MATH 110
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Using Your TI-nspire CAS

Guidebooks for all Texas Instruments calculators can be downloaded (in Adobe PDF format) from http://education.ti.com/en/us/guidebook/search Just search for your type of calculator. For your convenience I have also placed them in the Project Directory for our class in the folder *Information*.
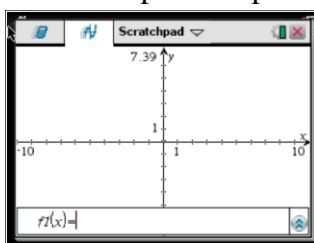
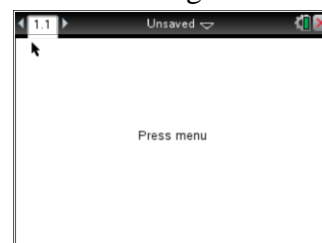Home Screen   Scratchpad: Calculate   Scratchpad: Graph   Document Page

Tips to Save Typing, etc.

1. To do calculations, you want to work in the Scratchpad (You can work in a document also). From the home screen scroll over to Scratchpad and highlight A Calculate or just press the A key. You can also get to the Scratchpad by pressing ▢ . To clear the Scratchpad press menu then 1:Actions then 5:Clear History. To clear the Scratchpad **and all its variables**, press doc▾ then choose option B: Clear Scratchpad. You can also save your work from the Scratchpad by pressing doc▾ then choosing option A: Save to Document.

2. To avoid retyping something that already appears on the Scratchpad, scroll up to the item you want so that it is highlighted, then press enter. This will paste that item into a new entry line.

3. The minus sign − is above enter, the negative number sign (−) is to the left of enter.

4. The backspace key looks like del .

5. To clear the entry line, press the ctrl del for clear.

6. The absolute value, floor, ceiling, and other functions can be found by pressing the catalog button ▦ then searching for the function. You can just type the functions name as well, for example abs for absolute value.

7. To use the algebra capabilities and later other capabilities from the Scratchpad or a Document, press menu.

8. It is good practice to zoom to the standard screen before moving on to a new graph. Use menu 4:Window/Zoom then 5:Zoom – Standard.

9. Pressing escape esc gets you out of any menu.

10. If your screen seems too bright or too dim, repeatedly press the ctrl key followed by − to dim it or + to brighten it.

11. You can save something as a variable by typing the value, followed by the STO button (above var) and then typing a variable name.

12. You can also clear all variables names in the Scratchpad by pressing menu then 1:Actions and 4: Clear a−z.

13. You **must** use the times button × for multiplication. You cannot type 3 X, you must type 3 × X.

14. If you want an approximation of a number, for example $\sqrt{2}$, you must press ctrl enter for ≈, which gives an approximation.

I.   Defining a Function with the TI-nspire CAS

You can define a function from the Scratchpad or a document. We will use the Scratchpad, which looks like the image at the right. If you are not at this screen, press ⌨.

Press menu and choose option 1:Actions and then 1:Define. You will see the command Define waiting for you in the command line. (You could also just type the word **Define**.)

Enter the function using function notation, for example
f(x)=3 × x x² −5 × x+1, then press enter.
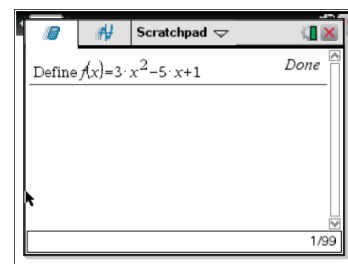
A. Special Functions

1. Absolute Value function $|x|$

To define the absolute value function, simply type abs(x) for $|x|$.

2. Greatest Integer function (step function)

Simply type int(x) for the greatest integer function of x.

3. Piecewise Defined Functions

This is best illustrated with an example. Suppose you wish to define $f(x) = \begin{cases} 3x-1 & x<1 \\ 2x+5 & x\geq 1 \end{cases}$. First press menu and choose option 1:Actions and then 1:Define. Type f(x)= then press |□|{□ and choose $\begin{cases} \Box,\Box \\ \Box,\Box \end{cases}$ (it is the seventh option in the first row.) For three pieces to a piecewise defined function chose the option to the right of the two piece function (the eighth option in the first row) and it will ask you how many function pieces you want.
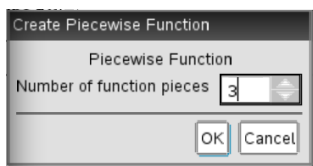
## B. Evaluating a Function (at a given input)

Once your function is defined, simply type in the evaluation you wish to perform. See the examples at right. You will need parentheses to get the fraction shown. ((f(2)−f(-3))/(2−-3))
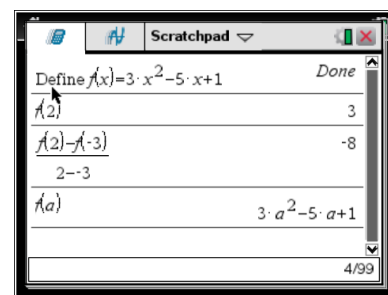
C. Solving an Equation (find the input(s) for a given output)

Once your function is defined, you can use the Solve command. For example, if f(x)=3*x^(2)-5*x+1 and you wish to find out which inputs give $f(x) = 0$, use menu 3: Algebra, then 1:Solve.
In the Solve command type f(x)=0,x.
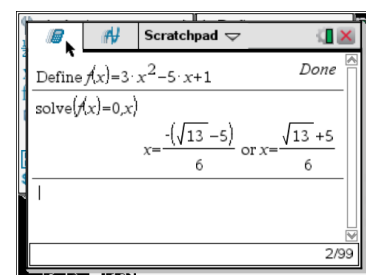
You could also simply type the command solve(f(x)=0,x) or solve(3x^2−5x+1=0,x).

This is the equation you wish to solve, and this is the variable you wish to solve for.

You can also solve *inequalities* by replacing ⎡=⎤ with the appropriate inequality symbol. Inequality symbols can be found above the ⎡=⎤ by pressing ⎡ctrl⎤.

D. Graphing a Function

To graph a function (or more than one function at once) from the home screen press B Graph or from the Scratchpad press ⎡▤⎤. The main graph screen will come up (picture below left).

If f1(x)= does not appear at the bottom of the screen, press ⎡menu⎤ 3:Graph Entry/Edit and then 1:Function.

Type your function into the f1(x)= input line and press ⎡enter⎤. If you have more than one function to graph at the same time, press ⎡menu⎤ 3:Graph Entry/Edit and then 1:Function and you will see the input change to f2(x)= etc.
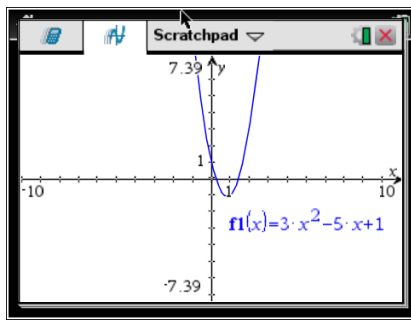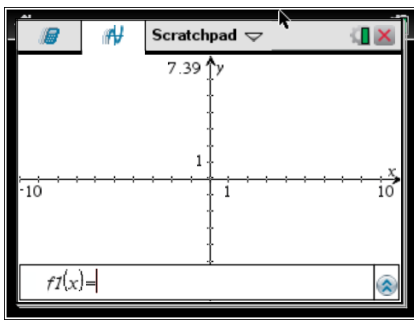
### Changing the Window Size (Zooming)

To get a different look at the function, change the window size. From the graph screen press ⎡menu⎤ then option 4:Window/Zoom.

1: Window Settings will enable you to change the viewing window size in the horizontal direction (XMin, XMax), the vertical direction (YMin, YMax) and the size of each tick mark in the horizontal and vertical directions (XScale, YScale). When you are done adjusting press ⎡enter⎤ or click OK.


5:Zoom – Standard returns you to the standard viewing window
8: Zoom – Trig is good for trigonometric functions, with XMin=−2Pi, XMax=2Pi.
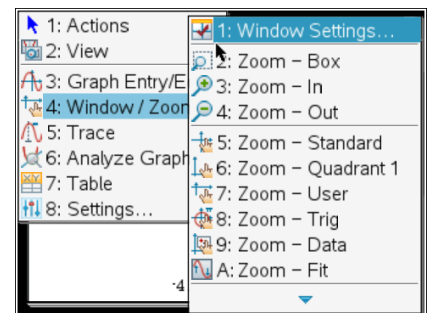
E. Tabulation of Functions

Tables are shown in the graph window of the Scratchpad. If you already have a function entered into f1(x) or defined [for example as f(x)] you can tabulate values of the function using tables. If the function is not entered, do that first, into f1(x) in the graph window. Then press ⎡menu⎤ then option 7:Table and option 1:Split−screen Table. A table will appear next to the graph.
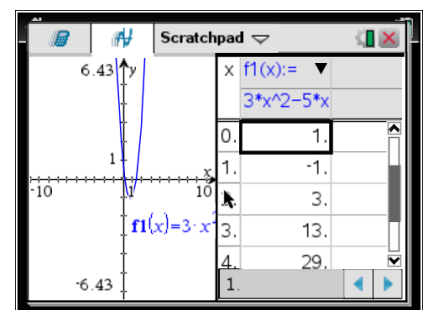
To change the table settings, make sure your cursor is in the table and press menu then option 2:Table and option 5: Edit Table Settings. You can then change where the table starts and its step size. To get rid of the table, press menu then option 2:Table and option 1:Remove Table.

F. Finding the Range of a Function by Graphing

Now consider the problem of finding the range of a function. Again you should graph the function, but this time you look for how high and/or low the graph gets (along the vertical axis). Just be careful that you see the whole picture. Change the window to see more of the graph.

For our example let's look at $a(x) = \frac{3}{5}(30x - x^2)$. From the graph screen press menu 3:Graph Entry/Edit and

then 1:Function. Enter your function or if a function is already there press up on the touchpad to switch to f1(x)= and then press ctrl del to clear.

Type the function f1(x)=(3/5)*(30*x−x^(2)) then press enter. The graph you see can be deceiving.
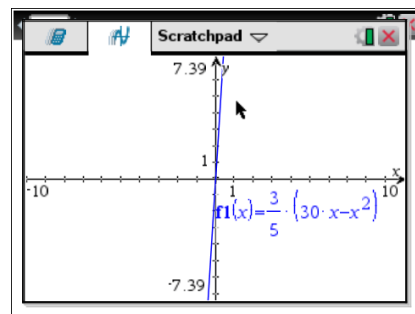
Is this the whole picture? Change the window to something larger: press menu then option 4:Window/Zoom.
For the picture below I used XMin=−10, XMax=40, YMin=−10 and YMax=150. You will need to experiment to get a good picture.
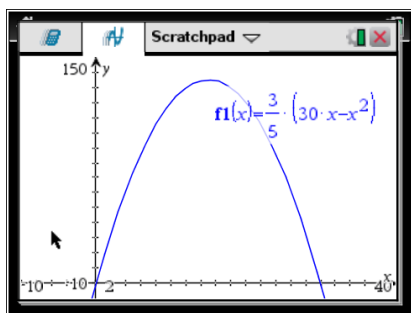
The graph is increasing, then it is decreasing. Where does it switch from increasing to decreasing?

We can now see the maximum, but what y value is it? Press menu 6:Analyze Graph and then 3:Maximum. You will be asked for a lower bound. Use the touchpad to move the cursor to the left of the peak and press enter. You will then be asked for an upper bound. Use the touchpad to move the cursor to the left of the peak and press enter. The calculator will then approximate the maximum point.

In this example we get a maximum at the point (15,135). So, the range of this function is $(-\infty, 135]$. In MATH 125, some techniques of calculus will enable us to do this problem by hand.

Occasionally you may get an answer such as −1.49999995. You can be reasonably certain the answer is −1.5. Also, keep in mind that a

calculator answer of 2.3333333 is really $2\frac{1}{3}$ or $\frac{8}{3}$.

If you get a decimal answer for which you do not recognize the rational number equivalent, make sure your instructor allows an approximate answer for the problem. If not, you will need to find the exact answer using algebra or calculus.
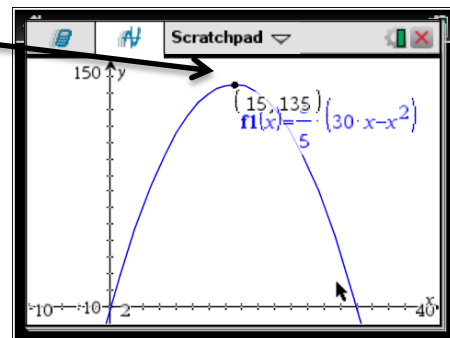
Also, make sure you look at the graph in a larger and/or smaller window. Doing this will ensure that you see all of the maxima/minima. You will need to find them all.

When you are done with a problem, it is a good idea to always press [menu] 4:Window/Zoom **then** 5:Zoom – Standard. **This will take you back to the standard window for the next problem.**
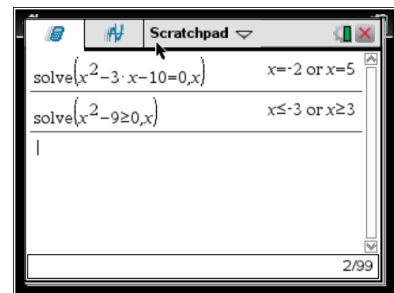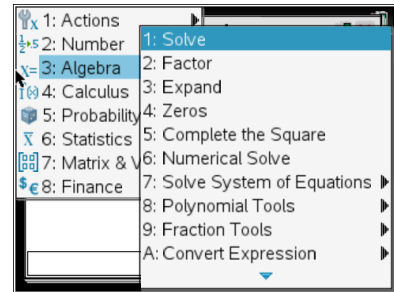
II.   Basic Algebra

Most basic algebra is accessed by pressing [menu] and choosing option 3:Algebra while you are in the Scratchpad or a document.

A. Solving Equations or Inequalities

To solve an equation or inequality, use [menu] 3:Algebra, 1:Solve. The syntax is Solve(equation or inequality, variable).

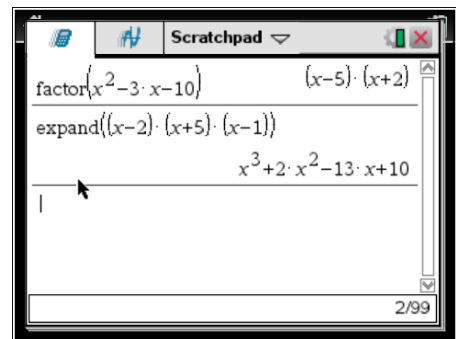Inequality symbols can be found above the [=] by pressing [ctrl].

B. Factoring

To factor a polynomial, use [menu] 3:Algebra, 2:Factor. The syntax is factor(polynomial).
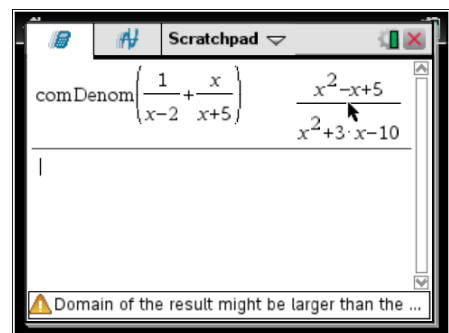
C. Expanding ("Multiplying Out")

Use [menu] 3:Algebra, 3:Expand. The syntax is expand(polynomial).

D. Getting a Common Denominator

You can combine rational expressions into one rational expression by finding a common denominator.

Use [menu] 3:Algebra, 9:Fraction Tools, 4:Common Denominator. The syntax is comDenom(expression).

There are more. Feel free to play around.

III. Plotting Points and Finding Regression (Best Fit) Curves
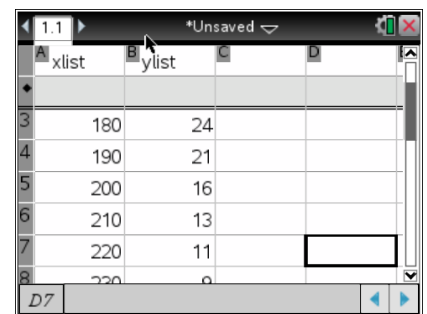
A. Enter Your Data Values

Lists and Statistical calculations are best done in a document, not on the Scratchpad. From the home screen, press the 4th button on the bottom row, the one that looks like a spreadsheet. This will start a new document with a spreadsheet interface.

Enter the values of the inputs (independent variable, explanatory variable) in column A and the values of the outputs (dependent variable, response variable) in column B. You must edit these names by scrolling up to A and pressing [enter]. Then type in xlist. Scroll up to B and pressing [enter]. Then type in ylist. This lets the TI-nspire know that you want to use these in a scatterplot.
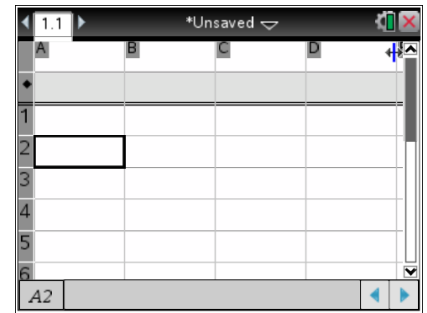
You can clear a column of data by using the touchpad to move to the name of the column, and then pressing up one more time to highlight the whole column. Then press [menu] 3:Data, 4:Clear.

This data at right is the measured viscosity (lbs sec/in^2) of motor oil as a function of the temperature in degrees F.

B. Make a Graph/Scatterplot of Your Data

While still in the spreadsheet, press [ctrl] [doc▾] to add a page to your document. Choose option 5:Add Data and Statistics. You might see some unorganized data on your screen. Use the touchpad to move over to the places where the screen says "Click to add variable." On the vertical, click and add ylist. On the horizontal, click and add xlist. You will now see your scatterplot.

Now is when you determine what type of function would be a good model/fit for this data. Your calculator can fit a linear function, a quadratic function, a cubic function, a quartic function, a power function, an exponential function, a logarithmic function, a sine function, and a logistic function. For this example we will use a line, although the steps are similar for other types of functions.

C. Fit a Function to the Data

While still in the spreadsheet, press [ctrl] [doc▾] to add a page to your document. Choose option 1:Add Calculator. On the new page press [menu] and choose option 6:Statistics, then 1:Stat Calculations and then choose your regression type (fit type) from the list. In this example we will use Linear Regression (mx+b). A box will come up for you to fill in. Most of this is self-explanatory. In X List you can either type xlist or select the arrow at the right and choose it from a drop-down menu. In Y List you can either type ylist or select the arrow at the right and choose it from a drop-down menu.
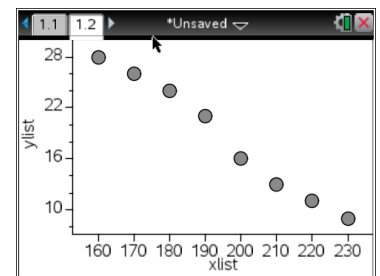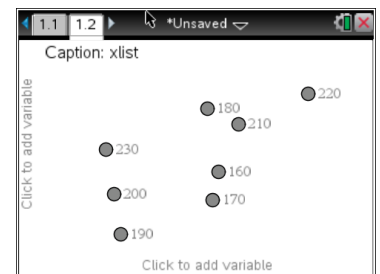
Save the regression equation (fit model) in the Save RegEqn to box. Typically you can use f1. Click OK. You will set the information you need. You can also plot the function with the scatterplot. Use the touchpad to scroll back to the page with the scatterplot. Then press menu 4:Analyze, 6:Regression, and then show your option, in our case it is Show Linear (mx+b).
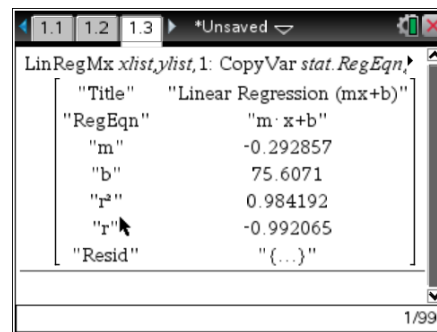
Since the function is stored in f1(x) you can use it to predict values of the function at points between the lowest and highest input values. Do not go outside this range. This is called *extrapolation* and can often lead to unrealistic predictions.
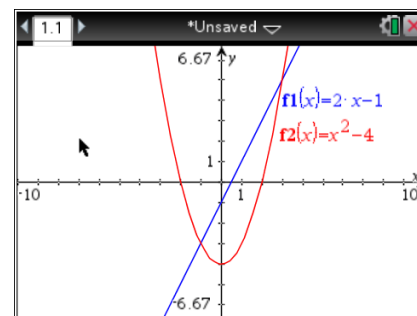
Press ctrl doc▾ to add a calculator page to your document (or press [calc icon] to open the Scratchpad), and, for example, type f1(192) to predict the viscosity of a motor oil at 192°F.

IV. Finding Points of Intersection of Two Graphs

Ideally, you should use algebra to find the points of intersection. If your functions are defined in f1(x) and f2(x), simply use solve(f1(x)=f2(x),x) from a calculator screen or the Scratchpad. For example, on the screen at right we have f1(x)=2*x−1 and f2(x)=x^(2)−4.
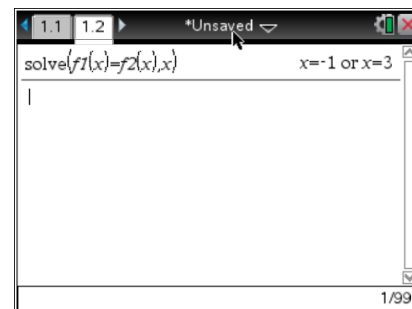
However, if you want an approximate answer from the graph screen, first graph the two functions. For example, on the screen at right we have f1(x)=2*x−1 and f2(x)=x^(2)−4. To find the approximate points of intersection, press menu 6:Analyze Graph, 4:Intersection. Just like finding a maximum or minimum of a function, you will be asked for a lower bound. Use the touchpad to move the cursor to the left of the point of intersection and press enter. You will then be asked for an upper bound. Use the touchpad to move the cursor to the left of the point of intersection and press enter. The calculator will then approximate the point of intersection. You will need to do this for *each* point of intersection. Do you have the whole picture? Change the window to something larger to make sure you see all the points of intersection: press menu then option 4:Window/Zoom.

Points of intersection