P-Value Method

Example 1 can also be solved with the *P*-value method of testing hypotheses as outlined in Figure 8-1. *P*-values are typically provided by technology, but Table A-4 must be used if technology is not available. When using Table A-4, we usually cannot find *exact P*-values because the chi-square distribution table includes only selected values of α and selected numbers of degrees of freedom. See Example 2.

Example 2 Supermodel Heights: *P*-Value Method

Repeat Example 1 using the *P*-value method of testing hypotheses.

Solution

In Example 1 we noted that technology provides a *P*-value of 0.0003. Because this *P*-value is less than the significance level of 0.01, we reject the null hypothesis and support the claim that supermodels have heights with a standard deviation that is less than 2.6 in. for the population of women.

If technology is not available, refer to Table A-4 and use it as follows:

1. Locate the row for 9 degrees of freedom. (Because $n = 10$, we have df $= n - 1 = 9$.)
2. Use the test statistic of $\chi^2 = 0.852$ and see that in the 9th row of Table A-4, the test statistic of 0.852 is less than the lowest table entry of 1.735, so the area to the *right* of the test statistic is greater than 0.995, which means that the area to the *left* of the test statistic is less than $1 - 0.995 = 0.005$.
3. In this left-tailed test, the *P*-value is the area to the left of the test statistic, so we know that "*P*-value < 0.005." (This agrees with our *P*-value of 0.0003 found from technology.)

Using technology we find that *P*-value $= 0.0003$, and using Table A-4 we find that *P*-value < 0.005.

Human Lie Detectors

Researchers tested 13,000 people for their ability to determine when someone is lying. They found 31 people with exceptional skills at identifying lies. These human lie detectors had accuracy rates around 90%. They also found that federal officers and sheriffs were quite good at detecting lies, with accuracy rates around 80%. Psychology Professor Maureen O'Sullivan questioned those who were adept at identifying lies, and she said that "all of them pay attention to nonverbal cues and the nuances of word usages and apply them differently to different people. They could tell you eight things about someone after watching a two-second tape. It's scary, the things these people notice." Methods of statistics can be used to distinguish between people unable to detect lying and those with that ability.

Confidence Interval Method

When testing claims about σ or σ^2, the *P*-value method, critical value method, and the confidence interval method are all equivalent in the sense that they will always lead to the same conclusion. See Example 3.

Example 3 Supermodel Heights: Confidence Interval Method

Repeat the hypothesis test in Example 1 by constructing a suitable confidence interval.

Solution

First, we should be careful to select the correct confidence level. Because the hypothesis test is left-tailed and the significance level is 0.01, we should use a confidence level of 98%, or 0.98. (See Table 8-1 from Section 8-2 for help in selecting the correct confidence level.)

Using the methods described in Section 7-4, we can use the sample data listed in Example 1 to construct a 98% confidence interval estimate of σ. We use $n = 10$, $s = 0.7997395$ in., $\chi^2_L = 2.088$, and $\chi^2_R = 21.666$. (The critical values χ^2_L and χ^2_R are found in Table A-4. Use the row with df $= n - 1 = 9$.