11

Learning more and further Minitab

Practice does not end here. (Ellis Ott, in Ott et al., 2000, p. 537)

Overview

To conclude the book, this final chapter highlights ways in which one can learn more about Minitab (the author invariably learns something new almost every time he uses the software!) and how one can obtain help with Minitab. Reference will be made to the creation of macros and their application. Brief reference will also be made to further features of Minitab not covered in this book and to Minitab Quality Companion.

11.1 Learning more about Minitab and obtaining help

11.1.1 Meet Minitab

The *Meet Minitab 16* guide (Minitab Inc., 2010), is available as a PDF at http://www.minitab.com/uploadedFiles/Shared_Resources/Documents/MeetMinitab/EN16_MeetMinitab.pdf. It deals with the following topics:

- Getting started
- Graphing data
- Analyzing data
- Assessing quality
- Designing an experiment
• Using Session commands
• Generating a report
• Preparing a worksheet
• Customizing Minitab
• Getting help
• Reference.

Its comprehensive index makes it a very useful resource for Minitab users, particularly beginners.

11.1.2 Help

Some reference has already been made to the Help facility in Chapter 2. It may be accessed in a variety of ways:

• Click Help in any dialog box.
• Click the Help icon on the tool bar.
• Select Help > Help from the menus.

General information on navigation for Help is available via Help > Help > How to Use Help. The reader is urged to explore! The author believes that each Minitab user will develop his/her own approach to the utilization of the Help facilities.

As an example of how one might seek assistance with a particular topic, consider the need to analyse quarterly sales data for a company, i.e. a time series of data values. The data are stored in Halcro.MTW as a single column of quarterly sales figures for the years 2006 to 2010 inclusive. On clicking the Help icon a window appears with two panes as displayed in Figure 11.1.

![Figure 11.1 Help window.](image)
Note the Hide icon in the top left-hand corner on the toolbar. On clicking on it the navigation pane on the left is hidden and the icon becomes a Show icon. Clicking on the Index tab and entering ‘time series’ reveals headings Time Series and Time Series Plot. Bearing in mind that display of data is wise whenever possible, on selecting Time Series Plot and clicking the Display button, a Topics Found window is displayed with links to Time Series Plot (Character Graph menu) and Time Series Plot (Graph and Stat menus). This indicates that a time series plot may be created via both the Graph menu and the Stat menu or via the archaic Character Graph menu. In order to access the Help information on the topic one can highlight Time Series Plot (Graph and Stat menus) and double-click on it, or click the Display button below the navigation pane. Alternatively, one can click on a menu link in the window on the right and then click the required topic in the list that appears. Thus the sequence Stat Menu > Time Series > Time Series Plot will also reveal the information displayed in Figure 11.2.

Underneath the display heading there are links to:

- overviews of the topic;
- instructions on how to complete the dialog;
- examples of use of the command;
- an explanation of how data should be structured;
- see also links to other relevant topics and information.

Exploration of all of these links can prove very informative. Clearly the information on completion of dialogs and the examples provided can be very helpful, especially when one is using a particular command for the first time. The links to other relevant topics in the
majority of instances may be used to access methods, formulae and references to textbooks and journal articles.

With the display in Figure 11.2 on screen, clicking on examples and selecting Simple from the menu that appears yields the display in Figure 11.3.

The reader is invited to minimize the Help screen and to use the information displayed in Figure 11.3 to create the required time series plot. In step 1 you will need to open Halero. MTW, in step 4 the name (Sales £000) of the column containing the data must be entered, and in step 7 you will need to enter 1 and 2006. As a further exercise the reader is also invited to delete the plot, to maximize the Help screen, to use the Back arrow to return to the previous Help screen and to find out how to add a Lowess smoother to the plot by clicking on the Data View . . . button in the main dialog for the simple time series plot and then using the Smoother tab. The final plot is shown in Figure 11.4.

11.1.3 StatGuide

Having used a command, one may use StatGuide™ to access guidance on interpretation on the output, whether it be Session window output or graphical output. For example, having created the plot displayed in Figure 11.4, clicking the StatGuide icon (immediately to the right of the Help icon) yields the output displayed in Figure 11.5 in the right-hand window. The left-hand window provides Contents, Index and Search tabs for Help.

There are three panes in the window. The first pane provides general information on the command, a Topics button giving access to a list of other associated topics and arrow keys that
enable access to these. The second gives example output from the command (in this case a plot) and a Data button giving access to a description of the data used. The third pane provides interpretation of the output together with a More button that provides access to further information that is shown in Figure 11.6. The reader should note that clicking on any word or

Figure 11.4 Time series plot of sales with smoother.

Figure 11.5 StatGuide for time series plot.
Figure 11.6 StatGuide information on time series plots versus other plots.
**Figure 11.7** StatGuide information on test for number of runs about the median.
phrase that is underlined leads to explanatory information being displayed such as the
definition of a time series in Figure 11.6. It is interesting to note that no mention is made
of run charts! Arrow keys are provided for navigation.

As a second example of the use of StatGuide, the reader is invited to open the Minitab
worksheet Scottish_Mean_Annual_Temperatures.MTW and to create a run chart of
mean annual temperatures using Stat > Quality Tools > Run Chart…. Clicking on the
StatGuide icon reveals two windows as in the previous case. A summary is given in the top
pane of the window on the right and further topics may be accessed either by using the arrow
keys or by using the drop-down menu that appears on clicking the Topics button. The right-
hand window is displayed in Figure 11.7 following use of the arrow keys to locate information
on the test for number of runs about the median. The middle pane gives example output
and information on the associated data set via the Data button. The bottom pane
provides interpretation of the output together with a More button that provides access to
further information.

As a final example, recall the door to needle time data considered at the beginning
of Chapter 7 and the test of the null hypothesis \( H_0: \mu = 19 \) versus the alternative hypothesis
\( H_1: \mu < 19 \). It was assumed that the standard deviation was 6. The Session window output is
shown in Panel 11.1. The data are available in DTNTime.MTW.

With the Session window active, clicking on StatGuide and selecting from Topics the one
entitled Hypotheses yields the display in Figure 11.8. Once again additional information may
be explored using the buttons, drop-down menus and arrow keys or by using the Contents,
Index and Search tabs in the left-hand window. StatGuide information may also be accessed
using Help > StatGuide.

### 11.1.4 Tutorials

A set of tutorials may be accessed via Help > Tutorials. The contents of the library of tutorials
are displayed in Figure 11.9. With P Chart selected the right-hand window displays the
information in Figure 11.10.

Note the Uses (current), Data and How To tabs in the top left-hand corner of the window. Data provides answers to the questions ‘What kind of data is required?’ and ‘What should my worksheet look like?’. How To provides guidance under the headings:

- Scenario
- Choose the appropriate analysis
Figure 11.8 StatGuide information on hypotheses for a one-sample z-test.
Enter your data

Specify options

Interpreting the output

with the final one stating ‘Now what? For guidance on interpreting the results of this analysis, see StatGuide’!

11.1.5 Assistant

This new facility in Minitab 16 provides interactive decision trees for users to follow on the topics following:

• Measurement system analysis

• Capability analysis
<table>
<thead>
<tr>
<th>Uses</th>
<th>Data</th>
<th>How To</th>
<th>P Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use 1:</td>
<td></td>
<td>To monitor the stability of your process</td>
<td>A bakery isn’t alarmed when a few loaves of bread are burnt, but a surge in the percentage of burnt loaves is a serious problem. Even very stable processes vary somewhat, and trying to fix minor fluctuations in a process can actually cause instability. A P chart monitors the proportion of defectives that are produced in your process and alerts you to those changes that could signal a problem that is worth addressing.</td>
</tr>
<tr>
<td>Use 2:</td>
<td></td>
<td>To determine whether your process is stable and ready for improvement</td>
<td>A call center is disappointed with the number of incomplete sales calls. It struggles to fix the problem by changing its calling script. However, a sudden influx of new, inexperienced operators has made the process unstable, which makes it difficult to tell what effect the process changes may have. A process needs to be stable before you attempt to fine tune it, and a P chart can confirm (or deny) this stability.</td>
</tr>
<tr>
<td>Use 3:</td>
<td></td>
<td>To demonstrate improved process performance</td>
<td>A construction company has received unacceptably high numbers of defective smoke detectors from one of its suppliers. The construction company wants to know for certain that the supplier has reduced process variability. Your customers, employees, and management want clear proof that you have improved a process. A P chart before and after an improvement can provide that proof.</td>
</tr>
</tbody>
</table>

**Figure 11.10** Part of tutorial on the P chart.
Graphical analysis

Hypothesis tests

Regression analysis

Control charts.

Suppose that you would like guidance on carrying out graphical analysis of the data in Vehicles.MTW giving engine capacity (litres) and fuel consumption (litres per 100 km) for a sample of 20 cars. Figure 11.11 indicates how, having decided that the objective is to graph relationships between variables, Assistant provides further help in the form of the decision tree shown in Figure 11.12 by clicking on Help me choose.

One could select a path through the tree to reach a decision through visual scrutiny of the tree or one could Click to start and proceed interactively. Figure 11.13 shows the outcome of clicking on the first decision box.

In Figure 11.13 the mouse pointer is shown as the author was about to click on Next in order to select the Association between variables option and to advance to the next step. Thus Association between variables with One continuous X (engine capacity) and No groups leads the user to the Scatterplot option (bottom left of the tree in Figure 11.12) with the display in Figure 11.14.

The user is informed that a scatterplot shows the relationship between a continuous X (engine capacity) and a continuous Y (fuel consumption). Some guidelines are provided: to view the detail one must click on the relevant + sign. In Figure 11.14 the guidelines on examining the regression equation and the model fit are displayed. In order to create the scatterplot the user simply uses the Click to Create Graph icon. In the dialog box that appears
consumption is specified as the $Y$ column and capacity as the $X$ column. On clicking OK and moving the mouse pointer to the fitted line on the plot, the display in Figure 11.15 is obtained. (Note that the dialog for the creation of the scatterplot via the Assistant is simpler than that obtained via Graph $>$ Scatterplot $\ldots$).

**Figure 11.12** Decision tree for choosing a graphical analysis.

**Figure 11.13** Assistance with first decision.
The line provides a reasonably good fit to the data. The $R^2$ value indicates that 87.5% of the variation in fuel consumption may be attributed to engine capacity. Substituting capacity 3 into the equation yields consumption of 10.6. Thus the model fitted to the data predicts that, on average, cars with 3-litre engine capacity would consume 10.6 litres per 100 km.

Once again the reader is urged to explore use of the Assistant. As Minitab develops further in the future perhaps books such as this will become redundant!

**11.1.6 Glossary, methods and formulas**

Help > Glossary provides access to a statistical glossary. As indicated in Figure 11.16, a statistical term of interest may be sought either via the Index tab or using the Search tab.
For example, if one wished to obtain information on $R^2$ (R-squared) in regression then clicking on the Search tab, entering ‘R’ in the search window and clicking on List Topics reveals a list including R-squared. Double-clicking on this entry in the list reveals the explanation shown in Figure 11.17.

Should the details of how R-squared is calculated be of interest, then Help > Methods and Formulas > Regression > General Regression > $R^2$ yields the required information shown in Figure 11.18.

Further information on methods and formulas in regression may be obtained by clicking on relevant items in the General Regression list shown.

11.1.7 Minitab on the web and Knowledgebase/FAQ

Either Help > Minitab on the Web or Help > Knowledgebase/FAQ accesses the Minitab website and a wealth of information. The home page displayed in Figure 11.19 was accessed using Help > Minitab on the Web and shows seven tabs: Products, Training, Support, Academic, Store, Company and Theater. The Theater tab provides access to a number of videos: Getting Started, Analysing Data, Assessing Capability, Data Manipulation, Graphing Data, Creating Control Charts, Using the Assistant Menu and Navigating Projects. The reader is urged to watch these in order to reinforce his or her understanding of the software and the statistical methods.

The Knowledgebase and answers to frequently asked questions may be accessed either using Help > Knowledgebase/FAQ or using the link at the bottom left of the home page. In Chapter 5 reference was made to the Deming funnel experiments. The displays in Figure 5.47 were created using a Minitab macro. Suppose that you wish to obtain a copy of the macro so that you can demonstrate the plots (in glorious colour!) to colleagues. Performing a search of the knowledgebase using the phrase Deming funnel led to the display in Figure 11.20.

The single result from the search performed has identification number ID 1259, and clicking on this leads to a display of the solution to the query – see Panel 11.2. The reader is
Figure 11.17 Glossary explanation of R-squared.
invited to access the link and to follow steps 2 and 3 so that the macro may be used as an example in the next section.

The Minitab Help menu also provides Keyboard Map..., Check for Updates, Licensing..., Contact Us and About Minitab which will not be referred to further. It should be noted that under the Support tab Online Support enables one to create an account with Minitab in order to seek help from the company’s experts.

Figure 11.18  Formula for calculation of R-squared.

Figure 11.19  Minitab on the web.
11.2 Macros

11.2.1 Minitab Session commands

Each day the accident and emergency department at a hospital records the number of patients admitted (Patients) and the number of patients who wait for more than 2 hours to see a doctor (Number). The file December2010.xls includes data for December 2010. Each month an individuals (X) chart of the percentage of patients who waited for more than 2 hours to see a doctor is required, with tests for evidence of special causes 1, 2, 5 and 6 implemented.

Figure 11.20 Knowledgebase search result.

Panel 11.2 Instructions for downloading a Minitab macro.
The reader is invited to set up a new Minitab project and, with the Session window active, to use Editor to select Enable Commands. The MTB > prompt will appear in the Session window. Open the file December2010.xls. Use Calc > Calculator, with Store result in variable: Percentage and Expression: ‘Number’/‘Patients’ * 100 specified using Select and the keyboard in the dialog box, to compute the required column of percentages, and Stat > Control Charts > Variables Charts for Individuals > Individuals… to create the required chart.

The Session window will appear as shown in Panel 11.3. Note the command prompt MTB > and the subcommand prompt SUBC >. As an alternative to using the menus and dialog boxes in Minitab one may perform tasks by typing session commands and subcommands directly into the Session window (once commands have been enabled as described above.) For example, typing the command Runchart c3 1 into the Session window, and pressing the enter key, creates a run chart of the data. Alternatively, Runc ‘Percentage’ 1 may be used; many commands may be abbreviated to the first four letters and variable names in quotes may be used instead of column numbers.

Information on Session commands is available via Help > Help > Session Commands. (The first version of Minitab that the author used was Release 7. It was entirely driven using session commands, and on occasion he finds it quicker to carry out work with a series of typed commands rather than using the menus. However, many whose first introduction to Minitab is via Release 16 may never use session commands.)

Suppose that we had omitted to activate the third test for evidence of special causes on the control chart. Use of Window > Project Manager and clicking on the History folder or clicking on the History icon reveals the Session commands generated as the tasks described earlier were performed. The pair of commands requiring editing may be highlighted as shown in Figure 11.21 – a command and any associated subcommands must all be highlighted for editing. When highlighting more than one line, keep the control key pressed after highlighting the first and click on the remaining lines requiring highlighting.

On selecting Edit > Command Line Editor the final line may be edited to read Test 1 2 3 5 6. Clicking on Submit Commands causes the individuals chart to be re-created with the additional test implemented. The History folder now contains two additional lines. The two
lines highlighted in Figure 11.21 may be deleted together with the first three lines that are the commands for reading the data from one particular file. A right click reveals a menu. Selection of **Save History As**... enables the commands for the creation of the control chart of the monthly data to be saved as an exec file.

The reader is invited to select **Save History As**... and to choose **Save as type**: Exec Files (*.MTB) and to save the commands in a file named Monthly.MTB. On opening the file November 2010.xls in Minitab the commands stored in the exec file may be implemented using **File > Other Files > Run an Exec**... Accept one, the default number of times to execute the set of stored commands, select the file Monthly.MTB and click **Open**. The commands will be executed, the percentages calculated and displayed on the control chart. Of course the set of tasks being carried out by the exec in this case is small, but the example serves to illustrate the potential value of an exec for carrying out repetitive routine tasks.

### 11.2.2 Global and local Minitab macros

An exec is one form of Minitab macro. In addition, one can create global and local macros. An exec file may be converted into a global macro by using Notepad and adding three lines of text to the set of commands stored in the exec file as indicated in bold in Panel 11.4.

The first and last additional lines *must* be `gmacro` and `endmacro`, and the second additional line is the macro name. The file may then be stored as `IChart.MAC`, with the extension. MAC indicating that it contains a Minitab macro. Instructions for this may be found by carrying out the Knowledgebase search displayed in Figure 11.20 and following the guidelines thereby

```plaintext
**gmacro IChart**
Name C3 'Percentage'
Let 'Percentage' = 'Weight > 2' / 'Patients'*100
IChart 'Percentage' ;
Test 1 2 3 5 6.
**endmacro**
```

**Panel 11.4** Global macro for creation of control chart of percentages.
obtained that are displayed in Panel 11.2. If it is stored in the Macros folder in the Minitab 16 folder then it may be invoked simply by typing the command %IChart in the Session window. Alternatively, the file may be stored as a text file named Ichart.txt and invoked by typing the command %Ichart.txt in the Session window.) Readers are encouraged to try this out for themselves. If the file is not stored in the Macros folder then the path must be specified. Readers are also encouraged now to try out the Deming funnel experiment macro they were invited to download in Section 11.1.5. The file FunnelBU.txt is supplied for the benefit of any reader unable to make the download.

In creating a local macro one is essentially writing a program that can involve variables and control statements such as if and goto, in addition to Minitab commands. Global macros operate directly on the current worksheet. Local macros are more complicated and hence more difficult to write. The term ‘local macro’ is used because this type of macro creates a ‘local worksheet’ during the running of the macro that is erased from the computer memory once the macro has been executed. Arguments and variables may be passed between the global and local worksheets during the running of a local macro. Details of the creation of local macros will not be covered in this book. Readers wishing to learn more about local macros will find comprehensive information available via Help > ? Help and a single click on Macros under the References heading in the Minitab Help window.

Some macros require information from the user. For example, the Minitab macro for the creation of the Bland–Altman plot in Figure 9.13 requires the user to indicate the two columns that contain the measurements. Thus if the macro is stored as blandalt. MAC in the Minitab Macros folder it would be invoked using %blandalt c2 c3 to create the plot in Figure 9.13 as the second and third columns of the supplied worksheet Outside_Diameters.MTW contain the measurements. The reader is invited to re-create the plot.

An example of a macro that requires numerical information to be provided via the keyboard is the macro blankch for the creation of a blank Xbar or individuals (X) control chart. As an exercise the interested reader could use the macro to create a blank chart for the Xbar chart component of Figure 5.13. The rod cutting process had historical mean and standard deviation of 60.00 and 0.02 respectively, and the samples were of size 4.

### 11.3 Further features of Minitab

In reliability and survival statistics interest often centre on the time to failure of a system, $T$. The survival or cumulative failure function is an alternative name for the cumulative distribution function of the random variable $T$. Stat > Reliability/Survival provides facilities for the display and analysis of data for time to failure of systems. Breyfogle (2003) devotes four chapters to reliability topics.

In a paper on multivariate methods and Six Sigma, Yang (2004, p. 94) made the following comments.

Multivariate statistical methods are powerful methods that are playing important roles in many fields. Data mining and chemometrics are among the successful applications of multivariate statistical methods in business and industry. However, multivariate statistical methods are seldom applied in Six Sigma practice as well as quality assurance practice in general . . . multivariate statistical methods can play important roles in Six Sigma (DMAIC) practice.
The multivariate procedures provided by Minitab are available under Stat > Multivariate. Johnson and Wichern (2001) give a comprehensive account of applications of multivariate statistical methods.

Comprehensive facilities for the analysis and modelling of time series are also provided under Stat > Time Series. Of particular importance for quality improvement are models that take into account time series in which autocorrelation is present. Montgomery (2009, pp. 527–545) gives further details and references.

11.4 Quality Companion

Six Sigma product and process improvement invariably involves work being done by project teams. Minitab Quality Companion® Release 3.0 is a project management aid that includes a variety of tools that are widely used in Six Sigma quality improvement. Minitab claims that Quality Companion simplifies quality initiatives by providing the soft tools need to develop, organize and execute projects. With tools, files and data in a single project file, project teams are able to focus less on managing details and more on reaching goals. Using Quality Companion it is possible to:

- create a plan of action with a Roadmap™;
- centralize and share project data;
- standardize project deliverables with built-in forms;
- customize data and forms to meet the needs of the organization;
- map processes and assign data to any process step;
- establish the flow of value through the organization;
- organize ideas and challenges with brainstorming tools;
- create presentations to keep stakeholders informed;
- guide project teams with templates and coaches.

The default DMAIC project template provided by the software contains a Roadmap based on the Six Sigma stages: define, measure, analyse, improve and control. However, customization of the template is possible for use with quality improvement strategies other than Six Sigma. An overview is provided in Getting Started: Quality Companion® 3 (Minitab Inc., 2009), available as a PDF at http://www.minitab.com/uploadedFiles/Shared_Resources/Documents/Brochures/companion3getstarted.pdf. The software provides coaches to help the user select an appropriate statistical method to analyse process data captured, for example, before and after a process change. The analysis capture tools enable output from Minitab analyses to be added to a Quality Companion project and Minitab project files may readily be added as related documents. Figure 11.22 displays a Quality Companion project window with Minitab output. Note the Project Manager window on the left with components of DMAIC.
11.5 Postscript

Hoerl and Snee (2005) claim that 'Six Sigma is the best way we have found to actually deploy statistical thinking broadly'. The author makes no apology for presenting for a second time in this book, in Box 11.1, the summary of the measure, analyse, improve and control phases of DMAIC given by Hoerl (1998). Statistical thinking has a major role to play in all four phases and Minitab is a powerful and versatile tool for the application of statistical tools that may be used to foster understanding of variation and to reduce it.

**Box 11.1** Description of key phases in applying Six Sigma methodology.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Analyze</th>
<th>Improve</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on customer input, select the appropriate responses (the Ys) to be improved and ensure that they are quantifiable and can be accurately measured.</td>
<td>Analyze the preliminary data to document current performance or baseline process capability. Begin identifying root causes of defects (the Xs or independent variables) and their impact.</td>
<td>Determine how to intervene in the process to significantly reduce the defect levels. Several rounds of improvement may be required.</td>
<td>Once the desired improvements have been made, put some type of system into place to ensure the improvements are sustained, even though additional Six Sigma resources may no longer be focused on the problem.</td>
</tr>
</tbody>
</table>
Invariably the author learns something new each time he uses Minitab – it provides a vast and growing resource. It is his earnest hope that the reader has benefited from study of this book and will continue to learn more about Six Sigma and other strategies for quality improvement and the statistical tools that are vital for their successful implementation.

In a presentation on the future of Six Sigma, Antony (2010) made the following points:

- Six Sigma is on the upswing in financial and healthcare services and its application in small and medium-sized enterprises will continue to grow in the years to come.

- ‘Six Sigma has been very successful – perhaps the most successful business improvement strategy of the last 50 years’ (Montgomery, 2005b).

- Six Sigma will continue to evolve. However, the key concepts and sound principles of Six Sigma will stay for many years whatever the ‘next big thing’ will be.

So good luck as you tackle the exciting and rewarding task of using Minitab to apply statistical methods to product and process improvement in the context of Six Sigma or other improvement methodologies and remember that, whenever you are dealing with data, ‘Display is an obligation’!