Solution

HINT Descriptions of a type I error and a type II error refer to the *null hypothesis* being true or false, but when wording a statement representing a type I error or a type II error, be sure that the conclusion addresses the *original claim* (which may or may not be the null hypothesis). In this example, the claim is that $p > 0.5$, so the following interpretations address the claim of $p > 0.5$.

a. Type I Error: A type I error is the mistake of rejecting a true null hypothesis, so the following is a type I error: In reality $p = 0.5$, but sample evidence leads us to conclude that $p > 0.5$. (In this case, a type I error is to conclude that the gender-selection method is effective when in reality it has no effect.)

b. Type II Error: A type II error is the mistake of failing to reject the null hypothesis when it is false, so the following is a type II error: In reality $p > 0.5$, but we fail to support that conclusion. (In this case, a type II error is to conclude that the gender-selection method has no effect, when it really is effective in increasing the likelihood of a baby girl.)

Controlling Type I and Type II Errors Step 4 in our standard procedure for testing hypotheses is to select a significance level α (such as 0.05), which is the probability of a type I error. The values of α, β, and the sample size n are all related, so if you choose any two of them, the third is automatically determined (although β can't be determined until an alternative value of the population parameter has been specified along with α and n). One common practice is to select the significance level α, then select a sample size that is practical, so the value of β is determined. Generally, try to use the largest α that you can tolerate, but for type I errors with more serious consequences, select smaller values of α. Then choose a sample size n as large as is reasonable, based on considerations of time, cost, and other relevant factors. Another common practice is to select α and β so the required sample size n is automatically determined. (See Example 4 in Part 2 of this section.)

Comprehensive Hypothesis Test

In this section we described the individual components used in a hypothesis test, but the following sections will combine those components in comprehensive procedures. We can test claims about population parameters by using the *P*-value method summarized in Figure 8-1 or the critical value method summarized in Figure 8-2, or we can use confidence intervals, as follows.

Confidence Interval Method for Hypothesis Testing A confidence interval estimate of a population parameter contains the likely values of that parameter. If a confidence interval does not include a claimed value of a population parameter, reject that claim. For two-tailed hypothesis tests, construct a confidence interval with a confidence level of $1 - \alpha$, but for a one-tailed hypothesis test with significance level α, construct a confidence interval with a confidence level of $1 - 2\alpha$. (See Table 8-1 for common cases.) (For a left-tailed test or a right-tailed test, we could also use a one-sided confidence interval. See Exercise 43 in Section 7-2.) After constructing the confidence interval, use this criterion:

A confidence interval estimate of a population parameter contains the likely values of that parameter. We should therefore reject a claim that the population parameter has a value that is not included in the confidence interval.

Commercials

Television networks have their own clearance departments for screening commercials and verifying claims. The National Advertising Division, a branch of the Council of Better Business Bureaus, investigates advertising claims. The Federal Trade Commission and local district attorneys also become involved. In the past, Firestone had to drop a claim that its tires resulted in 25% faster stops, and Warner Lambert had to spend $10 million informing customers that Listerine doesn't prevent or cure colds. Many deceptive ads are voluntarily dropped, and many others escape scrutiny simply because the regulatory mechanisms can't keep up with the flood of commercials.