

..... This test statistic is not significant because the corresponding  $P$ -value is given in the Minitab display as 0.463. We fail to reject the null hypothesis, so it appears that the performance IQ scores are not affected by the blood lead level. ....

In this section we have briefly discussed an important branch of statistics. We have emphasized the interpretation of computer displays while omitting the very complicated manual calculations and formulas, so we should all be thankful for that.

## using TECHNOLOGY

**STATDISK** Click on **Analysis** and select **Two-Way Analysis of Variance**. Make the required entries in the window, then click on **Continue**. Enter or copy the data in the “Values” column, then click on **Evaluate**.

**MINITAB** First enter all of the sample values in column C1. Enter the corresponding row numbers (or names) in column C2. Enter the corresponding column numbers (or names) in column C3. From the main menu bar, select **Stat**, then select **ANOVA**, then **Two-Way**. In the dialog box, enter C1 for Response, enter C2 for Row factor, and enter C3 for Column factor. Click **OK**. *Hint:* Avoid confusion by labeling the columns C1, C2, and C3 with meaningful names.

**EXCEL** You can use either XLSTAT or Excel’s Data Analysis add-in.

**XLSTAT** First enter all of the sample data in column A, then enter the corresponding row names in column B, and enter the corresponding column names in column C. Click on **XLSTAT**, then click on **Modeling data**, then click on **ANOVA**. For the “Quantitative” box, enter the range of cells in column A that contain all of the sample values (such as A1:A30). For the “Qualitative” box, enter the range of cells in columns B and C that contain all of the row names and column names (such as B1:C30). Put a checkmark next to the “Variable labels” box only if the first row contains names or labels. Click on the **Outputs** tab and place a checkmark next to the box identified as “Type I, II, III SS.” Click **OK**. You will get a new box labeled “Factors and Interactions”; click on **All**. Click **OK**. Look for the table of results under “Type I sum of squares analysis.” This table will include the  $F$  test statistic for the row factor, the column factor, and interaction.

**Data Analysis add-in:** For two-way tables with more than one entry per cell: Entries from the same cell must be listed down a column, not across a row. Enter the labels corresponding to the data set in column A and row 1, as in this example, which corresponds to Table 12-3:

	A	B	C	D
1		Low	Medium	High
2	Male	85	78	93
3	Male	90	107	97
⋮	⋮	⋮	⋮	⋮

If using Excel 2013, 2010, or 2007, click on **Data**, then click on **Data Analysis**; if using Excel 2003, click on **Tools**, then **Data Analysis**. Select the menu item of **Anova: Two-Factor With Replication**. In the dialog box, enter the input range. For the data in Table 12-3, enter A1:D11. For “rows per sample,” enter the number of values in each cell; enter 5 for the data in Table 12-3. Click **OK**.

For two-way tables with exactly one entry per cell, the labels are not required. Enter the sample data as they appear in the table. If using Excel 2013, 2010, or 2007, click on **Data**, then click on **Data Analysis**; if using Excel 2003, click on **Tools**, then **Data Analysis**. Select **Anova: Two-Factor Without Replication**. In the dialog box, enter the input range of the sample values only; do not include labels in the input range. Click **OK**.

**TI-83/84 PLUS** The TI-83/84 Plus program A1ANOVA can be downloaded from the CD-ROM included with this book. Select the *software* folder. The program must be downloaded to your calculator, then the sample data must first be entered as matrix D with three columns. Press **2ND** **X<sup>-1</sup>**, scroll to the right for **EDIT**, scroll down for **[D]**, then press **ENTER** and proceed to enter the total number of data values followed by 3 (for 3 columns). The first column of D lists all of the sample data, the second column lists the corresponding row number, and the third column lists the corresponding column number. After entering all of the data and row numbers and column numbers in matrix D, press **PRGM**, select **A1ANOVA** and press **ENTER** **ENTER**, then select **RAN BLOCK DESI** (for random block design) and press **ENTER** **ENTER**. Select **CONTINUE** and press **ENTER**. After a while, the results will be displayed.  $F(A)$  is the  $F$  test statistic for the row factor, and it will be followed by the corresponding  $P$ -value.  $F(B)$  is the  $F$  test statistic for the column factor, and it is followed by the corresponding  $P$ -value. (It is necessary to press **ENTER** to see the remaining part of the display.)  $F(AB)$  is the  $F$  test statistic for the interaction effect, and it is followed by the corresponding  $P$ -value.

**STATCRUNCH** Click on **Open StatCrunch**. First enter all of the sample values in one column and name that column “Responses.” Enter the corresponding row numbers (or names) in a second column and name that column “Row factor,” and enter the corresponding column numbers (or names) in a third column and name that column “Column factor.” Click on **Stat**, then select **ANOVA**, then **Two-Way**. In the dialog box, identify the columns to be used. Click **OK**.