Cheating Detected

Methods for cheating on tests include the use of cell phones to text answers to friends and the use of calculators to store notes or share answers.

Caveon Test Security uses statistical methods to identify when cheating has occurred. That company searches for unlikely patterns, such as identical wrong answers by different students. The company even analyzes erasures on answer sheets to determine whether tests have been compromised by dishonest teachers or administrators who can gain from the appearance of higher test scores. The company also searches the Internet looking for questions or answers that were posted or discussed by previous test subjects.

Statistics plays an important role in the analyses conducted by Caveon Test Security. Unusual patterns are identified and the probabilities of those patterns are computed. If the probability of a pattern is very small, such as less than one chance in a million, the answer sheets are turned over to school administrators.

CAUTION In some cases, a conclusion based on a confidence interval may be different from a conclusion based on a hypothesis test. The *P*-value method and critical value method are equivalent in the sense that they always lead to the same conclusion. The following table shows that for the methods included in this chapter, a confidence interval estimate of a proportion might lead to a conclusion different from that of a hypothesis test.

Parameter	**Is a confidence interval equivalent to a hypothesis test in the sense that they always lead to the same conclusion?**
Proportion	No
Mean	Yes
Standard Deviation or Variance	Yes

Part 2: Beyond the Basics of Hypothesis Testing: The Power of a Test

We use β to denote the probability of failing to reject a false null hypothesis, so $P(\text{type II error}) = \beta$. It follows that $1 - \beta$ is the probability of rejecting a false null hypothesis; statisticians refer to this probability as the *power* of a test, and they often use it to gauge the effectiveness of a hypothesis test in allowing us to recognize that a null hypothesis is false.

DEFINITION The **power** of a hypothesis test is the probability $1 - \beta$ of rejecting a false null hypothesis. The value of the power is computed by using a particular significance level α and a *particular* value of the population parameter that is an alternative to the value assumed true in the null hypothesis.

Note that in the definition above, determination of power requires a particular value that is an alternative to the value assumed in the null hypothesis. Consequently, a hypothesis test can have many different values of power, depending on the particular values of the population parameter chosen as alternatives to the null hypothesis.

Example 3 Power of a Hypothesis Test

Consider these preliminary results from the XSORT method of gender selection: There were 13 girls among the 14 babies born to couples using the XSORT method. If we want to test the claim that girls are more likely ($p > 0.5$) with the XSORT method, we have the following null and alternative hypotheses:

$$H_0: p = 0.5 \qquad H_1: p > 0.5$$

Let's use a significance level of $\alpha = 0.05$. In addition to all of the given test components, finding power requires that we select a particular value of p that is an alternative to the value assumed in the null hypothesis H_0: $p = 0.5$. Find the values of power corresponding to these alternative values of p: 0.6, 0.7, 0.8, and 0.9.

Solution

The values of power in the following table were found by using Minitab, and exact calculations are used instead of a normal approximation to the binomial distribution.