OVERVIEW

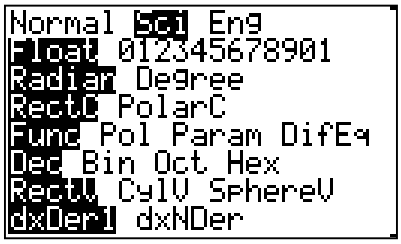
The intent of this material is to provide instruction for the TI-86 graphing calculator that may be used in conjunction with the second edition of Gary Rockswold's *College Algebra Through Modeling and Visualization.* It includes specific keystrokes needed to work several examples from the text. Students are also advised to consult the *Graphing Calculator Guidebook* provided by the manufacturer. These instructions are not meant to replace the manual that accompanies your calculator but rather they are an attempt to simplify some of the instructions you might find there.

DISPLAYING NUMBERS IN SCIENTIFIC NOTATION

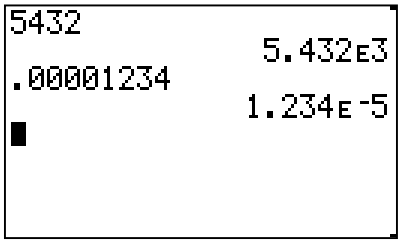
To change numbers entered on the home screen to scientific notation, you must change the setting of the calculator to scientific mode (Sci).

To display numbers in scientific notation:

1. Locate "MODE" above the MORE key in the first row on your calculator. Press 2nd MODE.
2. Use the right arrow cursor key to highlight "Sci".
3. Press ENTER to select this mode.
4. Press 2nd QUIT to return to the home screen.



Type in the numbers 5432 and 0.00001234, pressing ENTER after each number. You should see the screen similar to the one on the right.

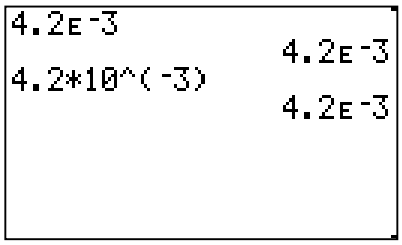


ENTERING NUMBERS IN SCIENTIFIC NOTATION

Numbers can be entered into the calculator in scientific notation.

To enter a number in scientific notation:

1. Locate the EE key in the fifth row of your calculator.
2. Enter the number that precedes the powers of ten.
3. Press EE followed by the exponent (or power of ten).
4. Press ENTER

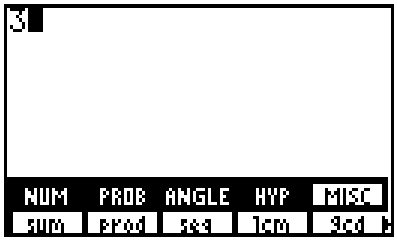


To enter 4.2×10^{-3}, use the following key strokes: **4.2** EE **- 3** OR **4.2** × **10** ∧ **- 3.** Follow either choice by pressing the ENTER key. Both examples are shown in the diagram on the left.

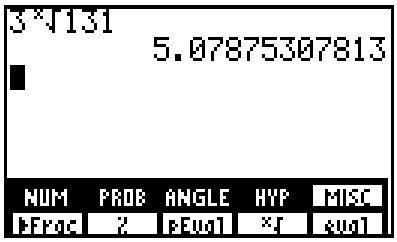
ENTERING MATHEMATICAL EXPRESSIONS

Several expressions are evaluated in Example 7, Section 1.1. The keystrokes below allow you to use the graphing calculator to evaluate these expressions.

1) To evaluate $\sqrt[3]{131}$, use the following keystrokes:

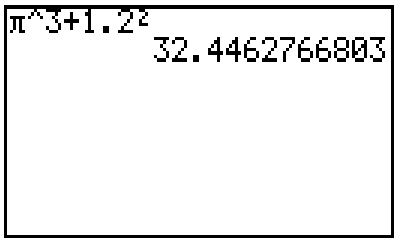


- Type the root of the expression, in this case 3
- Locate "Math" over the multiplication key. Press 2^{ND} MATH to access the MATH menu.
- Press F5 to access the MISC (miscellaneous) menu.
- You should see gcd ▸ in the bottom row of your screen. This indicates that there are more items in the MISC menu. Press MORE to access those additional features. Notice that the menu options on the bottom of the calculator screen have changed.
- Press F4 to select the $\sqrt[x]{\ }$ option. Now type 131.
- Press ENTER.



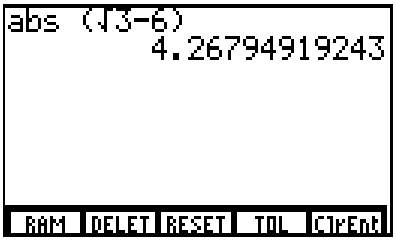
2) To evaluate $\pi^3 + 1.2^2$, use the following keystrokes:

- Locate π over the ^ symbol in the fourth row of your calculator. The ^ symbol is used to raise a number or variable to a power.
- Locate the x^2 key at the start of the sixth row of your calculator.
- Type 2ND π ^ 3 + 1.2 x^2
- Press ENTER.



3) To calculate $\left|\sqrt{3}-6\right|$, use the following keystrokes to access the absolute value function:

- Use the keystrokes 2ND MATH to access the MATH menu.
- Press F1 to access the MATH NUM menu.
- Press F5 to select *abs*.
- Locate the $\sqrt{\ }$ over the x^2 key.
- Type (2ND $\sqrt{\ }$ 3 –6). Press ENTER.



CALCULATING ONE VARIABLE STATISTICS

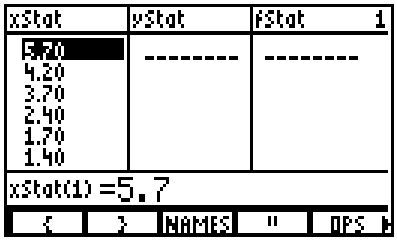
In Example 2, Section 1.2, the mean, median, minimum and maximum values for a data set are found using the built in statistical capabilities of the graphing calculator.

To calculate one variable statistics:

1. To enter the data from Example 2 into your calculator begin by locating the STAT menu found above the plus sign in the next to last row of your calculator.

2. Press 2ND STAT to access the statistics menus.

3. Press F2 (EDIT) to enter the data. Enter each value followed by the ENTER key. Your list will look like the screen on the right.



4. Press 2ND QUIT then 2ND STAT .

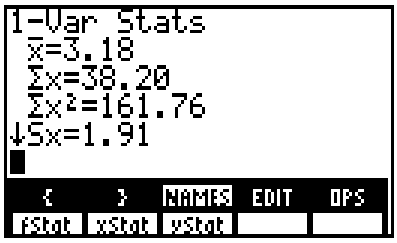
5. Press F1 to access the Calculations Menu

6. Press F1 again to select OneVa. This function will analyze the data in the xStat list.

7. Locate the LIST menu over the subtraction key in the third row up from the bottom.

8. Press 2nd LIST, F3 to open the lists window

9. Press F2 to select xStat then ENTER.



10. Note the ↓ in the lower left hand corner of your calculator screen. This indicates that there are other values to be viewed. Use the down cursor arrow to view these values.

As you scroll through the data you will find that the mean of the data is 3.18, the median (noted as Med) is 2.95, minX is .8 and maxX is 5.9.

SUMMARY: CALCULATING ONE-VARIABLE STATISTICS

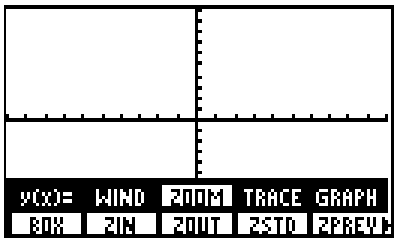
1. Press 2ND STAT F2 to enter the data in xStat.
2. Press 2ND QUIT then 2ND STAT .
3. Press F1 then F1 again to select OneVa.
4. Press 2nd LIST, F3 F2 to select xStat then ENTER.
5. Note the ↓ in the lower left hand corner of your calculator screen indicating there are other values to be viewed. Use the down cursor arrow to view these values.

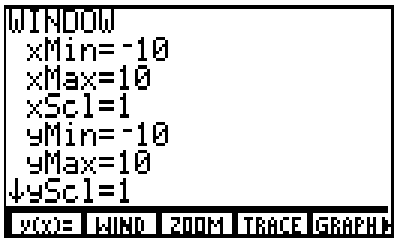
SETTING THE VIEWING RECTANGLE

Example 7, Section 1.2, asks you to show a standard viewing rectangle and then to change the window settings in the graphing window screen. The standard viewing window (or default setting of you calculator) shows the x and y axis as [-10,10,1] by [-10,10,1].

To set the window to the standard setting:

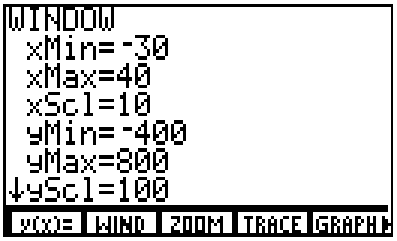
1. Locate the GRAPH key in the third row from the top on your calculator keypad.
2. Press GRAPH then F3 to access the ZOOM menu.
3. Press F4 to select ZSTD (or the standard window settings) as seen below.
4. Press 2ND M5 to see the graphing window you have set.





To change a viewing rectangle:

1. Press GRAPH then F2 to access the WIND setup.
2. Enter the values for the window in which to view your graph. In this example we use [-30,40,10] by [-400, 800, 100].
3. Press F5 to see the graphing window you have set.

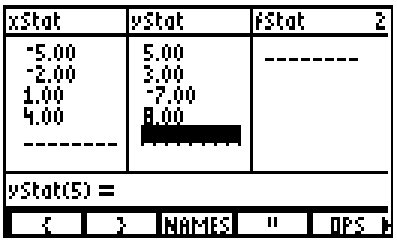


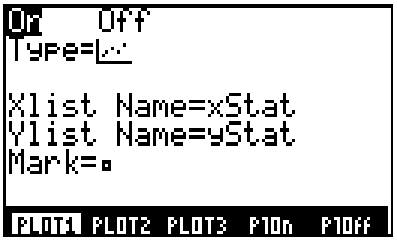
MAKING A SCATTERPLOT

Example 8, Section 1.2 asks us to make a scatterplot using the points (-5, 5), (-2, 3), (1, -7) and (4, 8).

To make a scatter plot:

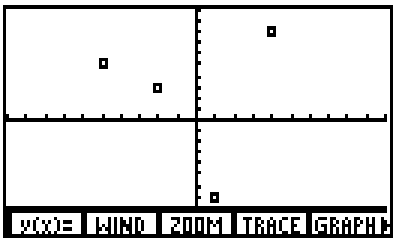
1. Press 2ND STAT then F2 (EDIT) to enter the points.
2. Enter the x values for xStat using the same method described in an earlier section on "calculating one variable statistics". When you are finished entering the x values use the right cursor arrow to move to the yStat column and enter the y values.
3. Press 2ND STAT F3 to access the PLOT options.
4. Press F1 to select PLOT1. Select ON by pressing ENTER. This will enable you to plot points in your graphing window.





5. Set an appropriate viewing window.

6. Press the GRAPH key located in the third row, then F5 to view your scatterplot as seen below.



SUMMARY: MAKING A SCATTERPLOT

1. Press 2ND STAT F2
2. Enter your data in the xStat and yStat column. .
3. Press 2ND STAT F3 to access the PLOT options.
4. Press F1 to select PLOT1. Select ON by pressing ENTER.
5. Press the GRAPH key then F5 to view your scatterplot. Adjust your viewing window if necessary.

ENTERING A FORMULA FOR A FUNCTION

To enter the formula for a given function *f*:

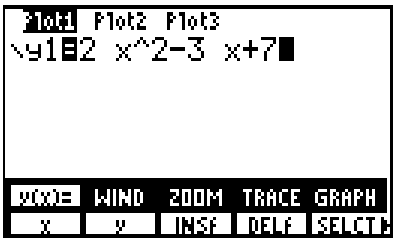
1. Press GRAPH .

2. Press F1 to select the y(x)= screen.

3. Enter the formula you wish to use. To enter the variable *x* in your formula use the x-VAR key located in the second row of your calculator.

To enter the function $f(x) = 2x^2 - 3x + 7$ once you are in the y(x) = screen use the following keystrokes:

2 x-VAR ^ 2 - 3 x-VAR + 7

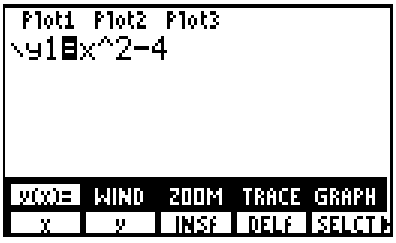


GRAPHING A FUNCTION

Since a picture is worth a thousand words it is often to our advantage to graph functions to learn more about them. Suppose we wished to graph the function $f(x) = x^2 - 4$.

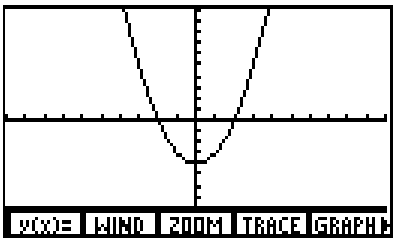
To graph a function:

1. Press GRAPH, then F1 to select the y(x)= screen.. If there is already a function in the y1= spot and you wish to remove this function, press the CLEAR key.



2. Enter the function you wish to graph.

3. Press 2ND M5 to display the graph of your function.



The equal sign after y1 should appear highlighted. This indicates that the function is "on" and that it will be graphed. If the equal sign is not "on", place the cursor over it and press ENTER .

SUMMARY: GRAPHING A FUCNTION

1. To graph a function press GRAPH, then F1 .
2. Enter the function you wish to graph.
3. Press 2ND M5 to display the graph of your function.

EVALUATING A FUNCTION GRAPHICALLY

In Example 7, Section 1.3, we evaluate the function $f(x) = 0.72x + 2$ at x = 65 graphically using the trace feature of the graph.

To evaluate a function:

1. Enter the formula into the y1 = screen.

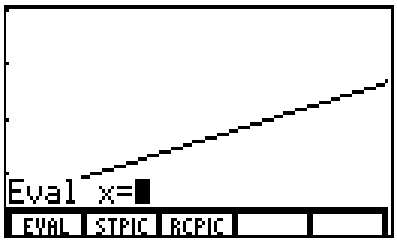
2. Graph the function in an appropriate viewing window. In this example we used [60,90,10] by [40, 80, 10].

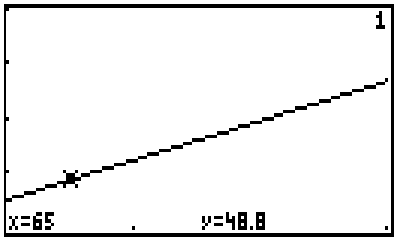
3. Notice that the last choice on the bottom row is GRAPH ▸. The ▸ indicates that there are more choices to view. To access those choices press the MORE key. Notice that the options on the bottom of the screen change.

4. Press the MORE key until you see EVAL in the lower left corner.

5. Press F1 to select the evaluation feature.

6. Enter the value for x (in this case x = 65) then press ENTER to view the screen on the right.





SUMMARY: EVALUATING A FUNCTION GRAPHICALLY

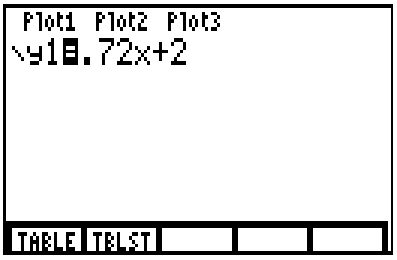
1. Graph the function in an appropriate viewing window.
2. Press the MORE key until you see EVAL in the lower left corner.
3. Press F1 to select the evaluation feature.
4. Enter the value for x where the function should be evaluated.
5. Press ENTER.

MAKING A TABLE

In Example 7, Section 1.3, a table of values is requested.

To create a table:

1. Enter the equation $Y_1 = .72X + 2$ using the instructions presented earlier for entering a formula for a function



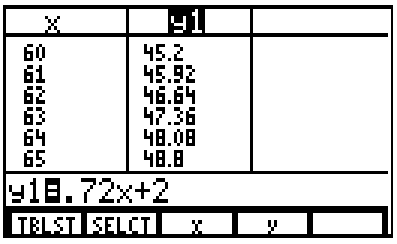
2. Press the TABLE button located in the third row from the top on your calculator. You should see the screen located on your right. In this screen we have two options: TABLE which will bring us right to the table screen and TBLST which is a table setup editor. Press the F1 key to access the table. Press the F2 key to access the table setup editor.

3. Press the F2 key. This window allows us to set the parameters for our table.

4. With the cursor blinking after TblStart = , type 60 and press ENTER

5. On the ΔTbl =1 you can change the increments of the independent variable displayed in the table. We will leave this at 1 for this problem. The values of Y_1 at x = 60, 61, 62… will be shown in the table. Press ENTER .

6. Make sure that AUTO is highlighted next to Indpnt:. This indicates that the calculator will automatically generate the x values based on the information entered in steps 3 and 4 above. If ASK is highlighted, use the left arrow cursor key to position the cursor over AUTO and press ENTER. (ASK displays an empty table and allows you to enter x values. As each value is added to the independent variable column the corresponding value for the dependent variable is calculated and displayed).



7. Press F1 to display the table. You can scroll through the x and y values by using the arrow keys.

SUMMARY: MAKING A TABLE OF A FUNCTION

1. Enter the formula for the function.
2. Press the TABLE
3. Press the F2 key to choose TBLST to set the parameters for the table.
4. Press F1 to display the table.

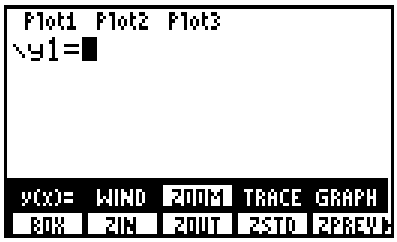
SQUARING A VIEWING RECTANGLE

The window in which you view your graphs on the calculator is a rectangle. In the [-10,10,1] by [-10,10,1] standard viewing window you will notice that tick marks on the x axis are further apart than the tick marks on the y axis. This leads to the distortion of some graphs. A circle does not appear truly circular in the standard viewing window and the line y = x does not make a 45^0 angle with the horizontal axis.

To square the viewing window:

1. Press the GRAPH key.

2. Press F3 to access the ZOOM menu. This will display the screen shown on the right. Notice that the last choice on the bottom row is ZPREV ▸. The ▸ indicates that there are more choices that we can view in the ZOOM menu.



3. To access these choices press the MORE key. The menu options on the bottom of the calculator screen have changed.

4. Press F2 to choose ZSQR to square the viewing rectangle.

SUMMARY: SQUARING A VIEWING RECTANGLE

1. Press the GRAPH key.
2. Press F3 to access the ZOOM menu.
3. Press the MORE key.
4. Press F2 to choose ZSQR to square the viewing rectangle.

PLOTTING DATA AND AN EQUATION

In Example 1, Section 2.1, we plot data and graph a modeling function in the same viewing window. Refer back to earlier instructions for creating a scatterplot and line graph as needed.

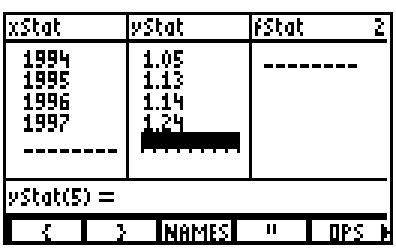
1. Begin by entering the x values in xStat and the y values in yStat as seen in the first screen shot below. (Refer to earlier instructions "Making a Scatterplot" if needed.)

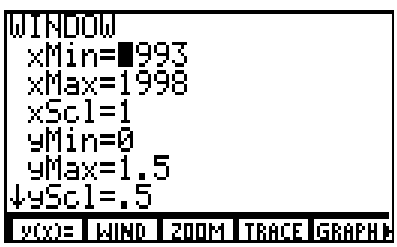
2. Turn STAT PLOTS on.

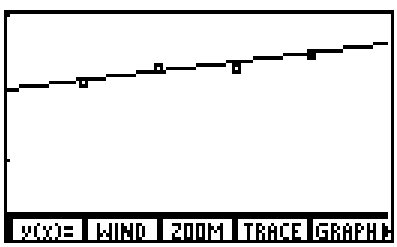
3. Enter the formula $Y_1 = .062x-122.57$

4. Set an appropriate viewing window. In this case use [1993,1998,1] by [0,1.5,.5] as seen in the middle screen below.

5. Now press F5 to access GRAPH to have both the scatterplot and the graph of Y_1 displayed in the same viewing window as seen in the screen shot on the far right.







SUMMARY: PLOTTING DATA AND AN EQUATION

1. Enter the x values in xStat and the y values in yStat.
2. Turn STAT PLOTS on.
3. Enter the equation to be graphed.
4. Set an appropriate viewing window.
5. Press F5 to display the scatterplot and the graph in the same viewing window.

USING THE ASK TABLE FEATURE

In Example 1, section 2.1 a table with the x values displayed above (1994, 1995, 1996, 1997) was created. In the preceding section of these instructions we plotted data and the graph of the modeling function in the same viewing window. To evaluate the function $Y_1 = .062x-122.57$ at these values we use the ASK feature rather than the AUTO feature found in the Table setup editor. Recall that ASK displays an empty table and allows you to enter x values. As each value is added to the independent variable column the corresponding value for the dependent variable is calculated and displayed.

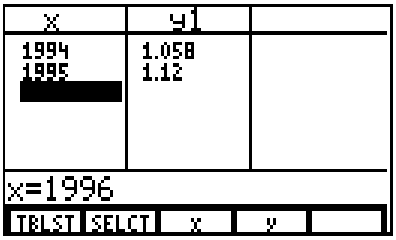
1. Enter the formula $Y_1 = .062x-122.57$

2. Press the TABLE button followed by the F2 key to access the table setup editor.

3. Use the down arrow cursor key to move to the Indpnt: line. If AUTO is highlighted, use the right arrow cursor key to position the cursor over ASK and press ENTER.

4. Press F1 to display the table.

5. An empty table is displayed. Type 1994 and press ENTER. Continue to enter x values. As each value is added to the independent variable column the corresponding value for the dependent variable is calculated and displayed.



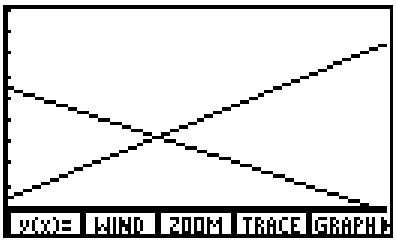
SUMMARY: USING THE ASK FEATURE FOR A TABLE

1. Enter the into Y_1 .
2. Press the TABLE button followed by the F2 key to access the table setup editor.
3. Highlight AUTO and press ENTER.
4. Press F1 to display the table.
5. Enter the x values of your choice. The corresponding y value will be calculated and displayed.

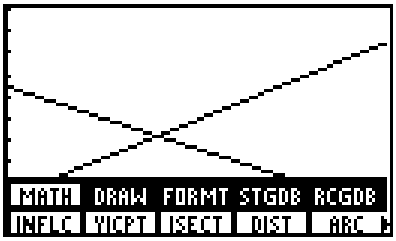
LOCATING THE POINT OF INTERSECTION

In Example 1, Section 2.3 we find the point of intersection of two lines. Given the two functions $f(x) = 5.91x + 13.7$ and $g(x) = -4.71x + 64.7$ we will locate the point of intersection of these two functions.

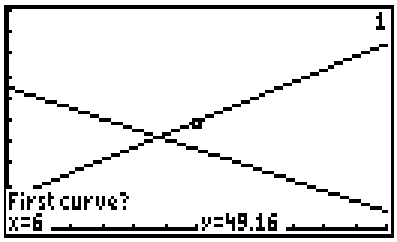
1. Enter the function given by *f(x)* as Y_1. Press ENTER.
2. Enter the function given by *g(x)* as Y_2.
3. Set the viewing window to [0,12,1] by [0,100,10]
4. Press F5 to see a graph of Y_1 and Y_2 as seen on the right.

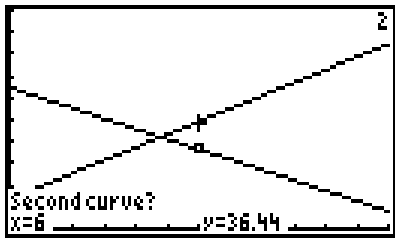


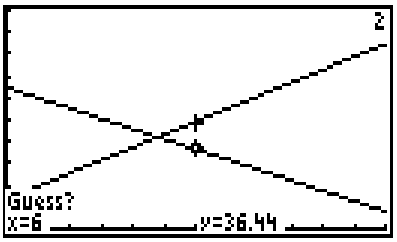
5. Notice that the last choice on the bottom row is GRAPH ▸. Recall that the ▸ indicates that there are more choices to view.
6. Press MORE
7. Press F1 to access the MATH menu
8. Press MORE. You should now see a screen similar to the one shown on the right.



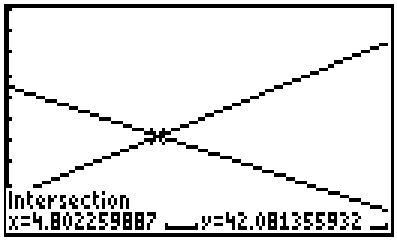
9. Press F3 to select ISECT. This will allow us to find the intersection between two functions.
10. A graph is displayed with a blinking cursor and "First curve ?" at the bottom of the screen. This is seen in the sequence of graphs below.
11. Move your cursor closer to the point of intersection of the two functions and press ENTER.
12. The cursor moves to the second function and "Second curve ?" is displayed. Press ENTER.







13. You will now see a screen with "Guess ?". Press ENTER.
14. You can now see that the two lines intersect at the point (4.802259887, 42.081355932) as shown in the figure below.



SUMMARY: FINDING A POINT OF INTERSECTION

1. Enter and graph the two functions in an appropriate viewing window
2. Notice that the last choice on the bottom row is GRAPH ▸. Press MORE
3. Press F1 to access the MATH menu. Press MORE .
4. Press F3 to select ISECT.
5. In the "First curve ?" screen move your cursor closer to the point of intersection of the two functions and press ENTER
6. In the "Second curve ?" screen press ENTER .
7. In the "Guess ?" screen press ENTER .
8. The cursor is now located at the intersection with the cursor coordinates displayed at the bottom of the screen.

LOCATING A ROOT OF A FUNCTION

In Example 3, Section 2.4, we locate an *x*- intercept or *root* of a function $f(x) = 1 - x - \left(\frac{1}{2}x - 2\right)$.

To find the *x* – intercept or *root* of a function

1. Enter the formula for *f(x)* as Y_1.

2. Set the viewing widow for your graph to [-6,6,1] by [-4,4,1] and graph Y_1.

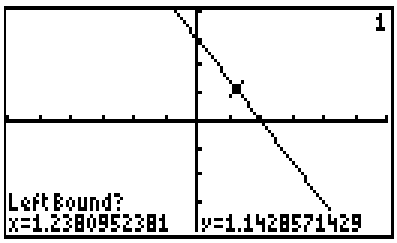
3. The last choice on the bottom row is GRAPH ▸. Press MORE then press F1 to access the MATH menu.

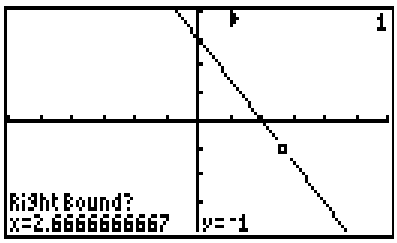
4. Press F1 again to select ROOT.

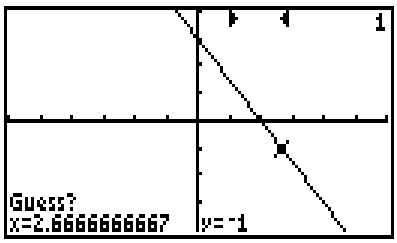
5. A graph is displayed with a blinking cursor and "Left Bound?" at the bottom of the screen. This is seen in the sequence of graphs below. Move your cursor closer to the x – axis, making sure that it is to the left of the x- intercept. Press ENTER .

6. You are now asked for a "Right Bound?". Move the cursor to the right of the of the x-intercept and press ENTER .

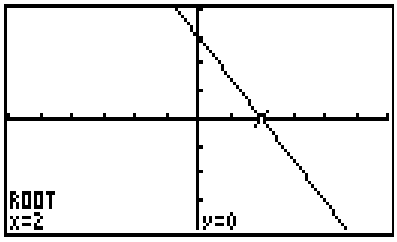
7. You will now see a screen with "Guess ?" . Press ENTER .







8. The calculator determines that the *x*-intercept or *root* of this equation is (2,0) as seen in the screen below.



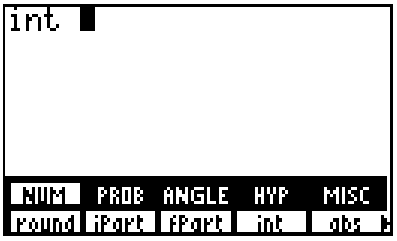
SUMMARY: LOCATING THE ROOT OF A FUNCTION

1. Graph the function in an appropriate viewing window
2. Press the MORE key
3. Press F1 to access the MATH menu.
4. Press F1 to select ROOT.
5. In the "Left Bound?" screen place your cursor to the left of the x – intercept and press ENTER .
6. In the "Right Bound?" screen place your cursor to the right of the x – intercept and press ENTER .
7. In the "Guess ?" screen press ENTER .
8. The calculator now displays the root of the equation at the bottom of the screen.

ACCESSING THE GREATEST INTEGER FUNCTION

To access the greatest integer:

1. Use the keystrokes 2ND MATH to access the MATH menu .
2. Press F1 to access the MATH NUM menu.
3. Press F4 to select *int*. This function will return the greatest integer less than or equal to the value you enter.



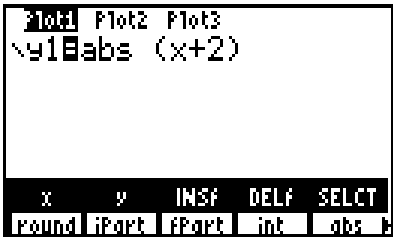
ACCESSING THE ABSOLUTE VALUE

In Example 4, Section 2.5 the absolute value was used to graph $f(x) = |x + 2|$. To graph this function we need to be able to access the absolute value on the calculator.

To access the absolute value:

1. Follow the first 2 steps from the preceding instructions to access the MATH NUM menu.
2. Press F5 to select *abs*. This function returns the absolute value or the magnitude of the value you enter.

To graph *f(x)* use the following keystrokes at the cursor prompt for $Y_1 =$ 2ND MATH F1 F5 to display the abs. Use parenthesis around $x + 2$.

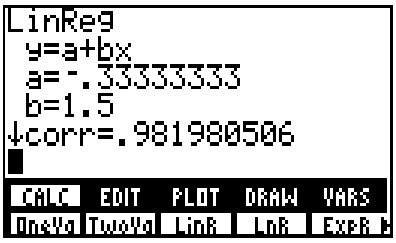


FINDING THE LINE OF LEAST-SQUARES FIT

In Example 3, Section 2.6, the line of least squares fit for the points (1,1), (2,3) and (2,4) is found.

To find the line of least-squares fit:

1. Enter the points in xStat and yStat as if to create a scatterplot.
2. Press 2ND QUIT to leave the lists you have created.
3. Press 2ND STAT followed by F1 to access the CALC (calculations) menu.
4. Press F3 to access the LinR (linear regression function) This function fits the equation $y = a + bx$ to the data. The format required by this function is LinR(xstat, ystat, y1).
5. Use the following keystrokes (2ND LIST NAMES F2 F3 2ND CATLG-VARS F3 F1 ENTER 1) to get the screen show on the top right.
6. Press ENTER . You should see the second screen on the right.



SUMMARY: FINDING THE LINE OF LEAST SQUARES FIT

1. Enter the data in xStat and yStat.
2. Press 2ND QUIT to leave the lists.
3. Press 2ND STAT F1 F3 to access the LinR.
4. Use the following format for LinR (xStat, yStat, y1). The keystrokes are outlines in step #4 above.
5. Press ENTER ..

FINDING EXTREMA (MAXIMA AND MINIMA)

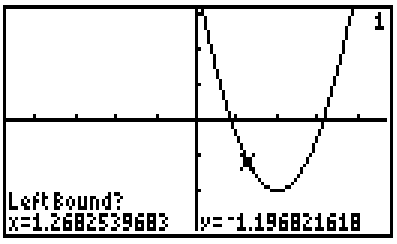
In Example 5, Section 3.1, we are asked to find the minimum point for the graph $f(x) = 1.5x^2 - 6x + 4$.

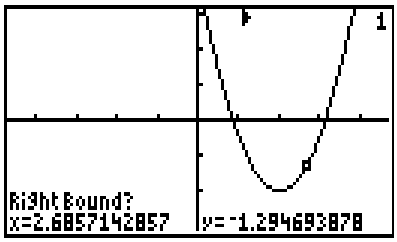
To find a minimum (or maximum) value:

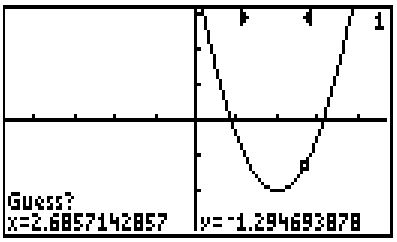
1. Enter and graph the function *f(x)* using a viewing window of [-4.7,4.7,1] by [-3.1,3.1,1].
2. The last choice on the bottom row is GRAPH ▸. Press MORE .
3. Press F1 to access the MATH menu.
4. Press F4 to select FMIN.
5. A graph is displayed with a blinking cursor and "Left Bound?" at the bottom of the screen. This is seen in the sequence of graphs below.
6. Position your cursor to the left of the vertex of the graph. Press ENTER .

7. In the "Right Bound?" screen position the cursor to the right of the vertex and press ENTER .

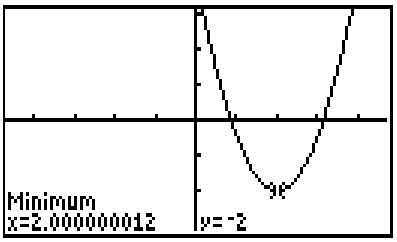
8. You will now see a screen with "Guess ?" . Press ENTER







9. The minimum point for this graph is (2.000000012, -2) as seen in the graph below.



Similar steps are used to find the maximum value of a function. The difference would be in the choice of F4 in step #4 above.
To find the maximum value of a function press F5 to select FMAX and follow the process as outlined above.

SUMMARY: FINDING EXTREMA (MAXIMA AND MINUMA)

1. Enter and graph the function *f(x)* using an appropriate viewing window.
2. Press MORE .
3. Press F1 to access the MATH menu.
4. Press F4 to select FMIN. (Press F5 to select FMAX).
5. When asked for a "Left Bound?" position your cursor to the left of the vertex of the graph and press ENTER .
6. In the "Right Bound?" screen position the cursor to the right of the vertex and press ENTER .
7. In the "Guess ?" screen press ENTER
8. The calculator will display the coordinated for the minimum (or maximum) value.

FINDING A NONLINEAR FUNCTION OF LEAST-SQUARES FIT

In Example 10, Section 3.1, a quadratic function of least-squares fit is found using steps similar to those used to find a line of least-squares fit.

To find a nonlinear function of least-squares fit:

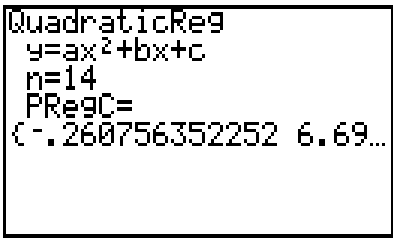
1. Enter the data points found in Table 3.4 in xStat and yStat.

2. Press 2ND QUIT to leave the lists.

3. Press 2ND STAT followed by F1.

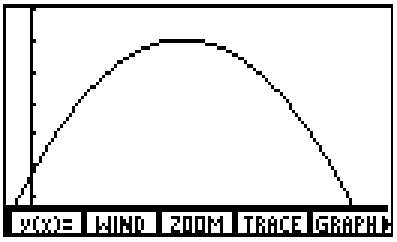
4. Press MORE to access additional functions.

5. Press F4 to access P2Reg (quadratic regression function) This function fits the equation $y = ax^2 + bx + c$ to the data. P2Reg requires at least 3 data points. The format required by this function is P2Reg(xstat, ystat, y1).



6. Use the following keystrokes (2ND LIST NAMES F2 , F3 , 2ND CATLG-VARS F3 F1 ENTER 1) to get the screen show on the top right.

7. Press ENTER . You should see the screen on the right.



8. To see a graph of this function press the GRAPH key followed by the F5 key. You may need to adjust your viewing window to fit the values in the table. To view the function press the F1 key and use the right arrow cursor key to see the entire equation.

SUMMARY: FINDING A NONLINEAR FUNCTION OF LEAST SQUARES FIT

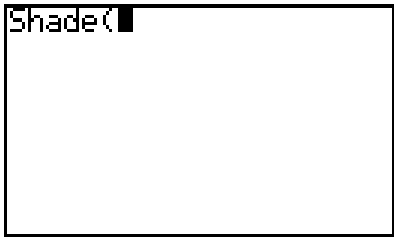
1. Enter the data points in xStat and yStat.
2. Press 2ND QUIT to leave the lists.
3. Press 2ND STAT F1 MORE and F4 to access P2Reg (quadratic regression function).
4. The format required is P2Reg(xstat, ystat, y1). The keystrokes are outlined in step #6 above.
5. Press ENTER .
6. Press GRAPH F5 to view a graph of this function. Adjust the window as needed.
7. Press F1 to view the equation.

SHADING BETWEEN TWO GRAPHS

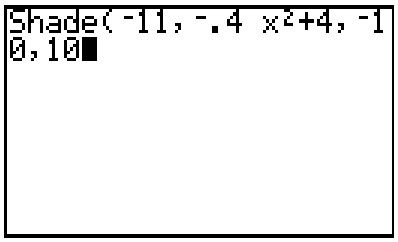
In Example4, Section 3.4, the region below the graph of $f(x) = -0.4x^2 + 4$ is shaded to make it appear like a mountain as illustrated in Figure 3.104.

To shade an area between two graphs:

1. Enter and graph the function. In this example we will use the standard viewing window.
2. Press 2ND QUIT to return to the home screen.
3. Press GRAPH MORE and then F2 to access the DRAW menu.
4. Press F1 to select *Shade.* This command is also used to shade the area between two graphs. The format required by this command is Shade(lower function , upper function , x left, x right). In this problem we do not have a lower function. Since the command will not shade in the region without a lower function select an arbitrary lower function. We will use -11 as our lower function since this value lies below the graph of *f(x)* and does not appear in our viewing window.



5. Type -11, $-.4x^2 + 4$, -10, 10 where the last two values represent the xMin and xMax of the graph viewing window. Press ENTER .
6. The region under the curve should be shaded.



SUMMARY: SHADING A GRAPH

1. Enter and graph the function using an appropriate viewing window.
2. Press 2ND QUIT to return to the home screen.
3. Press GRAPH MORE F2 to access the DRAW menu.
4. Press F1 to select *Shade.*
5. Enter a lower function , upper function , x left and x right value.
6. Press ENTER .

SETTING A DECIMAL WINDOW

In Example 3, Section 4.1, a decimal (or friendly) window is used to trace the graph of *f*. When we use the ZDECM setting the cursor stops on *x* values that are multiples of 0.1.

To set a decimal window:

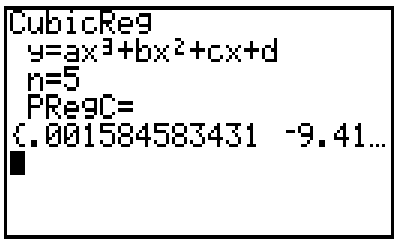
1. Press the GRAPH key followed by F3 for the ZOOM menu.
2. Press the MORE key.
3. Press F4 to select ZDECM.

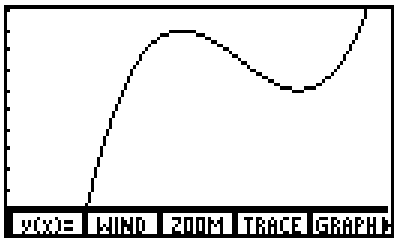
COPYING A REGRESSION EQUATION INTO Y1

In Example 3, Section 4.2, a cubic regression was used to model real data.

To graph a regression equation:

1. Enter the data points in xStat and yStat.
2. Press 2ND QUIT to leave the lists.
3. Press 2ND STAT followed by F1.
4. Press MORE to access additional functions.
5. Press F5 to access P3Reg (cubic regression function). The format required by this function is P3Reg(xstat, ystat, y1).
6. Use the following keystrokes (2ND LIST NAMES F2 , F3 , 2ND CATLG-VARS F3 F1 ENTER 1) to get the screen show on the top right. This sequence of steps is identical to those used earlier to "find a nonlinear function of least squares fit".
7. Press ENTER .
8. To graph this function press the GRAPH key followed by the F5 key. You may need to adjust your viewing window to fit the values in the table.
9. To view the function press the F1 key and use the right arrow cursor key to see the entire equation.





SUMMARY: COPYING A REGRESSION EQUATION INTO Y1

1. Enter the data points in xStat and yStat.
2. Press 2ND QUIT to leave the lists.
3. Press 2ND STAT F1 MORE to access the appropriate regression function.
4. The format required for a cubic regression formula is P3Reg(xstat, ystat, y1). A similar format is used for all regression formulas.
5. Press ENTER .
6. Press GRAPH F5 to view a graph of this function. Adjust the window as needed.
7. Press F1 to view the equation.

EVALUATING COMPLEX ARITHMETIC

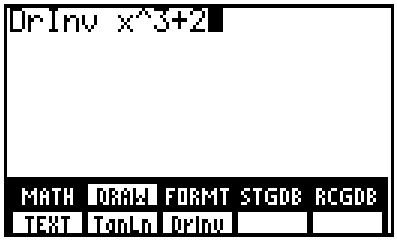
Complex numbers of the form $a + bi$ are entered into the graphing calculator as (a,b). To add the complex numbers $(-2 + 3i) + (7 - 5i)$ you would enter (-2,3) + (7, -5). Then press ENTER. The calculator returns the result (5, -2) which would be then be written as $5 - 2i$. Other arithmetic operations are performed in a similar fashion.

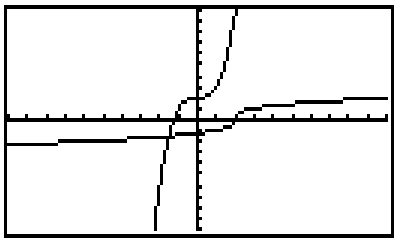
GRAPHING AN INVERSE OPERATION

In Example 7, Section 5.2, the inverse function of $f(x) = x^3 + 2$ is graphed. You can use your graphing calculator to graph the inverse of a function without knowing the formula for $f^{-1}(x)$.

To graph the inverse of a function:

1. Enter *f(x)* into the y(x)= screen.
2. Press 2ND QUIT to return to the home screen.
3. Press GRAPH MORE then F2 to access the GRAPH DRAW menu.
4. Press the MORE key 3 times until you see Drinv in the bottom row.
5. Press F3 to select the Drinv function. Enter the function.
6. Press ENTER to see a graph of both $f(x)$ and $f^{-1}(x)$





SUMMARY: GRAPHING AN INVERSE FUNCTION

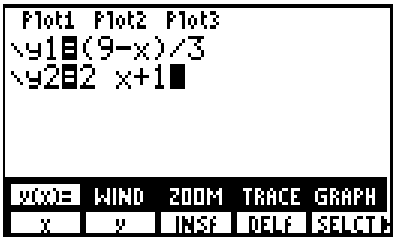
1. Enter *f(x)* into the y(x)= screen.
2. Press 2ND QUIT to return to the home screen.
3. Press GRAPH MORE F2 to access the DRAW menu.
4. Press the MORE key 3 times then F3 to select the Drinv function.
5. Enter the function.
6. Press ENTER to see a graph of both *f(x)* and $f^{-1}(x)$.

SHADING A SYSTEM OF INEQUALITIES

In Example 5(b), Section 6.2, we are asked to shade the solution set for a pair of inequalities $x + 3y \leq 9$ and $2x - y \leq -1$. In order to use these functions in our calculator we must first rewrite each inequality, expressing y in terms of x. These inequalities are rewritten as $y \leq (9-x)/3$ and $y \geq 2x + 1$.

To shade a system of inequalities:

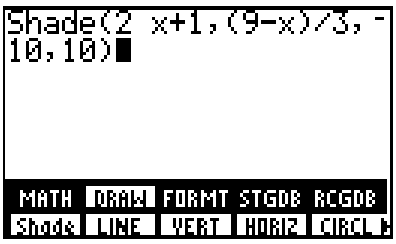
1. Enter each function in the y(x) = screen.
2. Press 2ND QUIT to return to the home screen.
3. Press GRAPH MORE F2 to access the DRAW menu.

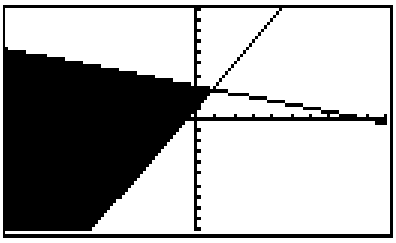


4. Press F1 to select *Shade*. The format required by this command is Shade(lower function , upper function , x left, x right). In this problem the lower function is $y \geq 2x + 1$ since we are interested in the area above this line. The upper function is $y \leq (9-x)/3$ since we are interested in the area below this line.

5. Type $2x + 1$, $(9 - x)/3$, -10, 10 where the last two values represent the xMin and xMax of the graph viewing window. Press ENTER .

6. The region between the two lines should be shaded.





SUMMARY:SHADING A SYSTEM OF INEQUALITIES

1. Enter each function in the y(x) = screen.
2. Press 2^{ND} QUIT to return to the home screen.
3. Press GRAPH MORE F2 to access the DRAW menu.
4. Press F1 to select *Shade*.
5. Use the format Shade(lower function , upper function , x left, x right).to enter the required information.
6. Press ENTER to see the region between the two inequalities shaded.

ENTERING THE ELEMENTS OF A MATRIX

In Example 8, Section 6.3, the elements of a matrix are entered into the graphing calculator. The augmented matrix A is given by $A = \left[\begin{array}{ccc|c} 2 & 1 & 2 & 10 \\ 1 & 0 & 2 & 5 \\ 1 & -2 & 2 & 1 \end{array}\right]$.

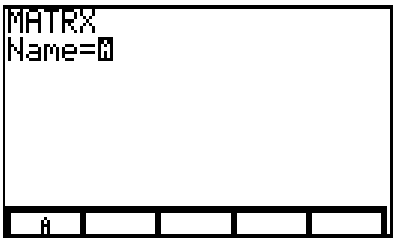
To create a matrix:

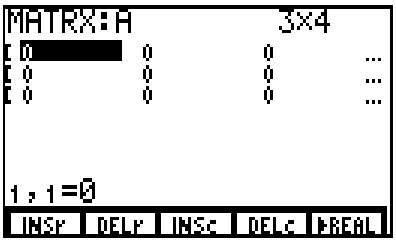
1. Locate the word MATRIX over the number 7 on the calculator keypad. Press 2ND MATRIX to access the MATRIX menu.

2. Press F2 to EDIT.

3. To name the matrix select a letter of the alphabet (in this case A) and press ENTER.

4. Enter the dimensions (*row X column*) of the matrix. Press ENTER.

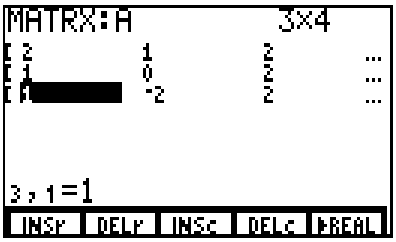


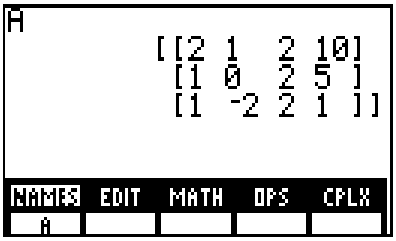


5. Begin entering the elements of the matrix. Press the ENTER key after each entry. The cursor moves to the next element.

6. Press 2ND QUIT to return to the home screen.

7. To display the matrix press 2ND MATRIX F1 F1 ENTER





SUMMARY: CREATING A MATRIX

1. Press 2ND MATRIX to access the MATRIX menu.
2. Press F2 to create the matrix.
3. Name the matrix. Press ENTER.
4. Enter the dimensions (*row X column*) of the matrix. Press ENTER.
5. Enter the elements of the matrix. Press ENTER after each entry.
6. Press 2ND QUIT to return to the home screen.
7. To display the matrix press 2ND MATRIX F1 F1 ENTER

REDUCED ROW ECHELON FORM

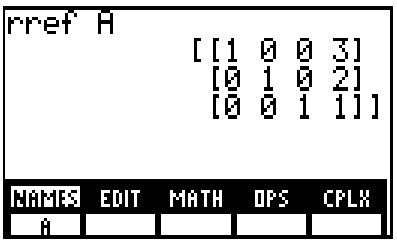
To transform a matrix into row reduced form:

1. Press 2ND MATRIX then F4 to access the OPS (operations) menu.

2. Press F5 to select *rref*.

3. Press 2ND M1 F1 to select matrix A.

4. Press ENTER.

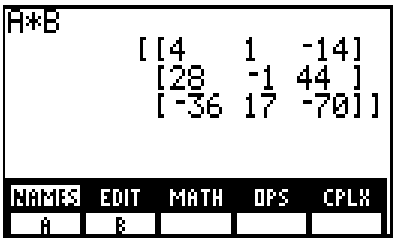


PERFORMING ARITHMETIC OPERATIONS ON MATIRCES

In Example 8, Section 6.4 the matrices A and B are multiplied. Begin by entering $A = \begin{bmatrix} 1 & 0 & 7 \\ 3 & 2 & -1 \\ -5 & -2 & 5 \end{bmatrix}$ and

$B = \begin{bmatrix} 4 & -6 & 7 \\ 8 & 9 & 10 \\ 0 & 1 & -3 \end{bmatrix}$ matrix B in your calculator using the instructions for creating a matrix.

To multiply two matrices:



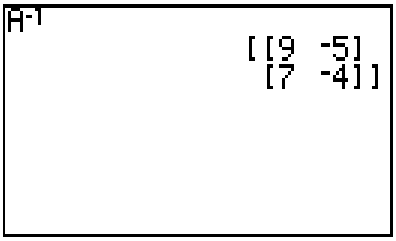
1. Enter the matrices into the calculator.
2. Press 2ND QUIT to return to the home screen.
3. Press 2ND MATRIX F1 F1 then the multiplication sign then F2.
4. Press ENTER.

Other arithmetic operations are performed in a similar way.

FINDING THE INVERSE OF A MATRIX

In Example 4, Section 6.5 the inverse of $A = \begin{bmatrix} 4 & -5 \\ 7 & -9 \end{bmatrix}$ is found.

To find the inverse of a matrix

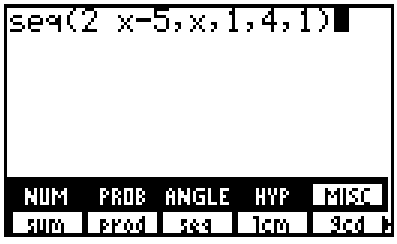


1. Enter the matrix into the calculator.
2. Press 2nd QUIT to return to the home screen.
3. Press 2ND MATRIX F1 then select the matrix whose inverse you wish to find.
4. Press 2nd x^{-1} (located above the EE key) followed by ENTER.

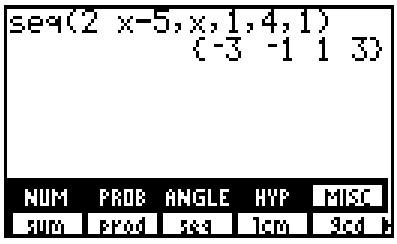
CREATING A SEQUENCE

A graphing calculator can be used to create a finite sequence of terms given a formula for the nth term. We will generate the terms of the sequence $f(n) = 2n - 5$ for n = 1, 2, 3, 4.

To generate a finite sequence of terms:



1. Use the keystrokes 2ND MATH to access the MATH menu .
2. Press F5 to access the MATH MISC menu.
3. Press F3 to select *seq*. The seq function returns a list in which each number in the list is the value of the formula evaluated for a given variable from beginning to end by step.
4. Enter the information as seen in the first screen on the right. The format used for the *seq* command is seq(*formula, variable, begin, end, step)*.
5. Press ENTER . The second screen shows the sequence of terms.



SUMMARY: CREATING A SEQUENCE

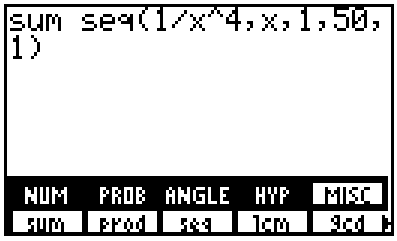
1. Use the keystrokes 2ND MATH to access the MATH menu .
2. Press F5 to access the MATH MISC menu.
3. Press F3 to select *seq*.
4. Enter the information using the format seq(*formula, variable, begin, end, step)*.
5. Press ENTER .

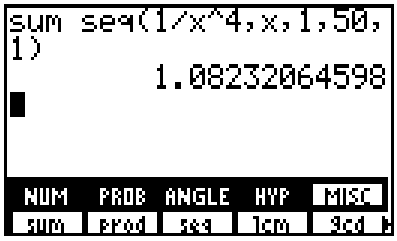
FIND THE SUM OF THE TERMS OF A SERIES

In Example 3, Section 8.2 the sum of the series $\sum_{n=1}^{50} \frac{1}{n^4}$ is found using the graphing calculator.

To find the sum of the terms of a series:

1. Use the keystrokes 2ND MATH to access the MATH menu .
2. Press F5 to access the MATH MISC menu.
3. Press F1 to select *sum*. The sum function returns the sum of the elements of a list. Since the seq function will return a list of values for the summation given above we will take the sum of a sequence.
4. Press F3 to select *seq* and enter the information using the format described in the section on creating a sequence.
5. Enter the information as seen in the first screen on the right.
6. Press ENTER . The second screen shows the sequence of terms.





SUMMARY: FINDING THE SUM OF THE TERMS OF A SERIES

1. Use the keystrokes 2ND MATH to access the MATH menu .
2. Press F5 to access the MATH MISC menu.
3. Press F1 to select *sum*.
4. Press F3 to select *seq*.
5. Enter the information using the format seq(*formula, variable, begin, end, step)*.
6. Press ENTER .

CALCULATING FACTORIAL NOTATION

In Example5, Section 8.3, factorial notation is evaluated using the graphing calculator. Suppose we wish to find the numerical value of 8!.

To calculate a factorial:

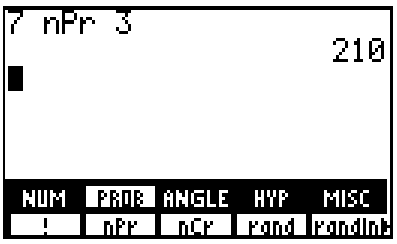
1. In the home screen type 8.
2. Use the keystrokes 2ND MATH to access the MATH menu .
3. Press F2 to access the MATH PROB menu.
4. Press F1 to select !.
5. Press ENTER .

CALCULATING PERMUTATINS AND COMBINATIONS

In Example 6(a), Section 8.3, the permutation $P(7, 3)$ is evaluated. Suppose we wish to evaluate this permutation using the graphing calculator.

To calculate a permutation:

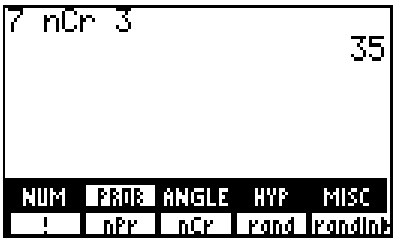
1. In the home screen type 7.
2. Access the MATH menu.
3. Press F2 to access the MATH PROB menu.
4. Press F2 again to select nPr.
5. Type 3.
6. Press ENTER.



In example 9(a), Section 8.3, the combination $C(7, 3)$ can be determined using the graphing calculator.

To calculate a combination:

1. In the home screen type 7.
2. Access the MATH menu.
3. Press F2 to access the MATH PROB menu.
4. Press F3 to select nCr.
5. Type 3.
6. Press ENTER.

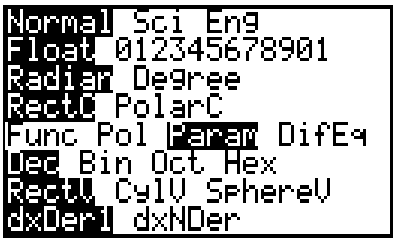


GRAPHING PARAMETRIC EQUATIONS

To graph the parametric equations $x = t + 3$ and $y = t^2$ for $-3 \le t \le 3$.

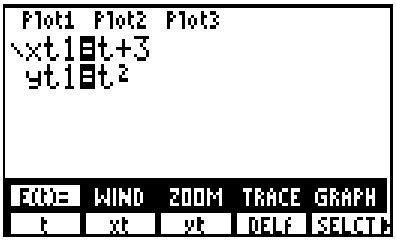
To graph parametric equations:

1. Press 2ND MODE. Highlight Param and press ENTER. Check other settings to match those seen on the right.



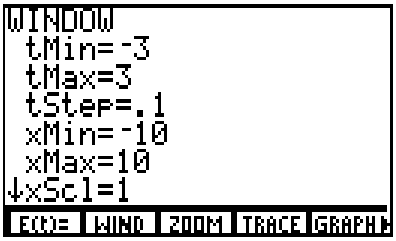
2. Press GRAPH then F1 to display the parametric equation options.

3. Enter the equations for *x* and *y* as seen on the right. Press F1 to select the *t* variable.

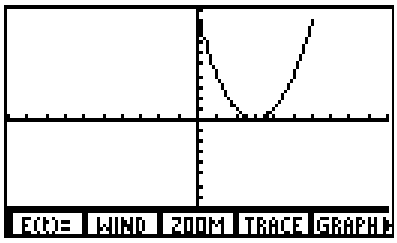


4. Press 2ND M2 to set the window for your graph. Notice that you will need to set a tMin, tMax and tStep in addition to set values for *x* and *y*. tStep represents the increments between consecutive points plotted on the graph. A reasonable value for tStep = 0.1

5. Set an appropriate viewing window. In this problem use the default settings for *x* and *y* and $-3 \le t \le 3$ for the values for *t*.



6. Press F5 to create the graph seen below.



SUMMARY: GRAPHING PARAMETRIC EQUATIONS

1. Change your calculator to Parametric mode
2. Press GRAPH then F1 to display the parametric equation options.
3. Enter the parametric equations for *x* and *y*. Use F1 to select the *t* variable.
4. Set an appropriate viewing window for your graph. A reasonable value for tStep = 0.1
5. Press F5 to view the graph.

GRAPHING IN POLAR COORDINATES

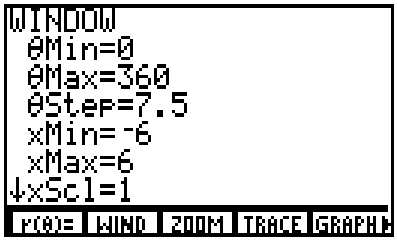
In Figure 8.92, Section 8.5 the polar equation r = 2 + 2cos θ for $0^o \le \theta \le 360^o$ is graphed.
To graph polar equations:

1. Press 2ND MODE . Highlight Pol and press ENTER . Set the calculator to Degree mode. Press ENTER.

2. Press GRAPH then F1 to display polar equation options.

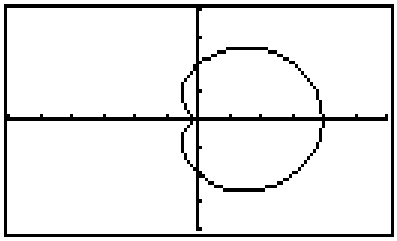
3. Enter the equation for r using F1 to select θ.

4. Press 2ND M2 to set the window for your graph. Notice that you will need to set a θMin, θMax and θStep in addition to values for x and y. θStep represents the increments between consecutive points plotted on the graph. In degree mode a reasonable value for θStep = 7.5.



5. Set an appropriate viewing window. In this problem use $-6 \le x \le 6$, $-4 \le y \le 4$ and $0^o \le \theta \le 360^o$ with θStep = 7.5.

6. Press F5 to view the graph.



SUMMARY: GRAPHING IN POLAR COORDINATES

1. Change the calculator to polar mode and select degree mode.
2. Press GRAPH then F1 to display polar equation options.
3. Enter the equation for r using F1 to select θ.
4. Set an appropriate viewing window. In degree mode a reasonable value for θStep = 7.5.
5. Press F5 to view the graph.