7 Hypothesis Testing I
The One-Sample Case

LEARNING OBJECTIVES

By the end of this chapter, you will be able to:

1. Explain the logic of hypothesis testing.
2. Define and explain the conceptual elements involved in hypothesis testing, especially the null hypothesis, the sampling distribution, the alpha level, and the test statistic.
3. Explain what it means to "reject the null hypothesis" or "fail to reject the null hypothesis."
4. Identify and cite examples of situations in which one-sample tests of hypotheses are appropriate.
5. Test the significance of single-sample means and proportions by using the five-step model and then correctly interpret the results.
6. Explain the difference between one- and two-tailed tests and specify when each is appropriate.
7. Define and explain Type I and Type II errors and then relate each to the selection of an alpha level.

USING STATISTICS

The statistical techniques presented in this chapter can be used to answer research questions in situations where we want to compare a sample to a population. Examples of this situation include:

1. A researcher working for a senior citizens advocacy group has asked a sample of 789 older residents of a particular state if they have been victimized by crime over the past year. He knows the percentage of the entire population of the state that was victimized and wants to test his hypothesis that senior citizens, as represented by this sample, are more likely to be victimized than the population in general.
2. The board of trustees of a small college wants to expand the school's athletic program but is concerned about the academic progress of student athletes. They have asked the dean to investigate. Among other tests, he will compare the GPAs of a random sample of 235 student athletes with the GPA of all students at the university.
3. A sociologist is assessing the effectiveness of a rehabilitation program for alcoholics in her city. The program serves a large area, so she cannot test every single client. Instead, she draws a random sample of 127 people from the list of all clients and questions them on a variety of issues. She notices

that, on average, the people in her sample miss fewer days of work each year than workers in the city as a whole. On the basis of this unexpected finding, she decides to conduct a test to see if the workers in her sample really are more reliable than workers in the community as a whole.

In Chapter 6, you were introduced to inferential statistics techniques for estimating population parameters from sample statistics. In Chapters 7 through 10, we investigate a second application of inferential statistics called **hypothesis testing** or **significance testing**. In this chapter, the techniques for hypothesis testing in the one-sample case are introduced. We can use these techniques when we have a randomly selected sample that we want to compare to a population. Note that we are not interested in the sample per se but in the larger group from which it was selected. We want to know if the group represented by the sample differs from a population parameter on a specific characteristic.

Of course, it would be better if we could test all members of the group in which we are interested rather than a small sample. However, as we have seen, researchers usually do not have the resources to test everyone in a large group and must use random samples instead. In these situations, conclusions will be based on a comparison of a single sample (representing the larger group) and the population. For example, if we found that the rate of criminal victimization for a sample of senior citizens was higher than the rate in the state as a whole, we might conclude that "senior citizens are significantly more likely to be crime victims." The word *significantly* is a key word: It means that the difference between the sample's victimization rate and the population's rate is very unlikely to be caused by random chance alone. In other words, it is very likely that *all* senior citizens (not just those in the sample) have a higher victimization rate than the state as a whole. On the other hand, if we found little difference between the GPAs of a sample of athletes and the whole student body, we might conclude that athletes (*all* athletes, not just those in the sample) are essentially the same as other students in terms of academic achievement.

Thus, we can use samples to represent larger groups (senior citizens, athletes, or treated alcoholics), compare and contrast the characteristics of the sample with those of the population, and be extremely confident in our conclusions. However, remember that there is no guarantee that random samples will be representative; thus, there will always be a small amount of uncertainty in our conclusions. One of the great advantages of inferential statistics is that we will be able to estimate the probability of error and evaluate our decisions accordingly.

An Overview of Hypothesis Testing

We will begin with a general overview of hypothesis testing—using the third research situation mentioned in "Using Statistics" as an example—and will introduce the more technical considerations and proper terminology throughout the remainder of the chapter. Let us examine this situation in some detail. First, the