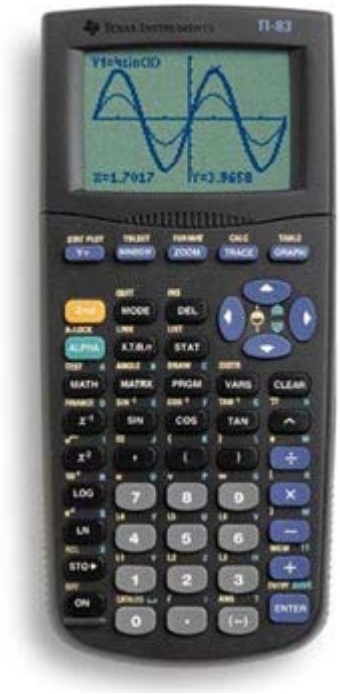
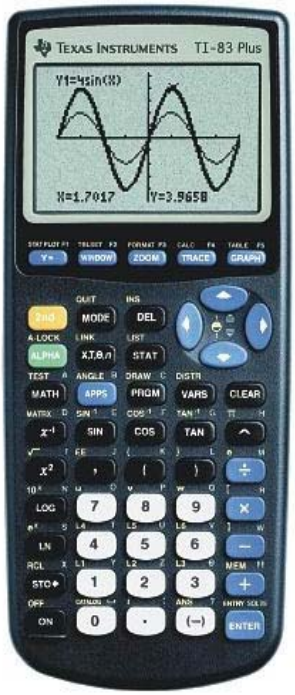
TI -83 Tutorials



TI-83



TI-83 Plus

TI-84 (or TI-84 Plus)

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Preface

Why did I do these tutorials? Money? Fame? Fortune? Of course, the real reason for writing these tutorials is to be number 1 on Google when someone types in "TI-83 Help." The following tutorials are yours for the taking. All I ask is that when (not if) you find any errors or omissions, you send me an email (smcdanie@mtsu.edu). You may be wondering why I did not publish these as HTML files. The font that is used to create the calculator-like keys is not available on you machine. So, "STAT PLOT" would look like an "i" when rendered on your computer.

If you would like me to write tutorials on any topic, let me know. I might actually get to them. Just send me an email and let me know what you think and how I can improve the lessons.

I am also feverishly working on video tutorials for those who prefer to kick back with popcorn and coke while learning the TI-83/TI84.

Scott McDaniel

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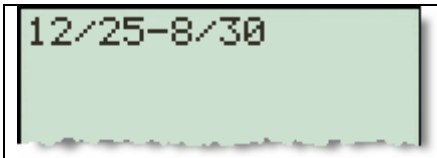
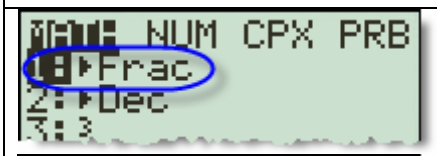
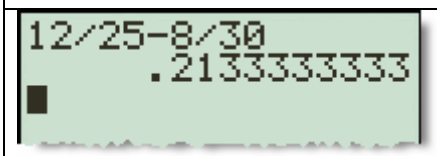
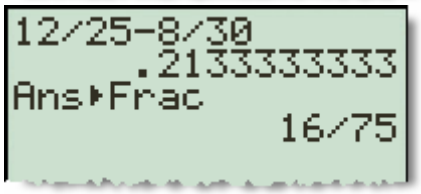
Expressing answers as fractions

Evaluate $\frac{12}{25} - \frac{8}{30}$.

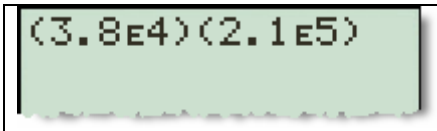
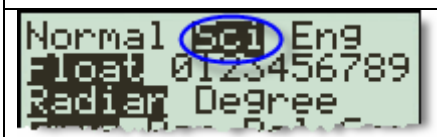
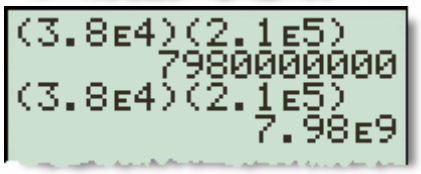
	**Step 1.** Press 1 2 ÷ 2 5 − 8 ÷ 3 0.
 	**Step 2.** To express the answer as a fraction, press MATH and select "Frac" by pressing ENTER or 1.
	**Step 3.** Press ENTER again to evaluate. The answer is $\frac{16}{75}$. **Note:** *The TI-84 cannot display the fraction if the denominator has more than 3 digits.*
 	**Note:** *If you press ENTER before converting to a fraction, you will get a decimal representation of the answer.* *To convert this decimal to a fraction press MATH ENTER ENTER.*

Entering/Displaying numbers in Scientific Notation

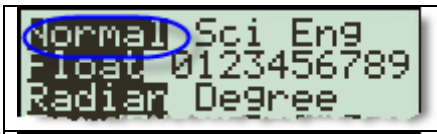
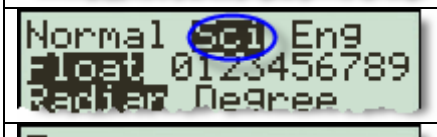
In order to type in scientific notation, you will be using the EE key by pressing 2ND , . The EE key means $\times 10^{\square}$. So in calculator notation 4.2E5 is equivalent to 4.25×10^5.

Note: *When you press EE only one "E" will appear on the screen.*

Example 1. Evaluate $\left(3.8 \times 10^4\right)\left(2.1 \times 10^5\right)$.

	**Step 1.** Press (3 . 8 2ND , 4) (2 . 1 2ND , 5).
	**Step 2.** Press ENTER and the answer 7,980,000,000 appears on the screen. If you need the answer in scientific notation it is 7.98 x 10^9.
 	**NOTE:** *If you want the calculator to give the answer in scientific notation, press MODE ▷ ENTER CLEAR. You are back on the home screen and want to get the answer from the problem, but you do not want to do the problem again, so just press 2ND (−) to get the last answer. Now if you press ENTER the answer will be expressed in scientific notation.*

Example 2. You may want the calculator to display all answers in scientific notation. To do this, follow the steps below.

	**Step 1.** Press MODE.
	**Step 2.** Change the top line from "Normal" to "Sci" by pressing ▷ ENTER.
	**Step 3.** Press CLEAR. Now all answers will be displayed in scientific notation.

Assuming you did example 2 and converted your calculator's mode to Scientific Notation, now do example 3.

Example 3. Evaluate 300×2.

	**Step 1.** Press 3 0 0 × 2.
	**Step 2.** Press ENTER and the answer is displayed as 6E2, which is interpreted as 6×10^2, in scientific notation, or just 600. **NOTE:** *Unless you want all your answers to be expressed in scientific notation, you should change the mode back to "NORMAL" by pressing* MODE ENTER

Making a table (AUTO)

Example. Create a table of values (or ordered pairs) from $x = -2$ to $x = 5$ for the equation $y = 2x - 4$.

Step 1. Press Y= .

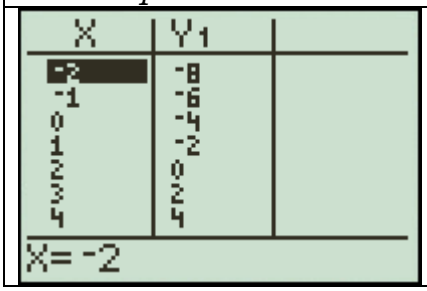
Note: *If there are items in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" then press* CLEAR.

Step 2. Put the equation into "Y1=" by pressing 2 X,T,Θ,n − 4.

Step 3. Go to "TBLSET" by pressing 2ND WINDOW. Change "TblStart" to -2 by pressing (−) 2. This is the starting value since the *x*-values are to go from -2 to 5

Note: "ΔTbl" *should be 1. (This is the incremental value; that is, you are telling the calculator how much to count by. If you make* "ΔTbl" *5, the calculator will count or increment by 5.)*

Note: *For this example "Indpnt" and "Depend" should each have "Auto" highlighted. This will force the calculator to automatically generate the values for x and y). If you wanted to put in your own values for x, change the "Indpnt" to "Ask" and leave "Auto" highlighted on "Depend".)*

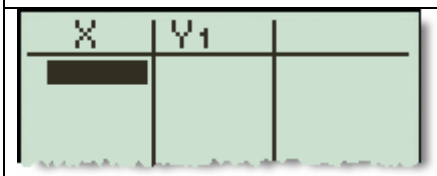
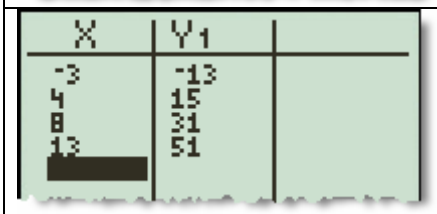


Step 5. To create the table, press 2ND GRAPH. The table should be displayed. On your calculator you may use the ⌒ ⌓ arrow keys to scroll through the values as necessary.

Using the ASK table feature

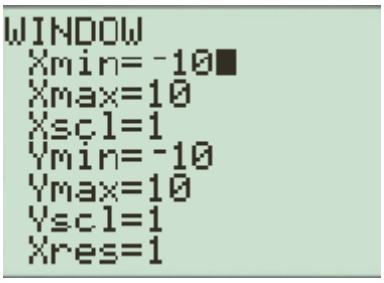
The ASK feature allows you to input non-sequential values for the independent variable.

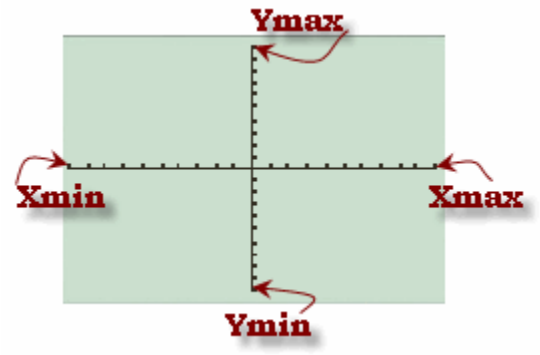
Example. Given the equation $y = 4x - 1$, create a table of ordered pairs whose x-coordinates are -3, 4, 8, and 13.

	**Step 1.** To graph the function press Y=. **Note:** *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing* CLEAR.
	**Step 2.** With the cursor immediately to the right of the "Y_1=", press 4 X,T,Θ,n − 1.
	**Step 3**. Go to "TBLSET" by pressing 2ND WINDOW.
	**Step 4.** Change the "Indpnt" from "Auto" to "Ask" by pressing ▼▼▶ to "Ask" and press ENTER. **Note:** *When the "Indpnt" is on "Ask," it does not matter what values "TblStart" or "ΔTbl" are set to. Leave "Depend" set on "Auto."*
	**Step 5.** To create the table, press 2ND GRAPH. A blank table is displayed.
	**Step 6.** Press (−) 3 ENTER. Notice that the y-value automatically appeared. The first ordered pair is (-3, -13). Press 4 ENTER 8 ENTER 1 3 ENTER. Each time you enter an x-value, the corresponding y-value appears.
	Step 7. You may want to change "Indpnt" back to "Auto" by pressing 2ND WINDOW ▼▼ ENTER before continuing.

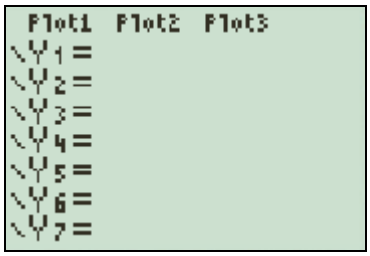
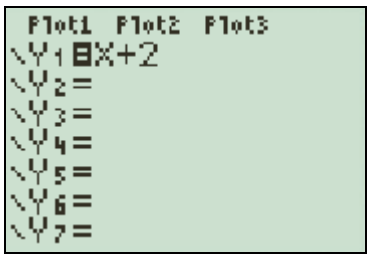
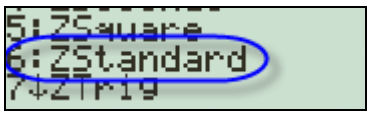
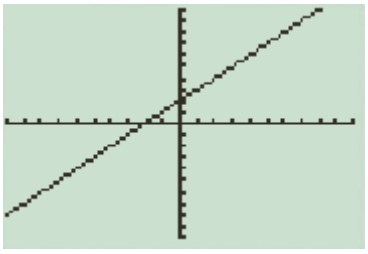
Setting the Standard Viewing Window

The standard viewing window creates a window with the following values for the window variables:



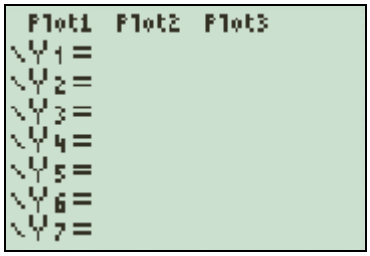


Example. Graph $y = x + 2$ on the standard viewing window.

	**Step 1.** Press Y=. **Note:** *If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing* CLEAR.
	**Step 2.** With the cursor immediately to the right of "Y_1=", press X,T,Θ,n + 2.
 	**Step 3.** To see the graph on a standard viewing window, press ZOOM 6.

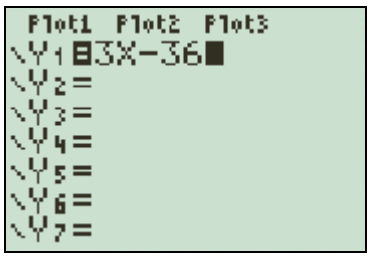
Setting the graph window (manually)

Example: Graph the equation $y = 3x - 36$. Find the viewing that shows both the x and y-intercepts.

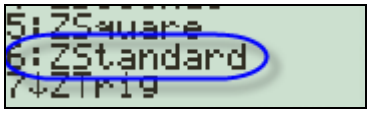


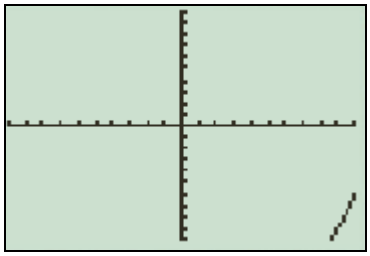
Step 1. Press Y=

Note: *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing* CLEAR. .



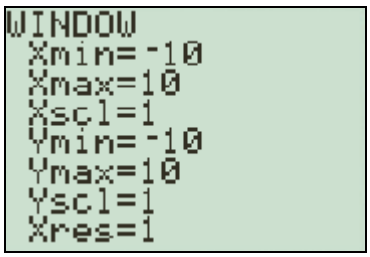
Step 2. Press 3 X,T,Θ,n − 3 6



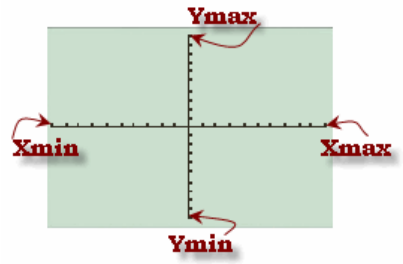


Step 3. Press ZOOM 6.

Notice that only a small portion of the graph is displayed. In order to get a better picture of the graph, you will need to make some manual adjustments to the window.

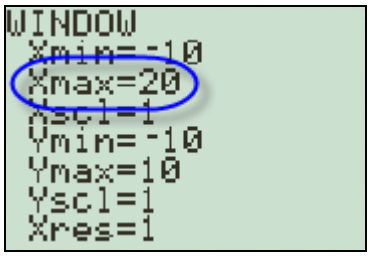
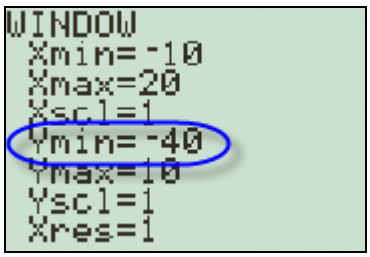
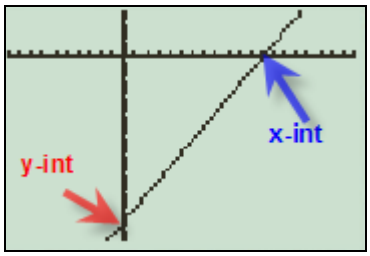
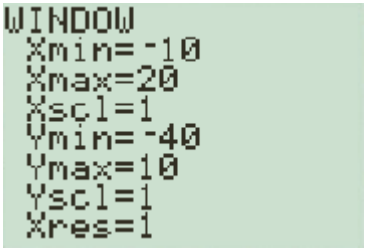
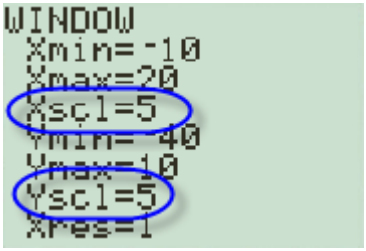
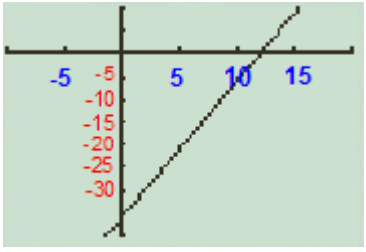


Step 4. Press WINDOW. *We need to make some adjustments. We need to find the x and y-intercepts.*



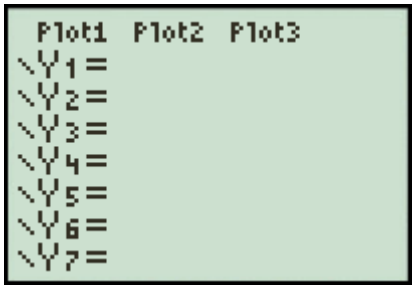
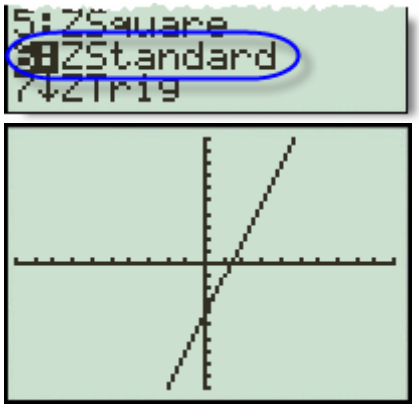
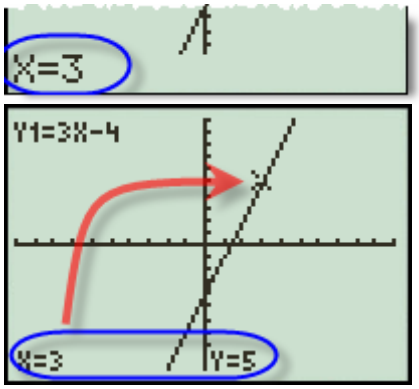
Note: *Find the x-intercept by substituting a 0 for y and solve for x.*

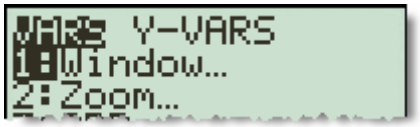
$$0 = 2x - 36$$
$$-2x = -36,$$
$$\text{so } x = 18$$

	**Step 5.** Note that the "Xmin" is -10 and the "Xmax" is 10. This particular range does not include the x-intercept for our equation. Change "Xmax" to 20 by pressing ▼ 2 0.
	**Step 6.** Notice from the equation that the y-intercept is –36. Currently the range for the y-axis is from –10 to 10. This range does not include –36. If we change "Ymin" to –40, our range will include the y-intercept of –36. Press ▼ ▼ (–) 4 0.
	**Step 7.** Press GRAPH. **Note:** *Notice that both the x and y-intercepts can be seen.*
	**Step 8.** Notice that the x and especially the y-axis appears a bit crowded with tic marks. To change this, press WINDOW.
	**Step 9.** Scroll down to "Xscl" and change this to a 5. Also scroll down to "Yscl" and change this to 5. This means that every 5 units there will be a tic mark.
	**Step 10.** Press GRAPH. Now we can see both the x and y-intercepts and the tic marks along the x and y-axes are easier to read.

Evaluating a Function Graphically

Example. Graph the function $g(x) = 3x - 4$ and evaluate it at $g(3)$.

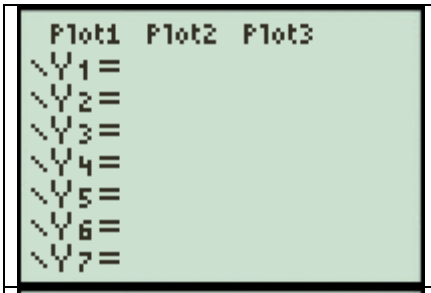
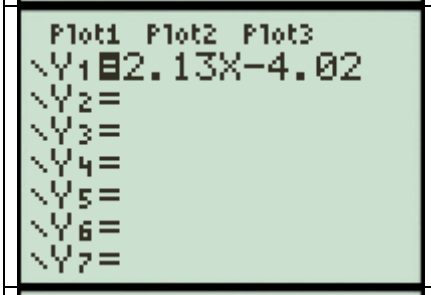
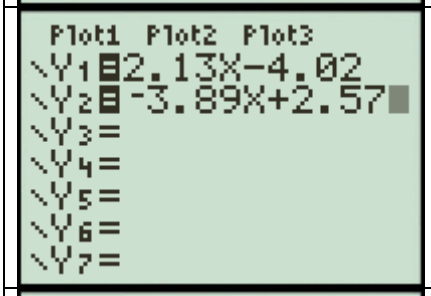
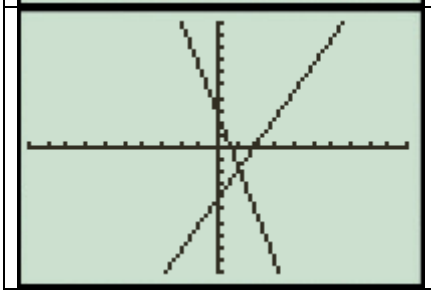
	**Step 1.** Press Y=. **Note:** *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing* CLEAR.
	**Step 2.** Enter the function into "Y1", by pressing 3 X,T,Θ,n − 4.
	**Step 3.** Go to the "STANDARD" viewing window by pressing ZOOM 6.
	**Step 4.** To find the value of g(3) go to the CALCULATION Menu by pressing 2ND TRACE. Choose "1:value" by either pressing 1 or ENTER.
	**Step 5.** Press 3 ENTER. You will see that when x=3, y=5 or g(3)=5. The point is also plotted on the graph.

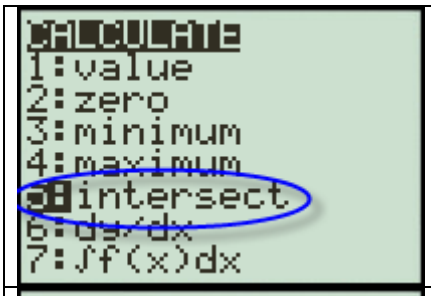
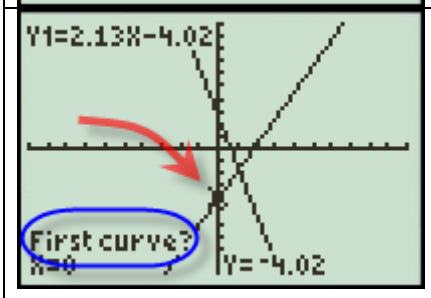
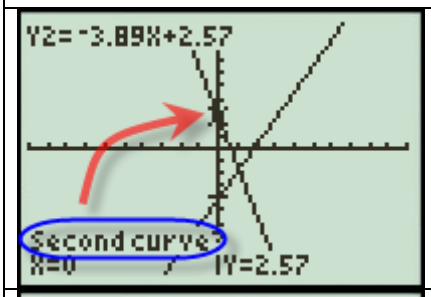
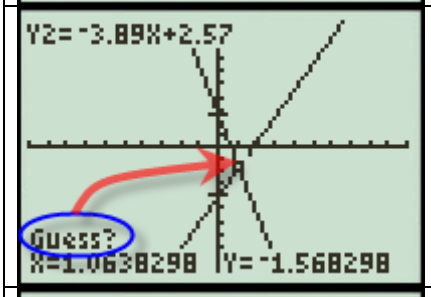
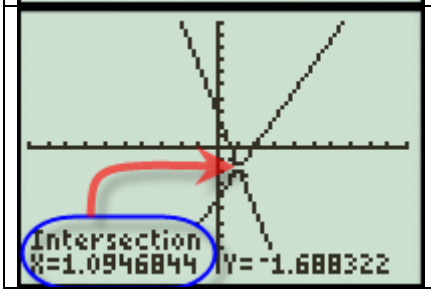
	**Step 6.** You can also find the value of $g(3)$ on the home screen. If you are on the graph screen, press 2ND MODE to QUIT the graph and return to the home screen.
	**Step 7.** Press VARS ▷ to go to the "Y-VARS" sub-menu in the "VARIABLES" menu. You are going to use the calculator's ability to do function notation. Since you put the $g(x)$ function in "Y1", you need to find "Y1" in the calculator.
	**Step 8.** Press ENTER or 1 to choose "1:Function".
	**Step 9.** Press ENTER or 1 to choose "1:Y1".
	**Step 10.** Press (3) ENTER to evaluate the function. So $g(3)=5$.

How to locate a point of intersection (when there is just 1)

Example. Solve the equation $2.13x - 4.02 = -3.89x + 2.57$.

Note: *One way to solve a linear equation in one variable graphically is to take each side of the equation and graph them as separate equations. The x-coordinate where they intersect is the solution of the equation.*

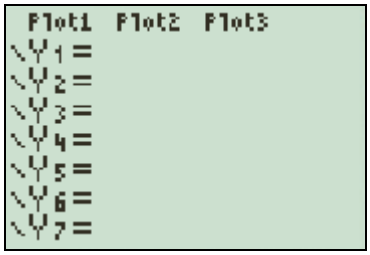
		**Step 1.** You need to put the left side of the equation into "Y1" and the right side into "Y2". Press Y= **Note:** *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing CLEAR.*
		**Step 2.** With the cursor immediately to the right of the "Y1=", enter the left side of the equation by pressing 2 . 1 3 X,T,Θ,n − 4 . 0 2 ENTER.
		**Step 3.** With the cursor to the right of the "Y2=", enter the right side of the equation by pressing (−) 3 . 8 9 X,T,Θ,n + 2 . 5 7.
		**Step 4.** To see the graph on a standard viewing window, press ZOOM 6 or press ZOOM and scroll down to "6:ZStandard" using the ▼ key and press ENTER when "6:" is highlighted.

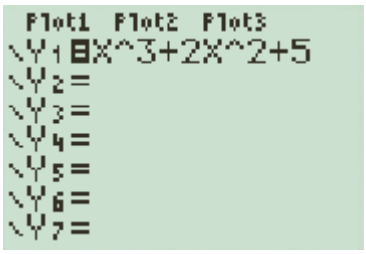
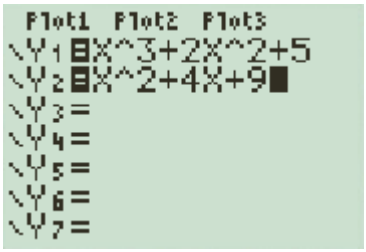
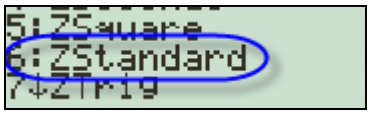
		**Step 5.** Press 2ND TRACE to get to the CALCULATION menu. **Step 6.** You want to find the x-coordinate of the intersection point. Press 5 to use the "intersect" feature of the menu.
		**Step 7.** The calculator will prompt you with 3 questions: "First curve?", "Second curve?", and "Guess?". Because you only have two curves and there is only one point of intersection, the correct response to each of these questions is to press ENTER. You will be pressing ENTER 3 times. The x-coordinate of the intersection point is the solution.
		Press ENTER.
		Press ENTER. **Note:** *If you want, you can scroll to the point of intersection and then press* ENTER*, but this is really only necessary when you have more than one intersection.*
		As you can see $x \approx 1.095$.

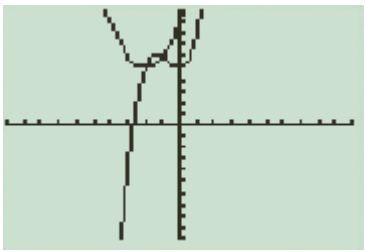
Use ZBox to see Hidden Behavior of a Curve

Using the ZBox feature on the TI-84 allows you to magnify part of a graph which you can not see well.

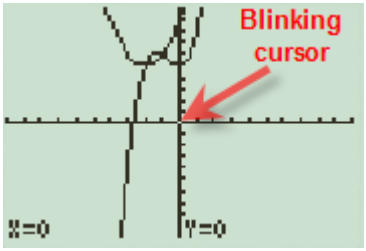
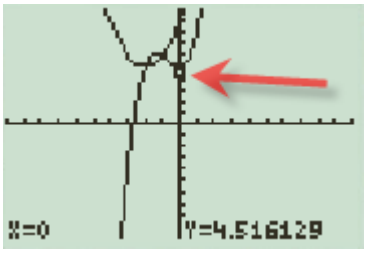
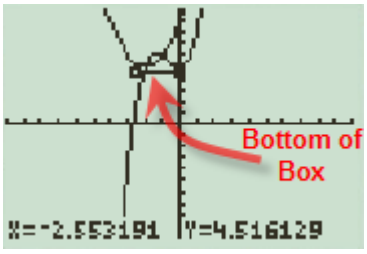
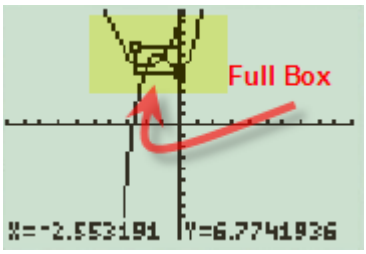
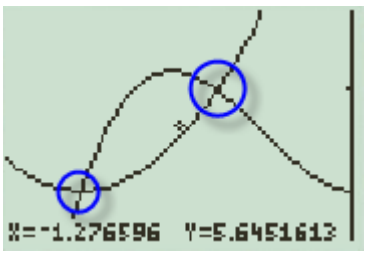
Example. Graph $y = x^3 + 2x^2 + 5$ and $y = x^2 + 4x + 9$. Examine their points of intersection.

<table>
<tr>
<td> 
</td>
<td>Step 1. Press (Y=).

Note: If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing CLEAR</td>
</tr>
<tr>
<td> 
</td>
<td>Step 2. With the cursor immediately to the right of "Y_1=", enter the first equation by pressing X,T,Θ,n ^ 3 + 2 X,T,Θ,n ^ 2 + 5 ENTER.</td>
</tr>
<tr>
<td> 
</td>
<td>Step 3. With the cursor to the right of "Y_2=", enter the second equation by pressing X,T,Θ,n ^ 2 + 4 X,T,Θ,n + 9.</td>
</tr>
<tr>
<td> 

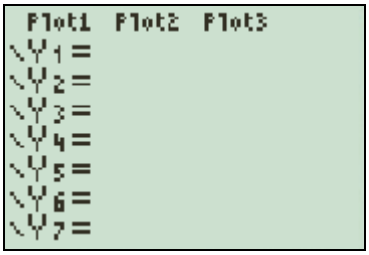
  </td>
<td>Step 4. To see the graph on a standard viewing window press ZOOM 6.

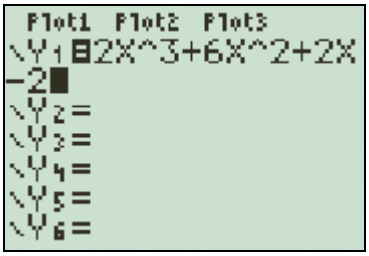
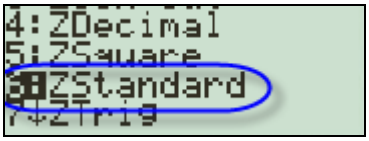
Note: You can not see the intersection points well enough, so you will use the "ZBox" feature to zoom in on those points</td>
</tr>
<tr>
<td> 
</td>
<td>Step 5. Press ZOOM and select "1:ZBox" by pressing 1.</td>
</tr>
</table>

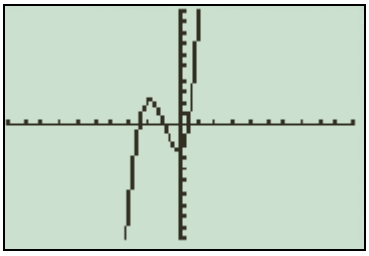
	**Step 6.** There is a blinking cursor at the origin. It needs to be moved up and to the left. Press ⌒ 14 times.
	**Step 7.** Press ENTER. This will mark the lower right hand corner of the box.
	**Step 8.** Press ⌓ 12 times. This segment represents the bottom of the box.
	**Step 9.** Press ⌒ 7 times. You see a fully formed box around the points of intersection of the two curves.
	**Step 10.** To see the parts of each curve which you have "boxed in" press ENTER. This would be very useful when trying to determine the intersection.

Cubic Functions

Example. Graph the cubic function $f(x) = 2x^3 + 6x^2 + 2x - 2$.

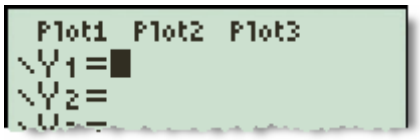
<table>
<tr>
<td> 
</td>
<td>Step 1. To graph the function press Y=.

Note: If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing CLEAR.</td>
</tr>
<tr>
<td> 
</td>
<td>Step 2. With the cursor immediately to the right of "Y_1=", press 2 X,T,Θ,n ^ 3 + 6 X,T,Θ,n ^ 2 + 2 X,T,Θ,n − 2.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td> 

  </td>
<td>Step 3. To see the graph on a standard viewing window, press ZOOM 6.</td>
</tr>
</table>

Graphing a single inequality and shading

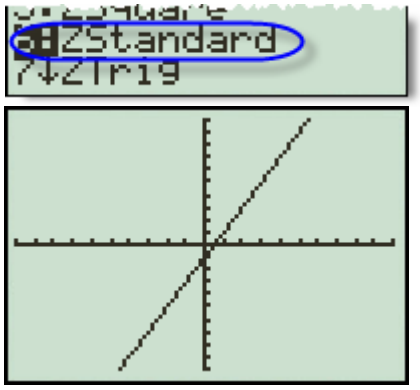
Example. Graph $y \le 2x - 1$.



Step 1. To graph press Y=.

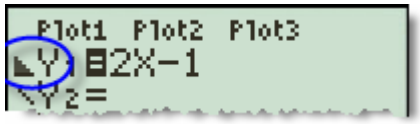
Note: *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing CLEAR.*

Step 2. With the cursor immediately to the right of "Y_1=", enter the first equation by pressing 2 X,T,Θ,n − 1.

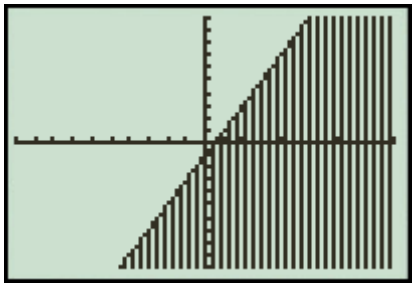


Step 3. To see the graph on a standard viewing window, press ZOOM 6.

Note: *You see the graph of the line $y = 2x - 1$. Graphing an inequality involves not only drawing the line, but also shading on one side of the line. Since this inequality is in the format "$y \le$", the region to be shaded is below the line.*

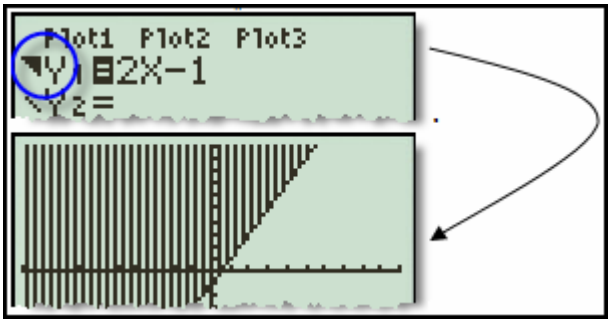


Step 4. Press Y= and scroll to the graph style icon by pressing ◄ ◄. The cursor is blinking on the connected graph style icon. To obtain the shade below icon, press ENTER 3 times. Each time you press ENTER you will see a different graph style icon.



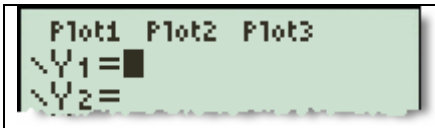
Step 6. Press GRAPH to see the line and the shaded region.

Note: If it had been $y \ge 2x - 1$, you would have selected the "upper triangle" as shown below:



Exponential Functions

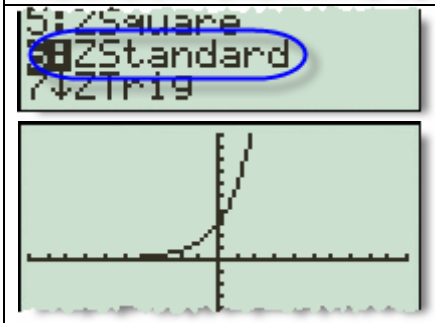
Example. Graph the exponential function $f(x) = 3\left(2^x\right)$.



Step 1. To graph the function press Y=.

Note: *If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing* CLEAR.

Step 2. With the cursor immediately to the right of "Y_1=", press 3 (2 ^ X,T,θ,n).



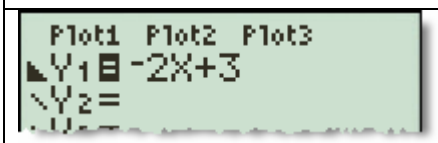
Step 3. To see the graph on a standard viewing window, press ZOOM 6.

Shading a system of inequalities

Example. Graph the system of inequalities $\begin{cases} y \le -2x + 3 \\ y \ge x - 4 \end{cases}$.

Step 1. To graph press Y=.

Note: *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing* CLEAR.

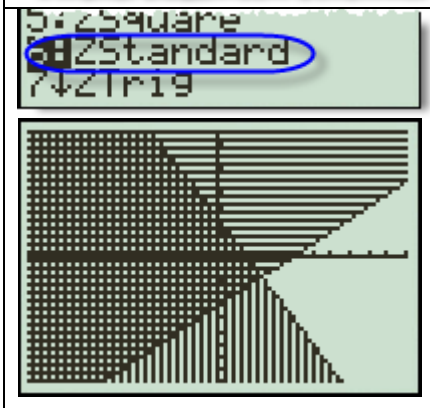


Step 2. With the cursor immediately to the right of "Y_1=", enter the first inequality by pressing (−) 2 X,T,Θ,n + 3. Scroll to the graph style icon by pressing ◄ 7 times. The cursor is blinking on the connected graph style icon. To obtain the shade below icon, press ENTER 3 times.

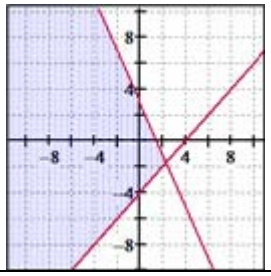
Note: *The first inequality is "*$y \le$*", therefore the shading will be below the line. As you press* ENTER*, you see the different graph style icons.*
Note: *The second inequality is "*$y \ge$*", therefore the shading will be above the line.*

Step 3. Change the graph style of the second inequality to the shade above icon by pressing ▼ and ENTER twice.

Step 4. Press ► ► to move the cursor to the right of "Y_2=". Enter the second inequality by pressing X,T,Θ,n − 4.

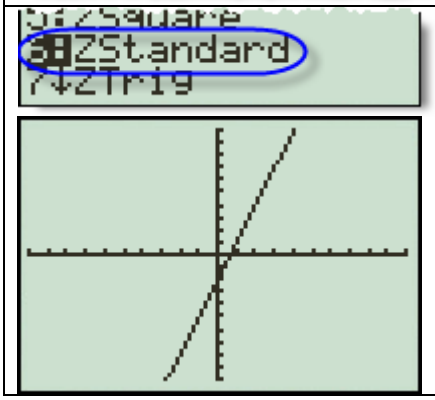


Step 7. Press ZOOM 6 to see both inequalities. The area where the shaded areas overlap is the solution of the system of inequalities. On paper it would look like this:



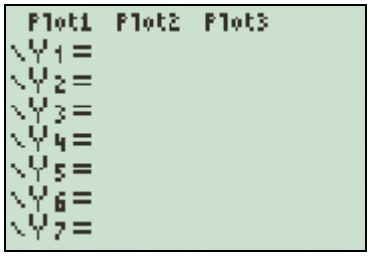
Graphing a function (Linear)

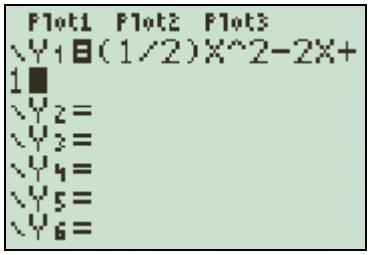
Example 1. Graph the function $f(x) = 3x - 2$.

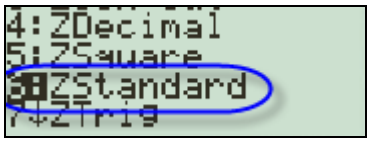
	**Step 1.** Press Y=. **Note:** *If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing* CLEAR.
	**Step 2.** Enter the function into "Y1". Press 3 X,T,Θ,n − 2.
	**Step 3.** Press ZOOM 6 and you will see the graph on a standard viewing window.

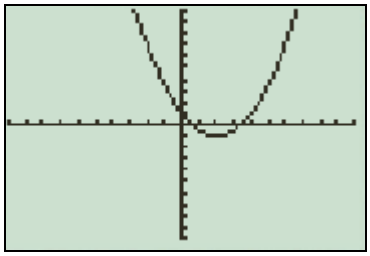
Graphing a function (quadratic)

Example. Graph $f(x)=\frac{1}{2}x^2-2x+1$.

<table>
<tr>
<td> 
</td>
<td>Step 1. Press Y=.

Note: If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing CLEAR.</td>
</tr>
<tr>
<td> 
</td>
<td>Step 2. Enter the function into "Y1" by pressing (1 ÷ 2) X,T,Θ,n ^ 2 − 2 X,T,Θ,n + 1.

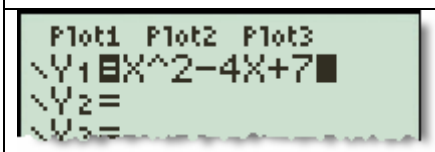
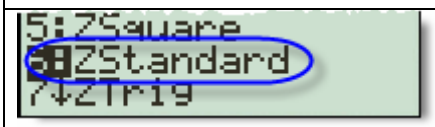
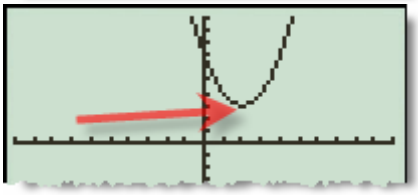
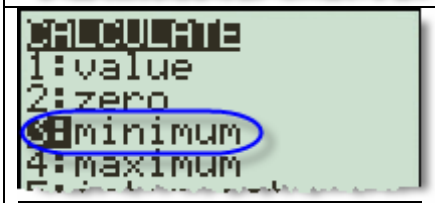
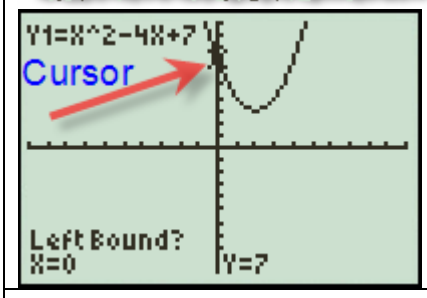
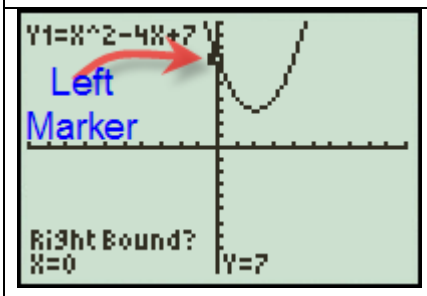
Note: You always have to use the X,T,Θ,n key no matter what variable is used. So if our equation had been $y=\frac{1}{2}p^2-2p+1$, I would still put it in with the X,T,Θ,n key.</td>
</tr>
<tr>
<td> 

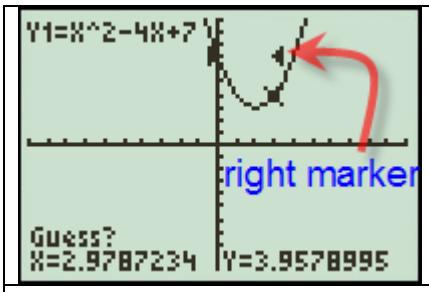
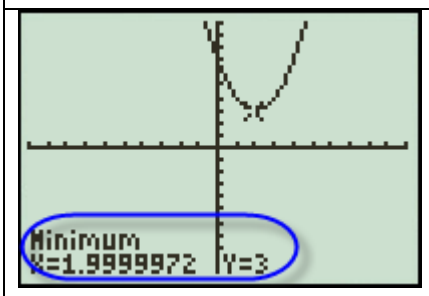
  </td>
<td>Step 3. Press ZOOM 6 to graph on the standard viewing window. You have the graph, which is the answer.

Note: If a function does not completely "fit" using the standard viewing window, press WINDOW and make the necessary adjustments.</td>
</tr>
</table>

Finding a maximum or minimum

Example. Find the vertex of the parabola defined by the function $y = x^2 - 4x + 7$.

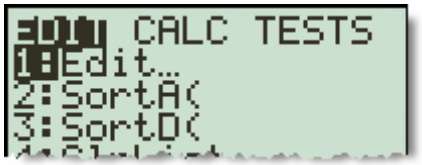
	**Step 1.** To graph the function, press Y=. **Note:** *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing* CLEAR.
	**Step 2.** With the cursor immediately to the right of "Y_1=", enter the equation by pressing X,T,Θ,n ^ 2 − 4 X,T,Θ,n + 7.
 	**Step 3.** To see the graph on a standard viewing window, press ZOOM 6. **Note:** *Because this parabola is concave up, its vertex is the lowest point on the graph, the minimum point.*
 	**Step 4.** To find the vertex of this parabola, press 2ND TRACE to get to the CALCULATION Menu. Press 3 to select "3:minimum." **Note:** *The calculator will prompt you with three questions: "Left Bound?", "Right Bound?" and "Guess?".*
	**Step 5.** To "Left Bound?" respond by pressing the arrow keys to position the cursor to the left of the vertex. The cursor is already to the left of the vertex, so press ENTER. Notice the triangular marker toward the top of the screen. It marks the "Left Bound" you chose.

	**Step 6.** To “Right Bound?” respond by pressing ▷ 14 times to move the cursor to the right of the vertex and press ENTER. Notice the triangular marker toward the top of the screen. It marks the "Right Bound" you chose.
	**Step 7.** To “Guess?” respond by pressing ◁◁◁◁◁ to move the cursor near the vertex. Press ENTER. The TI-84 now displays the coordinates of the vertex as x = 1.9999972, y = 3. The calculator has made a rounding error on the x-value. The vertex is x = 2, y = 3.
	Note: *A maximum point would be found in exactly the same way, except that in step 4, you would select "4:maximum" instead of "3:minimum."*

Making a scatter plot or line graph

Example. Make a scatter plot for the given data.

x	y
1	20
2	50
3	90
4	130
5	200

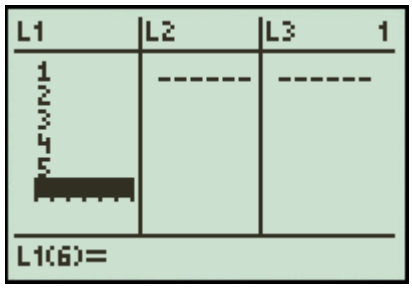


Step 1. When you know <u>both</u> the *x* and *y* values and want to plot the associated points, press STAT.

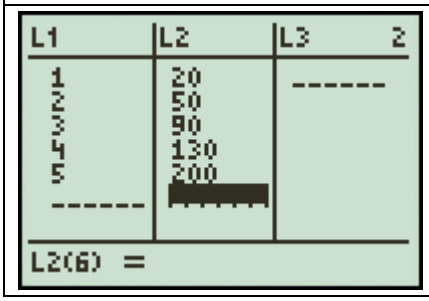
Note: *Don't confuse the* STAT *function and the* TABLE *feature. When you know both the x and the y values (as in our current example), press* STAT*. When you only know the x-values and are given the equation, you will place the equation into the "Y=" screen using* Y= *and then press* 2ND GRAPH *and the "TABLE" will appear, if you have both "Indent:" and "Depend:" set on "Auto"..*

Step 2. You are going to "Edit" "L1" by pressing ENTER or 1 .

Note: *If "L1" already has data in it, position your cursor on "L1" and press* CLEAR ENTER*. Repeat for "L2", if necessary.*

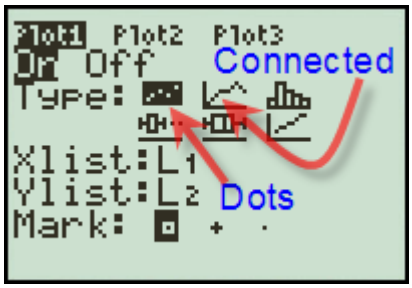
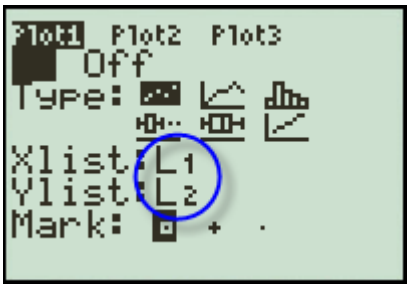
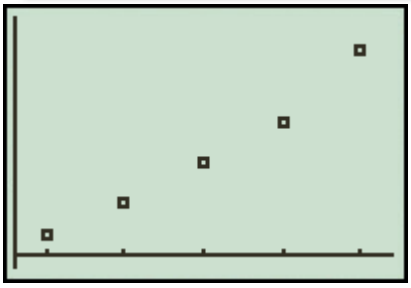
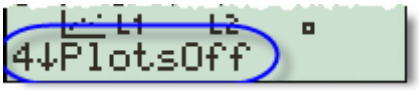


Step 3. You are now ready to enter the *x*-values into "L1". Make sure your cursor is in the "L1" list at the top just below the name of the list. Press 1 ENTER 2 ENTER 3 ENTER 4 ENTER 5 ENTER.



Step 4. You are now ready to enter the *y*-values. Press ▶ to move into "L2". Press 2 0 ENTER and repeat for the remaining values.

Note: *You should press* Y= *and clear any functions in the* Y_n*'s.*

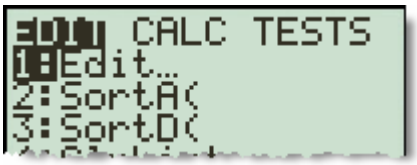
	**Step 5.** In order to graph anything in the "STAT" editor, a "Stat Plot" must be turned on. To do this press 2ND Y=.
	**Step 6**. Press ENTER to select "Plot 1."
	**Step 7.** Press ENTER to toggle it from "Off" to "On."
	**Step 8.** Press ▼ to get to "Type" press ENTER on the first icon to graph a scatter plot (or point plot) if it is not already selected. **Note:** *If you want to connect the points and create a line graph, you would scroll over to the 2nd icon and press* ENTER.
	**Step 9.** If L1 and L2 are not entered for the Xlist and Ylist, change them now by pressing ▼ 2ND 1 to make "L1" your "XList:" and press ▼ 2ND 2 to make "L2" your "YList:". Press ▼ ENTER to choose the type of mark with which you wish to graph. Here you will see something like a small square.
 	**Step 12.** Press ZOOM 9. This is "Zoom Stat" in the ZOOM menu. This command will automatically find the window which best fits your data points. **Note:** *If you want to see the coordinates of each of the points, press* TRACE *and use the left and right arrow keys to scroll through the points.*
	**Step 13.** You should turn your plots off before doing another lesson. Press 2ND Y= 4 ENTER.

Finding the line of best fit: Linear Regression

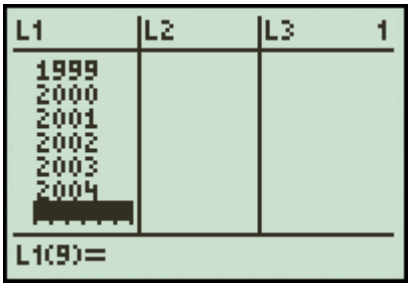
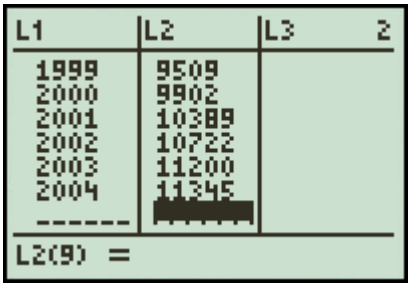
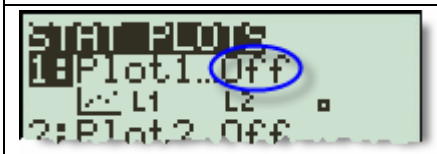
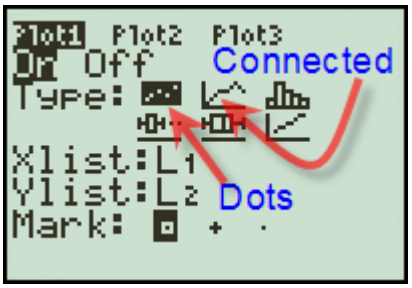
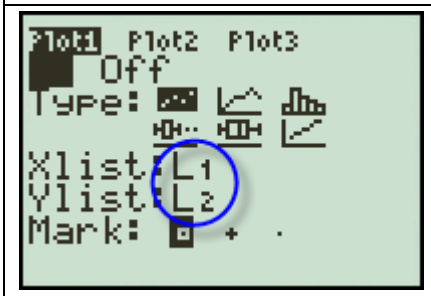
Example. The table below shows the growth of a local university:

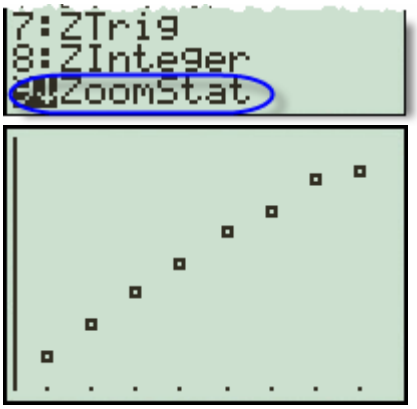
Year	Enrollment
1997	8500
1998	9003
1999	9509
2000	9902
2001	10389
2002	10722
2003	11200
2004	11345

Make a scatter plot, draw the regression line, and determine the equation that best fits the data. The years are the *x*-coordinates and the enrollment is the associated *y*-coordinate for each year.

<table>
<tr><td> 
</td><td>Step 1. You are going to plot the points represented by the data. Press STAT.</td></tr>
<tr><td colspan="2">Note: Don't confuse the lists with the table. When you have data points (as in the current example), you press STAT to put the data into the lists. When you put an equation into the "Y=" screen using Y= and then press 2ND GRAPH the "TABLE" will be created , if you have both "Indent:" and "Depend:" set on "Auto".</td></tr>
<tr><td> 
</td><td>Step 2. To "Edit" the lists, press ENTER.

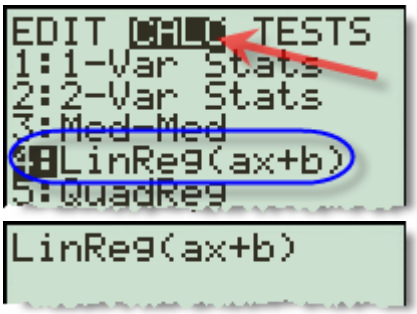
Note: You may press 1 to choose "1:Edit" if you prefer.</td></tr>
<tr><td colspan="2">Note: If "L1" has data in it, position your cursor on "L1" and press CLEAR ENTER . Repeat for "L2", if necessary. If either "L1" or "L2" is missing, press STAT to return to the original STATISTICS menu and press 5 to choose "5:SetUpEditor". Press ENTER to execute the command. If you do this, go back to Step 1 and begin again.</td></tr>
</table>

	**Step 3.** Enter the *x*-values (the years) into "L1". Make sure your cursor is in "L1" at the top just below the name of the list. Press (1) (9) (9) (7) ENTER (1) (9) (9) (8) ENTER etc., until all of the years have been input.
	**Step 4.** Enter the *y*-values (the enrollments) into "L2". Press (›) to move into "L2". Press (8) (5) (0) (0) ENTER and repeat for the remaining values. Both "L1" and "L2" should have the same number of entries before you proceed. **Note:** *Press* (Y=) *and clear any functions in the* Y_n*'s.*
	**Step 5.** In order to graph using the "STAT" editor, a "Stat Plot" must be turned on. To do this press 2ND (Y=).
	**Step 6**. Press ENTER to select "Plot 1."
	**Step 7.** Press ENTER to toggle it from "Off" to "On."
	**Step 8.** Press ▼ to get to "Type" press ENTER on the first icon to graph a scatter plot (or point plot).
	**Step 9.** If L1 and L2 are not entered for the Xlist and Ylist, change them now by pressing ▼ 2ND (1) to make "L1" your "XList:" and press ▼ 2ND (2) to make "L2" your "YList:". Press ▼ ENTER to choose the type of mark with which you wish to graph. Here you will see something like a small square..

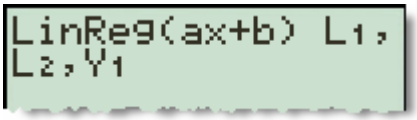


Step 10. Press ZOOM 9. This is "Zoom Stat" in the ZOOM menu. This command will automatically find the window which best fits your data points.
Note: *If you want to see the coordinates of each of the points, press* TRACE *and use the left and right arrow keys to scroll through the points.*

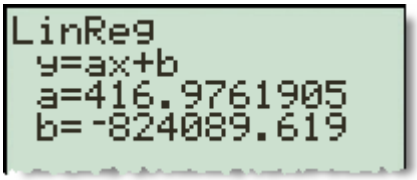
Note: *The data appears to be approximately linear. Therefore, to get the line of best fit you will run a linear regression.*



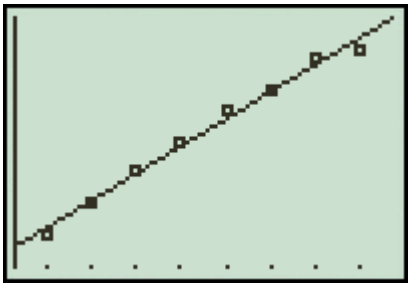
Step 11. Press STAT and scroll over to "CALC" by pressing ›.
To run a linear regression press 4.



Step 12. You want the calculator to find the regression line and graph it, press 2ND 1 , 2ND 2 , VARS › ENTER ENTER. This tells the TI-84 to execute a linear regression on the lists from "L1" and "L2" and store the equation into "Y_1."

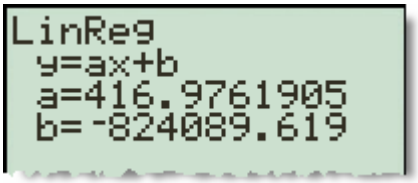


Step 13. Press ENTER and the TI-84 will display the regression equation.

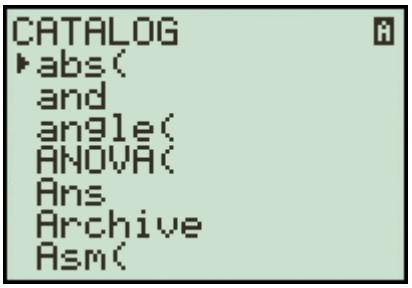


Step 14. To view the graph with the regression line, press ZOOM 9.

Note: *If you want to see the equation of the line which is being graphed, press* Y= and you see the regression equation in "Y_1=."

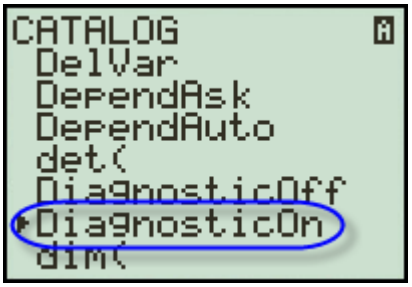


Step 15. Press 2ND MODE to go the home screen.



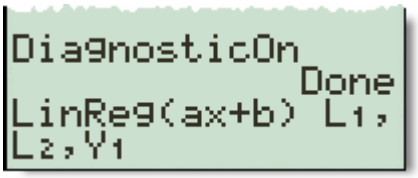
Step 16. When computing a linear regression, it is often helpful to know the values of certain coefficients. In order to display these, you will turn the diagnostic settings on. To do this, you will access the "CATALOG" by pressing 2ND 0. You see a small capital letter "A" in the upper right-hand corner of the screen. This indicates that the calculator is in "ALPHA" mode

Note: *You will see a ▶ to the left of the item to be chosen. You may press the up and down arrow keys ▲▼ to navigate to the item you want. All the calculator's functions are in the "CATALOG."*

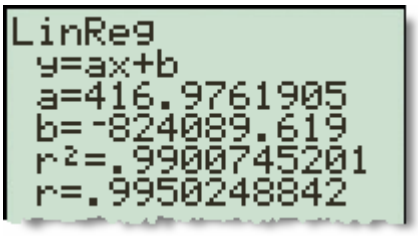


Step 17. Instead of scrolling to the "DiagnosticON" function, a quicker way to access it is to press the first letter of the wanted function; in this case it is a D, so press x^{-1}. Press ▼ 9 times until the ▶ is to the left of "DiagnosticOn" and press ENTER.

Step 18. With "DiagnosticOn" displayed on the home screen, press ENTER.



Step 23. Run the linear regression again by pressing 2ND ENTER 2ND ENTER. This will recall the 2nd to the last entry that was executed by the TI-84 on the home screen.



Step 24. Press ENTER. There are two coefficients r and r^2 that are now displayed. The nearer "r^2" is to 1, the closer the fit of the line to the data. Leaving the "DiagnosticOn" will not negatively impact future calculations.

Note: *Before proceeding, you may want to turn the plot off by pressing 2ND Y= to return to the "STAT PLOT" menu. Press 4 to choose "4:PlotsOff". Press ENTER to execute the command.*

Non-linear function of least squares fit

Example. The table below shows the growth of a local university:

Year	Enrollment
1997	4000
1998	4205
1999	4489
2000	5210
2001	5806
2002	6901
2003	8018
2004	9234

Make a scatter plot, draw the regression line, and determine the (4^{th} degree) polynomial that best fits the data. The years are the *x*-coordinates and the enrollment is the associated *y*-coordinate for each year.

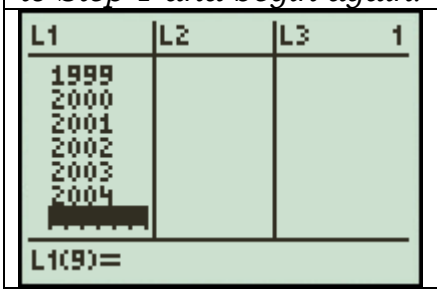
Step 1. You are going to plot the points represented by the data. Press STAT.

Note: *Don't confuse the lists with the table. When you have data points (as in the current example), you press* STAT *to put the data into the lists. When you put an equation into the "Y=" screen using* Y= *and then press* 2ND GRAPH *the "TABLE" will be created , if you have both "Indent:" and "Depend:" set on "Auto".*

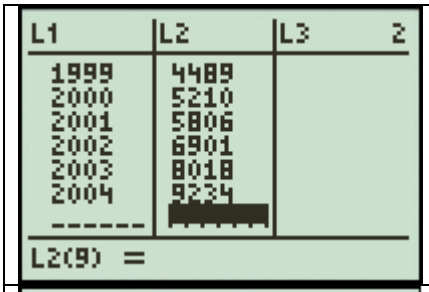
Step 2. To "Edit" the lists, press ENTER.

Note: *You may press* 1 *to choose "1:Edit" if you prefer.*

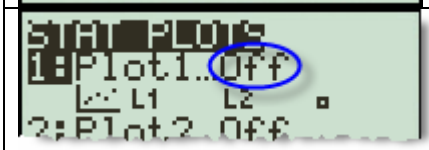
Note: *If "L1" has data in it, position your cursor on "L1" and press* CLEAR ENTER *. Repeat for "L2", if necessary. If either "L1" or "L2" is missing, press* STAT *to return to the original STATISTICS menu and press* 5 *to choose "5:SetUpEditor". Press* ENTER *to execute the command. If you do this, go back to Step 1 and begin again.*



Step 3. Enter the *x*-values (the years) into "L1". Make sure your cursor is in "L1" at the top just below the name of the list. Press 1 9 9 7 ENTER 1 9 9 8 ENTER etc., until all of the years have been input.



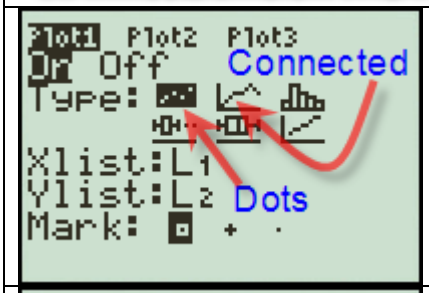
Step 4. Enter the *y*-values (the enrollments) into "L2". Press ▶ to move into "L2". Press 4 0 0 0 ENTER and repeat for the remaining values. Both "L1" and "L2" should have the same number of entries before you proceed.
Note: *Press* Y= *and clear any functions in the* Y_n*'s.*



Step 5. In order to graph using the "STAT" editor, a "Stat Plot" must be turned on. To do this press 2ND Y=.

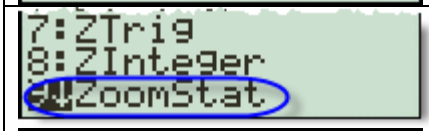
Step 6. Press ENTER to select "Plot 1."

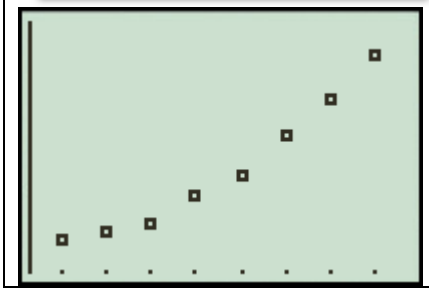
Step 7. Press ENTER to toggle it from "Off" to "On."



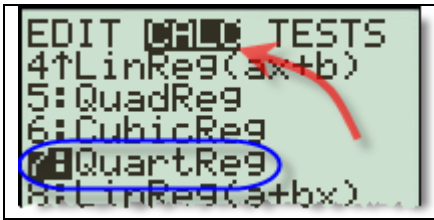
Step 8. Press ▼ to get to "Type" press ENTER on the first icon to graph a scatter plot (or point plot).

Step 9. If L1 and L2 are not entered for the Xlist and Ylist, change them now by pressing ▼ 2ND 1 to make "L1" your "XList:" and press ▼ 2ND 2 to make "L2" your "YList:". Press ▼ ENTER to choose the type of mark with which you wish to graph. Here you will see something like a small square.



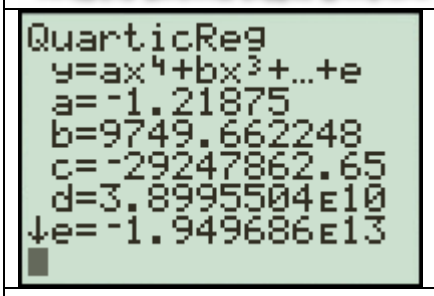


Step 12. Press ZOOM 9. This is "Zoom Stat" in the ZOOM menu. This command will automatically find the window which best fits your data points.
Note: *If you want to see the coordinates of each of the points, press* TRACE *and use the left and right arrow keys to scroll through the points.*
Note: *The data do appear to be linear. That is, they do not lie along a straight line.*



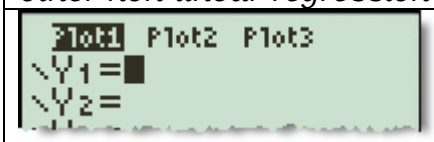
Step 13. Press STAT and scroll over to "CALC" by pressing ▷.

Step 14. To find a 4th degree polynomial that fits the data, press 7.

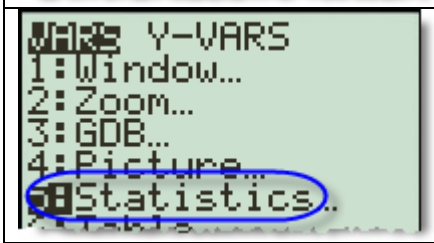


Step 15. You want the calculator to find the regression equation, press 2ND 1 , 2ND 2 ENTER. This tells the TI-84 to execute a quartic regression on the lists from "L1" and "L2".

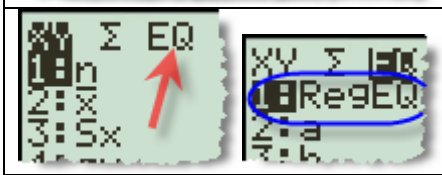
Note: *If you want a 2nd degree polynomial, select "QuadReg"; if you want a 3rd degree polynomial, select "CubicReg." You may want to investigate the other non-linear regression models on your own.*



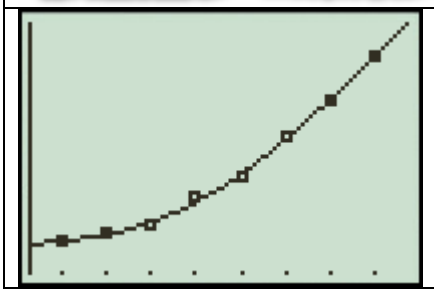
Step 16. Press Y=. You want to paste the regression equation into "Y_1".



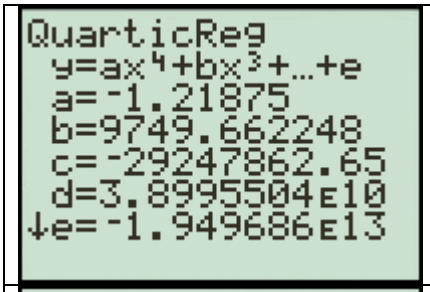
Step 17. With the cursor to the right of "Y_1=", press VARS 5 to choose "5:Statistics".



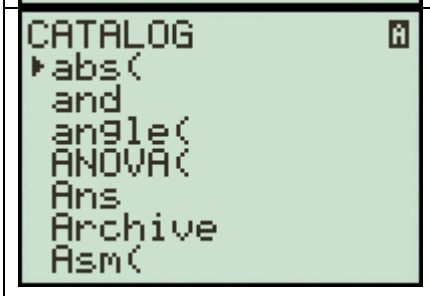
Step 18. Scroll over to "EQ" by pressing ▷▷ and select "RegEQ" by pressing ENTER. This will paste the regression equation into "Y_1".



Step 19. To view the graph with the regression curve along with the data points, press ZOOM 9.

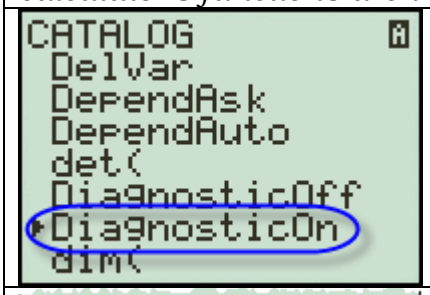


Step 20. Press 2ND MODE to go the home screen.



Step 21. When computing a quartic regression, it is often helpful to know the values of certain coefficients. In order to display these, you will turn the diagnostic settings on. To do this, you will access the "CATALOG" by pressing 2ND 0. You see a small capital letter "A" in the upper right-hand corner of the screen. This indicates that the calculator is in "ALPHA" mode

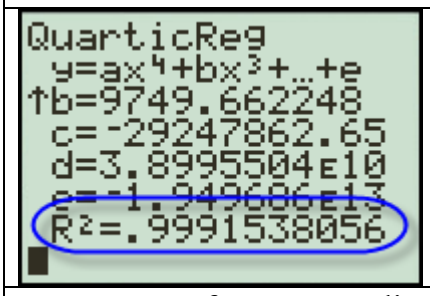
Note: *You will see a ► to the left of the item to be chosen. You may press the up and down arrow keys to navigate to the item you want. All the calculator's functions are in the "CATALOG."*



Step 22. Instead of scrolling to the "DiagnosticON" function, a quicker way to access it is to press the first letter of the wanted function; in this case it is a D, so press x^{-1}. Press ▼ 9 times until the ► is to the left of "DiagnosticOn" and press ENTER.

Step 24. With "DiagnosticOn" displayed on the home screen, press ENTER.

Step 25. Run the Quartic regression again by pressing 2ND ENTER 2ND ENTER. This will recall the 2nd to the last entry that was executed by the TI-84 on the home screen.

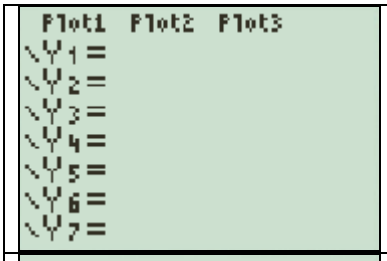


Step 26. Press ENTER ▼. There is one coefficient r^2 that is now displayed. The nearer "r^2" is to 1, the closer the fit of the curve to the data. Leaving the "DiagnosticOn" will not negatively impact future calculations.

Note: *Before proceeding, you should turn the plot off by pressing 2ND Y= to return to the "STAT PLOT" menu. Press 4 to choose "4:PlotsOff". Press ENTER to execute the command.*

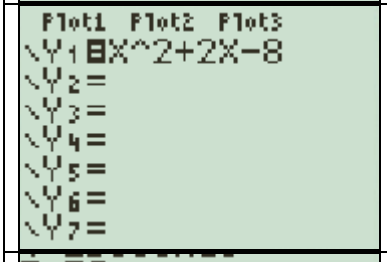
Locating a zero/root of a function

Example. Find the zeros of $f(x) = x^2 + 2x - 8$.

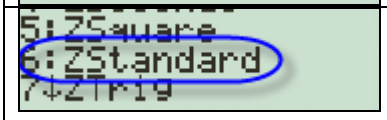


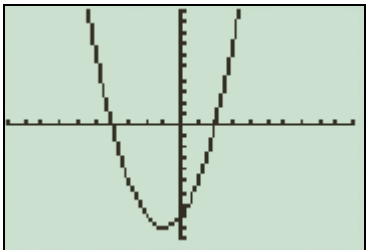
Step 1. To graph the function, press Y=

Note: *Clear any equations in your "Y=" screen by positioning your cursor to the right of the "=" and pressing* CLEAR. .



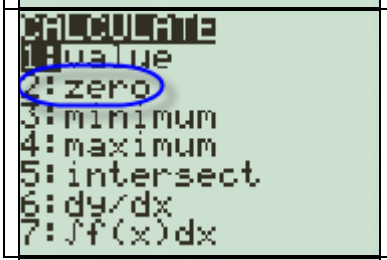
Step 2. With the cursor immediately to the right of "Y_1=", press X,T,Θ,n ^ 2 + 2 X,T,Θ,n − 8.





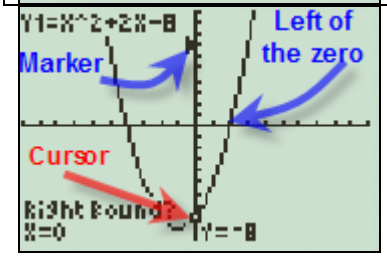
Step 3. To see the graph on a standard viewing window press ZOOM 6.

Note: *The zeros of a function (also called "roots") are the x coordinates of the x-intercept points.*

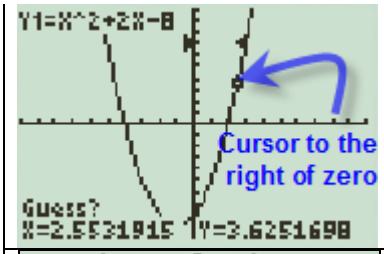
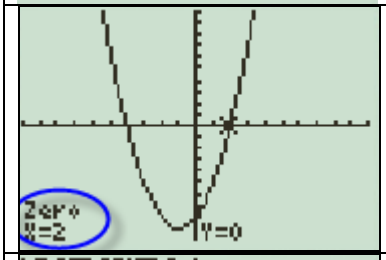
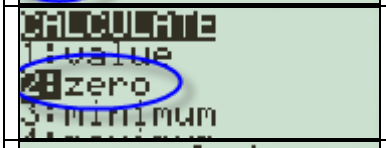
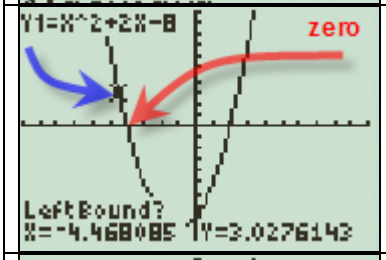
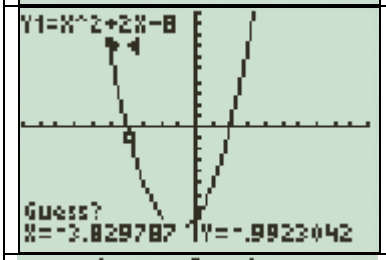
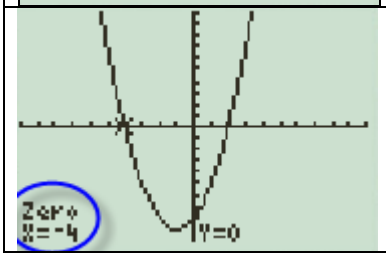


Step 4. Notice that there are two x-intercepts. To find the positive zero, press 2ND TRACE to go to the CALCULATION Menu press 2 to choose "2:zero."

Note: *The calculator will prompt you with three questions: "Left Bound?", "Right Bound?" and "Guess?".*



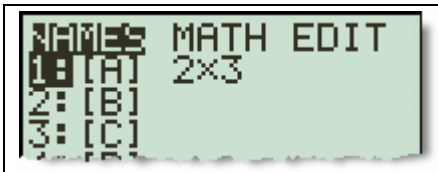
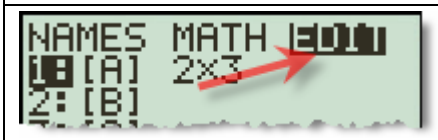
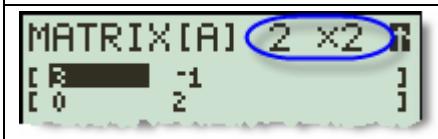
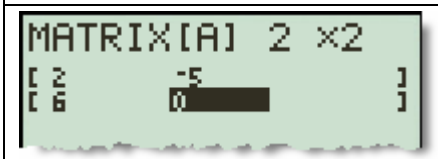
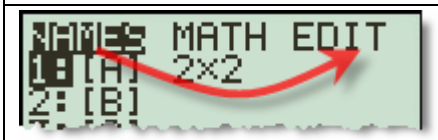
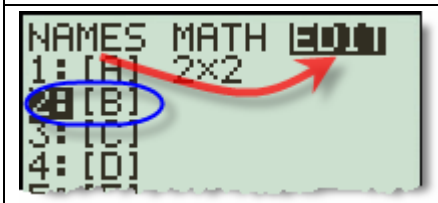
Step 5. To "Left Bound?" respond by pressing the arrow keys to position the cursor to the left of the zero you are finding. In this case, the cursor is already left of the positive zero, so press ENTER. Notice the triangular marker toward the top of the screen. It marks the "Left Bound" that you chose.

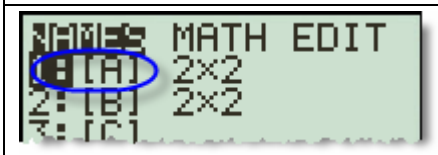
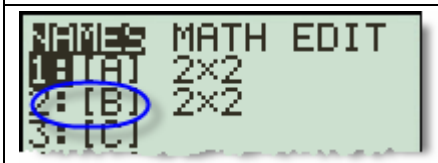
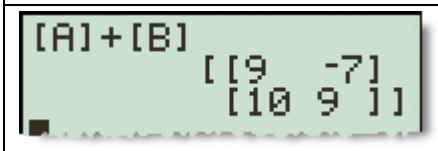
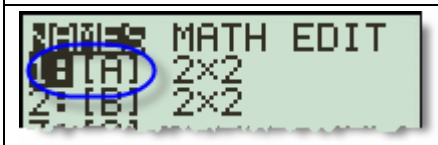
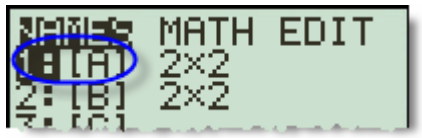
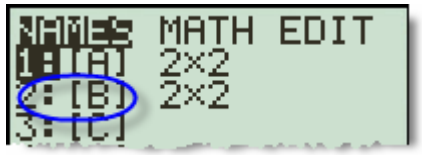
	**Step 6.** To "Right Bound?" respond by pressing ▷ 12 times to move to the right of the positive zero and press ENTER. This marks the "Right Bound". That is, the cursor is now to the right of the zero (x-intercept).
	**Step 7.** To "Guess?" respond by pressing ◁ ◁ to move the cursor near the zero. Press ENTER. The TI-84 now displays the zero of x = 2.
	**Step 8.** To find the negative zero press 2ND TRACE to go to the CALCULATION Menu press 2 to choose "2:zero."
	**Step 9.** To "Left Bound?" respond by pressing ◁ 30 times to move the cursor to the left of the negative zero. Press ENTER.
	**Step 10.** To "Right Bound?" respond by pressing ▷ 3 times to move the cursor to the right of the negative zero. Press ENTER.
	**Step 11.** To "Guess?" respond by pressing ENTER. You did not need to move the cursor as it was already positioned near the zero you sought . The TI-84 now displays the zero of x = -4.

Performing arithmetic operations on matrices

Example. Given $\mathbf{A} = \begin{bmatrix} 2 & -5 \\ 6 & 0 \end{bmatrix}$ **and** $\mathbf{B} = \begin{bmatrix} 7 & -2 \\ 4 & 9 \end{bmatrix}$ find:

A. $\mathbf{A} + \mathbf{B}$
B. $\mathbf{3A}$
C. $\mathbf{A} \times \mathbf{B}$.

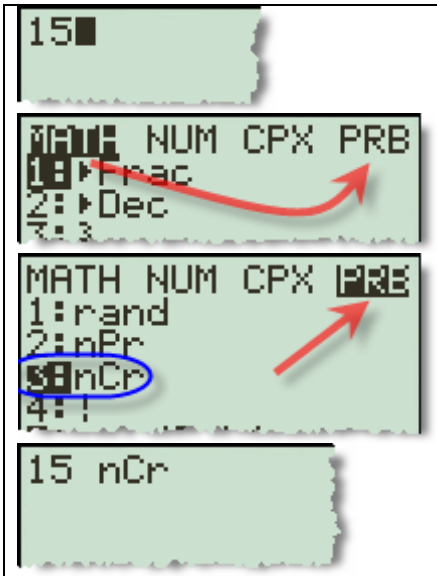
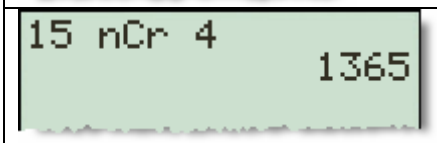
	**Step 1.** To enter matrix A, press 2ND x^{-1} to access the MATRIX menu.
	**Step 2.** Scroll over to “EDIT” by pressing ▶ ▶ . Press ENTER to choose "1:[A]".
	**Step 3.** You must enter the dimensions of the matrix. This matrix has 2 rows and 2 columns, so it is a 2 x 2 matrix. Press 2 ENTER 2 ENTER.
	**Step 4.** Enter the first row by pressing 2 ENTER (−) 5 ENTER.
	Step 5. Enter the second row by pressing 6 ENTER 0 ENTER.
	**Step 6.** To enter matrix B, press 2ND x^{-1} to access the MATRIX menu.
	**Step 7.** Scroll over to “EDIT” by pressing ▶ ▶ . Press 2 to choose "2:[B]".
	**Step 8.** You must enter the dimensions of the matrix. This matrix has 2 rows and 2 columns, so it is a 2 x 2 matrix. Press 2 ENTER 2 ENTER.
	Step 9. Enter the first row by pressing 7 ENTER (−) 2 ENTER.
	Step 10. Enter the second row by pressing 4 ENTER 9 ENTER.

	**Step 11.** Press 2ND MODE to go to the home screen.
	**Step 12.** In **Part A** you are to find **A + B**. To access the MATRIX menu by pressing 2ND x^{-1}.
	**Step 13.** Your first matrix is [A]. Press ENTER to select it. Press +
	**Step 14.** Go back to the MATRIX menu by pressing 2ND x^{-1}.
	**Step 15.** Your second matrix is [B]. Press 2 to select it.
	Step 16. Press ENTER to execute.
	**Step 17.** In **Part B** you are to find **3A**. Press 3.
	**Step 18.** Press 2ND x^{-1} to access the MATRIX menu.
	**Step 19.** Your matrix is [A]. Press ENTER to select it.
	Step 20. Press ENTER to execute.
	**Step 21.** In **Part C** you are to find **AB**. Press 2ND x^{-1} to access the MATRIX menu.
	**Step 22.** Your first matrix is [A]. Press ENTER to select it. Press ×
	**Step 23.** Go back to the MATRIX menu by pressing 2ND x^{-1}.
	**Step 24.** Your second matrix is [B]. Press 2 to select it.
	Step 25. Press ENTER to execute.

Combinations

The combination formula is $_{n}C_{r} = \frac{n!}{r!(n-r)!}$, where *n* is the total number of elements and *r* is the number selected. The combination formula is built into the TI-84's probability menu.

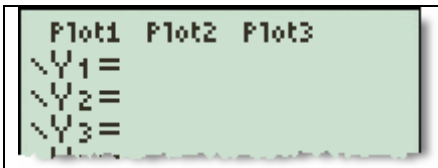
Example. How many different 4 person committees can be formed from a group of 15 people?

<table>
<tr>
<td> 
</td>
<td>Step 1. Because the order does not matter, we are going to evaluate the combination of 15 things taken 4 at a time or $_{15}C_{4}$. To do this press (1) (5) MATH scroll to "PRB" by pressing (▸)(▸)(▸) and select “3:nCr” by pressing (3).</td>
</tr>
<tr>
<td> 
</td>
<td>Step 2. Press (4) ENTER and you see that there are 1365 ways in which 4 person committees may be chosen.</td>
</tr>
</table>

Piece-wise Defined Functions

Functions that are defined over different domains are called piece-wise defined functions. Their graphs are a little more difficult to produce.

Example 1. Graph $f(x)=\begin{cases} x+2, & x<3 \\ 2x-9, & x\geq 3 \end{cases}$.

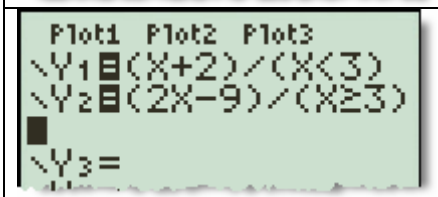


Step 1. Press Y=.

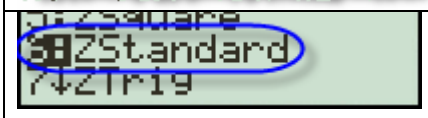
Note: *If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing* CLEAR.

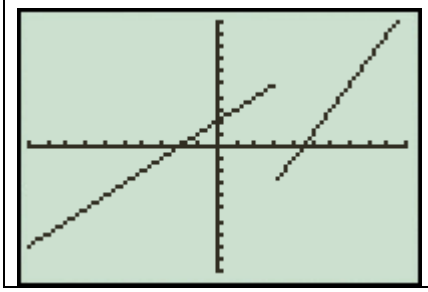
Note: *You enter each piece of a piecewise defined function in its own Y_n. So, you will enter the first piece into "Y_1" and the second piece into "Y_2." The function and the inequality are separated by a division sign. It is also important that each piece and the inequality portion be in parentheses.*

Step 2. Enter the first piece into "Y_1" by pressing (X,T,Θ,n + 2) ÷ (X,T,Θ,n 2ND MATH 5 3) ENTER.



Step 3. Enter the second piece into "Y_2" by pressing (2 X,T,Θ,n − 9) ÷ (X,T,Θ,n 2ND MATH 4 3).





Step 4. Press ZOOM 6 and you get the graph shown. Notice that there is a jump between the two pieces. This often happens with piece-wise defined functions.

Example 2. Graph $f(x)=\begin{cases}-2x, & x<-2\\ x^2-2, & -2\le x\le 2\\ x, & 2<x\le 6\\ 8, & x>6\end{cases}$.

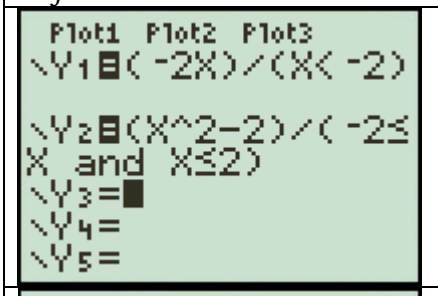
Step 1. Press Y=.

Note: *If there are functions in the Y_n's on your calculator, clear them by positioning your cursor immediately to the right of the "=" and pressing* CLEAR.

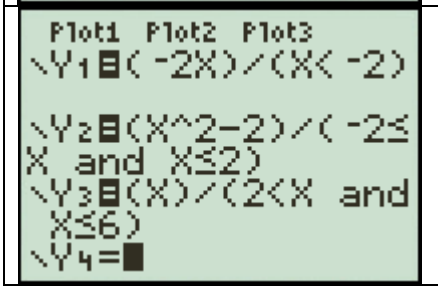
Note: *You enter each piece in its own Y_n. So, you will enter the first piece into "Y_1" and the second piece into "Y_2." The function and the inequality are separated by a division sign. It is also important that each piece and the inequality portion be in parentheses.*

Step 2. Enter the first piece into "Y_1" by pressing ((−) 2 X,T,Θ,n) ÷ (X,T,Θ,n 2ND MATH 5 (−) 2) ENTER.

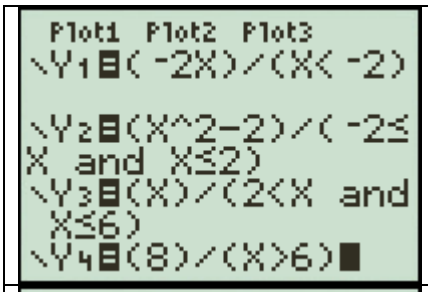
Note: *The second and third pieces of the function contain a compound inequalities. To put them in the calculator we write them as two separate inequalities separated by "and". As you will see in the keystrokes, "and" is found in the LOGIC sub-menu of the TEST menu.*



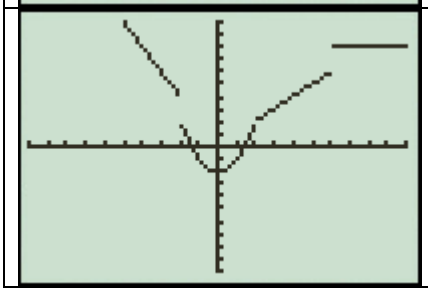
Step 3. Enter the second piece into "Y_2" by pressing (X,T,Θ,n ^ 2 − 2) ÷ ((−) 2 2ND MATH 6 X,T,Θ,n 2ND MATH) ENTER X,T,Θ,n 2ND MATH 6 2) ENTER.



Step 4. Enter the third piece into "Y_3" by pressing (X,T,Θ,n) ÷ (2 2ND MATH 5 X,T,Θ,n 2ND MATH) ENTER X,T,Θ,n 2ND MATH 6 6) ENTER.



Step 5. Enter the fourth piece into "Y_4" by pressing (8) ÷ (X,T,Θ,n 2ND MATH 3 6).

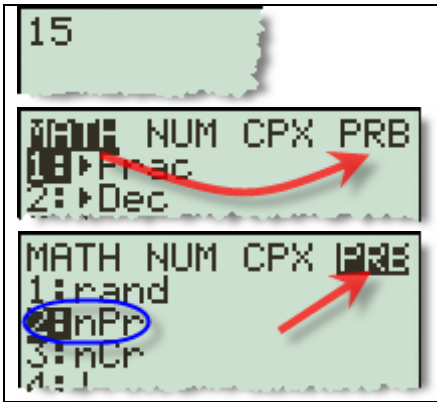


Step 6. Press ZOOM 6 and you will see the graph on the standard viewing window. Notice that there are 4 distinct pieces.

Permutations

The permutation formula is $_{n}P_{r} = \frac{n!}{(n-r)!}$, where *n* is the total number of elements and *r* is the number selected. The permutation formula is built into the TI-84's probability menu.

Example. How many ways can a group of 15 people elect a president, vice president, treasurer, and secretary? That is, how many different sets of officers are possible?

	**Step 1.** Because the order matters, we are going to evaluate the permutation of 15 things taken 4 at a time or $_{15}P_{4}$. To do this press 1 5 MATH scroll to "PRB" by pressing ▸ ▸ ▸ and select "2:nPr" by pressing 2.
	**Step 2.** Press 4 ENTER and you see that there are 32,760 different sets of officers.

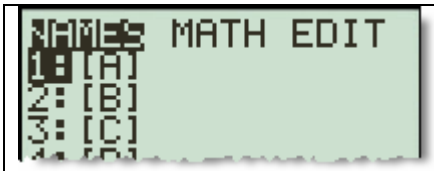
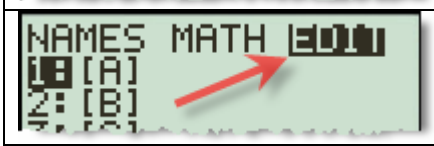
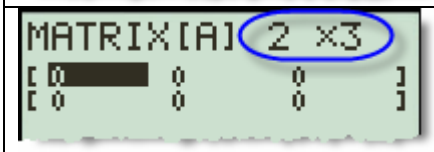
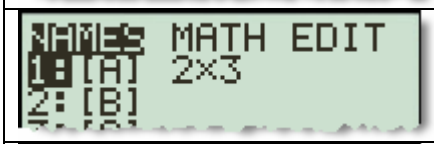
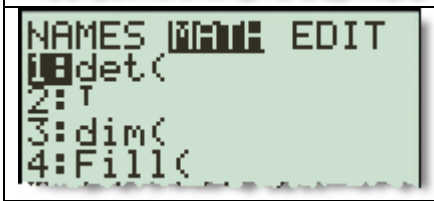
Reduced Row Echelon Form (rref)

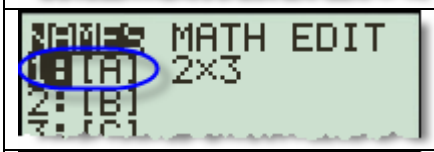
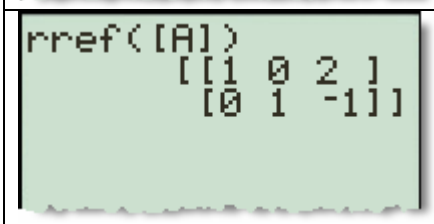
Example 1. Use Gauss-Jordan Elimination to solve the system of equations

$$\begin{cases} x - 3y = 5 \\ 2x + y = 3 \end{cases}.$$

Note: *Write the system of equations as an augmented matrix*

$$\begin{cases} x - 3y = 5 \\ 2x + y = 3 \end{cases} \longrightarrow \left[\begin{array}{cc|c} 1 & -3 & 5 \\ 2 & 1 & 3 \end{array}\right].$$

	**Step 1.** Press 2ND x^{-1} to access the MATRIX menu. (On the TI-83, you can just press the MATRIX key.)
	**Step 2.** Scroll over to "EDIT" by pressing ▷▷. Press ENTER to choose "1:[A]".
	**Step 3.** You must enter the dimensions of the matrix. This matrix has 2 rows and 3 columns, so it is a 2 x 3 matrix. Press 2 ENTER 3 ENTER.
	**Step 4.** Enter the first row by pressing 1 ENTER (−) 3 ENTER 5 ENTER.
	**Step 5.** Enter the second row by pressing 2 ENTER 1 ENTER 3 ENTER.
	**Step 6.** Press 2ND MODE to go to the home screen.
	**Step 7.** To put the matrix in reduced-row echelon form, press 2ND x^{-1} to access the MATRIX menu
	**Step 8.** Scroll to "MATH" by pressing ▷.

	**Step 9.** Scroll to "B: rref(" by pressing ▽ 11 times. **Note:** *On your calculator you may press* ALPHA APPS *to more quickly access the "rref" command.*
	**Step 10.** To tell the calculator which matrix to use, press 2ND x^{-1}.
	**Step 11.** Your augmented matrix is [A]. Press ENTER to select it.
	**Step 12.** Press) to close the parentheses and ENTER to execute. On paper, this would look like: $\left[\begin{array}{cc\|c} 1 & 0 & 2 \\ 0 & 1 & -1 \end{array}\right]$ Therefore $x = 2, y = -1$.

Solving a linear system with a matrix inverse

Example. Solve the system of equations by finding the inverse of its coefficient matrix.

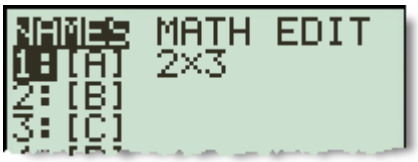
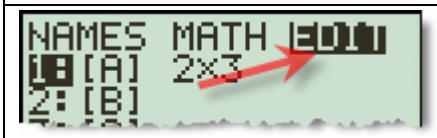
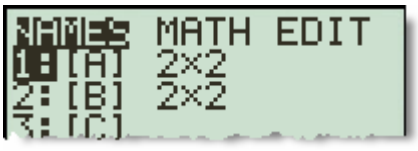
$$\begin{cases} 2x + 6y = 24 \\ 3x + 5y = -8 \end{cases}.$$

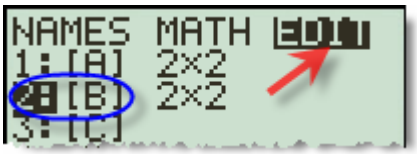
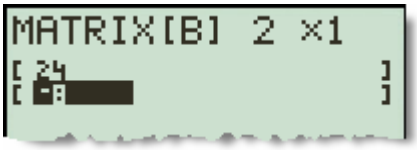
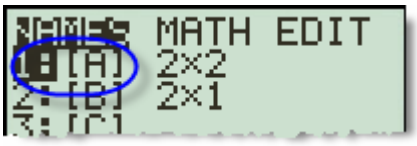
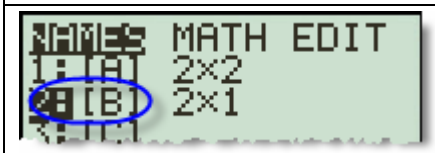
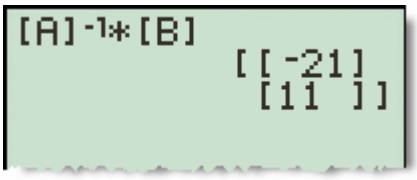
You should rewrite this as:

$$\begin{bmatrix} 2 & 6 \\ 3 & 5 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 24 \\ -8 \end{bmatrix},$$

where $\mathbf{A} = \begin{bmatrix} 2 & 6 \\ 3 & 5 \end{bmatrix}$ and $\mathbf{B} = \begin{bmatrix} 24 \\ -8 \end{bmatrix}$.

Once you find $\mathbf{A}^{-1}$, $\begin{bmatrix} x \\ y \end{bmatrix} = \mathbf{A}^{-1}\mathbf{B}$.

	**Step 1.** To enter matrix A, press 2ND x^{-1} to access the MATRIX menu.
	**Step 2.** Scroll over to “EDIT” by pressing ▷ ▷. Press ENTER to choose "1:[A]".
	**Step 3.** You must enter the dimensions of the matrix. This matrix has 2 rows and 2 columns, so it is a 2 x 2 matrix. Press 2 ENTER 2 ENTER.
	Step 4. Enter the first row by pressing 2 ENTER 6 ENTER.
	Step 5. Enter the second row by pressing 3 ENTER 5 ENTER.
	**Step 6.** To enter matrix B, press 2ND x^{-1} to access the “MATRIX” menu.

	**Step 7.** Scroll over to “EDIT” by pressing ▶ ▶. Press 2 to choose "2:[B]".
	**Step 8.** You must enter the dimensions of the matrix. This matrix has 2 rows and 1 column, so it is a 2 x 1 matrix. Press 2 ENTER 1 ENTER.
	Step 9. Enter the first row by pressing 2 4 ENTER.
	Step 10. Enter the second row by pressing (−) 8 ENTER.
	**Step 11.** Press 2ND MODE to go to the home screen.
	**Step 12.** Press 2ND x^{-1} to access the MATRIX menu.
	**Step 13.** Your first matrix is [A]. Press ENTER to select it.
	Step 14. You want the inverse of A. Press x^{-1}.
	Step 15. Press ×.
	**Step 16.** Go back to the MATRIX menu by pressing 2ND x^{-1}.
	**Step 17.** Your second matrix is [B]. Press 2 to select it.
	Step 18. Press ENTER to execute. The answer is x = 21, y = 11.

The TVM solver

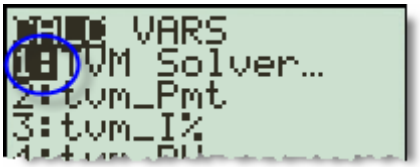
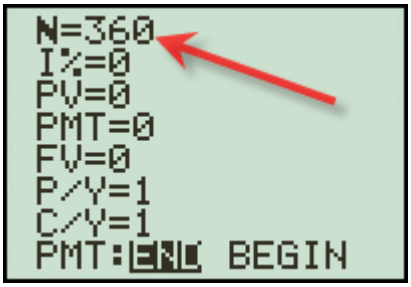
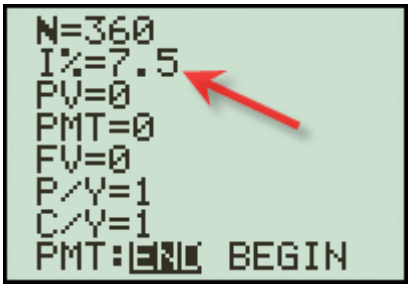
The Time-Value-of-Money (TVM) solver displays the following variables:

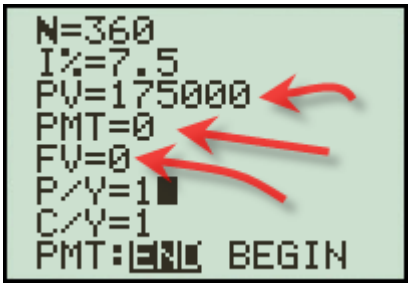
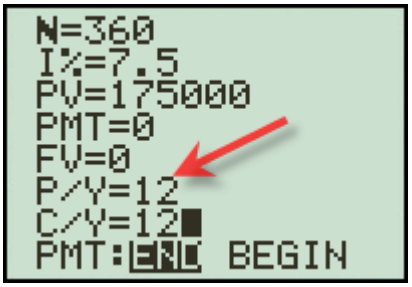
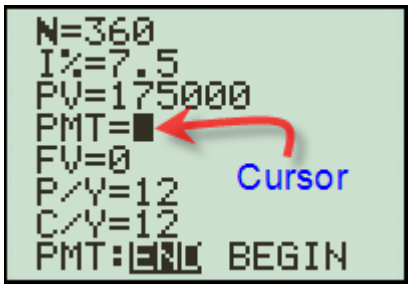
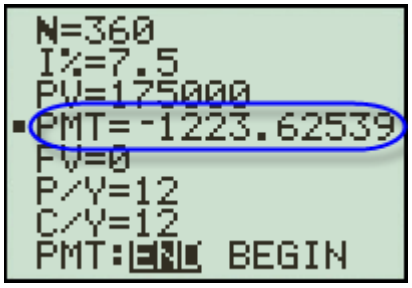
If 4 of these are known, the TVM solver will solve for the fifth variable

N	The number of payment/compounding periods
I%	Annual Interest rate
PV	Present Value
PMT	Periodic Payment amount
FV	Future Value
P/Y	Payment periods per year
C/Y	Compounding periods per yea

You may decide if the payment is at the beginning or the end of the period.

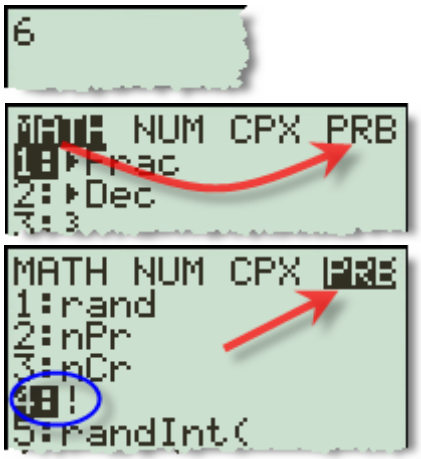
Example. Suppose you have found a house on sale for $175,000. What would your monthly payments be if you financed it for 30 years at 7.5% interest?

	**Step 1.** Press APPS and select "1:Finance" by pressing ENTER.
	**Step 2.** Select "TVM Solver…" by pressing ENTER.
	**Step 3.** The cursor is positioned to the right of "**N**=", which is the number of payment periods over the life of the loan. If you are financing the loan for 30 years, you will make 12 payments a year for 30 years. Press 1 2 × 3 0 ENTER. You see "**N**=360"
	**Step 4.** With the cursor flashing to the right of "I%=,"press 7 · 5 ENTER. **Note:** *When you are using interest formulas you have to convert the interest rate into a decimal, you do not have to do this in the "TVM Solver."*

	**Step 5.** The cursor is positioned to the right of "PV=", which is the present value of the loan. Press 1 7 5 0 0 0 ENTER.
	Step 6. With the cursor positioned to the right of "PMT=", press 0 ENTER.
	Step 7. With the cursor positioned to the right of "FV=", press 0 ENTER.
	**Step 8.** You need to adjust the number of payment periods to 12 (12 months in a year). With the cursor positioned to the right of "P/Y=", press 1 2 ENTER. **Note:** *The "C/Y=" will automatically be changed to 12.*
	**Step 9.** Position the cursor to the right of "PMT=" by pressing ^ ^ ^. This is the variable which represents the loan payment.
	**Step 10.** To "SOLVE", press ALPHA ENTER. Your house payment is $1223.63. **Note:** *The TI-84 designates outflows of money with a negative sign and inflows of money with a positive sign.*

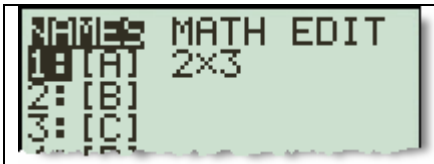
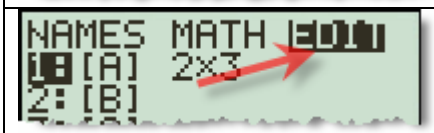
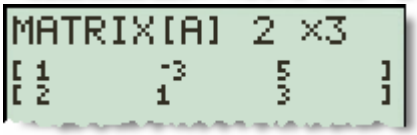
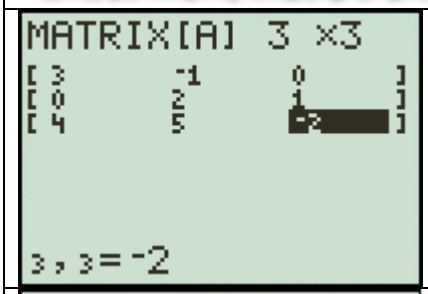
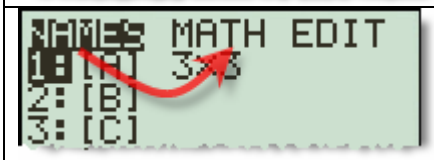
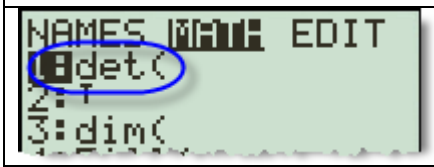
Factorials

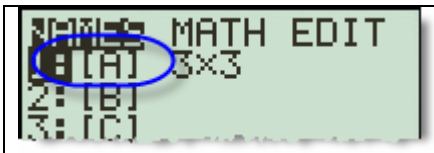
Example. Evaluate 6!

	**Step 1.** Press 6 MATH and scroll to "PRB" by pressing ›››.
	**Step 2.** Select the factorial symbol by pressing 4
	**Step 3.** Press ENTER to evaluate. You see that 6! = 720.

Evaluating a determinant

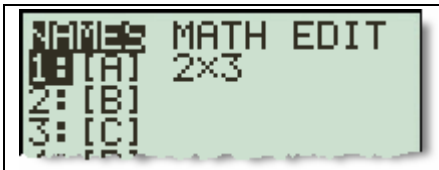
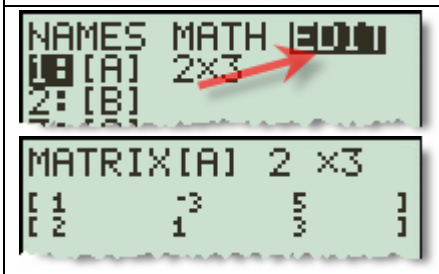
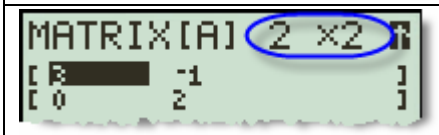
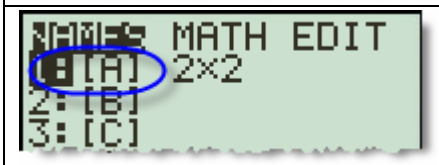
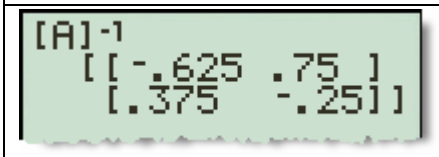
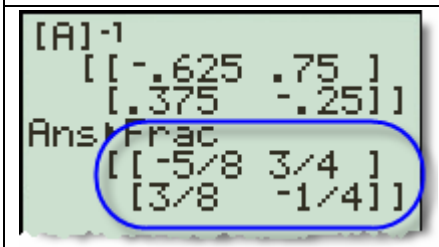
Example. Evaluate $\begin{vmatrix} 3 & -1 & 0 \\ 0 & 2 & 1 \\ 4 & 5 & -2 \end{vmatrix}$.

	**Step 1.** Press 2ND x^{-1} to access the MATRIX menu.
 	**Step 2.** Scroll over to “EDIT” by pressing ▶▶. Press ENTER to choose "1:[A]".
	**Step 3.** You must enter the dimensions of the matrix. This matrix has 3 rows and 3 columns, so it is a 3 x 3 matrix. Press 3 ENTER 3 ENTER.
	**Step 4.** Enter the first row by pressing 3 ENTER (−) 1 ENTER 0 ENTER. **Step 5.** Enter the second row by pressing 0 ENTER 2 ENTER 1 ENTER. **Step 6.** Enter the third row by pressing 4 ENTER 5 ENTER (−) 2 ENTER.
	**Step 7.** Press 2ND MODE to go to the home screen.
	**Step 8.** To find the determinant, press 2ND x^{-1} to return to the MATRIX menu. **Note:** *Only square matrices (2 x 2, 3 x 3, 4 x 4, etc.) have determinants*
	**Step 9.** Scroll to “MATH” by pressing ▶.
	**Step 10.** Press ENTER to select “1: det(”.

	**Step 11.** To tell the calculator which matrix to use, press 2ND x^{-1} to return to the MATRIX menu. (or press MATRIX on the TI-83)
	**Step 12.** Your matrix is [A]. Press ENTER to select it.
	**Step 13.** Press) to close the parentheses and ENTER to execute. The determinant is -31.

Finding the inverse of a matrix

Example. Find the inverse of $\begin{bmatrix} 2 & 6 \\ 3 & 5 \end{bmatrix}$.

	**Step 1.** Press 2ND x^{-1} to access the MATRIX menu.
	**Step 2.** Scroll over to "EDIT" by pressing ▷▷. Press ENTER to choose "1:[A]".
	**Step 3.** You must enter the dimensions of the matrix. This matrix has 2 rows and 2 columns, so it is a 2 x 2 matrix. Press 2 ENTER 2 ENTER.
	**Step 4.** Enter the first row by pressing 2 ENTER 6 ENTER.
	Step 5. Enter the second row by pressing 3 ENTER 5 ENTER.
	**Step 6.** Press 2ND MODE to go to the home screen.
	**Step 7.** To find the inverse go to "MATRIX" by pressing 2ND x^{-1}.
	**Step 8.** Your matrix is [A]. Press ENTER to select it.
	**Step 9.** To find the inverse, press x^{-1}. Press ENTER to execute. **Note:** *Only square matrices (2 x 2, 3 x 3, 4 x 4, etc.) that have non-zero determinants have inverses.*
	**Step 10.** To convert to the entries to fractions press MATH ENTER ENTER. You see that the inverse of $\begin{bmatrix} 2 & 6 \\ 3 & 5 \end{bmatrix}$ is $\begin{bmatrix} -\frac{5}{8} & \frac{3}{4} \\ \frac{3}{8} & -\frac{1}{4} \end{bmatrix}$.