

How to Calculate a One Proportion Z-Test in Excel

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The One Proportion Z-Test is a foundational statistical tool used to assess whether the proportion of a characteristic observed within a sample significantly deviates from a known or hypothesized population proportion. While advanced statistical software is often employed, this critical test can be executed efficiently using Microsoft Excel. This guide details the step-by-step process of performing the Z-Test in Excel, requiring users to structure their sample data, calculate the necessary test statistic using specific formulas, and ultimately interpret the resulting P-value to draw meaningful conclusions about the population.

A **one proportion z-test** is specifically utilized when the objective is to compare an observed proportion--derived from empirical data--against a theoretical or established population proportion. This method is indispensable in fields ranging from quality control to market research, providing a robust framework for hypothesis testing.

Consider a practical scenario: A major telecommunications company asserts that 90% of its clientele express satisfaction with their service quality. To validate this significant claim, an independent researcher undertakes a study, collecting data from a simple random sample of 200 customers. The survey results indicate that 85% of this sample reported being satisfied.

The One Proportion Z-Test allows us to determine if the observed 85% is statistically close enough to the claimed 90% to uphold the company's assertion, or if this difference is substantial enough to reject the claim, confirming that the true percentage of satisfied customers is indeed different from 90%.

Key Steps for Executing the One Proportion Z-Test

To properly execute the Z-Test, a standardized procedure involving three primary steps must be followed. These steps guide the researcher from defining the research question to interpreting the statistical outcome.

Define the Hypotheses: The first crucial step is formulating the null hypothesis (H_0) and the alternative hypothesis (H_a). The null hypothesis always represents the status quo or the claim being tested, while the alternative hypothesis represents what we suspect is true if the null is proven false. In our example, where the company claims 90% satisfaction ($P = 0.90$), we define the hypotheses for a two-tailed test as:

The Null Hypothesis (H_0): $P = 0.90$

The Alternative Hypothesis (H_a): $P \neq 0.90$ (meaning the true proportion is not 90%)

Calculate the Test Statistic and P-value: The test statistic, denoted as z , quantifies how many standard deviations the sample proportion (p) is away from the hypothesized population proportion (P). The formula used for the Z-Test is:

Test statistic $z = (p - P) / (\sqrt{P(1-P) / n})$

Here, p is the sample proportion (0.85), P is the hypothesized population proportion (0.90), and n is the sample size (200). Plugging in our values yields:

$$z = (0.85 - 0.90) / (\sqrt{0.90(1 - 0.90) / 200}) = (-0.05) / (0.0212) = -2.358$$

Using standard statistical tables or functions, a z score of -2.358 for a two-tailed test results in a corresponding P-value of **0.018**.

Make the Decision (Reject or Fail to Reject H_0): The final step involves comparing the calculated P-value to the predetermined significance level (α). Common choices for α are 0.01, 0.05, or 0.10. For this illustration, we set the significance level at $\alpha = 0.05$. Since the calculated P-value (0.018) is demonstrably less than our chosen α (0.05), we are compelled to reject the null hypothesis.

The rejection of the null hypothesis provides strong statistical evidence that the true percentage of customers satisfied with the service is not 90%.

Implementing the One Proportion Z-Test Using Microsoft Excel

While manual calculation is instructive, performing the Z-Test efficiently requires leveraging the computational power of software like Excel. Excel simplifies the calculation of the test statistic and, more importantly, the precise P-value using built-in statistical functions. The methodology differs slightly based on whether the test is two-tailed (testing for inequality) or one-tailed (testing for directionality).

Case Study 1: Two-Tailed One Proportion Z-Test in Excel

For a two-tailed test, we are interested in detecting whether the sample proportion is significantly different from the hypothesized proportion in either direction (greater than or less than). Returning to the telecommunications example: A company claims 90% satisfaction. A sample of 200 customers is taken, and 190 report satisfaction ($p = 190/200 = 0.95$).

The research objective is to **Test the null hypothesis ($H_0: P = 0.90$) against the alternative hypothesis ($H_a: P \neq 0.90$), utilizing a 0.05 significance level (α).** This structure tests for simple inequality.

The subsequent image demonstrates the proper setup within an Excel spreadsheet, including the required input values and the formulas necessary to derive the statistical results automatically:

	A	B	C	D	E	F
1	Test proportion	0.9				
2	Sample size	200				
3	Frequency	170				
4						
5	Sample proportion	0.85	=B3/B2			
6	Test statistic	-2.35702	=(B5-B1)/SQRT(B1*(1-B1)/B2)			
7	P-value	0.018422	=2*NORM.S.DIST(B6, TRUE)			
8						
9						
10						
11						

Users must manually populate the input fields (cells **B1:B3**) with the observed frequency, sample size, and hypothesized population proportion. The core outputs--the sample proportion, test statistic, and P-value (cells **B5:B7**)--are then automatically calculated using the formulas detailed in column C.

The formulas perform three distinct calculations essential for the Z-Test:

Formula in cell **C5**: This calculates the sample proportion (\$p\$) by dividing the **Frequency of Successes** by the **Sample Size**.

Formula in cell **C6**: This calculates the test statistic (\$z\$) using the standard formula: $z = (p - P) / (\sqrt{P(1-P) / n})$.

Formula in cell **C7**: This determines the P-value associated with the calculated \$z\$-score. Crucially, because this is a two-tailed test, the Excel function **NORM.S.DIST**--which provides the cumulative probability for the standard normal distribution--is multiplied by two to account for both tails of the distribution.

Upon analysis, the resulting P-value (**0.018**) is less than the established significance level (\$\alpha = 0.05\$). Consequently, we reject the null hypothesis. This finding suggests that there is statistically sufficient evidence to conclude that the true percentage of satisfied customers is not 90%.

Case Study 2: One-Tailed One Proportion Z-Test in Excel

A one-tailed test, conversely, focuses on a specific direction--either testing if the true proportion is strictly greater than, or strictly less than, the hypothesized value. This is typically employed when directional claims are made.

In this adjusted scenario, the phone company claims satisfaction is **at least** 90%. The researcher

samples 200 customers, finding that 176 are satisfied ($p = 176/200 = 0.88$).

The goal is to **Test the null hypothesis ($H_0: P \geq 0.90$) against the alternative hypothesis ($H_a: P < 0.90$), using a significance level (α) of 0.10**. Since the alternative hypothesis suggests the proportion is less than 90%, this constitutes a left-tailed test.

The screenshot below illustrates the required setup in Excel for this specific one-tailed hypothesis test:

	A	B	C	D	E	F
1	Test proportion	0.9				
2	Sample size	200				
3	Frequency	176				
4						
5	Sample proportion	0.88	=B3/B2			
6	Test statistic	-0.94281	= (B5-B1)/SQRT(B1*(1-B1)/B2)			
7	P-value	0.172889	=NORM.S.DIST(B6, TRUE)			
8						
9						
10						

Similar to the two-tailed approach, input data is entered into cells **B1:B3**. The calculation cells (**B5:B7**) utilize the corresponding formulas shown in column C to derive the statistical measures.

The fundamental difference in the one-tailed calculation lies in the P-value formula:

Cell C5 and C6 Formulas: These remain identical to the two-tailed test, calculating the sample proportion and the test statistic (z) respectively.

Cell C7 Formula: This calculates the P-value using the Excel function **NORM.S.DIST**. Crucially, for a one-tailed test, this value is **not** multiplied by two, as the probability is concentrated entirely in one tail of the normal distribution.

The analysis reveals a P-value of **0.17**. Since 0.17 is greater than the chosen significance level ($\alpha = 0.10$), we **fail to reject the null hypothesis**. This outcome indicates that there is insufficient statistical evidence, at the 10% level, to support the claim that the true percentage of satisfied customers is less than 90%.