

Appendix

Introduction to Inference with Excel, JMP, Minitab, SPSS, CrunchIt!, R, and TI-83/-84 Calculators

This chapter introduces the basic logic of inference. We use the unrealistic assumption that the population standard deviation is known to avoid having to introduce too many new concepts at once.

Minitab is the only technology that will automatically find the sample size needed for a desired margin of error. None of these technologies will compute a prediction interval automatically; JMP will compute prediction intervals, but they are not based on the standard Normal (z) distribution.

Inference for the Mean (σ Known)



EXCEL

Confidence Interval

Excel does not have a routine for reporting the lower and upper limits of a confidence interval for the mean. However, you can use Excel to compute the margin of error, which can then be subtracted and added to the sample mean to get the confidence interval.

1. Click an empty cell in the spreadsheet.
2. Click **Formulas** → **More Functions** → **Statistical**.
3. Scroll down the list of functions and click on “CONFIDENCE.NORM.”
4. In the “Alpha” box, input a (for example, 0.05) to obtain a $100(1 - a)\%$ (here, 95%) confidence interval.
5. In the “Standard dev” box, input the known population standard deviation (σ).
6. In the “Size” box, input the sample size.
7. Click **OK**.

Tests of Statistical Significance

To conduct a test of the mean with known population standard deviation, Excel only provides a statistical function that will report the P -value for a *one-sided, greater-than* alternative hypothesis and *only with data*.

1. Click an empty cell in the spreadsheet.
2. Click **Formulas** → **More Functions** → **Statistical**.
3. Scroll down the list of functions and click on “ZTEST.”
4. In the “Array” box, input the cell range of the data.
5. In the “X” box, input the null hypothesis mean value (μ_0).
6. In the “Sigma” box, input the known population standard deviation (σ).
7. Click **OK** to find the P -value, which is reported in the selected cell.

Note: If your alternative hypothesis is a less-than alternative, subtract the reported P -value from 1 to obtain the appropriate P -value. For a two-sided alternative, if the reported P -value is less than 0.5, you should double it; otherwise, you should double $(1 - \text{reported } P\text{-value})$.

Prediction Interval

Excel cannot calculate a prediction interval or its margin of error.

The Excel Video Technology Manuals on Confidence Intervals: Z - with Data, Confidence Intervals: Z - Summarized Data, One Mean Test: Z - with Data and Sample Size Computation can help here with additional explanation and worked examples.



Confidence Interval

With Raw Data:

1. Click **Analyze** → **Distribution**.
2. Click to enter the variable into the box labeled “Y, Columns.”
3. Click **OK**.
4. Click the red arrow next to the variable name. Select **Confidence Interval** → **Other**.
5. Change the confidence level if needed. Click the radio button next to “Use known Sigma” Click **OK**. Enter the value of sigma.
6. Click **OK**.

With Summarized Data:

1. Click **Help** → **Calculators** → **Confidence Interval for One Mean**.
2. Choose “Summary Statistics.”
3. Use the radio button to select “z” as the interval type.
4. Enter the sample average, population standard deviation, sample size, and change the confidence level (if needed).
5. Press “Enter.”

Note: A Z-Based Confidence Interval can also be obtained from the Calculator option with raw data. Select that option instead of summary statistics. Select the data column on the interim screen, then enter σ and change the confidence level (if needed) on the main dialog screen.

Tests of Statistical Significance

With Raw Data:

1. Click **Analyze** → **Distribution**.
2. Select a numeric column and click “Y, Columns” to enter this variable in the Y role.
3. Click **OK**.
4. Select the red triangle and click “Test Mean.”
5. Enter the hypothesized value of the mean and the known population standard deviation.
6. Click **OK**.

With Summarized Data:

1. Click **Help** → **Calculators** → **Hypothesis Test for One Mean**.
2. Choose “Summary Statistics” or “Raw Data” and click **OK**. If using raw data, there will be an interim dialog that asks you to select the variable.

3. Use the radio button to select “z-test” as the type of test.
4. Choose the type of alternative hypothesis using the radio buttons.
5. With summarized data, enter the value of the hypothesized mean, the sample mean, the population standard deviation, the sample size, and alpha.
6. With raw data, enter the hypothesized mean, the population standard deviation, and alpha.
7. Click **Enter**.

Note: There is an option here to check the box labeled “Reveal Decision,” and you will be given the Reject/Fail to Reject decision based on the specified alpha level.

The JMP Video Technology Manuals on Confidence Intervals: Z - with Data, Confidence Intervals: Z - Summarized Data, One Mean Test: Z - with Data, One Mean Test: Z - Summarized Data and Sample Size Computation can help here with additional explanation and worked examples.



Both confidence intervals and hypothesis tests are done through the **Stat → Basic Statistics → 1-Sample Z** dialog.

1. Select the correct option “One or more samples, each in a column” for raw data or “Summarized data.”
2. For raw data, click and select the column of interest; enter the population standard deviation.
3. For summary statistics, enter the sample size (n), sample mean (\bar{x}), and population standard deviation (σ).
4. The defaults are 95% confidence and a “not equal” alternate (two-sided confidence interval). To change either of these, click “Options,” change the value, then click **OK**.
5. For the confidence interval, click **OK**.
6. For a hypothesis test, check the box and enter the value of μ_0 ; then click **OK**.

Note: You can select Graphs and select a histogram, boxplot, or individual value plot (like a dotplot) to check the assumption that your sample came from a Normal population. This is especially helpful with small sample sizes, when you cannot appeal to the central limit theorem for the distribution of \bar{x}

Sample Size Needed for a Given Margin of Error

1. Click **Stat → Power and Sample Size → Sample Size for Estimation**.
2. The default option is Mean (Normal); enter the given standard deviation and desired margin of error.
3. Click **Options** and change the confidence level (if needed); check the box labeled “Assume population standard deviation is known.” Click **OK** to return to the main dialog and **OK** for the results.

The Minitab Video Technology Manuals on Confidence Intervals: Z - with Data, Confidence Intervals: Z - Summarized Data, One Mean Test: Z - with Data, One Mean Test: Z - Summarized Data and Sample Size Computation can help here with additional explanation and worked examples.



SPSS does not compute confidence intervals, hypothesis tests, or power for one mean when sigma is known.

Note: See the SPSS technology manual for this chapter for instructions on using SPSS as a calculator to perform the tests and procedures above.

CRUNCH IT!

Both confidence intervals and hypothesis tests are done through the **Statistics → z → 1-Sample** dialog.

1. For raw data in a column, click the **Columns** tab; otherwise, click **Summarized**.
2. For raw data, select the column of interest and enter the known standard deviation.
3. For summarized data, enter the sample size (n), observed sample mean, and known standard deviation.
4. Select the **Confidence Interval** tab and enter the desired confidence level or the **Hypothesis Test** tab and enter the hypothesized mean value and type of alternate hypothesis.
5. Click **Calculate**.

The CrunchIt! Help Video: One Sample Z and T Tests can help here with an example.



TI-83/-84

Confidence Interval

1. Press **[STAT]** **[▶]** **[▶]** to select “TEST.”
2. Select 7:Zinterval by arrowing down or pressing **[7]**.
3. Select “Data” (if you have entered the actual sample data in a list) or “Stats” using the left and right arrows. Press **[ENTER]** to finalize the selection.
4. For raw data, enter L1 (or whichever list has your data) as the data location, the population standard deviation, and the confidence level (in decimal form).
5. For summarized data (you have Stats), enter the population standard deviation, the sample mean, the sample size, and the confidence level (in decimal form).
6. Arrow down to Calculate and press **[ENTER]**.

Tests of Statistical Significance

1. Press **[STAT]** **[▶]** **[▶]** to select TESTS.
2. Select 1:Z-test by pressing **[ENTER]**.
3. Select “Data” (if you have entered the actual sample data in a list) or “Stats.” Press **[ENTER]** to finalize that selection.
4. Enter the value of the mean under the null hypothesis and the value of σ .
5. For raw data, enter L1 (or whichever list has your data) as the data location; set Freq to 1.
6. For summarized data (you have Stats), enter the sample mean, and sample size.
7. Select the desired type of alternative hypothesis.
8. Arrow down to Calculate and press **[ENTER]**.

The TI-83/-84 Video Technology Manuals on Confidence Intervals: Z - with Data, Confidence Intervals: Z - Summarized Data, One Mean Test: Z - with Data, One Mean Test: Z - Summarized Data and Sample Size Computation can help here with additional explanation and worked examples.



R does not have automatic routines to compute confidence intervals, hypothesis tests, or power for one mean when sigma is known. You can use `pnorm(z)` to find $P(Z < z)$ for the P -value of a test or the power of a test as described in the text.

The R Video Technology Manuals on Confidence Intervals for a Population Mean Based on Z, Significance Test for a Population Mean Based on Z, and Sample Size Computation for Inference on a Population Mean can help here with additional explanation and worked examples.