CHAPTER 1 Appendix

Getting Started with Statistical Computing

This appendix introduces you to some basic statistical concepts and graphs for one variable. You learn about the individuals in a study (the people or things that were measured), categorical and quantitative variables, and ways to create descriptive graphs of the data. The distinction between variable types is critical to creating proper graphs, as the graph type depends on the type of variable. Computers and calculators will help you create the graphs, but you will need to determine which type is best suited to any given variable. We begin this appendix with some basic introductory material for each technology that will be discussed, then explain in detail how to create the graphs for each technology.

Most statistical analyses rely heavily on statistical software. In this appendix, we discuss the use of Excel 2016; JMP 12; Minitab Statistical Software, version 18; SPSS 24; CrunchIt!; R; and a TI-83/-84 calculator for conducting statistical analysis. As specialized statistical packages, JMP, Minitab, and SPSS are the most popular software choices both in industry and in colleges and schools of business. R is an extremely powerful statistical environment that is available for free to anyone; it relies heavily for support on members of the academic and general statistical communities. As an all-purpose spreadsheet program, Excel provides a limited set of statistical analysis options in comparison. However, given its pervasiveness and wide acceptance in industry and the computer world at large, we believe it is important to give Excel proper attention. For users who want more statistical capabilities but still prefer to work in an Excel environment, there are a number of commercially available add-in packages (if you have JMP, WinSTAT, or StatTools, for instance, they can be invoked from within Excel, although the last two are not addressed in this manual).

In addition, instructions are provided for the TI-83/-84 calculators. While this kind of tool is generally sufficient for an introductory course, most statistical analysis is beyond the capabilities of even the best calculator. For this reason, those students seeking to continue their learning of statistics should consider learning one of the specialized statistical packages.

Even though basic guidance is provided in this and subsequent appendices, it should be emphasized that PSLS is not bound to any of these programs. Computer output from statistical packages is very similar, so you can feel quite comfortable using any one these packages. In this and following chapters of the appendix, commands that are clicked or entered are shown in **bold**.

File Naming Conventions

Each program has its own file extensions for saving data worksheets and output. All use the typical interface to open and save (or "save as," to change the file's name) files from the File menu.

The extensions are shown here. To access data files from the CD or website, the naming convention is xxyy-nn.ext, where "xx" is "eg" for examples, "ex" for exercises, or "ta" for tables; "yy" is the chapter number; and "nn" is the number of the exercise, example, or table within the chapter. File extensions depend on the software.

	Data file extension	Output file extension
Excel	.xls or .xlsx	.xls or .xlsx (Excel embeds output, including graphics, into the worksheet)
jmp	.jmp	.jmpprj Projects contain all data, reports, and output.
Minitab	.mtw	.mpj Projects contain both data and output
SPSS	.sav	.spv
R	.csv (R can read many formats; comma separated is typical)	.Rdata (saves the entire workspace)

Getting Help

If you encounter a question not answered in this material, most software platforms offer help (both general and contextual in dialog boxes). To access all help topics, click **Help** in the menu bar at the top of the screen or in the menu ribbon. For contextual help, click **Help** in a dialog box. Several of these packages (Minitab, JMP, SPSS, and R) also have tutorials available that will help you get started. Click on the **Tutorial** option from the Help pull-down menu.

If you are using LaunchPad in your course, it includes videos describing how to use most of the routines discussed here; those videos are specifically listed in each content section. YouTube can also be a resource for "how-to" videos, but be careful: We do not endorse any particular YouTube channel, and some of those videos may be erroneous.

Getting Started

We assume that the reader is familiar with the basic layout and usage of Excel. As noted earlier, Excel provides a number of standard statistical analysis procedures but is not as comprehensive as a stand-alone statistical package. Therefore, for a few topics covered in this book, software support is available only in a statistical package or in an enhanced add-in version of Excel (rather than in standard Excel). Excel is the only software platform with a dynamic worksheet (meaning it updates as data are changed that affect formulas). All of the other programs have the capability to compute new columns, but once computed, the data residing there are static.

Built-in Statistical Functions and Charts

Excel has a variety of built-in statistical functions that can be used to compute common descriptive statistics for a given set of data or to compute probabilities for well-known statistical distributions. To find these functions, select the **Formulas** tab found in the main menu. Then click **More Functions**, which allows you to select the category **Statistical** to reveal all the statistical functions.

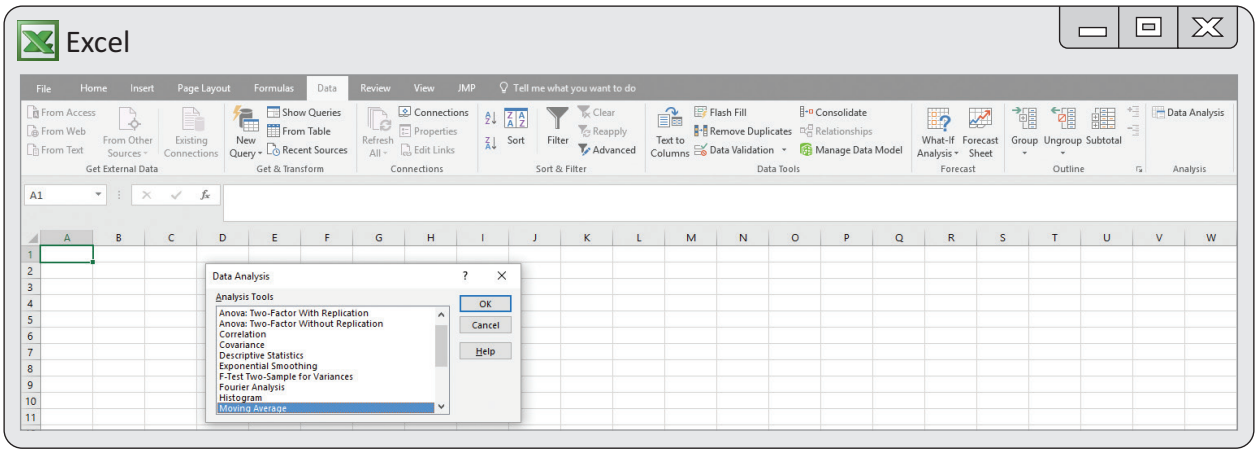
In addition to the built-in statistical functions, a number of graphing options are available that may prove useful for data analysis (use the simplest option available—tilting or 3-D options can distort the graphs!). The available charts are found by selecting the **Insert** tab found in the main menu. A variety of graphing options can then be found in the Charts group. A few statistical options (for example, regression fitting) can be implemented within the charts.

Installing the Data Analysis ToolPak Add-in

Excel's built-in statistical functions can be useful for isolated computations. However, attempting to do a more complete statistical analysis with a collection of "raw" functions can be a laborious and clumsy process. Excel provides an add-in known as Analysis ToolPak that enables you to perform a more integrative statistical analysis. This add-in is not loaded with the standard installation of Excel. To install it, click **File**, **Options**, **Add-ins**. Then, in the Manage box, choose **Excel Add-ins** and click **Go**. Select **Analysis ToolPak** and finally click **OK**.

Invoking Data Analysis ToolPak Procedures

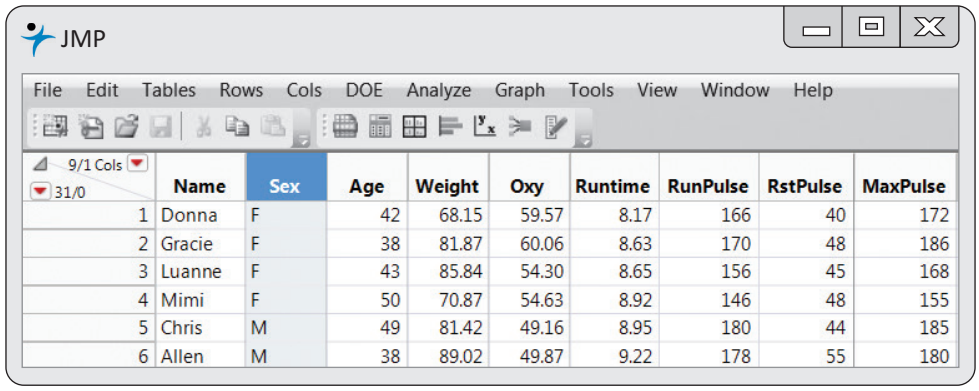
Once the Data Analysis ToolPak is installed, the statistical analysis routines are found by first selecting the **Data** tab found on the main toolbar. You will then see the Data Analysis command in the Analysis group. The following figure shows a blank Excel spreadsheet with the Data Analysis command invoked, resulting in the appearance of the Data Analysis menu box.



Within the Data Analysis menu box, there are 19 menu choices. When you select one of them, a dialog box specific to the statistical routine appears that asks you to indicate where the data can be found and where the output should be displayed. To indicate where the data for analysis reside, specify the range of cells for the data in the Input Range box. This can be accomplished by first clicking the cursor in the Input Range box and then

typing in the cell range; alternatively (and more easily), you can highlight the data by clicking and dragging the mouse over the cell range. The statistical output can be placed either in the current worksheet (placement indicated with Output Range box), in a new worksheet tabbed with the current workbook (New Worksheet Ply option), or in an entirely new workbook (New Workbook option).

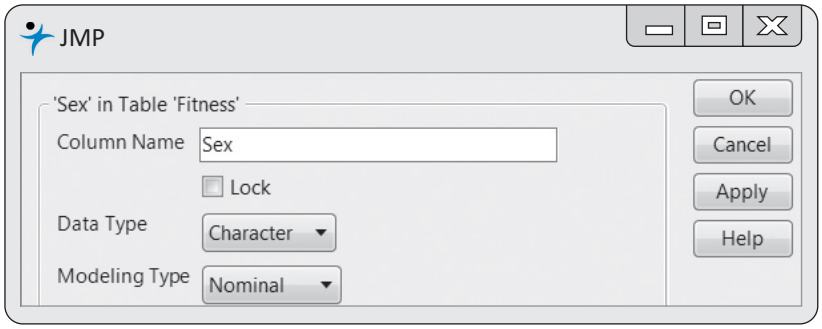
Upon entering JMP on either Mac or Windows, you will find the JMP home window, which is partitioned into four sections, including recent files, and a list of open windows. Upon opening a data set (as illustrated below), a data table will be shown in a separate window.



	Name	Sex	Age	Weight	Oxy	Runtime	RunPulse	RstPulse	MaxPulse
1	Donna	F	42	68.15	59.57	8.17	166	40	172
2	Gracie	F	38	81.87	60.06	8.63	170	48	186
3	Luanne	F	43	85.84	54.30	8.65	156	45	168
4	Mimi	F	50	70.87	54.63	8.92	146	48	155
5	Chris	M	49	81.42	49.16	8.95	180	44	185
6	Allen	M	38	89.02	49.87	9.22	178	55	180

Modeling Types

Variables in JMP take on a property called "modeling type," which is just a classification for what measurements in a variable mean. For example, the chromosomal sex of an individual (male versus female) is a different type of measurement than the age of an individual: One is a category, whereas the other is a numeric quantity. In JMP, variables are designated as being nominal (categories), ordinal (ordered categories), or continuous (numeric measurements on a scale, like age). This designation is important for JMP, because JMP will help you produce analyses and graphical output that are appropriate for the variable type. To change or set the modeling type of a variable, simply double-click on the variable name, and select the data and modeling types appropriate for that variable (as shown in the following figure).



Invoking Statistical Procedures

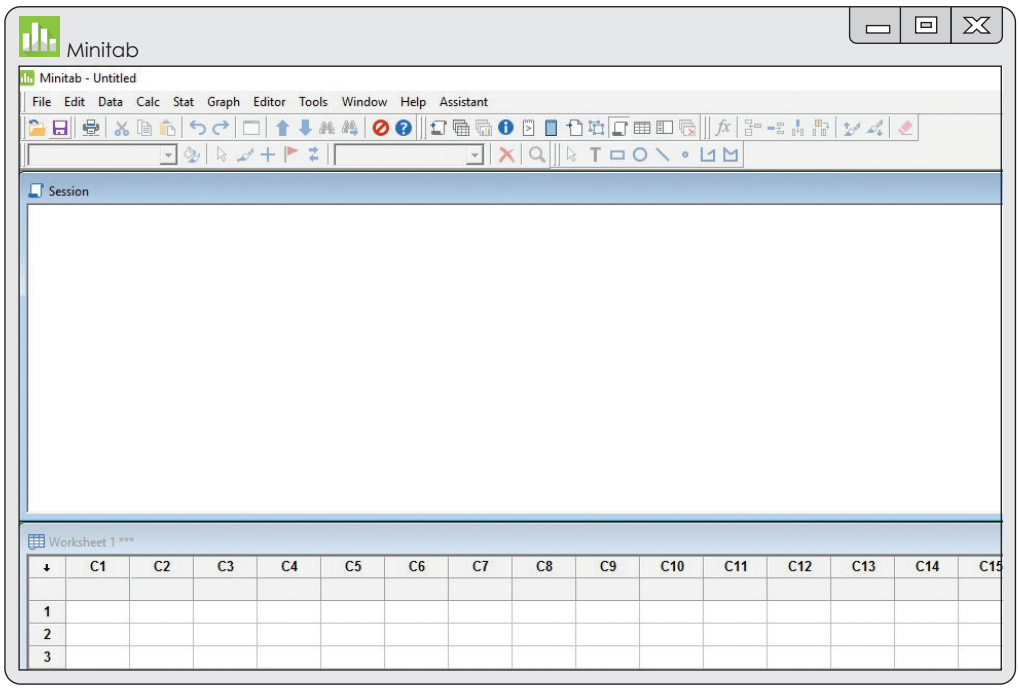
To produce an analysis or create a graph, users can make a sequence of selections from a series of menus that all begin in the menu bar. In JMP, analyses and graphics are grouped

by their context within "platforms." For example, the Fit Y by X platform under the Analyze menu allows users to test hypotheses when there is one *Y* variable and one *X* variable (for instance, a two-group *t* test or a simple regression). Which type of analysis is returned depends on the modeling types of the variables specified.

Once a platform is launched, additional options are available under the Red Triangles in the output window. These Red Triangles are special menus that show contextualized options—that is, analyses and options that make sense for the types of variables specified. In this regard, JMP is said to have a "progressive" interface: Launching a platform is the first step, and once in a platform you can produce any number of analyses. If you are looking for a specific analysis, the Statistics Index, which is found under the Help menu, provides a list of all available procedures, and can even launch an example for a given analysis. If you need additional help, select the question mark tool in the menu and click on any object in JMP to see the documentation for that object.

Minitab

Upon entering Minitab, you will find the display partitioned into two windows, as seen in the accompanying figure. The Session window is the area where all nongraphical statistical output and Minitab commands generating statistical output (graphical and nongraphical) are displayed. The Data window displays a spreadsheet environment (known as a worksheet) where data can be directly entered and edited. Each column represents a variable to be analyzed. The Project manager window—which is minimized when Minitab starts—keeps track of all the analyses that have been done in a project.



Invoking Statistical Procedures

There are two ways to invoke procedures:

1. Type commands in the Command Line window. To do so, you must first enable the command language:
   - Click in the Session window.
   - Click **Editor**, **Show Command Line**.

This will produce a "MTB>" prompt in a partition of the Session window. At this prompt, you can then type the desired commands.

2. Make a sequence of selections beginning in the toolbar menu. For example, to create the graph known as a boxplot, you would click **Graph** and then select **Boxplot**. In this appendix, such a sequence of selections will be presented as **Graph ➔ Boxplot**. Once you have made the necessary selections, dialog and/or option boxes will be encountered that allow you to indicate which variable(s) will be part of the analysis, along with other information. If further help is needed, you can click the **Help** button that appears with every dialog box. Once you have entered all of the appropriate information, click the **OK** button to get the desired output.

CRUNCH IT!

Access CrunchIt! within Launchpad by clicking **Resources**, **Content by type**, then **CrunchIt!**. Your instructor may have made this software available on the main "home" Launchpad menu as well.

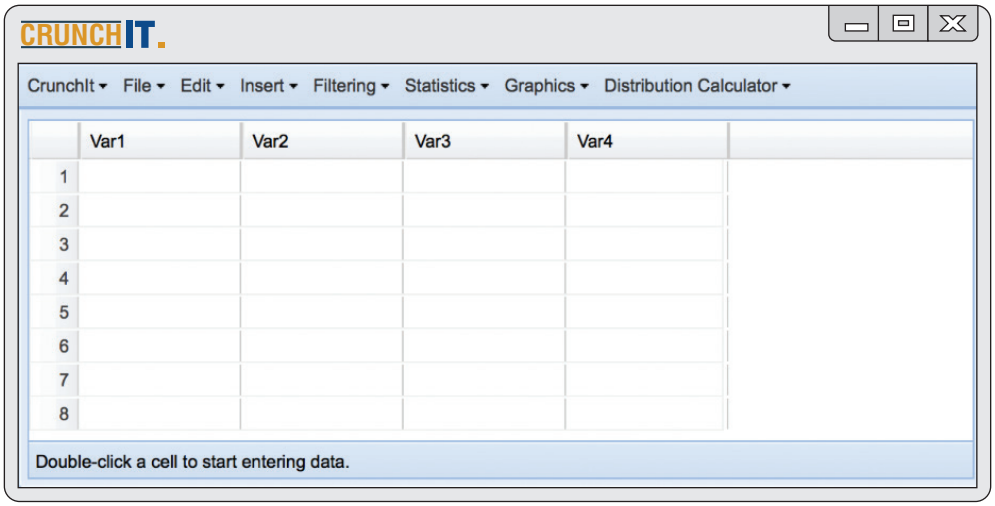
Upon entering CrunchIt!, you will be shown a blank data set with rows and columns (see the accompanying figure). To enter data, click in a cell and enter a value. To change a column name, double-click the column header and enter a new column name.

Invoking Statistical Procedures

Users can make a sequence of selections from a series of menus that all begin in the main menu. Once you have made the necessary selections, dialog and/or option boxes will be encountered that allow you to indicate which variable will be part of the analysis, along with other information. If further help is needed, you can click the **Help** button that appears in dialog boxes. Once you have entered all of the appropriate information, click the **Calculate** button to get the desired output.

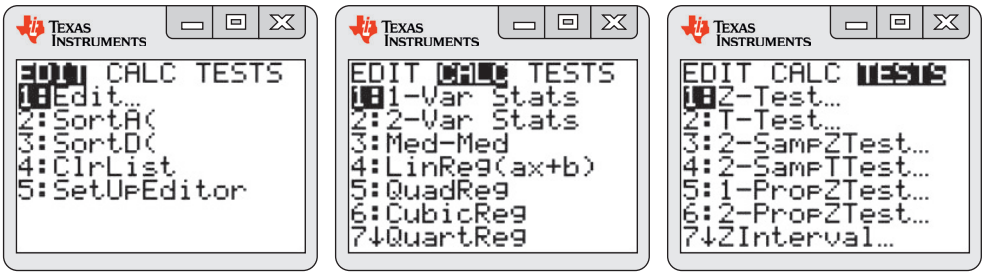
CrunchIt! Files

CrunchIt! provides file options from the File menu, including creating a new data set, importing data from a file and URL, and exporting data sets to a file. CrunchIt! also provides direct access to data sets from this book by selecting **Load from The Practice of Statistics in the Life Sciences**.



In this section, we provide a very basic overview of using the TI-83/-84 calculator. For more instruction, access Texas Instruments' "getting started" tutorials at **education.ti.com ➔ Products ➔ Graphing calculators**. At that point, you would select your calculator model and then **Support Resources**.

After pressing the **STAT** button, you have three options: EDIT, CALC, and TESTS (shown below). Selecting **EDIT** invokes the data-table editor, allowing you to enter data; **CALC** includes options for descriptive statistics as well as regression procedures; and **TESTS** includes hypothesis testing procedures.



Invoking Statistical Procedures

After entering data, statistical procedures can be selected from the CALC and TEST sections. After you make the necessary selections, your calculator will return the results of the tests and procedures.

R is command-line software, but some "menu" interfaces (such as R commander) can make it easier to use—especially for beginners. To load R commander, after installing the package, click **Packages ➔ Load Package**, and then select **Rcmdr**. This interface also allows for an easier means of inputting data.

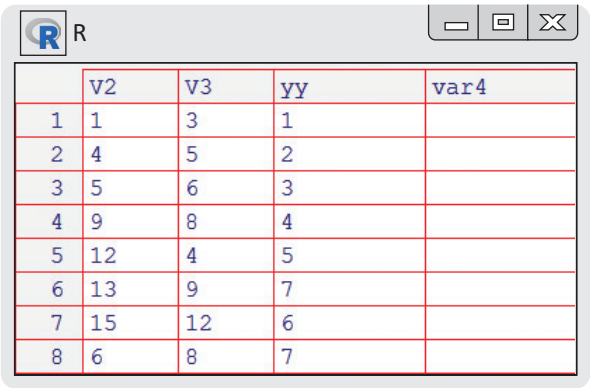
Note: *R is case-sensitive*. If the variable name is "Color", referring to it as "color" will not find the variable! This is also true of all parameter names for commands.

R works from data frames (a collection of variables). There are several methods of inputting data. For a small data set, you may want to enter the data directly from the command line, as in the following example. This example creates a data frame called mydat with variables x and y:

```
> x= c(1,2,3,4,5,6,7,8)
> y=c(10,13,8,7,9,8,4,10)
> mydat <- data.frame(x,y)
```

Another method evokes a spreadsheet-like input frame:

```
> mydata <- data.frame(num=numeric(0))
> mydata <- edit(mydata)
```



	V2	V3	yy	var4
1	1	3	1	
2	4	5	2	
3	5	6	3	
4	9	8	4	
5	12	4	5	
6	13	9	7	
7	15	12	6	
8	6	8	7	

Exit the data editor by clicking on the red X at the upper-right corner.

You can also input data by reading from a file. R can read many types, including .csv (comma-separated variable) format and .xls and .xlsx (Excel), among others. The following command to read a .csv file indicates the first row has variable names:

```
> mydata <- read.csv("file.txt",head=T)
```

R commands have many possible parameters that can be used to specify graphs' titles and other information. To obtain the full documentation for any command, click **Help**, select **R functions(text)**, and enter the name of the command in the box.

The *R Video Technology Manuals: Introduction* video can be helpful for users new to R.

Picturing Distributions with Graphs

Excel

Bar Graphs

1. With pretabulated frequencies, the spreadsheet should have two columns with a column name in the top row: One column should have the category names, and the other column should have the total counts of each category.
2. Select all cells, including the column names.
3. Click the **Insert** tab and click **PivotChart** in the Charts group.
4. Select the desired field(s) by clicking a check mark next to the name(s).
5. A bar graph will be created automatically.

Note: When only one column requires counting, the field name will appear in a section titled Axis Fields (Categories). This field name should also appear in the section titled "∑ Values." To add it there, click and hold the field name and then drag the field from the field section into the ∑ Values section. Excel will then automatically make the counts and create a corresponding bar graph.

6. Add a descriptive title to the graph (we want to know what it is about) by clicking in the placeholder title. Drag the cursor to highlight the placeholder, and type in the desired text.
7. Excel will likely add elements to the graph that are undesired. To remove them, click to select any unwanted elements, then press the **Delete** key.

Pie Charts

1. Follow the steps for making a bar graph.
2. To change the created bar graph into a pie chart, click the **Design** tab, then click the **Change Chart Type** in the Type group, then select the **Pie chart** type.

Note: Alternatively, right-click on the bar graph and click the **Change Chart Type** option.

Histograms

1. **Data ➔ Data Analysis**
2. Select **Histogram** in menu box and click **OK**.

   Note: You can also click **Insert**, then choose **Histogram** from the "Recommended Charts, All charts" list. Menu boxes there are similar to those described in these instructions.

3. Enter the cell range containing the data into the **Input Range** box. If you want Excel to automatically select the classes, leave the Bin Range box empty.
4. Place a check mark next to the **Chart Output** option. Click **OK**.
   If you want to change the automatically selected classes, enter *upper* values for each class into a column in the spreadsheet and input their cell range in the **Bin Range** box.
5. Click in the default title ("Chart Title"). Drag the cursor to highlight it. Type the descriptive title to replace the default.

Dotplots

Excel cannot make dotplots.

Time Plots

1. Click and drag the mouse to highlight the cell range of the data you want to use as the basis for the time plot (include the column name if you want it to appear as a chart label).
2. With the cell range highlighted, click the **Insert** tab and then click **Line** in the Charts group.
3. Within the **2-D Line** choices, you can choose whether to have data symbols at the data values or not.

Stemplots (discussed in the chapter exercises)

Excel cannot make stemplots.

For videos to help with these topics, see the *Excel Video Technology Manuals* on Bar Chart, Pie Chart, Histogram, and Stemplot, Timeplot.

Bar Graphs

Using the Distribution Platform (which does *not* separate bars):

1. **Analyze ➔ Distribution**
2. Click to select the variable(s) of interest, then click **Y, Columns** to cast variables into that role.
3. **OK**

Note: Frequency bar graphs are produced for nominal and ordinal variables, and histograms are produced for continuous variables. If necessary, you can change the modeling types of variables by clicking the icon next to the variable name in columns list in the data set.

Using Graph Builder (which properly separates bars):

1. **Graph ➔ Graph Builder**
2. Drag a nominal or ordinal variable of interest to the *x* axis.
3. Click the bar chart icon in the toolbar.
4. Give the graph a title (we need to know what it is about) by double-clicking in the **Title** placeholder. Type the desired graph title.

Pie Charts

Using the Pareto Plot Platform:

1. **Analyze ➔ Quality and Process ➔ Pareto Plot**
2. Select the nominal or ordinal variable of interest, then click **Y, Cause** to cast the variable into that role.
3. **OK**
4. Click the Red Triangle and select **Pie Chart**.

Using Graph Builder:

1. **Graph ➔ Graph Builder**
2. Drag a nominal or ordinal variable of interest to the *x* axis.
3. Click the pie chart in the toolbar.
4. Give the graph a title (we need to know what it is about) by double-clicking in the **Title** placeholder. Type the desired graph title.

Histograms

1. **Analyze ➔ Distribution**
2. Select continuous variables of interest, then click **Y, Columns** to cast variables into that role.
3. Click to check the box by **Histogram Only**.
4. **OK**

Note: This method does *not* allow you to give the graph a meaningful title or change binning (intervals). Histograms can also be created using Graph Builder, which will allow you to change the bins for the variable of interest, but those graphs do not display a frequency *y* axis.

Note: The JMP default is to display the histogram "vertically" (the data axis is on the *y* axis instead of the *x* axis). To change this default, click the Red Triangle next to the variable name, then click **Histogram Options ➔ Vertical** to turn that option off.

Dotplots

1. **Help ➔ Sample Data ➔ Teaching Demonstrations ➔ Dotplot**
2. At the upper left, select the column of interest.

   Note: The Dot Width slider at the left allows you to change the size of the dots, and the scaling of the *x*-axis.

Time Plots

Time Series Platform:

1. **Analyze ➔ Modeling ➔ Time Series**
2. Select the variable, and click **Y, Time Series** to enter that variable.
3. If a time variable is available, enter it into **X, Time ID**. If you do not specify a time variable, JMP will order and label the time plot by row.
4. **OK**

Graph Builder (requires a time variable for X):

1. **Graph ➔ Graph Builder**
2. Drag the time variable to the *x* axis.
3. Drag a continuous outcome variable to the *y* axis.
4. Click the line chart (next to the bar chart icon) in the toolbar.

Stemplots

1. **Analyze ➔ Distribution**
2. Select continuous variables of interest, then click **Y, Columns** to cast variables into that role.
3. **OK**
4. Click the Red Triangle next to a variable's name and select **Stem and Leaf**.

For videos to help with these topics, see the *JMP Video Technology Manuals* on Bar Chart, Pie Chart, Histogram, and Stemplot, Timeplot.

Minitab

Bar Graphs

1. **Graph ➔ Bar Chart**
2. If the frequencies have been pretabulated, select **Values from a table** from the Bars represent menu.

   If the frequencies have not been tabulated, select **Counts of unique values** from the Bars represent menu. Select **Simple** for the type of bar graph.
3. **OK**
4. For pretabulated frequencies, click-in the data column into the **Graph variables** box and click-in the column that has the names of the categories into the **Categorical variables** box.

   If the frequencies have not been pretabulated, click-in the column that has data on the categorical values that need to be counted into the **Categorical variables** box.

5. To give the chart a title, click **Labels**. Enter the title in the appropriate box and then click **OK**.
6. **OK**

Pie Charts

1. **Graph ➔ Pie Chart**

   If the frequencies have been **pretabulated**:

2. Select the **Chart values from a table** option.
3. Click-in the column that has the names of the categories into the **Categorical variables** box and the frequency column into the **Summary variables** box.

   If the frequencies have *not* been **pretabulated**:

2. Select the **Counts of unique values** option.
3. Click-in the column that has data on the categorical names that need to be counted into the **Categorical variables** box.
4. Click **Labels**. Enter a descriptive title for the chart in the appropriate box. If you want the pie slices to be labeled by categorical names and have percents reported, click the **Slice Labels** tab and place check marks next to the desired labels.

Histograms

1. **Graph ➔ Histogram**
2. Select **Simple** for the type of histogram.
3. **OK**
4. Click-in the data column into the **Graph variables** box.
5. To give the chart a title, click **Labels**. Enter the title in the appropriate box and then click **OK**.
6. **OK**
7. To change the automatically selected classes (bins), double-click on the horizontal axis to make the Edit Scale box appear. Click the **Binning** tab and then choose the **Midpoint/Cutpoint positions** option found in the Interval Definition section. Depending on whether you choose the Interval type as "Midpoint" or "Cutpoint," you would then give the desired values of the midpoints (that is, the middle values of the classes) or the cutpoints (that is, lower and upper values of the classes). It is not necessary to enter all the values; Minitab will extend your bins to the entire scale of values when you click **OK**.

Stemplots

1. **Graph ➔ Stem-and-Leaf**
2. Click-in the data column into the **Graph variables** box.
3. **OK**

Dotplots

1. **Graph ➔ Dotplot**
2. For a single distribution (sample), click the icon for One Y, simple, then **OK**.
3. Select and enter the variable to graph into the Graph variable(s) box.
4. **OK**

   Note: Titles can be added using **Labels** before clicking OK.

Time Plots

1. **Graph ➔ Time Series Plot**
2. Select **Simple** for the type of time series plot.
3. **OK**
4. Click-in the data column into the **Series** box.

   Note: By default, Minitab will label the time periods as "1," "2," "3," … If you want to label the time periods by year, click the **Time/Scale** button, select the **Calendar** option, and select the desired time periods (for example, "Year") from the adjacent menu and enter a starting value. Clicking **OK** returns to the main dialog, and clicking **OK** again produces the plot.

For videos to help with these topics, see the *Minitab Video Technology Manuals* on Bar Chart, Pie Chart, Histogram, and Stemplot, Timeplot.

SPSS

Note: If you are creating several graphs in a sequence using Chart Builder, click **Reset** at the bottom of the dialog box between each one.

Bar Charts

1. **Graphs ➔ Chart Builder**
2. Select the **Bar Chart** graph type from the Gallery and drag it to the graph area.
3. Select the categorical variable of interest on the left, and drag it to the **X-axis?** box. If data have been summarized (that is, if you have counts for each category instead of raw data), select the frequency variable and drag it to the **Y-axis?** box.
4. Click the **Titles/Footnotes** tab. Type an appropriate title into the **Content** box.
5. **Apply ➔ OK**

Pie Charts

1. **Graphs ➔ Chart Builder**
2. Select the **Pie/Polar** graph type from the Gallery and drag it to the graph area.
3. Select the categorical variable of interest on the left, and drag it to the **Slice by** box. If data have been summarized (that is, if you have counts for each category instead of raw data), select the frequency variable and drag it to the **Angle variable?** box.
4. Click the **Titles/Footnotes** tab. Type an appropriate title into the **Content** box.
5. **Apply ➔ OK**

Histograms

1. **Graphs ➔ Chart Builder**
2. Select the **Histogram** graph type from the Gallery and drag it to the graph area.
3. Select the categorical variable of interest on the left, and drag it to the **X-axis?** box.
4. Click the **Titles/Footnotes** tab. Type an appropriate title into the Content box.
5. **Apply ➔ OK**
6. To change the binning (bar scaling), double-click in the graph for the Chart Editor, then click in a bar of the graph for Properties. Select the **Binning** tab. Move the radio button to **Custom** and enter either a number of bars (bins) *or* a bin width, using the appropriate radio button. Click **Apply**. To change the maximum or minimum *x* value, click **X** in the *graph* tool bar, and then click the **Scale** tab. Uncheck the box under Auto next to the value you want to change and enter the new value. Click **Apply ➔ Close** to apply the changes and close the chart editor.

Dotplots

1. **Graphs ➔ Chart Builder**
2. In the graph type box at lower left, select **Scatter/Dot**. Drag the "Simple Dot Plot" icon at lower left of the displayed graphs to the *x*-axis.
3. Drag the variable to the *x*-axis.
4. If desired, click the **Titles/Footnotes** tab to label your graph.
5. **OK**

Time Plots

With Sequence Charts:

1. **Analyze ➔ Forecasting ➔ Sequence Chart**
2. Select the variable of interest on the left, then click the right arrow next to **Variables** to move the variable to that section.
3. If you have a variable identifying time, select it and click the right arrow next to **Time Axis Labels**.
4. **OK**

With Scatter/Dot (requires a "time" variable):

1. **Graphs ➔ Chart Builder**
2. Select the **Simple Scatter** graph type from the Gallery and drag it to the graph area.
3. Select the outcome variable and drag it to the **Y-Axis?** box.
4. Select the time variable and drag it to the **X-Axis?** box.
5. Click the **Titles/Footnotes** tab. Type an appropriate title into the **Content** box.
6. **Apply ➔ OK**
7. Double-click the scatterplot in the output window to open the editor.
8. In the toolbar, select the **Interpolation Line** button  to connect the points.
9. Close the editor to finalize the graph.

Stemplots

1. **Analyze ➔ Descriptive Statistics ➔ Explore**
2. Select the variable of interest on the left, then click the right arrow next to **Dependent List** to move the variable to that section.
3. **OK**

   Note: This procedure also produces a box plot and descriptive statistics by default.

For videos to help with these topics, see the *SPSS Video Technology Manuals* on Bar Chart, Pie Chart, Histogram, and Stemplot, Timeplot.

CRUNCHIT!

Bar Graphs

With summarized data:

1. **Graphics ➔ Bar Chart With Summarized Data**
2. For **Labels**, select the column identifying the groups.
3. For **Heights**, select the frequency variable.
4. Add a title and *x* and *y* -axis labels, if desired.
5. **Calculate**

With raw data:

1. **Graphics ➔ Bar Chart With Raw Data**
2. For **Sample**, select the column of interest; to avoid many "short" bars, you can enter a value in **Cutoff** that will gather together all categories with frequencies less than the specified value into an "Other" category.
3. Add a title and *x*- and *y*-axis labels, if desired.
4. **Calculate**

Pie Charts

1. With summarized data:
2. **Graphics ➔ Pie Chart With Summarized Data**
3. For **Labels**, select the column identifying the categorical variable.
4. For **Sizes**, select the frequency variable.
5. Add a title, if desired.
6. **Calculate**

With raw data:

1. **Graphics ➔ Pie Chart With Raw Data**
2. For **Sample**, select the column of interest; to avoid many small slices, you can enter a value in **Cutoff** that will gather together all categories with frequencies less than the specified value into an "Other" category.
3. Add a title and *x*- and *y* -axis labels if desired.
4. **Calculate**

Histograms

1. **Graphics ➔ Histogram**
2. For **Sample**, select the column of interest.
3. If desired, specify either the number of bins *or* the bin width and start point.
4. Add a title and axis labels.
5. **Calculate**

Dotplots

1. **Graphics ➔ Dot Plot**
2. Use the drop-down to select the column with your data. If desired, enter a title and axis label.
3. **Calculate**

Time Plots (must have a time or index variable)

1. **Graphics ➔ Scatter Plot**
2. For **X**, enter a time variable; this variable must be numeric, such as the day, the year, or an index (1, 2, …, *n*).
3. For **Y**, select the variable of interest.
4. In the Parameters section, change Points to **Lines** or **Both**.
5. **Calculate**

Stemplots

1. **Graphics ➔ Stem and Leaf**
2. For **Sample**, select the column of interest.
3. If desired, enter a title.
4. **Calculate**

For videos to help with these topics, see the *CrunchIt! Help Videos* on Pictures for Categorical Data and Pictures for Quantitative Data.

TI-83/-84

TI calculators try to graph everything they can at the same time. For that reason, before creating any statistical graph/plot, you should confirm that no functions are entered on the [Y=] screen; if so, use [CLEAR] to erase those functions. Also, make sure only one STAT PLOT is "On" at a time; use STAT PLOTS option **4:PlotsOff** to turn them all off.

Because graphs created with TI calculators are unlabeled, they can be used only as a guide. To see the graph contents and have an aid to copying them onto paper, use [TRACE] and the left and right arrows to move through the graph.

Bar Graphs

1. Press [STAT] [ENTER] to select **Edit**.
2. In **L1**, enter sequential values (1, 2, 3, …) up to as many categories you have.
3. Enter the values associated with each category in **L2**.
4. Press **WINDOW**, then set the **Xmin** and **Xmax** to match the values in L1, and adjust **Ymin** and **Ymax** to be an appropriate range for your frequency (Y) variable.
5. Press [2nd] [Y=] = **STAT PLOT**. Select **Plot 1** by pressing [ENTER].
6. Turn the plot "On" if needed by using the [▶] and pressing [ENTER] to move the highlight. Select the histogram.
7. Select L1 for **Xlist**, and L2 for **Freq**.
8. Press [GRAPH].

Pie Charts

Pie charts are not available on TI-83/-84 calculators.

Histograms

1. Press [2nd] [Y=] = **STAT PLOT**, and select a plot (press [ENTER] to select **Plot 1**). Select the histogram.
2. Turn the plot "On" if needed by using the [▶] and pressing [ENTER] to move the highlight. Select the histogram.
3. Enter the name of the list that contains the data by pressing [2nd] [1] = [L1], [2nd] [2] = [L2], ….
4. Get an initial histogram by pressing [ZOOM] [9].
5. Adjust the windowing (if needed) using [WINDOW]. Reset Xmin, Xmax, Xscl (the bar width), and Ymax as needed.
9. Press [GRAPH].

Dotplots

TI calculators cannot make dotplots.

Time Plots

1. Press [STAT] and select **Edit** to enter the list editor.
2. In **L1**, enter time values (or an index from 1 to *n*).
3. In **L2**, enter data for the outcome variable.
4. Press [2nd] [Y=] = **STAT PLOT** (2nd, then Y= button), and select the connected scatterplot.
5. Select L1 for **Xlist**, and L2 for **Ylist**.
6. Press [ZOOM] [9].

Stemplots

Stemplots are not available on TI calculators.

For videos to help with these topics, see the *TI Video Technology Manuals* on Histogram and Timeplot.

Here, we presume the data are in a data frame named "mydat." A categorical variable is named "catvar," a frequency variable is named "frq," and a numeric variable is named "numvar."

Bar Graphs

A basic bar graph with raw data can be created using the command

```
> barplot(table(mydat$catvar))
```

If data are already summarized, use the command

```
> barplot(mydat$frq, names.arg=mydat$catvar)
```

Pie Charts

A pie chart with raw data can be created with the command

```
> pie(table(mydat$catvar))
```

If data are already summarized, modify the command to

```
> pie(mydat$frq, names=mydat$catvar)
```

Histograms

A basic histogram can be created using the command

```
> hist(mydat$numvar)
```

To set your own bins (bins start and end at the specified values, which must span the whole range of the variable), modify the command to

```
> hist(mydat$numvar, breaks=c(5,10,15,20,25))
```

Dotplots

The R command for a dotplot is "stripchart." The stack parameter indicates how observations with the same value should be treated. See an example below.

```
> stripchart(mydat$numvar,method="stack")
```

Time Plots

A time series plot using an index or other variable for time can be done as a connected scatterplot. Use **type="b"** to have both points and lines, or **type="l"** to simply have connect lines.

```
> plot(mydat$x,mydat$numvar, type="b")
```

Stemplots

```
> stem(mydat$numvar)
```

For videos to help with these topics, see the *R Video Technology Manuals* on Bar Chart, Pie Chart, Histogram, and Stemplot, Timeplot.