

# Appendix A:

## OVERVIEW OF MINITAB

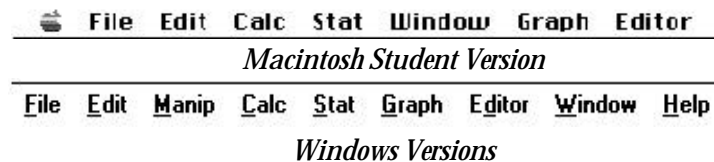
### Starting Minitab:

To launch Minitab, click your (left) mouse button two times quickly while pointing to the Minitab icon or the Minitab Student icon:



### Once in Minitab:

Once you start Minitab, the Minitab menu bar will appear across the top of the screen:



Minitab will open two windows: the Data window and the Session window. You may see only the Data window (which looks like a spreadsheet) if the windows are placed on top of each other. To see the Session window, you can click (and hold) on **Window** in the menu bar. This will show the Window menu and list all the available windows. Then drag the mouse to **Session** and let go to see the Session window, e.g.:



A series of menu steps like this will be written as **Window** > **Session** throughout this text. You can then choose **Data** from the **Window** menu (**Window** > **Data**) to go back to the Data window.

The Data window is used for entering, viewing, and editing data. Each column contains data for a different variable. The rows contain the observations for different observational units:

Untitled					Worksheet 1 ***				
	C1	C2	C3	C4		C1	C2	C3	C4
→					↓				
1					1				
2					2				

*Macintosh Versions*                      *Windows Versions*

The Session window is used for entering Minitab commands that tell the program what to do:

Session		Session	
Worksheet size: 100000 cells MTB >		Worksheet size: 100000 cells MTB >	

*Macintosh Versions*                      *Windows Versions*

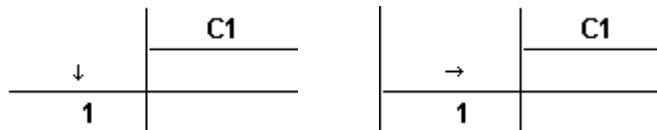
You should always click in the Session window to highlight it before you start entering commands. In the *Windows Professional* version you need to select **Editor > Enable Command Language** from the menu before you will see the MTB> prompt. Minitab commands can also be given using the menus across the top of the screen.

You can resize and move these windows for more convenient viewing. Click on the box in the lower right corner of the window and drag to resize. You can also click and hold the mouse button down on the top bar of the window and drag the mouse to move the window.

## Entering Data into Minitab:

To type data into the Minitab worksheet directly, activate the Data window and type each data value into a different cell, hitting Return, Enter, Tab, or one of the arrow keys to move from cell to cell. Remember that each column contains data for a different variable.

In the *Professional versions* and the *Windows Student version*, the arrow in the upper left corner of the Data window determines the direction in which the Minitab cursor moves when you press Enter/Return.



Clicking the mouse on this arrow changes its direction. If the arrow is pointing down, hitting Return/Enter moves you to the next row in the same column. If the arrow points to the right, hitting Return/Enter moves you to the next column in the same row.

## Opening an Existing Minitab Worksheet:

The data sets in this book are available in Minitab worksheets. You can open such a file by choosing **File** ➤ **Open Worksheet** from the menu bar. You will then see a list of saved worksheets (with the `.mtw` extension).

*Note:* In the *Windows Student version*, you will be asked to select a file type. In this book, all files will be “Minitab Worksheets,” so just click on the SELECT FILE button.

Once you find the file you want, you can click on the file name once to highlight it, and then click on the OK/OPEN button, or you can double click on the file name. Check that the data now appear in the Data window.

*Note:* In this book, we assume that the Minitab worksheets are stored in the default Minitab Data folder. If the data are stored elsewhere, e.g., on your disk, you will need to change folders. See Activity 2-2 on page 25 for an example.

## Using Minitab Commands:

Commands for Minitab are either typed in at the `MTB>` prompt in the Session window or selected through the menu bar (notice that after selecting a command with the menus, the equivalent session commands appear in the Session window). In this book these commands will appear in *this font*. As you use Minitab you will find some situations for which typing the command directly is easier and others for which using the menu bar is easier. Each command produces output or updates the Data window. Output appears either in the Session window or in a special graphics window.

### Subcommands:

You will occasionally want to specify a subcommand to a command in the Session window. Minitab uses a semicolon to signify that the next line should be a subcommand. For example:

```
MTB> hist c1;  
SUBC>
```

The prompt changes to SUBC> because Minitab is now expecting a subcommand. You can continue to issue subcommands by ending each line with a semicolon. To indicate that you are finished with subcommands, type a period at the end of the last subcommand. For example:

```
MTB> hist c1;  
SUBC> nint 5;  
SUBC> by c2.
```

Minitab will produce the histogram and then change back to the MTB> prompt, awaiting your next command.

### Reverting to a Minitab Worksheet:

In the *Macintosh versions*, if you make changes to a Minitab worksheet but then want to return to the last saved version of the worksheet, choose **File** ➤ **Revert Worksheet** from the menu bar. In the *Windows Professional versions*, you may be able to choose **File** ➤ **Restart Minitab**, clicking on NO when asked if you want to save changes to the data file.

### Opening an Empty Minitab Worksheet:

If you have been working in Minitab and want to change to a new (empty) worksheet, choose **File** ➤ **New Worksheet** from the menu bar. Minitab will ask whether you want to save any changes you made to the previous worksheet.

### Deleting Data:

To delete a cell entry, click the mouse on the undesired value and press the Delete/Backspace key. When you hit Return/Enter, the value will be replaced by a \*, which Minitab uses to represent a missing observation.

To delete an entire row, click the mouse in the undesired row in the Data window and choose **Editor** ➤ **Delete Row** (*Macintosh Student*, making sure you choose the Editor, not the Edit, menu) or **Manip** ➤ **Delete Rows** from the menu bar (*other versions*). In the latter case, specify the row number(s) in the first box and which column(s) you want the row values to be deleted from in the second box. This allows you to delete rows from a subset of columns, e.g., rows 1, 2, and 5 from C1. Alternatively, you can also type:

```
MTB> dele 1:2 5 c1
```

at the Minitab prompt in any version of the Minitab program.

To delete an entire Minitab column, e.g., C1, type:

```
MTB> erase c1
```

at the Minitab prompt or choose **Manip > Erase Variables** in the *Professional versions* and *Windows Student* versions.

### Pending Cell Change/Dimmed Menu Items:

To move from cell to cell in the Data window, you can use the arrow keys, the tab key, or hit Return/Enter. You must finish putting data in a cell (complete the cell) before you can execute a command. When you have not completed a cell, many menu items will be dimmed so that you cannot select them. If you then try to execute a command in the Session window, Minitab will tell you that it cannot execute the command until you accept the pending cell change. To fix this problem, go back to the Data window and press Enter, Return, Tab, or an arrow key. The highlighted cell then fills in, enabling you to issue a command. Thus, whenever Minitab will not accept a command, make sure that the current cell in the Data window is filled in. Similarly, if you have not finished executing a command in the Session window, Minitab will not let you select items from the menus.

### Alpha Columns:

Entering any letters into a column converts it to an alpha column, preventing you from performing any mathematical operations on that column. If you accidentally type a letter and notice your mistake before you complete the cell, use the delete key or select **Edit > Undo Cell Changes** (*Macintosh Student*) or **Edit > Undo Change Within a Cell** (*Macintosh Professional, Windows Student*). An alternative is to use the `erase` command, which deletes the entire column and removes the alpha column designation. You can then reenter the numeric data. In the *Windows version* you can choose **Manip > Change Data Type** as well.

### Saving Your Worksheet:

When you are entering your own data, you should periodically save the worksheet by choosing **File > Save (Current) Worksheet**. If you have not already done so, Minitab asks you to name the worksheet and then creates a file with that name and the extension `.mtw`. You should save the worksheet onto your disk directly. See Activity 2-1 on page 21 for an example. Use **File > Save (Current) Worksheet As** to save an existing worksheet under a new name. This is useful for creating your own copies of the textbook worksheets before you make changes to them.

## Saving Minitab Output:

There are three main ways to save Minitab output:

### (a) Recording Sessions: (*Macintosh versions, Windows Student version*)

You may occasionally want to keep a record of the Minitab output and the commands you have used. Initiate this process by selecting **File** > **Other Files** > **Start Recording Session** from the menu bar. *You should always remember to do this before you start working.* Click on the SELECT FILE button in the next window or press Return/Enter. In the next window, enter a name for the file in the box under “Record Session as” or “File name.” You should always save these files to your disk. Click on the SAVE/OK button, and Minitab creates a file with this name and the extension `.lis`. You can close this `.lis` file by either exiting Minitab or choosing **File** > **Other File** > **Stop Recording Session**. If you then choose **Start Recording Session** again later, and use the same name, the new output will be appended to the file. The `.lis` file can be opened by most word-processing applications, so that you may edit your output. Open the `.lis` file from within the word-processing application; do not try to double click on the file icon.

### (b) Saving the Session Window:

If you forget to record the session, you can still save all of the output contained in the Session window. Make sure the Session window is highlighted and choose **File** > **Save (Session) Window As**. You should change folders, name the file, and save it to your disk. This file can then be opened by any word-processing program.

### (c) Cutting and Pasting Minitab Output:

If you have both Minitab and a word-processing program open at the same time, you can select portions of the Minitab output by holding the mouse button down and dragging over that section. Once the region you desire is selected, choose **Edit** > **Copy** or type ⌘C/ctrl C to copy that text. Move to the word-processing document and then select **Edit** > **Paste** or type ⌘V/ctrl V to paste the section where you want it in your word-processing document.

## Saving High-Resolution Graphs:

When Minitab creates a high-resolution graph, the graph appears in a new window instead of in the Session window. To save this graphics window, make sure the window is active and choose **File** > **Save Window/Graph As**. You can then name this graphics file and save it to your disk. The Windows versions will add the `.mgf` extension. This graph can then be imported into a word-processing program. Alternatively, you can copy the graphics window (**Edit** > **Copy Graph**) and then paste the graph into a word-processing file.

## Printing High-Resolution Graphs:

If you want to print a high-resolution graph directly, make sure the graphics window is highlighted and choose **File** > **Print Window/Graph**. Click on OK in the Print Window screen. The graph can then be labeled and included with your work. *Note:* It is often more economical to import the graph into a word-processing file first and then add text and comments around the graph. In many applications, you can trim the excess white space surrounding these graphs by clicking on the graph once and then holding the shift key down while you use the mouse to move the edge of the picture inward.

When you are done with the graphics window, you can click in the box in the upper left corner (*Macintosh*) or upper right corner (left square, *Windows*) of the window to close it. Notice that you can get this window back by selecting its name from the bottom of the **Window** submenu. To get rid of the window permanently, choose **Window** > **Manage Graph** (*Windows*) or **Window** > **Discard Graph** (*Macintosh*). In the *Windows* versions, you can also click in the right square (with the X) in the upper right corner.

## Using Macros:

You will occasionally be asked to execute Minitab macros, which are files that contain a sequence of Minitab commands. To run a macro, choose **File** > **Other Files** > **Execute Macro** (*Macintosh Student*) or **File** > **Other Files** > **Run an Exec** (*other versions*) from the menu bar.

Minitab will first ask you how many times you want to run the macro. You should usually run the macro once to make sure that it works and then as many more times as is required for the activity. Next you have to tell Minitab which macro to execute. This book assumes that macros are stored in the default Minitab Macros folder and always end in the extension `.mtb`. You can view the commands issued by the macro by opening up this `.mtb` file in any word-processing application.

## Printing Data:

You cannot print data directly from the Data window. To print some or all of the data, use the `print` command, e.g.,

```
MTB> print c1-c5
```

which will type the data in columns 1–5 into the Session window, where it can be recorded, saved, or printed directly. In the *Macintosh versions*, you can use the mouse to select the data and then choose **File** > **Print Selection** from the menu bar.

## Getting Minitab Help:

Minitab has extensive on-line help documentation. To view the help files, you can either choose **Help** from the apple menu (*Macintosh*) or choose **Help** from the Minitab menu bar (*Windows*) or type `help` at the `MTB>` prompt in the Session window. You can also type `help` followed by a command to find help on a specific command. For example, typing

```
MTB> help commands
```

displays a table of contents for all possible Minitab commands. Double clicking on one of these commands will give you an information window for that command and list any potential subcommands.

## Quitting Minitab:

When you are done using Minitab, click on **File** in the menu bar and drag the mouse to **Quit/Exit** or hit `⌘Q` (*Macintosh*) or `Alt-F-X` (*Windows*) to quit the program.

If you have been using a Minitab worksheet created for class use, you should NOT save your changes to the worksheet. You should either save the changes under a different worksheet name on your disk (**File** > **Save Worksheet As**) or simply exit Minitab and answer NO when asked whether you want to save changes.

Please note that closing all windows is not equivalent to exiting the Minitab program.

## Glossary of Minitab Commands:

Listed below are some commonly used Minitab commands, arranged by the type of function the command performs. Use the `help` command to see how the commands should be formatted. While the commands are listed with specific columns, any columns can be substituted. When `k1-k4` appear, numerical values (constants) should be used. Many of the descriptive words in the command are not needed to run the command, but are used here to clarify the command. The corresponding path through the Minitab menu bar is also given. More information may be found in the text by looking for the command name in the index.

### Editing and Manipulating Data (also see the **Calc** menu)

Performing algebraic manipulations: `let c3=c1+c2`

Creates a new column (C3) adding data from C1 and C2

Can also use `let` with `abs`, `sqrt`, `loge`, `logten`, `expo`, `round`

You can name the new column from the session window with `name`.

Delete rows from selected columns: `delete 1,2 c2`

This would delete rows 1 and 2 from column 2.

Delete columns (all rows): `erase c1-c5`

This would erase all the data in columns 1–5.

Code data values: `code (k1 k2) (k3 k4) c1-c5 c6-c10`

Here, k1 and k2 have the old values, and k3 and k4 have the desired new values. These changes are being applied to columns 1–5, and the new columns are put in C6–C10 (could use C1–C5 again). Examples of use: changing from 0's and 1's to 1's and 2's or recoding specific values.

Can also code ranges of data: `code (k1:k2) 5 c1 c2`

This would change all values in column 1 that are between k1 and k2 into a 5 and put the results in column 2.

Change text column to numbers: **Manip** > **Change Data Type** > **Text to Numeric**

Combine several columns: `MTB> stack c2 c3 into c4; MTB> subs c5.`

Takes data in columns 2 and 3 and puts them together into one column, stored in C4. C5 will contain 1's and 2's, indicating whether the corresponding data point in C4 came from C2 or C3. Can be used to stack any number of columns.

Can reverse this process using the `unstack` command.

Make a two-way table: `table c1 c2` (See also **Stat** > **Tables** > **Cross Tabulation**)

C1 contains outcomes for one categorical variable, and C2 contains outcomes for a second categorical variable. Each row represents one observational unit (the columns must have equal number of rows). This command makes a two-way table *cross-classifying* the two variables. There is a chi-square analysis option in the **Tables** > **Cross Tabulation** menu, or this two-way table can be typed into new columns and used with the `chisq` command.

**Descriptive Statistics** (also see **Stat** > **Basic Statistics**)

One variable: `mean, stdev, median, min, max, describe, info, sum, tally`  
Applied to a specific column (e.g., `mean c1`) calculates the desired information for that column.

`describe`: gives the sample size, mean, median, trimmed mean (dropping 5% on both ends), standard deviation, standard error, min, max, and quartiles for that column. Can be used for multiple columns.

Can be used with the `by` subcommand, which separates the data into groups first, using a `subscripts` column (a categorical variable indicating the groups).

`info`: Gives the name and count for each column in the worksheet.

`sum`: Adds the values in the column.

`tally`: Displays the number of occurrences for each observation.

Can also perform arithmetic across rows using **Calc** > **Row Statistics**.

Two variables: `corr c1 c2`

Calculates the correlation coefficient between paired data in columns 1 and 2. Each row represents one observational unit, and columns must be of equal length.

**Plotting Data** (also see **Graph** menu)

One variable: `dotplot, histogram, stemplot, boxplot`

Applied to specific columns (e.g. `hist c1-c2`) produces the desired plot.

Two variables: `plot` (scatterplot), `lplot` (includes labels).

Applied to two columns of paired data (e.g. `plot c1*c2`). The `lplot` allows you to “tag” different groups from a third (categorical) variable.

Many of these plots have subcommands, in particular, the `by` subcommand for separating the column data by groups, e.g.,

```
MTB> boxplot c1;
SUBC> by c2.
```

In this form, all the quantitative observations are in C1, and the categorical grouping variable is in C2 (so may need to stack the data before you run this command).

### **Inference Procedures** (also see **Stat > Basic Statistics** menu)

Basic Inference: One proportion, Two proportions

1 sample  $t$ , 2 sample  $t$ , Paired  $t$

Often applicable to column of data or summarized data. With two-sample  $t$ , data can be stacked with column of subscripts or separate columns.

For the confidence intervals, can set confidence level. For the one sample tests, need to give the hypothesized value of the population parameter (or zero is assumed). See the Help menu for more detailed description of how to format the command.

Can calculate the power of a procedure using **Stat > Power and Sample Size**.

Regression: (See also **Stat > Regression > Regression**)

```
regress c1 1 c2
```

Here C1 is the response variable; C2 contains the data for the explanatory variables. Columns must have same length.

Can use a subcommand to store the residuals of the regression, e.g.,

```
regress c1 1 c2;
resids c3.
```

Chisquare: (See also **Stat > Tables > Chi-Square Test**)

```
chisquare on table in c1-c3
```

Enter the two-way table directly into the Minitab worksheet, then apply the chi-square command to those columns. Will calculate the expected counts and test statistic. See above for how to create the table from raw data.

### **Simulation** (also see **Calc > Random Data**)

Generating random data:

```
random k observations into each of c1, c2, c3
```

Randomly selects  $k$  values per sample and puts a sample in each column specified. The default is to sample from a Standard Normal distribution. Use the subcommand option to specify other distributions and their parameters.

Sampling data: `sample k rows from c1-c3 put into c4-c6`

Samples  $k$  observational units from columns C1–C3 and put the samples into the second set of columns specified (e.g., C4–C6).

**Calculating Normal Probabilities** (see also **Calc > Probability Distributions**)

Finding the probability below:

```
MTB> cdf 15;
```

```
SUBC> Normal 20 5.
```

Finds the probability below the value you specify for k.

Example output:

x	P(X ≤ x)
15	.1587

So for a Normal(20,15) distribution,  $P(X \leq 15) = .1587$

Assumes a Standard Normal distribution unless you use the subcommand option to specify otherwise.

