(Because the hypothesis test is one-tailed with a significance level of $\alpha = 0.05$, the confidence level should be 90%. See Table 8-1.)

Solution

Requirement check The solution for Example 1 includes verification that the requirements are satisfied. ✓

The preceding SPSS display shows the lower and upper confidence interval limits for a 90% confidence interval, but we will show how those values are obtained. We use the values of $\bar{d} = 3.2$ cm, $s_d = 11.4$ cm, and $t_{\alpha/2} = 2.132$ (found from Table A-3 with $n - 1 = 4$ degrees of freedom and an area of 0.10 in two tails). We first find the value of the margin of error E.

$$E = t_{\alpha/2}\frac{s_d}{\sqrt{n}} = 2.132 \cdot \frac{11.4}{\sqrt{5}} = 10.8694$$

We now find the confidence interval.

$$\bar{d} - E < \mu_d < \bar{d} + E$$
$$3.2 - 10.8694 < \mu_d < 3.2 + 10.8694$$
$$-7.7 \text{ cm} < \mu_d < 14.1 \text{ cm}$$

Interpretation

We have 90% confidence that the limits of -7.7 cm and 14.1 cm contain the true value of the mean of the differences in height (president's height $-$ opponent's height). In the long run, 90% of such samples will lead to confidence interval limits that actually do contain the true population mean of the differences. See that the confidence interval includes the value of 0 cm, so it is very possible that the mean of the differences is equal to 0 cm, indicating that there is no significant difference between heights of presidents and heights of their opponents.

using TECHNOLOGY

General Comment: If it appears that your technology does not have a procedure designed specifically for dependent samples, find the differences d and then use technology for conducting a t test of a claim about one population mean, or use the differences to construct a confidence interval estimate of the mean of one population.

STATDISK First enter the matched data in columns of the STATDISK Data Window, then select **Analysis** from the main menu. Select either **Hypothesis Testing** or **Confidence Intervals,** then select **Mean-Matched Pairs.** Complete the entries and make any selections in the dialog box, then click on **Evaluate.**

MINITAB Enter the paired sample data in columns C1 and C2. Click on **Stat,** select **Basic Statistics,** then select **Paired t.** Enter C1 for the first sample, enter C2 for the second sample, then click on the **Options** box so that you can change the confidence level or the form of the alternative hypothesis or to use a value of μ_d different from zero.

EXCEL Enter the paired sample data in columns A and B and proceed to use either XLSTAT or Excel's Data Analysis add-in.

XLSTAT for Hypothesis Test: Click on **XLSTAT** at the top. Click on **Parametric tests,** then select **Two sample t test and z test.** In the dialog box that appears, enter the range of values for the first sample (such as A1:A13) and enter the range of values for the second sample. For "Data format," select the option of **Paired Samples.** For the "Column labels" box, include a checkmark only if the first row of the sample data consists of names or labels. Put a checkmark next to "Student's t test" (use z test if σ_1 and σ_2 are known). Click on the **Options** tab and select the type of test. For a two-tailed test, select the case including the symbol $\neq$, for a left-tailed test, select the case including $<$; and for a right-tailed test, select the case including $>$. Enter a value in the "Significance level (%)" box. For example, enter 5 for a 0.05 significance level. Click **OK** to get results that include the test statistic and P-value.