The 0.98 confidence level indicates that $\alpha = 0.02$, and we divide that area of 0.02 equally between the two tails so that the areas to the *right* of the critical values are 0.99 and 0.01. Refer to Table A-4 and use the columns with areas of 0.99 and 0.01 and use the 9th row.)

$$\sqrt{\frac{(n-1)s^2}{\chi_R^2}} < \sigma < \sqrt{\frac{(n-1)s^2}{\chi_L^2}}$$

$$\sqrt{\frac{(10-1)(0.7997395^2)}{21.666}} < \sigma < \sqrt{\frac{(10-1)(0.7997395^2)}{2.088}}$$

$$0.5 \text{ in.} < \sigma < 1.7 \text{ in.}$$

Based on this confidence interval, we can support the claim that $\sigma < 2.6$ in. (because all values of the confidence interval are less than 2.6 in.). We reach the same conclusion found with the *P*-value method and the critical value method.

## using TECHNOLOGY

**STATDISK** Select **Analysis,** then **Hypothesis Testing,** then **StDev-One Sample.** Provide the required entries in the dialog box, then click on **Evaluate.** STATDISK will display the test statistic, critical values, *P*-value, and confidence interval.

**MINITAB** For Minitab Release 15 and later, select **Stat,** then **Basic Statistics,** then select the menu item of $\sigma^2$ **1 Variance.** Click on the **Summarized Data** box and enter the sample size and sample standard deviation. Click on the box labeled **Perform hypothesis test** and enter the assumed value of $\sigma$ from the null hypothesis. Click on the **Options** button and select the correct form of the alternative hypothesis. Click on the **OK** button twice and the *P*-value will be displayed.

In **Minitab 16,** you can use the **Stat** menu as described above, or you could also click on **Assistant,** then **Hypothesis Tests,** then select the case for **1-Sample Standard Deviation.** Fill out the dialog box, then click **OK** to get three windows of results that include the *P*-value and much other helpful information.

**EXCEL** Neither Excel nor XLSTAT have a function for conducting a hypothesis test of a claim about a standard deviation or variance. Excel does have a function (CHISQ.INV or CHIINV or CHISQ.INV.RT) that could be used to find critical values.

**T1-83/84 PLUS** The TI-83/84 Plus calculator does not test hypotheses about $\sigma$ or $\sigma^2$ directly, but the program **S2TEST** can be used. That program was written by Michael Lloyd of Henderson State University, and it can be downloaded from the CD included with this book, or www.aw.com/Triola. The program S2TEST uses the program ZZINEWT, so that program must also be installed. After storing the programs on the calculator, press PRGM, select **S2TEST,** and enter the claimed variance $\sigma^2$, the sample variance $s^2$, and the sample size $n$. Select the format used for the alternative hypothesis and press ENTER. The *P*-value will be displayed.

**STATCRUNCH** Click on **Open StatCrunch.** Click on **Stat,** then select **Variance.** 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** and enter the claimed value of the population variance and select the form of the alternative hypothesis. Click on **Calculate.**

## 8-5 Basic Skills and Concepts

### Statistical Literacy and Critical Thinking

**1. Waiting in Line** The Jefferson Valley Bank once had a separate customer waiting line at each teller window, but it now has a single waiting line that feeds the teller windows as vacancies occur. The standard deviation of customer waiting times with the old multiple-line configuration was 1.8 min. Listed below is a simple random sample of waiting times (minutes) with the single waiting line. The 10 sample values have a standard deviation of 0.5 min.

**a.** When the bank changed from multiple waiting lines to a single line, how was the mean waiting time affected?

6.5 6.6 6.7 6.8 7.1 7.3 7.4 7.7 7.7 7.7