x} = The calculated sample mean.

μ = The hypothesized population mean (15 inches).

s = The sample standard deviation.

n = The sample size.

The following image shows how to calculate the t-statistic by entering the appropriate cell references and formula structure into Excel, ensuring that the standard error calculation (the denominator) is correctly grouped using parentheses:

	A	B	C	D	E	F
1	Plant Height (inches)					
2	14		Sample size	12	=COUNT(A2:A13)	
3	14		Sample mean	14.3333	=AVERAGE(A2:A13)	
4	16		Sample standard deviation	1.3707	=STDEV.S(A2:A13)	
5	13					
6	12					
7	17		Hypothesized mean	15		
8	15		Test statistic t	-1.68485	=((D3-D7)/(D4/SQRT(D2)))	
9	14					
10	15					
11	13					
12	15					
13	14					
14						
15						
16						

After performing the calculation using the botanist's data, the resulting test statistic t is calculated to be **-1.68485**.

Step 3: Calculating the p-value and Degrees of Freedom

Following the derivation of the t-statistic, we proceed to calculate the corresponding p-value. The p-value is the probability of observing our specific sample result (or a result more extreme) purely by chance, assuming the null hypothesis is true. This value is critical for making the final decision in the hypothesis test.

For a two-tailed test, we calculate the p-value using the Excel function `=T.DIST.2T(ABS(x), deg_freedom)`. This function requires two key inputs for accurate distribution mapping: the absolute value of the test statistic t and the degrees of freedom.

The required inputs for the `T.DIST.2T()` function are:

x : The magnitude of the test statistic t . We use the `ABS` function to handle the negative sign of our calculated t value.

$deg_freedom$: The degrees of freedom, calculated as $n-1$. Since our sample size (n) is 12, the degrees of freedom is 11.

The following image shows the implementation of this function in the worksheet, which utilizes the calculated t-statistic from the previous step to find the associated two-tailed probability:

	A	B	C	D	E
1	Plant Height (inches)				
2	14		Sample size	12	=COUNT(A2:A13)
3	14		Sample mean	14.3333	=AVERAGE(A2:A13)
4	16		Sample standard deviation	1.3707	=STDEV.S(A2:A13)
5	13				
6	12				
7	17		Hypothesized mean	15	
8	15		Test statistic t	-1.68485	=(D3-D7)/(D4/SQRT(D2))
9	14				
10	15		Degrees of freedom	11	=D2-1
11	13		P-value	0.120145	=T.DIST.2T(ABS(D8), D10)
12	15				
13	14				
14					
15					
16					

The resulting p-value for our two-tailed test is precisely calculated as **0.120145**.

Technical Deep Dive: Understanding T.DIST Functions

Technical Notes on T-Distribution Functions:

It is essential to select the correct Excel function based on the intended directionality of the hypothesis test. The function **T.DIST.2T()** is specifically designed to return the p-value appropriate for a **two-tailed t-test**, which aligns with our alternative hypothesis that the mean is simply unequal to the hypothesized value ($\mu \neq 15$).

If you were instead conducting a directional test, you must use a different function: for a **left-tailed t-test** (where $H_A: \mu < 15$), you would use the function **T.DIST(x, deg_freedom, TRUE)**. For a **right-tailed t-test** (where $H_A: \mu > 15$), you would use the function **T.DIST.RT(x, deg_freedom)**. Utilizing the wrong function will inevitably lead to an incorrect p-value calculation and, consequently, a potentially flawed interpretation of the statistical evidence.

Step 4: Interpreting the Hypothesis Test Results

The final and most crucial stage is interpreting the results by comparing the calculated p-value against the predetermined level of statistical significance (α), which is standardly set at 0.05. This comparison provides the basis for the final conclusion regarding the null hypothesis (H_0).

Recall the formalized hypotheses for this specific One Sample t-Test:

H_0 : $\mu = 15$ (The mean height for this species of plant is 15 inches).

H_A : $\mu \neq 15$ (The mean height is *not* 15 inches).

The decision rule requires us to **reject the null hypothesis** only if the p-value is less than or equal to α (0.05). Since our calculated p-value (**0.120145**) is significantly larger than the chosen alpha level of 0.05, we must conclude that we **fail to reject the null hypothesis**.

This failure to reject signifies that the data collected from the 12 plants does not provide sufficient statistical evidence to confidently claim that the true mean height for this particular species of plant is different from 15 inches. The observed difference between the sample mean and the hypothesized value is statistically insignificant at the 5% level.

Conclusion and Related Statistical Tests

The methodology detailed above provides a robust, manually calculated approach to executing the One Sample t-Test in Excel, ensuring the results are statistically valid and comparable to those obtained from dedicated statistical software. While the process requires careful management of individual functions, Excel remains an incredibly powerful and accessible tool for fundamental hypothesis testing and statistical inference.

For researchers conducting comparative analyses involving two groups, Excel also supports other types of t-tests, which are used when comparing the means of two independent samples or two related samples, rather than comparing a single sample to a fixed constant.

The following tutorials provide detailed guides on performing these other common types of t-tests in Excel:

[How to Conduct a Two Sample t-Test in Excel](#)

[How to Conduct a Paired Samples t-Test in Excel](#)