APPENDIX C

GETTING STARTED WITH THE TI-83/TI-84 PLUS FAMILY OF CALCULATORS

ON-OFF

To turn on the calculator, press the ON key. To turn off the calculator, press 2nd and then ON .

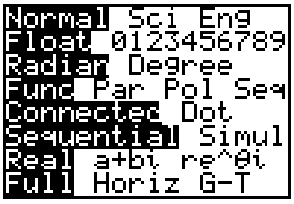
Most keys on the calculator have multiple purposes. The number or symbolic function/command written directly on the key is accessed by simply pressing the key. The symbolic function/commands written above each key are accessed with the aid of the 2nd and ALPHA keys. The command above and to the left is color coded to match the 2nd key. That command is accessed by first pressing the 2nd key and then pressing the key itself. Similarly, the command above and to the right is color coded to match the ALPHA key and is accessed by first pressing the ALPHA key and then pressing the key itself.

Contrast

To adjust the contrast on your screen, press and release the 2nd key and hold ▲ to darken and ▼ to lighten.

Mode

The MODE key controls many calculator settings. The activated settings are highlighted. For most of your work in this course, the settings in the left-hand column should be highlighted.



To change a setting, move the cursor to the desired setting and press ENTER .

The Home Screen

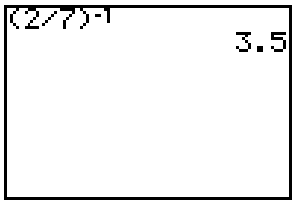
The home screen is used for calculations.

You may return to the home screen at any time by using the QUIT command. This command is accessed by pressing [2nd] [MODE] . All calculations in the home screen are subject to the order of operations convention.

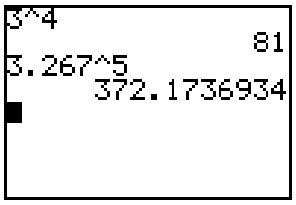
Enter all expressions as you would write them. Always observe the order of operations. Once you have typed the expression, press [ENTER] to obtain the simplified result. Before you press [ENTER] , you may edit your expression by using the arrow keys, the delete command [DEL] , and the insert command [2nd] [DEL] .

Three keys of special note are the reciprocal key [X^{-1}] , the caret [^] key, and the negative key [(−)].

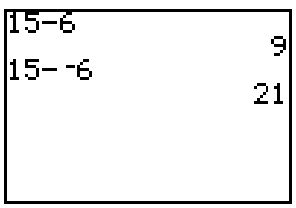
Typing a number and then pressing the reciprocal command key [X^{-1}] will give the reciprocal of the number. The reciprocal of a nonzero number, n, is $\frac{1}{n}$. As noted in the screen below, when performing an operation on a fraction, the fraction MUST be enclosed in parentheses before accessing this command.



The caret key [^] is used to raise numbers to powers



The negative key [(−)] on the bottom of the keyboard is different from the subtraction key [−] . They cannot be used interchangeably. The negative key is used to change the sign of a single number or symbol; it will not perform a subtraction operation. If you mistakenly use the negative key in attempting to subtract, you will likely obtain an ERROR message.



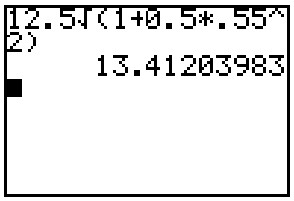
A table of some frequently used keys and their functions follows.

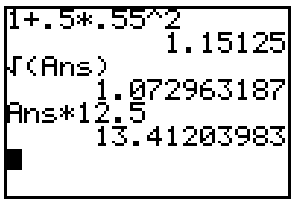
KEY	FUNCTION DESCRIPTION
ON	Turns calculator on or off.
CLEAR	Clears the line you are currently typing. If cursor is on a blank line when CLEAR is pressed, it clears the entire home screen.
ENTER	Executes a command.
(−)	Calculates the additive inverse.
MODE	Displays current operating settings.
DEL	Deletes the character at the cursor.
^	Symbol used for exponentiation.
ANS	Storage location of the result of the most recent calculation.
ENTRY	Retrieves the previously executed expression so that you may edit it.

ANS and ENTRY

The last two commands in the table can be real time savers. The result of your last calculation is always stored in a memory location known as ANS. It is accessed by pressing 2nd (−) or it can be automatically accessed by pressing any operation button.

Suppose you want to evaluate $12.5\sqrt{1 + 0.5 \cdot (0.55)^2}$. It could be evaluated in one expression and checked with a series of calculations using ANS.

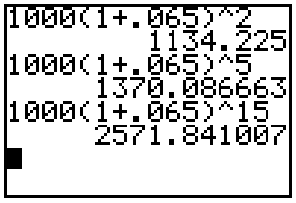




After you have keyed in an expression and pressed ENTER, you cannot move the cursor back up to edit or recalculate this expression. This is where the ENTRY (2nd ENTER) command is used. The ENTRY command retrieves the previous expression and places the cursor at the end of the expression. You can use the left and right arrow keys to move the cursor to any location in the expression that you wish to modify.

Suppose you want to evaluate the compound interest expression $P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, n is the number of compounding periods annually, and t is the number of years, when $P = \$1000$, $r = 6.5\%$, $n = 1$, and $t = 2$, 5, and 15 years.

Using the ENTRY command, this expression would be entered once and edited twice.



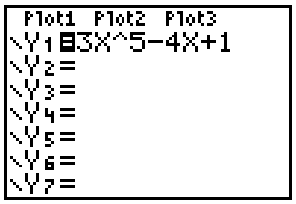
Note that there are many last expressions stored in the ENTRY memory location. You can repeat the ENTRY command as many times as you want to retrieve a previously entered expression.

Functions and Graphing with the TI-83/TI-84 Plus Family of Calculators

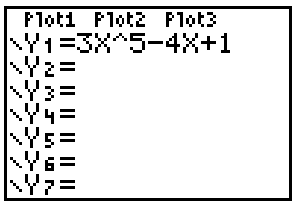
"Y =" Menu

Functions of the form $y = f(x)$ can be entered into the TI-83/TI-84 Plus using the "Y = " menu. To access the "Y = " menu, press the [Y=] key. Type the expression $f(x)$ after Y_1 using the [X,T,θ,n] key for the variable x and press [ENTER].

For example, enter the function $f(x) = 3x^5 - 4x + 1$.

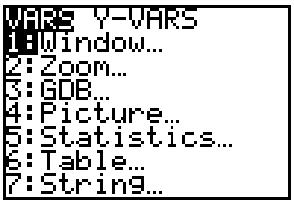


Note the = sign after Y_1 is highlighted. This indicates that the function Y_1 is active and will be graphed when the graphing command is executed and will be included in your table when the table command is executed. The highlighting may be turned on or off by using the arrow keys to move the cursor to the = symbol and then pressing [ENTER]. Notice in the screen below that Y_1 has been deactivated and will not be graphed nor appear in a table.

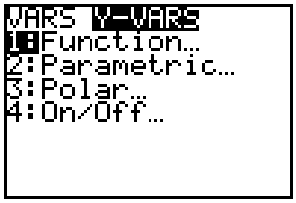


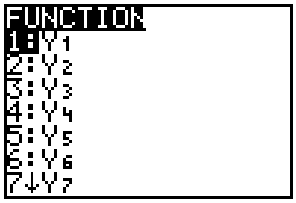
Once the function is entered in the "Y = " menu, function values may be evaluated in the home screen.

For example, given $f(x) = 3x^5 - 4x + 1$, evaluate $f(4)$. In the home screen, press [VARS] .



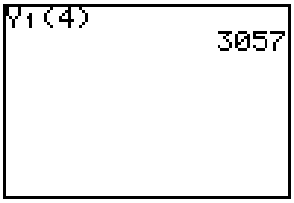
Move the cursor to Y-VARS and press [ENTER] .





Press [ENTER] again to select Y_1. Y_1 now appears in the home screen.

To evaluate $f(4)$, press [(] [4] [)] after Y_1 and press [ENTER] .

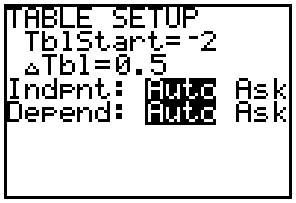


Tables of Values

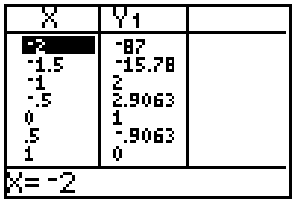
If you are interested in viewing several function values for the same function, you may want to construct a table.

Before constructing the table, make sure the function appears in the "Y =" menu with its "=" highlighted. You may also want to deactivate or clear any functions that

you do not need to see in your table. Next, you will need to check the settings in the Table Setup menu. To do this, use the TBLSET command (2nd WINDOW).

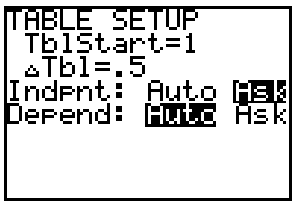


As shown in the screen above, the default setting for the table highlights the Auto options for both the independent (x) and dependent (y) variables. Choosing this option will display ordered pairs of the function with equally spaced x-values. TblStart is the first x-value to be displayed, and here is assigned the value -2. ΔTbl represents the equal spacing between consecutive x-values, and here is assigned the value 0.5. The TABLE command (2nd GRAPH) brings up the table displayed in the screen below.

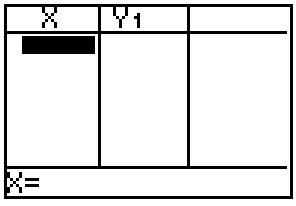


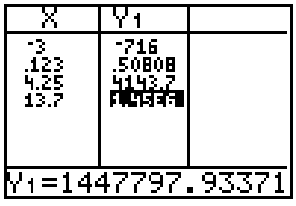
Use the ▲ and ▼ keys to view additional ordered pairs of the function.

If the input values of interest are not evenly spaced, you may want to choose the Ask mode for the independent variable from the Table Setup menu.



The resulting table is blank, but you can fill it by choosing any values you like for x and pressing ENTER after each.





Note that the number of digits shown in the output is limited by the table width, but if you want more digits, move the cursor to the desired output and more digits appear at the bottom of the screen.

Graphing a Function

Once a function is entered in the "Y = " menu and activated, it can be displayed and analyzed. For this discussion we will use the function $f(x) = -x^2 + 10x + 12$. Enter this as Y_1 making sure to use the negation key (−) and not the subtraction key −.

The Viewing Window

The viewing window is the portion of the rectangular coordinate system that is displayed when you graph a function.

Xmin defines the left edge of the window.

Xmax defines the right edge of the window.

Xscl defines the distance between horizontal tick marks.

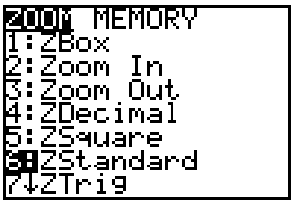
Ymin defines the bottom edge of the window.

Ymax defines the top edge of the window.

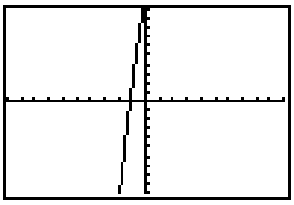
Yscl defines the distance between vertical tick marks.

In the standard viewing window, Xmin = −10, Xmax = 10, Xscl = 1, Ymin = −10, Ymax = 10, and Yscl = 1.

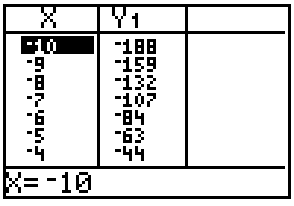
To select the standard viewing window, press ZOOM 6.

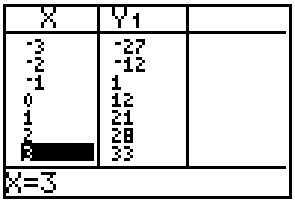


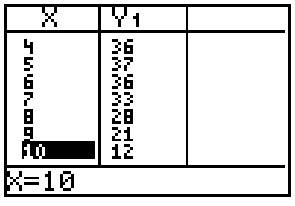
You will view the following:



Is this an accurate and/or complete picture of your function, or is the window giving you a misleading impression? You may want to use your table function to view the output values that correspond to the input values from −10 to 10.



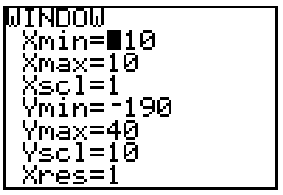


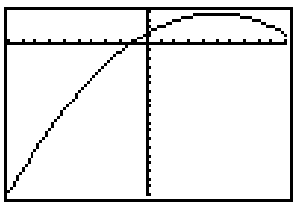


The table indicates that the minimum output value on the interval from $x = -10$ to $x = 10$ is -188, occurring at $x = -10$, and the maximum output value is 37 occurring at $x = 5$. Press [WINDOW] and reset the settings to the following:

$$\text{Xmin} = -10, \text{Xmax} = 10, \text{Xscl} = 1,$$
$$\text{Ymin} = -190, \text{Ymax} = 40, \text{Yscl} = 10$$

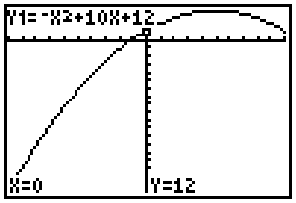
Press [GRAPH] to view the graph with these new settings.



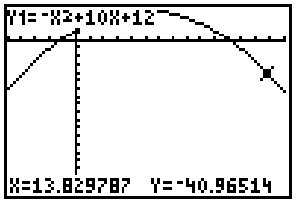


The new graph gives us a much more complete picture of the behavior of the function on the interval $[-10, 10]$.

The coordinates of specific points on the curve can be viewed by activating the trace feature. While in the graph window, press [TRACE]. The function equation will be displayed at the top of the screen, a flashing cursor will appear on the curve at the middle of the screen, and the coordinates of the cursor location will be displayed at the bottom of the screen.

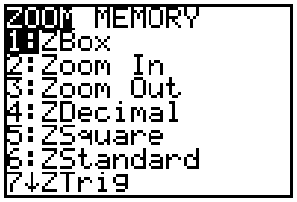


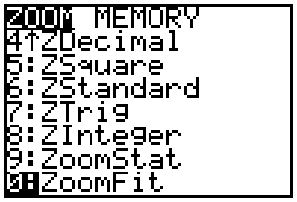
The left arrow key, [◀], will move the cursor toward smaller input values. The right arrow key, [▶], will move the cursor toward larger input values. If the cursor reaches the edge of the window and you continue to move the cursor, the window will adjust automatically.



Zoom Menu

The Zoom menu offers several options for changing the window very quickly.





The features of each of the commands are summarized in the following table.

ZOOM COMMAND	DESCRIPTION
1: ZBox	Draws a box to define the viewing window.
2: Zoom In	Magnifies the graph near the cursor.
3: Zoom Out	Increases the viewing window around the cursor.
4: ZDecimal	Sets a window so that Xscl and Yscl are 0.1.
5: ZSquare	Sets equal size pixels on the *x*- and *y*-axes.
6: ZStandard	Sets the window to standard settings.
7: ZTrig	Sets built-in trig window variables.
8: ZInteger	Sets integer values on the *x*- and *y*-axes.
9: ZoomStat	Sets window based on the current values in the stat lists.
0: ZoomFit	Replots graph to include the max and min output values for the current Xmin and Xmax.

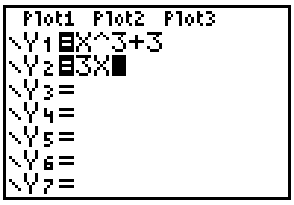
Solving Equations Graphically Using the TI-83/TI-84 Plus Family of Calculators

The Intersection Method

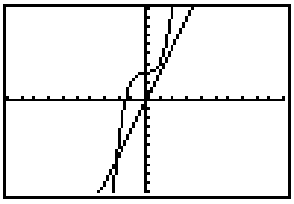
This method is based on the fact that solutions to the equation $f(x) = g(x)$ are input values of x that produce the same output for the functions f and g. Graphically, these are the x-coordinates of the intersection points of $y = f(x)$ and $y = g(x)$.

The following procedure illustrates how to use the intersection method to solve $x^3 + 3 = 3x$ graphically.

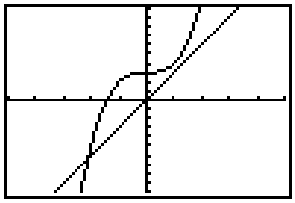
Step 1 Enter the left-hand side of the equation as Y_1 in the "Y = " editor and the right-hand side as Y_2. Select the standard viewing window.



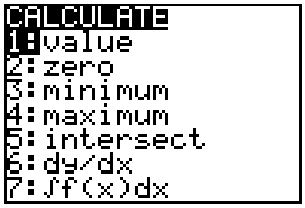
Step 2 Examine the graphs to determine the number of intersection points.

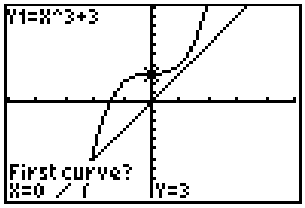


You may need to examine several windows to be certain of the number of intersection points.



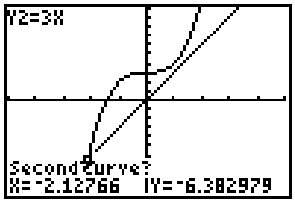
Step 3 Access the Calculate menu by pushing 2nd TRACE , then choose option 5: intersect.





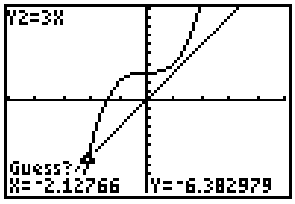
The cursor will appear on the first curve in the center of the window.

Step 4 Move the cursor close to the desired intersection point and press ENTER .



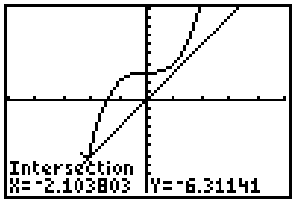
The cursor will now jump vertically to the other curve.

Step 5 Repeat step 4 for the second curve.



Step 6 To use the cursor's current location as your guess, press ENTER in response to the question on the screen that asks Guess? If you want to move to a better guess value, do so before you press ENTER .

The coordinates of the intersection point appear below the word Intersection.



The *x*-coordinate is a solution to the equation.

If there are other intersection points, repeat the process as necessary.

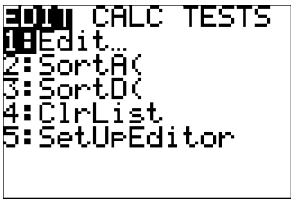
Using the TI-83/TI-84 Plus Family of Calculators to Determine the Linear Regression Equation for a Set of Paired Data Values

Example 1:

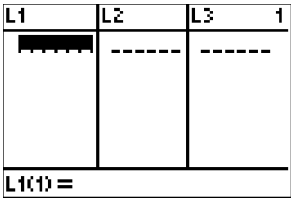
INPUT	OUTPUT
2	2
3	5
4	3
5	7
6	9

Enter the data into the calculator as follows:

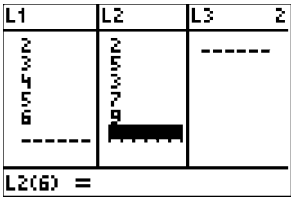
1. Press [STAT] and choose EDIT.



2. The calculator has six built-in lists, L1, L2, . . . , L6. If there is data in L1, clear the list as follows:
   a. Use the arrows to place the cursor on L1 at the top of the list. Press [CLEAR] followed by [ENTER], followed by the down arrow.
   b. Follow the same procedure to clear L2 if necessary.

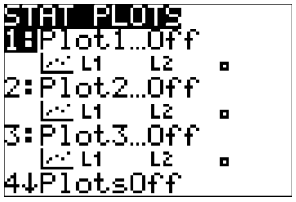


   c. Enter the input values into L1 and the corresponding output values into L2.

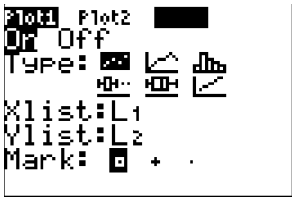


To see a scatterplot of the data proceed as follows.

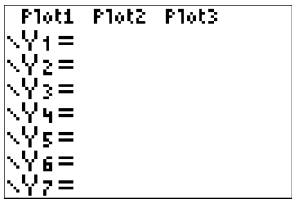
1. STAT PLOT is the 2nd function of the [Y=] key. You must press [2nd] before pressing [Y=] to access the STAT PLOT menu.



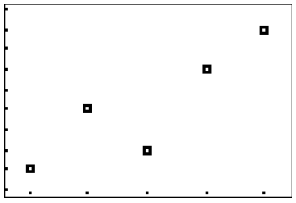
2. Select Plot 1 and make sure that Plots 2 and 3 are Off. The screen shown below will appear. Select On and then choose the scatterplot option (first icon) on the Type line. Confirm that your *x* and *y* values are stored, respectively, in L_1 and L_2. The symbols L_1 and L_2 are 2nd functions of the [1] and [2] keys, respectively. Finally, select the small square as the mark that will be used to plot each point.



3. Press [Y=] and clear or deselect any functions currently stored.

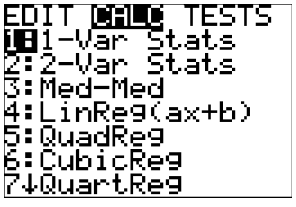


4. To display the scatterplot, have the calculator determine an appropriate window by pressing [ZOOM] and then [9] (ZoomStat).



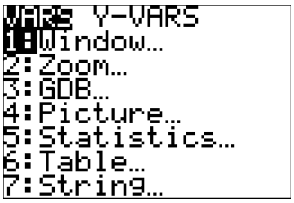
The following instructions will calculate the linear regression equation and store it in Y_1.

1. Press [STAT] and right arrow to highlight CALC.

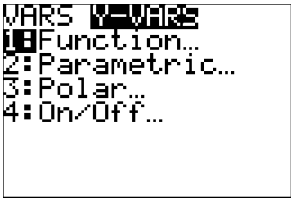


2. Choose 4: LinReg (ax + b). LinReg (ax + b) will be pasted to the home screen. To tell the calculator where the data is, press [2nd] and [1] (for L1), then [,], then [2nd] and [2] (for L2) because the Xlist and Ylist are stored in L_1 and L_2, respectively. The display should look like this:

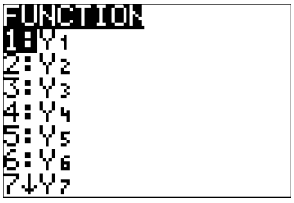
3. Press [,] and then press [VARS].



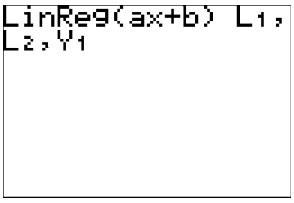
4. Right arrow to highlight Y-VARS.



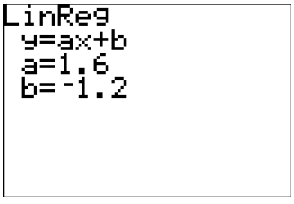
5. Choose 1, FUNCTION.



6. Choose 1 for Y_1 (or 2 for Y_2, etc. if you prefer to store the regression equation in another location).

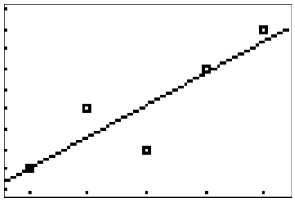


7. Press [ENTER].



The linear regression equation for this data is $y = 1.6x - 1.2$.

8. To display the regression line on the scatterplot screen, press GRAPH .



9. Press the Y= key to view the equation.