

pooling sample variances is that the number of degrees of freedom is a little higher, so hypothesis tests have more power and confidence intervals are a little narrower. Consequently, statisticians sometimes use this method of pooling, and that is why we include it in this subsection.

using TECHNOLOGY

STATDISK Select the menu item of **Analysis**. Select either **Hypothesis Testing** or **Confidence Intervals**, then select **Mean-Two Independent Samples**. Enter the required values in the dialog box. You have the options of “Not Eq vars: NO POOL,” “Eq vars: POOL,” or “Prelim F Test.” The option of **Not Eq vars: NO POOL** is consistent with the methods described in Part 1 of this section, and this method is recommended. (The F test is described in Section 9-5.)

MINITAB Minitab allows the use of summary statistics or original lists of sample data. If the original sample values are known, enter them in columns C1 and C2. Select the options **Stat**, **Basic Statistics**, and **2-Sample t**. Make the required entries in the window that pops up. Use the **Options** button to select a confidence level, enter a claimed value of the difference, or select a format for the alternative hypothesis. The Minitab display also includes the confidence interval limits.

If the two population variances appear to be equal, Minitab does allow use of a pooled estimate of the common variance. There will be a box next to **Assume equal variances**, so click on that box only if you want to assume that the two populations have equal variances, but this approach is not recommended.

In **Minitab 16**, you can also click on **Assistant**, then **Hypothesis Tests**, then select the case for **2-Sample t**. 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 Excel requires entry of the original lists of sample data. Enter the data for the two samples in columns A and B and 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 **One column per sample**. 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 is 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. Put a checkmark next to “Cochran-Cox” so that the variances are not assumed to be equal. Click **OK** to get results that include the test statistic and P -value.

XLSTAT for Confidence Interval: 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 **One column per sample**. 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 is known). Click on the **Options** tab. For the alternative hypothesis, select the format of a two-tailed test. Enter a value in the “Significance level (%)” box. For example, enter 5 for a 95% confidence interval. Put a checkmark next to “Cochran-Cox” so that the variances are not assumed to be equal. Click **OK** to get results that include the confidence interval.

Data Analysis Add-in: If using Excel 2013, 2010, or 2007, click on **Data**, then **Data Analysis**; if using Excel 2003, click on **Tools** and select **Data Analysis**. Select one of the following two items (we recommend the assumption of *unequal variances*):

t -test: Two-Sample Assuming Equal Variances

t -test: Two-Sample Assuming Unequal Variances

Enter the range for the values of the first sample (such as A1:A50) and then enter the range of values for the second sample. Enter a value for the claimed difference between the two population means, which will often be 0. Enter the significance level in the Alpha box and click on **OK**. (Excel does not provide a confidence interval.)

TI-83/84 PLUS To conduct tests of the type found in this section, press **STAT**, then select **TESTS** and choose **2-SampTTest** (for a hypothesis test) or **2-SampTInt** (for a confidence interval). The TI-83/84 Plus calculator does give you the option of using “pooled” variances (if you believe that $\sigma_1^2 = \sigma_2^2$) or not pooling the variances, but we recommend that the variances not be pooled, so we recommend selecting **No** for the line labeled “Pooled.”

STATCRUNCH Click on **Open StatCrunch**. Click on **Stat**, then select **T statistics**. Select **Two sample**, then select **with data** (for lists of sample data) or **with summary** (for entering known summary statistics). Click on **Next**, then select **Hypothesis Test** or **Confidence Interval**. There is a box with a check indicating that variances be pooled, but it is recommended that variances should not be pooled. Click on **Next**, then make the required entries. Click on **Calculate**.