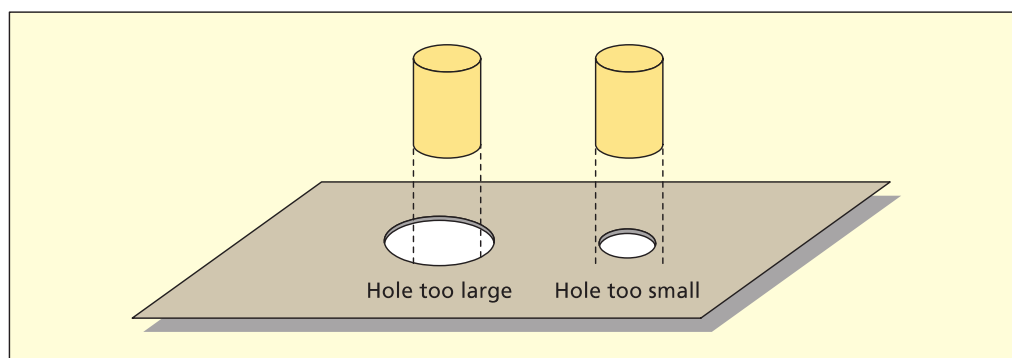


expect rejection in one direction, it is reasonable to use a two-tailed test. Rejection in a two-tailed test guarantees rejection in a one-tailed test, other things being equal.

When the consequences of rejecting H_0 are asymmetric, or where one tail is of special importance to the researcher, we might perform a one-tailed test. For example, suppose that a machine is supposed to bore holes with a 3.5-mm diameter in a piece of sheet metal. Although any deviation from 3.5 mm is a violation of the specification, the consequences of rejecting H_0 may be different. Suppose an attachment pin is to be inserted into the hole. If the hole is too small, the pin cannot be inserted, but the metal piece might be reworked to enlarge the hole so the pin does fit. On the other hand, if the hole is too large, the pin will fit too loosely and may fall out. The piece may have to be discarded since an oversized hole cannot be made smaller. This is illustrated in Figure 9.3.

FIGURE 9.3

Asymmetric Effects of Nonconformance



SECTION EXERCISES

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VAIL RESORTS

- 9.7 A manufacturer claims that its compact fluorescent bulbs contain an average of 2.5 mg of mercury. Write the hypotheses for a two-tailed test, using the manufacturer's claim about the mean as the null hypothesis.
- 9.8 Noodles & Company is interested in testing whether their new menu design helps reduce the average order time for their customers. Suppose that the average order time prior to the introduction of their new menu was 1.2 minutes. Write the hypotheses for a left-tailed test, using their previous average order time as the claim about the mean for the null hypothesis.
- 9.9 The Scottsdale fire department aims to respond to fire calls in 4 minutes or less, on average. State the hypotheses you would use if you had reason to believe that the fire department's claim is not being met. *Hint:* Remember that sample data are used as evidence *against* the null, not to prove the null is true.
- 9.10 The average age of a part-time seasonal employee at a Vail Resorts ski mountain has historically been 37 years. State the hypotheses one would use to test if this average has decreased since the last season.
- 9.11 Sketch a diagram of the decision rule for each pair of hypotheses.
 - a. $H_0: \mu \geq 80$ versus $H_1: \mu < 80$
 - b. $H_0: \mu = 80$ versus $H_1: \mu \neq 80$
 - c. $H_0: \mu \leq 80$ versus $H_1: \mu > 80$
- 9.12 The Ball Corporation's aluminum can manufacturing facility in Ft. Atkinson, Wisconsin, wants to use a sample to perform a two-tailed test to see whether the mean incoming metal thickness is at the target of 0.2731 mm. A deviation in either direction would pose a quality concern. State the hypotheses they should test.

9.3 TESTING A MEAN: KNOWN POPULATION VARIANCE

We will first explain how to test a population mean, μ . The sample statistic used to estimate μ is the random variable $\bar{X}$. The sampling distribution for $\bar{X}$ depends on whether or not the population variance σ^2 is known. We begin with the case of known σ^2 . We learned in Chapter 8 that the sampling distribution of $\bar{X}$ will be a normal distribution provided