CHAPTER 15 Appendix

Inference in Practice

Most of this chapter involves issues with inference that technology will not help you answer. Questions such as which type of data collection methods were used and how large the sample size was can be answered only by a careful attention to detail and critical thinking.

Calculation of the minimum sample size needed to achieve a particular margin of error is, practically speaking, solving the equation $n \geq \left(\frac{z^*\sigma}{E}\right)^2$. From the information given, you will need to determine the population standard deviation, σ (or its reasonable approximation), and the desired margin of error, E. To find z^*, use an inverse Normal calculation as described in Chapter 11 of these technology appendices.

The last (optional) section of the chapter addresses power—that is, the probability that a null hypothesis is correctly rejected, given some alternative value of the parameter. The power of a test depends on three things: the sample sizes (larger samples have more power); the significance level of the test, α; and the difference between the "actual true value" and the value specified in the null hypothesis. The larger that difference, the more power the test has. Because we do not know the actual true value of the parameter (if we did, there would be no need to do a test), we typically calculate power as the ability to detect a difference of size Δ between the hypothesized value and a possible "true" value. The concept of power is used to determine a minimum necessary sample size in basic settings such as are discussed in your text and in more complex design situations. Designing one's study with a large enough sample size to detect a difference of practical importance, yet not having too large a sample size to waste resources, is an ethical consideration, as discussed in Chapter 7.

Power

Excel

Automated power calculations are not available in standard Excel or the enhanced add-on version of Excel. However, you can compute power in Excel by following the general steps for computing power described in this chapter and then use Excel's **NORMDIST** function.

1. **DOE ➔ Sample Size and Power ➔ One Sample Mean**. If you do not have a DOE menu, enter the JMP preferences, select **Menu**, and check the box for **Design of Experiments**.
2. Enter a value for alpha and the population standard deviation.
3. Supply two values in the table and click **Continue** to calculate the third.
4. If desired, click **Animation Script** to view an interactive visualization of power.

Minitab

1. **Stat ➔ Power and Sample Size ➔ 1-Sample Z**
2. You can specify values for any two of the following three dialog boxes: Sample sizes, Differences, or Power values. Minitab will then compute the item not specified.
3. Enter the value for the assumed standard deviation, σ.
4. **OK**

Note: Minitab assumes a two-sided alternative and 5% significance level. If you wish to have a one-sided alternative or change an α level, click **Options**, change the value, and click **OK** to return to the main dialog. Additionally, Minitab will produce a "power curve," which is simply a graph of the different power values against a range of difference (Δ) values.

SPSS does not compute power for one mean when sigma is known.

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To determine power for a given sample:

1. **Statistics ➔ Power Analysis ➔ Calculate Power**
2. Enter the values for alpha (as a decimal), the size of the effect you want to detect, the population standard deviation, and the sample size.
3. Select the type of alternative hypothesis.
4. Click **Calculate**. The value of power is given in the current window next to Power:.

To determine sample size for a desired power:

1. **Statistics ➔ Power Analysis ➔ Calculate Sample Size**
2. Enter the values for alpha (as a decimal), the size of the effect, the population standard deviation, and the desired power.
3. Select the type of alternative hypothesis.
4. Click **Calculate**. The needed sample size is given in the current window next to Sample Size:.

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Automated power calculations are not available; however, power can be calculated using **normalCDF** as described in the Chapter 11 appendix. For more detailed instructions, see the technology manual for this chapter

R does not compute power for one mean when sigma is known. You can use **pnorm(z)** to find the power of a test as described in the text.