

APPENDIX B

INTRODUCTION TO THE TI-84

Section 1: Calculating

The calculator is programmed to follow the “order of operations”: Parentheses, Exponents, Multiplication/Division, and Addition/Subtraction. Be sure to use parentheses whenever necessary and know the difference between subtraction [-] and the negative sign [(-)].

Press the caret key [^] to raise values to exponents. Press [2ND] [x²] to obtain a square root. Other roots can be found in the [MATH] menu or you can convert them to exponents first.

The ►FRAC command (option 1) in the [MATH] menu will express answers as fractions. Simply type in the expression to be evaluated followed by the ►FRAC command.

The following exercises demonstrate common errors. Be sure to focus on the differences between each pair. Answers are given to three decimal places.

EXERCISES

1. (a) $-4^{2.4} =$	Answers: (-27.858)	(b) $(-4)^{2.4} =$	Answers: (27.858)
2. (a) $\sqrt{17+8} =$	(5)	(b) $\sqrt{17} + \sqrt{8} =$	(6.952)
3. (a) $(2.1+3.2)^2 =$	(28.09)	(b) $2.1^2 + 3.2^2 =$	(14.65)
4. (a) $2^3 \cdot 1.414 =$	(11.312)	(b) $2^{3 \cdot 1.414} =$	(18.922)
5. (a) $0.1 - (6.7 + 4.6) =$	(-11.2)	(b) $0.1 - 6.7 + 4.6 =$	(-2)
6. (a) $5 \cdot 14 + \frac{895}{7} =$	(197.857)	(b) $\frac{5 \cdot 14 + 895}{7} =$	(137.857)
7. (a) $\frac{1}{8-4} =$	(0.25)	(b) $\frac{1}{8} - \frac{1}{4} =$	(-0.125)

A summation is entered as “sum(seq(*term*, *index*, *lower limit*, *upper limit*, *increment*)).” In

particular, $\sum_{k=1}^n f(x_k)$ is entered as “sum(seq($f(x_k)$, k , 1, n , 1)).” To select the summation

command, press [2ND] [STAT] [] [] and choose **5:sum**(. To select the sequence command, press [2ND] [STAT] [] and choose **5:seq**(.

Section 2: Graphing

Press the [**Y=**] key and enter the equation(s) you want to graph. Use the [**X,T,θ,n**] key to type the variable x . Only the equations which have a black box over the = sign will be graphed. Move the cursor over the equal sign and press [**ENTER**] to turn an equation on or off.

Press the [**GRAPH**] key to view the graph using the current viewing settings. If necessary, change the viewing window in one of the following ways:

- Press the [**WINDOW**] key to manually set the viewing window.
- Press the [**ZOOM**] key and choose one of the following zoom options:

ZStandard Automatically sets the window from -10 to 10 along the x - and y -axes.

ZBox Position the cursor at one corner of the region you wish to view and press [**ENTER**]. Position the cursor at the opposite corner and press [**ENTER**].

ZoomIn/Out Position the cursor at the point where you wish to center the new window and press [**ENTER**].

Press [**TRACE**] to trace the graph(s). An equation will appear at the top of the screen and the x - and y -coordinates of the cursor position will appear at the bottom. Switch from one graph to the other by using the up and down arrow keys, and move along a graph by using the right and left arrow keys. Tracing can be used to get a rough approximation of points, including points of intersection.

EXERCISES

1. Enter the expressions $Y_1 = -x^3 + 13x$ and $Y_2 = x^2 - 9x - 11$, and view the graphs on the same screen in the standard window using **6:ZStandard**.
2. The graphs of Y_1 and Y_2 intersect three times. Find a viewing window that includes all three intersection points.
3. Use [**TRACE**] to approximate the points of intersection. To get better approximations you can use **1:Zbox** repeatedly for each point of intersection. Later we will learn how to find the exact values.

Section 3: Evaluating Functions [Find the output given an input.]

Given a function $y = f(x)$ and a number a , we “evaluate f at $x = a$ ” by replacing all x ’s in the formula for f with the number a . For example, suppose we want to plug in $x = -4.9766$, $x = 1.25$, and $x = 11$ into the function $Y_2 = x^2 - 9x - 11$. We could evaluate Y_2 by using one of (at least) three options: a trace, a table, or function notation.

- Graph the function in a window that includes the given x -value(s). Press [**TRACE**]. Type -4.9766 and press [**ENTER**]. The approximate function value will show at the bottom of the screen. Repeat for the other x -values.
- Press [**2ND**] [**WINDOW**] to get the TABLE SETUP menu. Be sure **Indpnt:** is set to **Ask** and **Depend:** is set to **Auto**. Go to the table by pressing [**2ND**] [**GRAPH**]. Type -4.9766 and then press [**ENTER**]. The function value appears in the Y_2 column. Repeat for the other x -values. Note that you could evaluate multiple functions at once.
- From the home screen, press [**VARS**] [**Y-VARS**]. Choose **1:Function** and then **2:Y₂**. The expression “ Y_2 ” will appear on the home screen. To evaluate Y_2 at $x = -4.9766$, type $Y_2(-4.9766)$ and press [**ENTER**]. To evaluate Y_2 at $x = 1.25$, press [**2ND**] then [**ENTER**], move inside the parentheses to change the -4.9766 to 1.25 , and press [**ENTER**]. Repeat with $x = 11$.

Section 4: Solving Equations [Find the inputs that yield a given output.]

Given a function $y = f(x)$ and a number b , we “solve $f(x) = b$ for x ” by finding all values that yield b when they are plugged in for x . For example, suppose we want to solve the equation $x^2 - 9x - 11 = -17$. Note that the left side is Y_2 . Enter the right side as Y_3 . Graphically, solving an equation is the same as finding the intersection points of the graphs of the separate sides of the equation. First graph Y_2 and Y_3 on the same screen (you might want to temporarily turn off Y_1) making sure that the intersection points are visible. Press [**2ND**] [**TRACE**] and then choose **5:intersect**. The upper left corner of the screen will show which equation the cursor is on. Place the cursor on Y_2 and press [**ENTER**], and then on Y_3 and press [**ENTER**]. When prompted to enter a “**Guess**,” move the cursor near the desired point of intersection and press [**ENTER**]. The result will appear at the bottom of the screen.

EXERCISES

1. Use a trace, a table, and function notation to evaluate $Y_1 = -x^3 + 13x$ at $x = -4.9766$, 1.25 , and 11 .
2. Solve the following equations: (a) $-x^3 + 13x = -17$, (b) $-x^3 + 13x = 0$ (the x -intercepts or roots of Y_1), and (c) $-x^3 + 13x = x^2 - 9x - 11$ (compare with Exercise 3 in Part B.)

Section 5: Working with Data

A set of discrete data points can be graphed as a “scatter plot” by typing the inputs and outputs into lists. Press **[STAT]** and choose **1:Edit**, which will bring you to the list menu. Clear old data by moving the cursor to the heading of a column, press **[CLEAR]** **[ENTER]**, and then move the cursor back down to the top of the list. Type inputs into L_1 , one at a time, pressing **[ENTER]** after each one. Repeat for the outputs into L_2 .

To view a scatter plot of the data, press **[2ND]** **[Y=]** to go to the STAT PLOTS menu. Choose **1:Plot1**, turn the plot **ON**, and press **[ENTER]**. You might want to turn off or clear any other irrelevant equations. Now press **[ZOOM]** and choose **9:ZoomStat**.

EXERCISES

Input the following data into your calculator as two lists:

x	1995	1998	2001	2004	2007	2010
y	28	34	37	29	19	15

1. View a scatter plot of the data.
2. Sometimes inputs (such as years) are too large to use and we need to “align” inputs to smaller values. Align the inputs so that $x = 0$ corresponds to 1995 by doing the following:
 - Press **[STAT]** and choose **1:Edit**, which will bring you to the list menu.
 - Move the cursor to the heading of the input column, say L_1 , and type $L_1 - 1995$.
 - Press **[ENTER]**.

View the “new” scatter plot. Why does it look the same?

Section 6: Writing a Regression Model

Study the scatter plot and decide on which function type would be the best fit. Possibilities include linear, quadratic, cubic, natural logarithm, exponential, and sine. To write and store the model, press **[STAT]** and then **[►]** to the CALC menu. This will bring you to the list of regression models. Depending on your calculator model, do one of the following:

- Press **[2ND]** **[1]** **[,]** **[2ND]** **[2]** **[,]** **[VARS]** **[►]** **[1]** **[1]**. You should see **QuadReg L1,L2,Y1** on the home screen; OR
- Fill in **Xlist** (press **[2ND]** **[1]** **[,]**), **Ylist** (press **[2ND]** **[2]** **[,]**), and Store **RegEQ** (press **[VARS]** **[►]** **[1]** **[1]**).

Press **[ENTER]**. The model will be stored in the graph menu under Y_1 . Press **[GRAPH]** to view the graph of the model over the scatter plot.