If we repeat Example 1 with the assumption that the value of $\sigma = 0.480$ W/kg is known, the test statistic is

$$z = \frac{\bar{x} - \mu_{\bar{x}}}{\frac{\sigma}{\sqrt{n}}} = \frac{0.938 - 1.00}{\frac{0.480}{\sqrt{11}}} = -0.43$$

Using this test statistic of $z = -0.43$, we can proceed to find the P-value. (See Figure 8-4 for the flowchart summarizing the procedure for finding P-values.) Example 1 refers to a left-tailed test, so the P-value is the area to the *left* of $z = -0.43$, which is 0.3336 (found from Table A-2). Because the P-value of 0.3336 is greater than the significance level of $\alpha = 0.05$, we fail to reject the null hypothesis, as we did in Example 1. As in Example 1, we conclude that there is not sufficient evidence to support a claim that the population mean is less than 1.00 W/kg.

using TECHNOLOGY

STATDISK If working with a list of the original sample values, first find the sample size, sample mean, and sample standard deviation by using the STATDISK procedure described in Section 3-2. After finding the values of n, $\bar{x}$, and s, select **Analysis** from the main menu, then select **Hypothesis Testing,** followed by **Mean-One Sample.**

MINITAB Minitab allows you to use either the summary statistics or a list of the original sample values. Select the menu items **Stat, Basic Statistics,** and **1-Sample t.** (For σ known, select 1-Sample z.) Enter the summary statistics or enter the column containing the list of original sample values. Use the **Options** button to change the format of the alternative hypothesis or the significance level from the default.

EXCEL Use XLSTAT. First enter the list of original sample values in a list. Click on **XLSTAT** at the top, click on **Parametric tests,** then select **One sample t test and z test.** In the screen that appears, for the "Data" box enter the range of data, such as A1:A11 for 11 data values in column A. For "Data Format" select **One sample.** Click on the "Student's t test" box (or click on the "z test" box if σ is known). Click on the **Options** tab to select the type of test; select the option including $\neq$ for a two-tailed test, select the option including $<$ for a left-tailed test, or select the option including $>$ for a right-tailed test. For the "Theoretical mean" box, enter the claimed value of the population mean, which is the same value used in the statement of the null hypothesis. Enter the desired "Significance level (%)." For example, enter 5 for a 0.05 significance level. Click **OK.** After the results are displayed, look for the test statistic identified as "t (Observed value)" or "z (Observed value)." The P-value and critical value(s) will also be displayed.

T1-83/84 PLUS If using a TI-83/84 Plus calculator, press STAT, then select **TESTS** and choose the menu item of **T-Test.** (For σ known, select Z-Test.) You can use the original data **(Data)** or the summary statistics **(Stats)** by providing the entries indicated in the window display. The first three items of the TI-83/84 Plus calculator results will include the alternative hypothesis, the test statistic, and the P-value.

STATCRUNCH Click on **Open StatCrunch.** Click on **Stat,** then select **T statistics.** Select **One sample,** then select **with data** (for a list of sample data) or **with summary** (for summary statistics). Click on **Next,** then select **Hypothesis Test.** Enter the claimed value of the population mean and enter the form of the alternative hypothesis. Click on **Calculate.**

8-4 Basic Skills and Concepts

Statistical Literacy and Critical Thinking

1. Requirements Twelve different video games showing alcohol use were observed. The duration times of alcohol use were recorded, with the times (seconds) listed below (based on data from "Content and Ratings of Teen-Rated Video Games," by Haninger and Thompson, *Journal of the American Medical Association,* Vol. 291, No. 7). What requirements must be satisfied to test the claim that the sample is from a population with a mean greater than 90 sec? Are the requirements all satisfied?

84 14 583 50 0 57 207 43 178 0 2 57