Supplement On Using The TI-83

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1 Getting Started and Editing Tips

Turning on the calculator and turning it off: Press [ON] to turn the calculator on. The calculator is turned off automatically after about five minutes without any activity. Press [2nd] [OFF] to turn off the calculator manually.

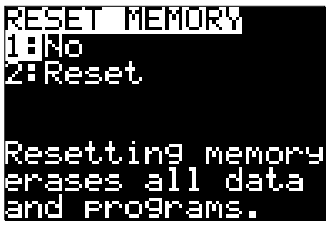
Adjusting the Display Contrast: Adjust the contrast as follows. Press and release the [2nd] key. Press and hold [▲] or [▼], which are above and below the contrast symbol (yellow, half-shaded circle). [▲] darkens the screen and [▼] lightens the screen. As you press and hold [▲] or [▼], an integer between **0** (lightest) and **9** (darkest) appears in the upper right corner of the display.

The keys on the TI-83 are color-coded to help you easily locate the key you need. The grey keys are the number keys. The blue keys along the right side of the keyboard perform common math operations. The blue keys across the top are the graphing keys. Most keys access more than one operation. The secondary function of each key is printed in yellow; whereas, the alpha function of each key is printed in green. For example, consider the squaring key [x^2]. Above this key, a yellow square root symbol is to the left and a green upper case **I** is to the right. To access the squaring operation, you press the [x^2] key. To access the square root operation, you press the yellow [2nd] key and then the [x^2] key. In this supplement, we say "press [2nd] [$\sqrt{}$]." Press the green [ALPHA] key and then the [x^2] key to access the upper case **I**. We say "press [ALPHA] [I]." To access the lower case **i**, press, in sequence, the keys [2nd], [ALPHA], and [x^2].

Factory Settings: With the calculator on, press [2nd] [MEM] ([2nd] operation of [+]). The MEMORY menu is displayed.

(1.1)

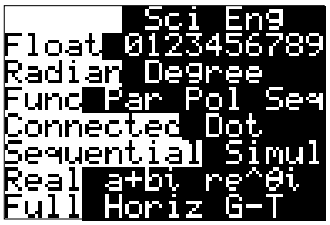
(1.2)



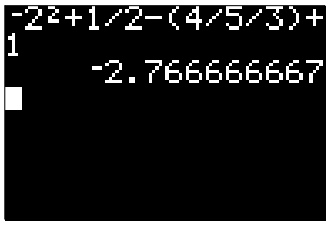
(1.3)

Press **5** to select **5:Reset**. The RESET MEMORY menu is displayed. Select **1:All Memory** by pressing **1** to display the RESET MEMORY menu. Next press **2** to select **2:Reset**. The calculator is reset to the factory default setting. All memory is cleared.

(1.4)



(1.5)



(1.6)

Press [MODE] to see the factory (default) mode settings for the calculator. See (1.5). To change mode settings, follow these steps.

1. Press [▼] or [▲] to move the cursor to the line of the setting that you want to change.
2. Press [◄] or [►] to move the cursor to the setting you want.
3. Press [ENTER].

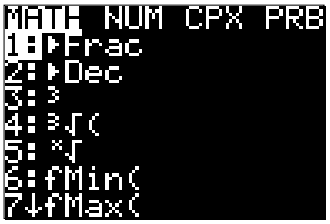
Press [2nd] [QUIT] to return to the home screen. The home screen is the primary screen of the calculator. To return to the home screen from any other screen, press [2nd] [QUIT].

Order of Operations: The T-83 performs calculations according to standard algebraic rules. Calculations are performed from left to right, working outwards from inner parentheses. Powers and roots are evaluated first. Multiplication and division are evaluated next, followed by addition and subtraction.

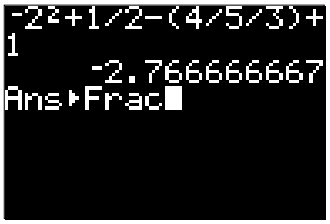
Example 1.1: Evaluate $-2^2 + \frac{1}{2} - \left(\frac{4}{5} \div 3\right) + 1$

Press [(-)] **2** [x^2] [+] [1] [÷] **2** [-] [(] **4** [÷] **5** [÷] **3** [)] [+] **1**. Press [ENTER] to evaluate the expression. See the result in (1.6). You can show the answer as a fraction. Press [MATH] to display the MATH menu. Press **1** to select **1:►Frac** from the MATH menu. **Ans ►Frac** is displayed on the home screen. **Ans** is a variable that contains the last calculated answer. Now press [ENTER] to convert the result to a fraction. See (1.7)-(1.9). The result of your

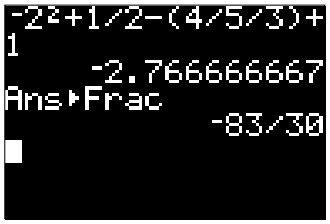
last calculation is always stored in memory location **ANS** and replaces any previous result. To access **Ans**, press [2nd] [ANS] (above the [(-)] key).



(1.7)



(1.8)

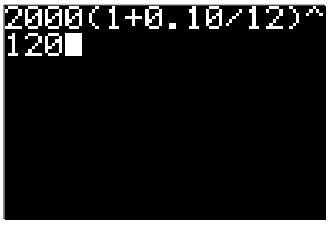


(1.9)

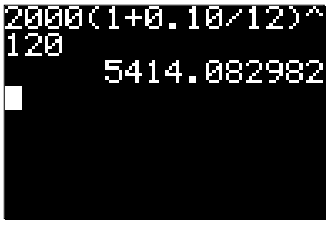
Basic Calculations: Recall that if an amount P is invested at an annual rate of R compounded monthly, the amount A in the account after N months is given by the compound interest formula $A = P(1 + R/12)^N$. We use this formula to demonstrate some of the basic features of the TI-83.

Example 1.2: The amount in the account after 10 years for an investment of \$2000 at 10% compounded monthly is given by $2000(1 + 0.10/12)^{120}$. To calculate this amount, clear the home screen by pressing [CLEAR] and enter **2000** [(] **1** [+] **0.10** [÷] **12** [)] [^] **120** . See (1.10). Press [ENTER] to evaluate the expression. Notice that the TI-83 does implied multiplication; therefore, it is not necessary to press [×] after entering 2000.

Example 1.3: Compute $2000(1+0.08/12)^{288}$. We could compute this expression by entering it as we did in Example 1.2; however, we use the ENTRY and editing features of the calculator to simplify the work. The calculator stores entry lines in its memory. To scroll previous entry lines, press [2nd] [ENTRY] repeatedly. Now press [2nd] [ENTRY] (above [ENTER]) to recall the most recent entry. Use the keys [◄], [▲], [►], [▼] (cursor pad keys) to move the blinking cursor until it covers **1** in 0.10. Press [0] [8]. Proceed in a similar fashion to change 120 to 288. Then press [ENTER] to get the result in (1.13).



(1.10)



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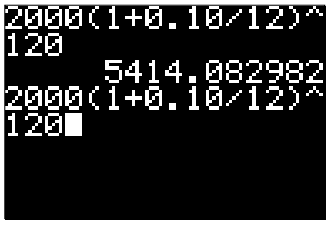

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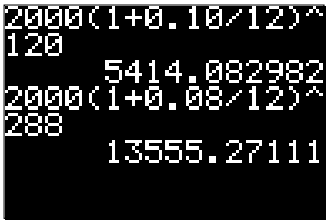
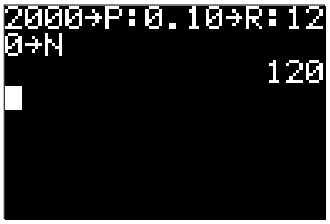
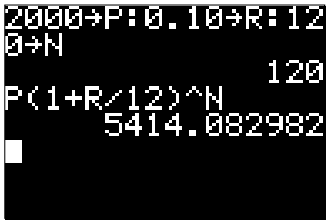


(1.13)



(1.14)



(1.15)

Delete and Insert Keys: The delete key [DEL] deletes a character at the cursor; this key repeats. By default, the TI-83 is in overtype mode. Press [2nd] [INS](above [DEL]) to change from overtype mode to insert mode. [2nd] [INS] changes the cursor to _; inserts characters in front of the underline cursor. To end insertion, press [2nd] [INS] or press [◄], [▲], [►], or [▼].

Using Stored Values: To illustrate this feature, we redo the compound interest problem above by storing values to P, R, and N and then entering and executing the entry line $P(1 + R/12)^N$.

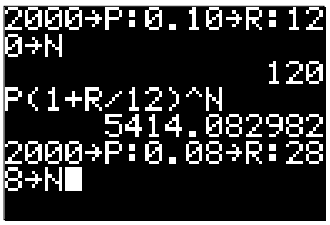
Example 1.4: To compute $2000(1 + 0.10/12)^{120}$, we first store 2000, 0.10, and 120 as the values for the variables P, R, and N, respectively as follows.

Press **2000** [STO ►] [ALPHA] [P] [ALPHA] [:] **0.10** [STO ►] [ALPHA] [R] [ALPHA] [:] **120** [STO ►] [ALPHA] [N]

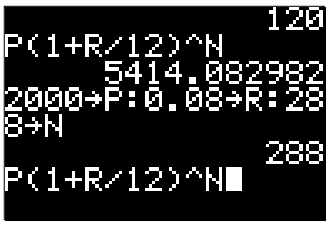
Notice that **:** is above the decimal key [·]. Press [ENTER] to execute the entry line. See (1.14).

Press [ALPHA] [P] [(] **1** [+] [ALPHA] [R] [÷] **12** [)] [^] [ALPHA] [N] to enter $P(1+R/12)^N$. Press [ENTER] to execute the entry line and obtain the result in (1.15).

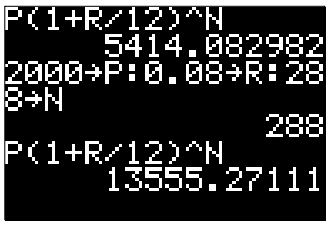
Now to compute $2000(1 + 0.08/12)^{288}$, use ENTRY to recall the entry line that stored the values to the variables. Edit this entry line to obtain the entry line shown in (1.16). Press [ENTER] to execute the entry line. Then use ENTRY again to recall the compound interest formula. See (1.17) Press [ENTER] to get the result (1.18).



(1.16)



(1.17)



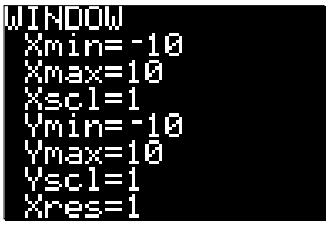
(1.18)

2 Function Graphing

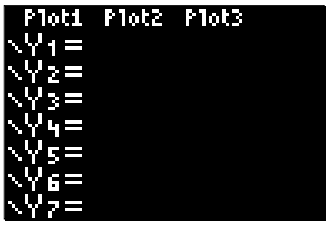
Set the mode setting as in (1.5). **Func** graphing mode is selected. The TI-83 has four graphing modes: **Func** (function graphing), **Par** (parametric graphing), **Pol** (Polar graphing), and **Seq** (Sequence graphing). We enter function to be graphed in the Y= editor and enter the viewing window values using the WINDOW screen. Then press [GRAPH] to see the graph.

Viewing Window: This refers to the rectangular screen in which the graph appears. The viewing window is described by the four numbers **Xmin**, **Xmax**, **Ymin**, and **Ymax**, which represent the left and right endpoints of the x-axis and the bottom and top endpoints of the y-axis. Press [WINDOW] to view the default setting of the viewing window shown in (2.1). The setting in (2.1) is referred to as the **standard viewing rectangle** or the **standard window**. **Xscl** (X scale) defines the distance between tick marks on the x-axis. **Ycsl** (Y scale) defines the distance between tick marks on the y-axis. Graphs are made up of black rectangular dots called pixels. **Xres** sets pixel resolution (1 through 8). At **Xres=1**, functions are evaluated and graphed at each pixels on the x-axis. At **Xres=8**, functions are evaluated and graphed at every eighth pixel along the x-axis. In this supplement, the viewing window will be given in the format [**Xmin, Xmax, Xscl**] $\times$ [**Ymin, Ymax, Yscl**]. Unless otherwise stated, we will use **Xres=1**. Therefore, $[-10, 10, 1] \times [-10, 10, 1]$ denotes the standard window.

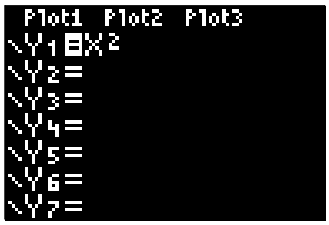
Example 2.1: Graph $y = x^2$.
Press [Y=] to obtain (2.2). Type x^2 after the $Y_1 =$ by pressing [X,T,θ,n] [x^2] to obtain (2.3). Press [GRAPH] to obtain the graph of $y = x^2$ in the standard viewing window. See (2.4). Press [WINDOW] to verify that the viewing window is as shown in (2.1). To make the graph appear bigger, change the viewing window to $[-3, 3, 1] \times [-2, 8, 1]$. See (2.5). Remember, the negation key [(-)] and the subtraction key [-] are different. Press [GRAPH] to obtain (2.6).



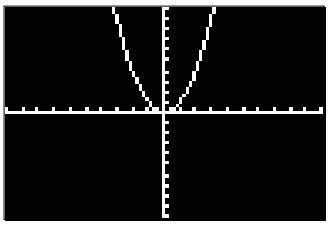
(2.1)

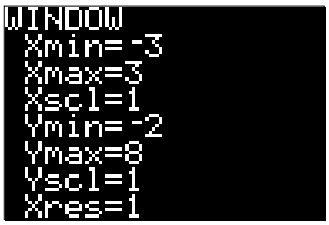


(2.2)



(2.3)


(2.4)



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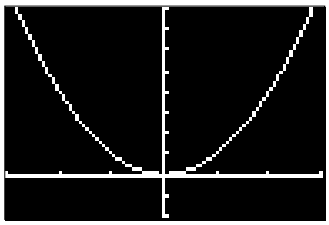
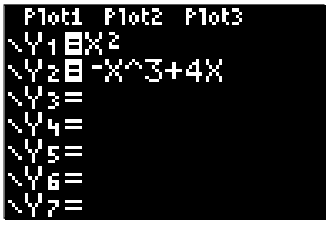

(2.6)

Graphing Several Functions:
Example 2.2: Graph $y = -x^3 + 4x$. Do not delete $y = x^2$ from the Y= editor. Press [Y=] [ENTER] and enter $-x^3 + 4x$ after $Y_2 =$ by pressing [-] [X,T,θ,n] [^] [3] [+] [4] [X,T,θ,n]. See (2.7). Press [WINDOW] and change the viewing window to $[-5, 5, 1] \times [-10, 10, 1]$. Then press [ENTER] to obtain (2.8).

Graph Styles: The TI-83 has 7 graph styles: line, thick, shade above, shade below, path animated path, and dotted. Let's graph the function $y = -x^3 + 4x$ with the style set to thick.

To set the graph style for a function, follow these steps.

1. Press [Y=] to display the Y= editor.
2. Press [▼] and [▲] to move the cursor to the function.
3. Press [◄] [◄] to move the cursor left, pass the = sign, to the graph style icon in the first column. The insert cursor is displayed.
4. Press [ENTER] repeatedly to rotate through the graph styles. The seven styles rotate in the same order.
5. Press [►], [▲], or [▼] when you have selected a style.



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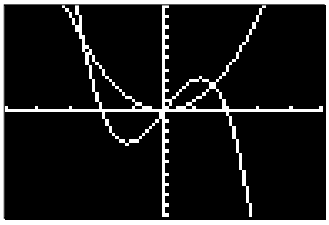
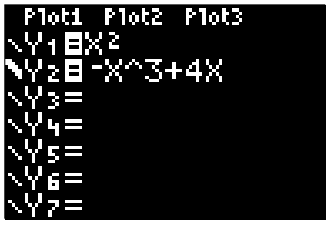
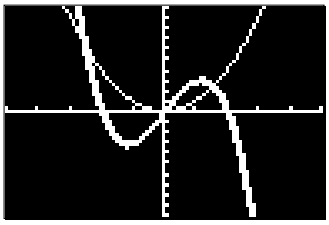
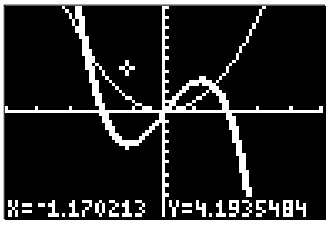

(2.8)



(2.9)

To graph the function $y = -x^3 + 4x$ with the style set to thick, press [Y=] [▼] [◄] [◄] [ENTER] to obtain (2.9). Press [ENTER] to obtain (2.10).


(2.10)



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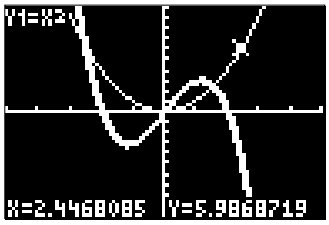
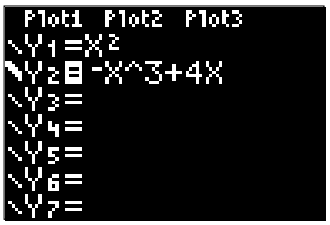


(2.12)

TRACE: Press [GRAPH] to display the graph in (2.10). Press any of the arrow keys [◄] [▲] [►] [▼] and see the cursor move from the center of the viewing rectangle. The coordinates of the cursor's location are displayed at the bottom of the screen, as in (2.11). The cursor is called a *free-moving cursor* because it can move from dot (pixel) to dot (pixel) *anywhere* in the graph window. Press [TRACE] to enable the left [◄] and right [►] arrow keys to move the cursor along the function. The cursor is no longer free-moving, but is now constrained to the function. The cursor appears first on the graph of $y = x^2$ because it is higher up in the Y= list. You know that the cursor is on the graph of this function, $y = x^2$, because

its equation is displayed in the top left corner of the window. The coordinates that are displayed are points on the function's graph. See (2.12). Press the up ▲ or ▼ down arrow key to move the cursor vertically to the graph of $y = -x^3 + 4x$. Next press the right and left arrow keys to trace along the graph of $y = -x^3 + 4x$. When in trace mode, you can enter a value for x directly from the keyboard and the corresponding point with coordinates (x, y) is displayed on the screen.



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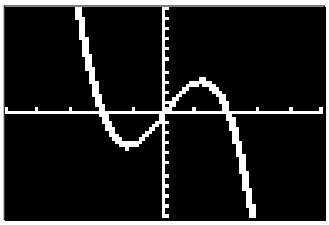
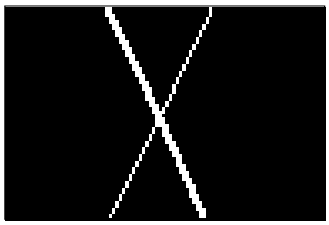


(2.14)



(2.15)

Press Y= to get (2.9). Notice that the equal signs next to Y_1 and Y_2 are both highlighted. This means both functions are selected to be graphed. In the Y= screen, move the cursor on top of the equal sign next to Y_1 and press ENTER. The equal sign in Y_1 is no longer highlighted. See (2.13). Press GRAPH to obtain (2.14). Only Y_2 is plotted. You can select and deselect (turn on and turn off) a function in the Y= editor by moving the cursor to the function you want to select or deselect, place the cursor on the function's = sign, and press ENTER to change the selection status.

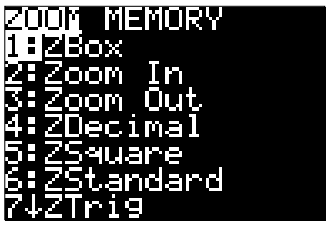
Trace along the graph of $y = -x^3 + 4x$ and press and hold either ◄ or ►. When you reach the edge of the window, keep pressing the arrow key and the calculator will allow you to continue to trace by panning the viewing rectangle. Press ENTER. The location of the cursor becomes the center of the viewing window.

ZOOM: Display the graphs of $y = x^2$ and $y = -x^3+4x$ using the viewing window $[-5, 5, 1] \times [-10, 10, 1]$ as in (2.10).

Example 2.3: Find the point of intersection in quadrant I of the graphs in (2.10). The TI-83 provides several ways to enlarge the view around this point. Using the arrow keys to move the free-moving cursor as close as possible to the point of intersection, it appears that the point of intersection is near the point (1.5, 2.5). Change the viewing window to $[1.46, 1.67, 1] \times [2.34, 2.55, 1]$ and press GRAPH to obtain (2.15). Press TRACE and use the arrow keys to move the cursor closer to get the best approximation possible for the coordinates of the intersection. See (2.16). Notice that the cursor is on the graph of $y = x^2$ since its equation is displayed on the screen. Now press ▲ or ▼ to switch to the graph of $y = -x^3 + 4x$. See (2.17). The results indicate that to two-decimal-place accuracy, the point of intersection is (1.56, 2.44).

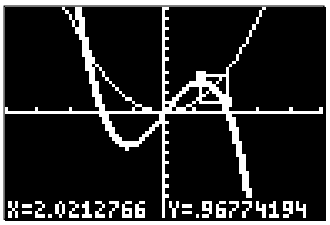
(2.16)

(2.17)

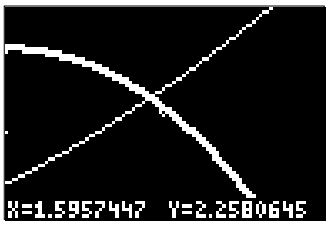


(2.18)

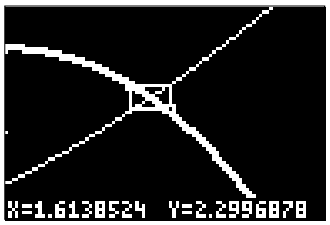
A more efficient method for enlarging the view is to draw a new viewing rectangle with the cursor. Start with (2.10). Press ZOOM to obtain (2.18). Press **1** to select **1:ZBox**. The cursor is at the center of the viewing window, blinking in zoom mode. ZBox draws a box to define the viewing window. To draw a box around the point of intersection, use the arrow keys to move the free-moving zoom cursor to one corner of the box to be drawn and press ENTER. Now as you move the cursor away from the first defined corner, a small square dot indicates the spot. Move the cursor to form the box. See (2.19). Press ENTER to magnify the region in the box, around the point of intersection. See (2.20). (To cancel **ZBox** before you press ENTER, press CLEAR.) Repeat the steps to draw another box around the point of intersection in (2.20). See (2.21). Press ENTER to get (2.22). Press TRACE and move the cursor to the point of intersection to obtain (2.23). Press ▲ or ▼ to obtain (2.24). Thus, to two-decimal-place accuracy, the point of intersection is (1.56, 2.44).



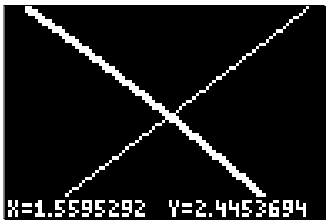
(2.19)



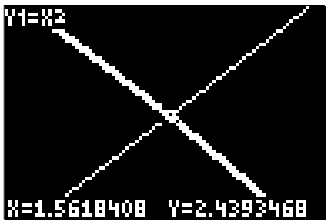
(2.20)



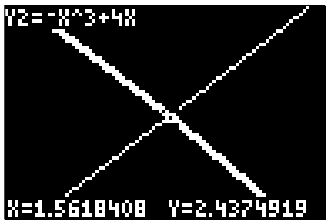
(2.21)



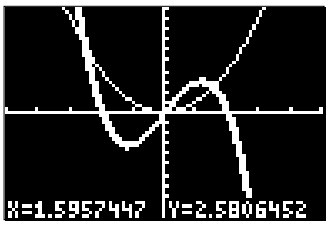
(2.22)



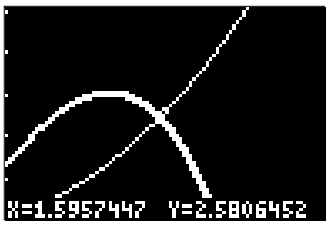
(2.23)



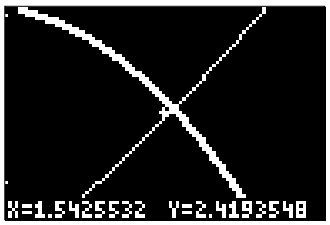
(2.24)



(2.25)



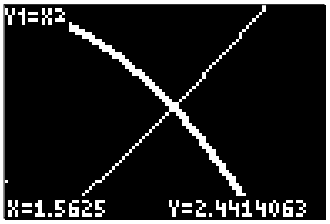
(2.26)



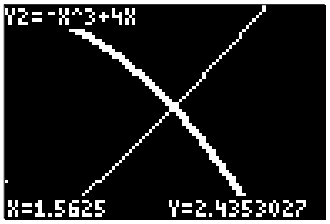
(2.27)

We can also use **Zoom In** from the ZOOM Menu to magnify the region around the point of intersection. Start with (2.10), where the viewing window is $[-5, 5, 1] \times [-10, 10, 1]$. Press ZOOM **2** to select **2:Zoom In**. Then move the free-moving cursor as close as you can to the point of intersection. See (2.25). Press ENTER and the calculator draws a magnified graph, centered at the cursor's position. See (2.26). The calculator is still in zoom mode. Move the cursor to the point of intersection and press ENTER to obtain (2.27). Now press TRACE and trace along the graph of $y = x^2$ until you come as close as possible to the point of intersection. See (2.28). Press ▲ or ▼ to obtain (2.29). Again the point of intersection is (1.56, 244), accurate to two decimal places. There is a better way to easily find the point of intersection using the CALC Menu. We shall discuss this later in Section 3.

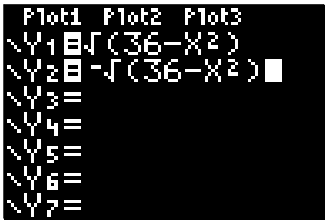
As shown in the ZOOM Menu in (2.18), the TI-83 can **Zoom In**, **Zoom Out**, or use **ZBox**.



(2.28)

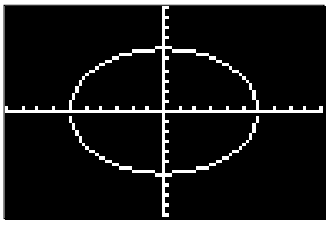


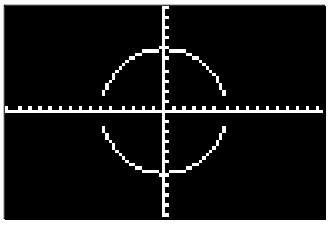
(2.29)

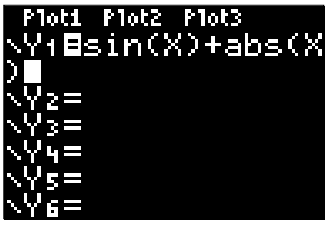


(2.30)

Example 2.4: Graph $x^2 + y^2 = 36$. This is an equation of a circle of radius 6 with center at (0,0)). In FUNC Mode, the calculator graphs equations of the form $y = f(x)$. Thus, first solve $x^2 + y^2 = 36$ for y to get $y = \pm\sqrt{36 - x^2}$. $y = \sqrt{36 - x^2}$ is the equation for the top semicircle; and for the bottom semicircle, $y = -\sqrt{36 - x^2}$. Press Y= to display the Y= editor. Use the CLEAR and the arrow keys to clear the equations in the Y= editor. Press 2nd [$\sqrt{}$] **36** - X, T, θ, N x^2) ENTER. Press (-) 2nd [$\sqrt{}$] **36** - X, T, θ, N x^2). See (2.30). Press ZOOM **6** to select **2:ZStandard**. This is a quick way to reset the viewing window to the standard viewing rectangle. It also graphs the functions. See (2.31). The graph appears as an ellipse in the standard viewing window, because the units along the axes are not the same. To adjust the display so that each pixel represents an equal width and height, press ZOOM **5** to select **5:ZSquare**. The graph now appears circular. See (2.32). Press WINDOW to see the corresponding window settings.


(2.31)

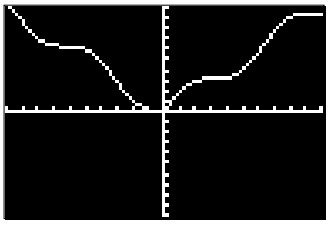

(2.32)



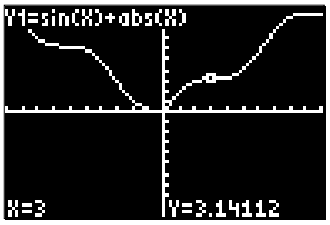
(2.33)

Evaluating Functions:
Example 2.5: Let $y = \sin x + |x|$. Find y when $x = 3$. One way to find y is to first graph $y = \sin x + |x|$. Clear the Y= editor and enter the equation as follows. Press [SIN] [X,T,θ,N] [)] [+] [MATH] [▶] **1** [X,T,θ,N] [)] to obtain (2.33). **abs** represents the absolute value symbol | |. **abs** is also listed in the CATALOG Menu. Press [2nd][CATALOG] to see the CATALOG listing. The CATALOG is an alphabetical listing of all functions and instructions on the TI-83. Now press [ZOOM] **6** to graph using the standard window setting. See (2.34). Press [TRACE] **3** [ENTER] to obtain (2.35). As shown in (2.35), the value of y corresponding to $x = 3$ is 3.14112.

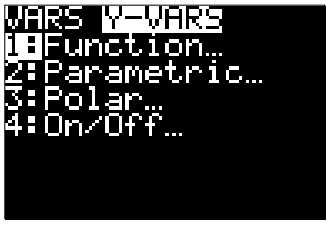
An alternative approach: With the equation entered as in (2.33), press [2nd] [QUIT] to go to the home screen. Press [CLEAR] to clear the home screen. Press [VARS] [▶] to display the VARS Y-VARS Menu. See (2.36). Press **1** and then **1** to obtain (2.37). Enter **(3)** in front of Y_1 and press [ENTER] to obtain (2.38). Again the value of y corresponding to $x = 3$ is 3.14112. We shall show later on how to use the TI-83 TABLE features to obtain the same result.



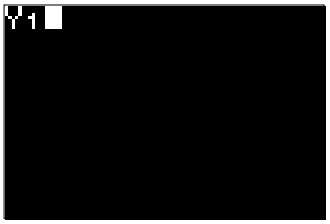
(2.34)



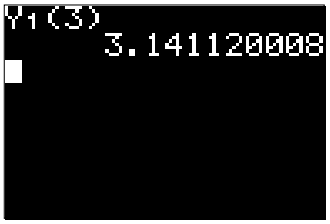
(2.35)



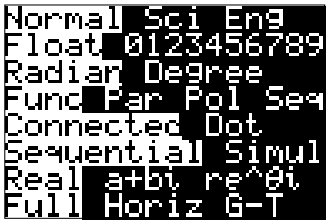
(2.36)



(2.37)



(2.8)



(3.1)

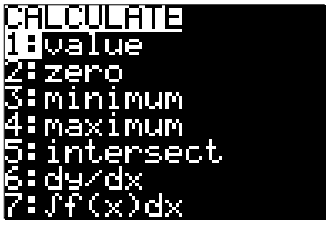
3 Graphing And The CALC Menu

Press [MODE] to set the mode settings as in (3.1). Also press [2nd] [FORMAT] to set the format settings as in (3.2). Press [2nd] [CALC] to display the CALC Menu. See (3.3). We shall use this menu to find the **zero**, **minimum**, or **maximum** of a function. It is also used to find a point of **intersection** of two functions.

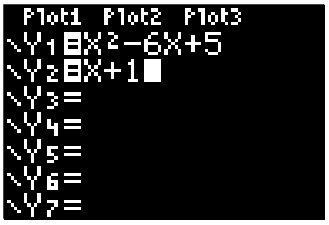
Example 3.1: Solve $x^2 - 6x + 5 = x + 1$ graphically.
Method 1. Graph $y = x^2 - 6x + 5$ and $y = x + 1$. The x coordinates of the points of

intersection are the solutions to the given equation. Enter these equations in the Y= editor to obtain (3.4). Press [ZOOM] **6** to obtain (3.5). **Intersect**, in the CALC Menu, finds the coordinates of a point at which two or more functions intersect. To find the points of intersection in (3.5), follow these steps.

(3.2)



(3.3)



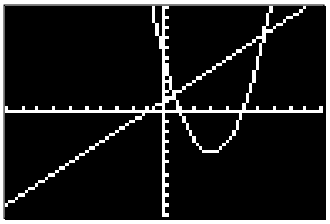
(3.4)

1. Press [2nd] [CALC] **5** to obtain (3.6).

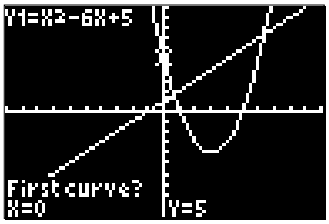
2. Notice that the cursor is on the graph of $y = x^2 - 6x + 5$. Press [ENTER] to select it as the **First Curve**. **Second Curve?** is displayed and the cursor is now on the graph of $y = x + 1$.

3. Press [ENTER] to select the graph of $y = x + 1$ as the **Second Curve**. See (3.7). **Note:** If there are more than two functions use [▼] or [▲] to move the cursor to the appropriate graphs.

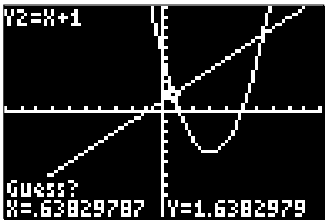
4. Use [►] or [◄] to move the cursor closer to the point of intersection on the left. Then press [ENTER] to obtain (3.8). Thus, $(0.628, 1.628)$ is a point of intersection. Repeat steps 1-4 to get the other point of intersection $(6.372, 7.372)$. See (3.9). Thus, the two solutions to the given equation are: $x = 0.628$ or $x = 6.372$



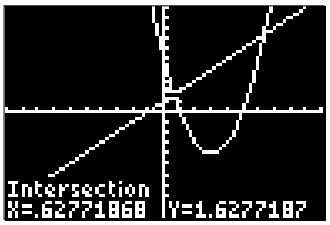
(3.5)



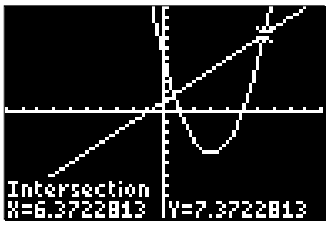
(3.6)



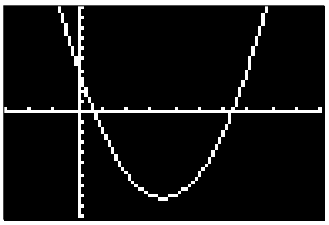
(3.7)



(3.8)



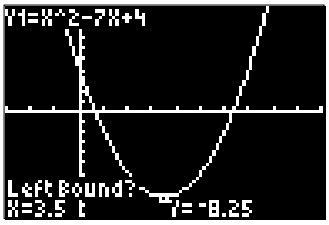
(3.9)



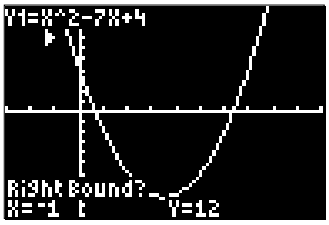
(3.10)

Method 2. Rewrite $x^2 - 6x + 5 = x + 1$ to get $x^2 - 7x + 4 = 0$. Then graph $y = x^2 - 7x + 4$. The zeros (x coordinates of the x-intercepts) of the function are the solution to the given equation $x^2 - 6x + 5 = x + 1$. Follow these steps.

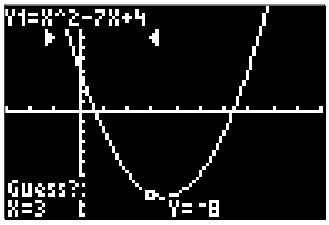
1. Clear the Y= editor and graph $y = x^2 - 7x + 4$ using the viewing window $[-3, 10, 1] \times [-10, 10, 1]$ to obtain (3.10).
2. Press 2nd [CALC] **2** to select **2:Zero**. (3.11) is displayed.
3. Press ◄ or ► (or enter a value) to select the x-value for the **Left Bound** of the interval. For this example, Press (-) **1** ENTER. A ► indicator on the graph screen shows the left bound. See (3.12). **Right Bound?** is displayed. Press ◄ or ► (or enter a value) to select the x-value for the **Right Bound**. Again, for this example, press **3** ENTER. A ◄ indicator on the graph screen shows the right bound. **Guess?** is displayed. See (3.13).
4. Press ◄ or ► to move the cursor closer to the x-intercept on the left, between the bounds, and then press ENTER. See (3.14). Thus, $x = 0.628$ is a solution. Repeat steps 1-4 to get the other solution $x = 6.372$. See (3.15).



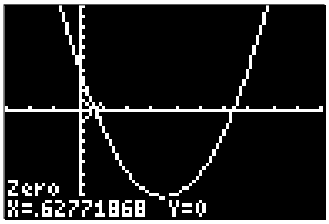
(3.11)



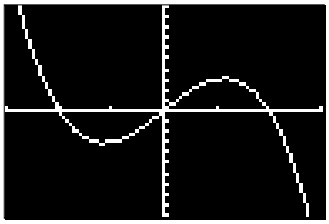
(3.12)

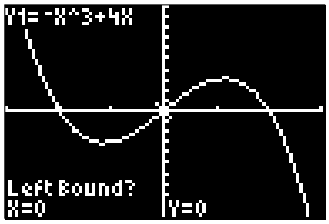


(3.13)



(3.14)


(3.16)

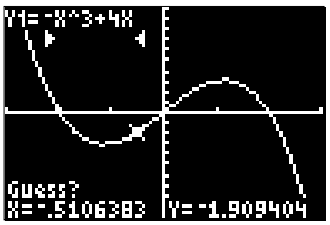


(3.17)

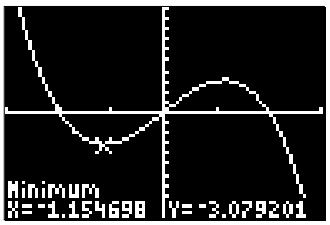
Example 3.2: Find the local (relative) maximum and local(relative) minimum value of the function $y = -x^3 + 4x$.

Minimum and **Maximum**, in the CALC Menu, find a minimum or maximum of a function in the closed x-interval [**Left Bound, Right Bound**]. Graph $y = -x^3 + 4x$ using the viewing window $[-3, 3, 1] \times [-10, 10, 1]$ to obtain (3.16). Press 2nd [CALC] **3** to select **2:Minimum**. See (3.17). Select **Left Bound**, **Right Bound**, and **Guess** as described for **Zero** above to obtain (3.18) and (3.19). As indicated in (3.19), $y = -x^3 + 4x$ has a

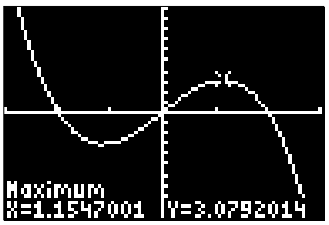
local minimum value of $y = -3.079$ at $x = -1.155$. Now press 2nd [CALC] **4** to select **4:Maximum**. Select the **Left Bound**, **Right Bound**, and **Guess** to obtain (3.20). Thus, $y = -x^3 + 4x$ has a local maximum value of $y = 3.079$ at $x = 1.155$



(3.18)



(3.19)



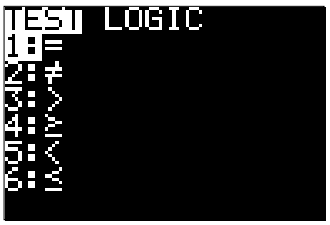
(3.20)

Graphing Piecewise Functions: Graphing functions defined piecewise on the TI-83 involves the use of the inequality symbols in the TEST Menu. Press 2nd [TEST] to obtain (3.21).

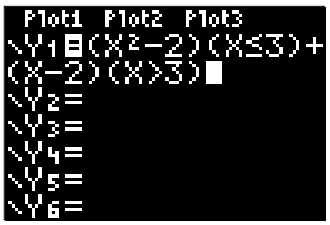
Example 3.3: Graph the piecewise function

$$f(x) = \begin{cases} x^2 - 2, & \text{for } x \leq 3 \\ x - 2, & \text{for } x > 3. \end{cases}$$

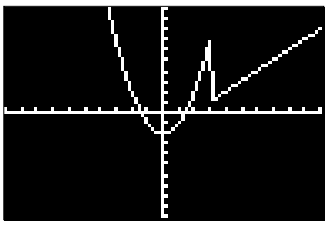
To graph this piecewise function, enter $Y_1 = (x^2 - 2)(x \leq 3) + (x - 2)(x > 3)$ in the Y= editor. The inequality symbols are in the TEST Menu. See (3.22). Press ZOOM **6** to obtain (3.23). The vertical line on the graph in (3.23) is not part of the graph. This is a flaw displayed by the calculator in graphing certain functions (piecewise functions, rational functions, etc.) in connected mode or connected graphing style. Press Y=. Move the cursor to the left of Y_1= and press ENTER six times to change the graph style to Dot Style. See (3.24). Press GRAPH to obtain (3.25) (a better graph). The vertical line is no longer there.



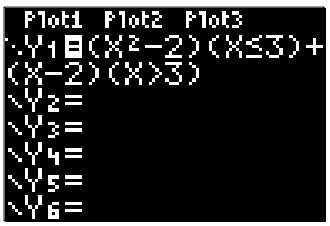
(3.21)



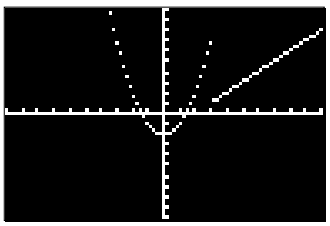
(3.22)



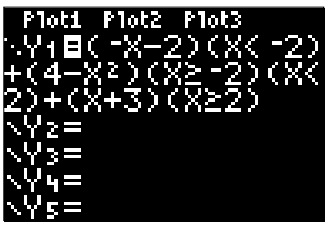
(3.23)



(3.24)



(3.25)

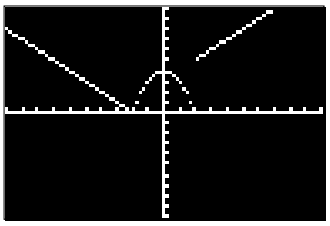


(3.26)

Example 3.4: Graph the piecewise function

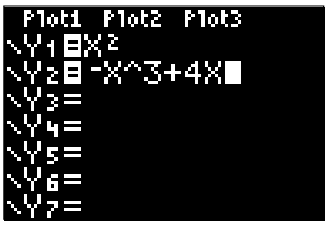
$$g(x) = \begin{cases} -x-2, & \text{for } x < -2 \\ 4-x^2, & \text{for } -2 \le x < 2 \\ x+3, & \text{for } x \ge 2 \end{cases}$$

Enter $Y_1 = (-x-2)(x<-2)+(4-x^2)(x\ge -2)(x<2)+(x+3)(x\ge 2)$ in the Y= editor. See (3.26). Graph using Dot Style to obtain (3.27).



(3.27)

(4.1)

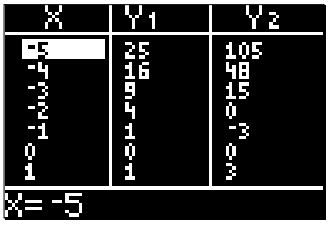


(4.2)

4 The TABLE Features

To display the TABLE SETUP screen, press 2nd [TBLSET]. See (4.1). **TblStart** (table start) defines the initial value for the independent variable. TblStart applies only when the independent variable is generated automatically(when **Indpnt:Auto** is selected). ΔTbl (table step) defines the increment for the independent variable.

Example 4.1: Evaluate the functions $y = x^2$ and $y = -x^3 + 4x$ at each integer between -5 and 15. Enter the given equations in the Y= editor to obtain (4.2). We are using FUNC mode. Press 2nd [TBLSET] to display the TABLE SETUP screen. Press (-) **5** ENTER to set TblStart=-5. Press **1** ENTER to set ΔTbl=1. Press ENTER to select **Indpnt:Auto**. Press ▼ ENTER to select **Depend:Auto**. Now press 2nd [TABLE] to display the table screen. See (4.3). You can use the arrow keys to scroll through the table.



(4.3)

5 Mathematical Modeling Using Regression

Example 5.1: In a study by Dr. Harold J. Morowitz of Yale University, the following data were gathered that showed the relationship between the death rate of men and the average number of hours per day that the men slept.

Average number of hours of sleep, x	Death Rate per 100,000 males, y
5	1121
6	805
7	626
8	813
9	967

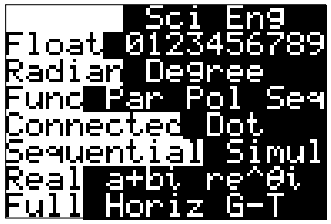
(a) Make a scatter plot of the data.

(b) Find a function that fits the data.

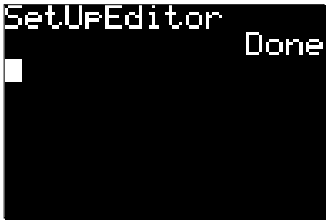
(c) Use the model to find the death rate for males who sleep 2 hours, 8 hours, and 10 hours.

Solution:

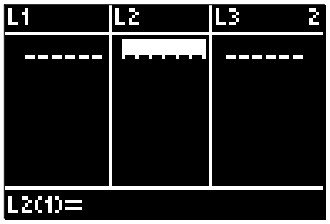
(a) 1. Press [MODE] and set the mode settings as in (5.1), where we are using **FUNC** graphing mode.



(5.1)



(5.2)



(5.3)

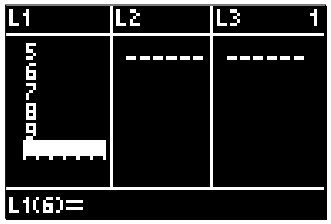
2. Press [STAT] **5** to select **5:SetUpEditor**. Press [ENTER]. See (5.2). This removes lists from stat list editor columns and stores lists $\mathbf{L}_1$ through $\mathbf{L}_6$ in columns **1** through **6** to stat list editor. The TI-83 has six list names in memory: $\mathbf{L}_1$, $\mathbf{L}_2$, $\mathbf{L}_3$, $\mathbf{L}_4$, $\mathbf{L}_5$, and $\mathbf{L}_6$. $\mathbf{L}_1$ through $\mathbf{L}_6$ are on the keyboard above the keys [1] through [6].

3. Press [STAT] **1** to select **1:Edit**. The start list editor is displayed. See (5.3).If data are stored in $\mathbf{L}_1$ and $\mathbf{L}_2$, press [▲] to move the cursor onto $\mathbf{L}_1$ and press [CLEAR] [ENTER] [►] [▲] [CLEAR] [ENTER] to clear both lists.

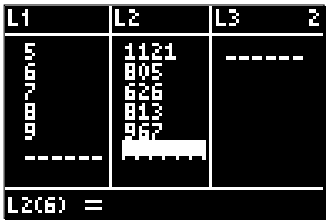
4. Enter the data for average number of hours of sleep in $\mathbf{L}_1$. See (5.4). Enter the death rate data in $\mathbf{L}_2$ to obtain (5.5).

5. Press [Y=] to obtain (5.6). If necessary, clear the functions in the equation editor, and press [▲], [ENTER], and [►] to turn off **Plot1**, **Plot2**, and **Plot3** from the top of Y= editor.

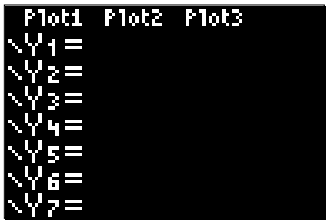
6. Press [2nd] [STAT PLOT] **1** to select **1:Plot1**. The stat plot editor is displayed for Plot1. See (5.7).



(5.4)



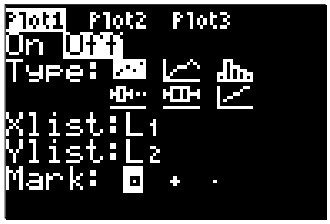
(5.5)



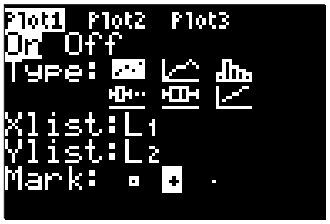
(5.6)

7. Press [ENTER] to select **On**, which turns on Plot1. Press [▼] [ENTER] to select scatter plot format. Press [▼] [2nd] [L_1] to specify **XList:$\mathbf{L}_1$** for plot1. Press [▼] [2nd] [L_2] to specify **YList:$\mathbf{L}_2$** for plot1. Press [▼] [►] [ENTER] to select + as mark for each data point on the scatter plot. See (5.8).

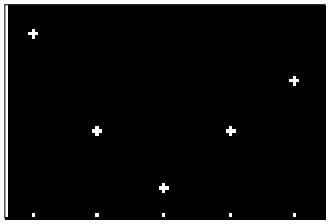
8. Press [ZOOM] **9** to select **9:ZoomStat**. The window variables are adjusted automatically to get the plot in (5.9). This is a scatter plot of average number of hours of sleep versus death rate per 100,000 males.



(5.7)



(5.8)

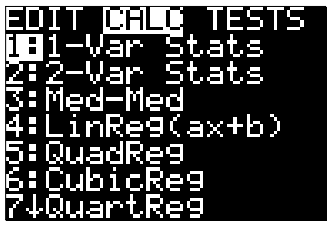


(5.9)

(b) We fit a parabola to the data since the scatter plot appear to be a parabola.

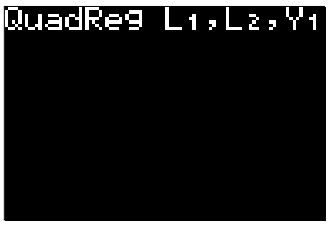
9. Press [STAT] [►] to obtain (5.10). Press **5** to select **5:QuadReg** (Quadratic Regression Model). See (5.11).

10. Press [2nd] [L_1] [,] [2nd] [L_2] [,] [VARS] [►] **1** to display the VARS Y-VARS FUNCTION Menu. Press **1** to select **1:$\mathbf{Y}_1$**. See (5.12). The regression equation will be stored in Y_1 in the Y= editor.



(5.10)

(5.11)

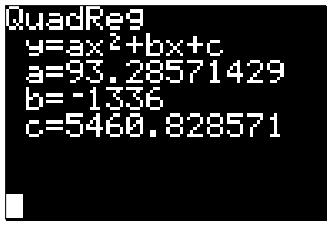


(5.12)

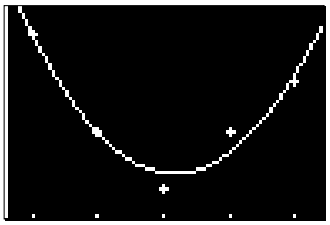
11. Press [ENTER] to obtain (5.13). The quadratic regression for the data $\mathbf{L}_1$ and $\mathbf{L}_2$ is calculated. Values for a, b, and c in $y = ax^2 + bx + c$ are displayed. The regression equation is stored in Y_1.

12. Press [GRAPH] to obtain (5.14). Press [Y=] to see the regression equation in (5.15).

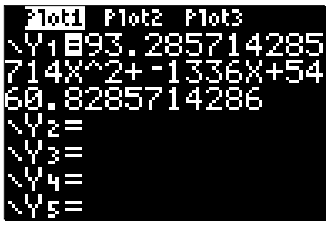
(c) 13. Press [2nd] [QUIT] to return to the home screen. Press [CLEAR]. We use the TABLE feature to find the death rates for males who sleep 2 hours, 8 hours, and 10 hours. With the regression equation in the Y= editor, press [2nd] [TBLSET] and choose the settings in (5.16). Press [2nd] [TABLE]. Now enter **2**, **8**, and **10** in the x column to get (5.17). Thus, the rates corresponding to 2 hours, 8 hours, and 10 hours are 3162, 743, and 1429 respectively.



(5.13)

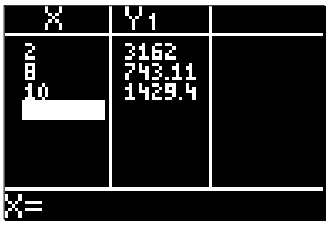


(5.14)



(5.15)

(5.16)



(5.17)

References

[1] Texas Instrument, *TI-83 Graphing Calculator GUIDEBOOK*, 1996

[2] Fred Dodd and John Cruthirds, *EXPLORATIONS: TI-86*, Texas Instrument Inc,. 1997

[3] Benjamin N. Levy, *GRAPHING TECHNOLOGY GUIDE*, D. C. Heath and Company, 1993