This side left blank.
It will face the back page of your lab book when you tape it in.

Analyzing data using your TI-83 or TI-84 calculator

Introduction

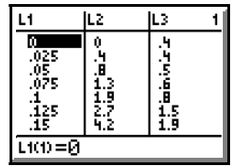
These instructions will mention the key to type. If this key is a "second function" key, the keystroke will be in square brackets and requires you to press the [2nd] key first, e.g. to get [STAT PLOT] type [2nd] [Y=] .

1. Get your calculator in the correct mode. Press [MODE] [▼] [▼] [▼] then select FUNC for the graphing mode.

Note: This is also where you can change from RADIANS to DEGREE mode if you don't get 1.Ø for sin(9Ø).

A: Data is stored in lists

Experimental data is stored in what your calculator calls ***Lists***. These are labeled L1, L2, up through L6. You can see the data in lists by using the [STAT] 1Edit... key sequence. This will display a screen similar the image on the right.



List window

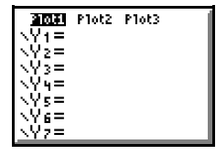
1. To prepare for graphing, clear any old, unneeded data already in your calculator:
   a. Press [STAT] [1] EDIT... This will display the first three lists (L1, L2, and L3) on the screen. If any of them are not blank and you want to clear them, use the [▲] and [▶] arrows to highlight the title of a list. Then press [CLEAR] [ENTER] to clear.
   b. Press [2nd] [MODE] to [QUIT].

B: Entering data into a list

1. Decide which list will contain your data, then enter your data:
   a. [STAT] [1] to get the List editing display.
   b. If needed, use the arrow navigation keys to get to the first entry line in the list number you want: L1, L2, etc.
   c. After entering each number, press the [ENTER] key to move to the next entry line for that list.

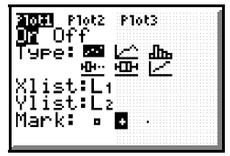
C: Graphing two lists

1. To graph two lists, **they must contain the same number of data points.** Scroll to the bottom of your lists and if one has more data points than the other, check your data to see if you have missing data.
   a. In some cases (e.g. when you calculate the difference between sequential values in one list) you may have different numbers of data in the two Lists. In this case, delete the extra using the [DEL] key until the ending lines _ _ _ match at the end of each list.
2. Clear the graphs:
   a. Press [Y=] to display the *Equation* window.
   b. If there are any functions (equations) listed, clear them by using the [CLEAR] key.



Equation window

3. Set the parameters for your graph: [2nd] [Y=] for [STAT PLOT].
4. If Plot2 or Plot3 are selected (dark highlighting) in the top row, use the [▲] and [▶] navigation keys to move to them, then the [ENTER] key to deselect them. When you move down out of the top row, only Plot1 should be highlighted.



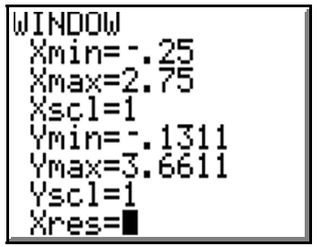
[STAT PLOT] window

4. In Plot1, the first two rows should be set to On , and . The last row should be + or □ (the box sometimes works better, but the small dot is usually too small).
6. In Xlist, press [2nd] [L1] (or other list number to plot on X).
7. In Ylist, press [2nd] [L2] (or another list number).
8. Press [ZOOM] 9 to select 9:ZoomStat. Your calculator should now show a graph zoomed in on the area that contains your data.

D: Manually setting the scale for your graph

[ZOOM] 9 is very handy in science labs because it zooms to the region of the graph with your experimental results. But often you will need to adjust the scale of the graph to see the origin (0,0) and to set the divisions of your scale into easy to understand values. Use the following directions to adjust the scale to the "best" values.

1. Use the [WINDOW] key to see the scale of the current graph:
2. Set the Xmin and Ymin both to 0 *(unless you have data in the negative region of either of these axes, then set it to a negative number just below your lowest value).*

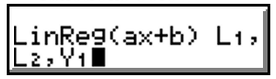


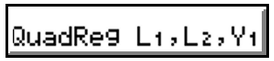
[WINDOW] window

3. Look at your X data, then select an Xmax value that is just above your highest value, but also of an number than can easily be divided into 8-10 portions of a familiar value (e.g. your divisions will be 0.1, 0.2, 2, 10, etc., not 0.13, 2.45, etc.).
4. Set the Xscl value to the value of this 8 to 10 divisions of your Xmax.
   a. For example, if your maximum data is 18.8, and you chose 20 as your Xmax, then set your Xscl value to 2, which is 1/10 of 20.
   b. Xres controls how the [TRACE] key moves: 1 traces every pixel on the screen, 2 every second pixel, etc.
5. Repeat Steps 3 & 4 for the Ymax and Yscl values.
   a. To avoid confusion, when possible use the same Xscl and Yscl. In some case you may need to use different scales for X and Y (e.g. if X range is 0-6s but Y range is 0-100m).
6. Use the [GRAPH] key to see your new graph!
   a. Copy the graph into your lab book, using two blue lines for every one hash mark on your calculator.
   b. Using the [WINDOW] display, label the hash marks so they correspond to your Xscl and Yscl. labeling to the maximum values of your X and Y axes.

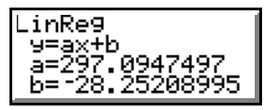
E: Fitting an equation to your data.

1. Press [STAT] [▶] to open the CALC menu.
2. Select your "regression" type:
   a. If your graph looks like a linear relationship, select 4:LinReg(ax+b)
   b. If your graph looks like half a parabola, select 5:QuadReg.
3. The regression type you selected above will display on the screen.
4. Press [2nd] [L1] [,] [2nd] [L2] [,] [VARS] [▶] 1 to display the VARS Y-VARS FUNCTION secondary menu, then press 1 to select Y1. *(This example assumes you are using L1 and L2.)* The screen should display one of the functions below:





5. Press [ENTER] and your results should show up in one of the formats below:



6. Copy the results into your lab book. **Write neatly and put a box around this regression solution.**
   a. If your calculator displays R or R^2 values, these represent statistical methods of determining how well the equation matches the data.
7. Use the [GRAPH] key to visually check how well your data fits your equation (it may take a few seconds to add the equation's line to the graph).
8. Are you still satisfied with your choice of regression type? If not, go back and try the other to see if it is a better visual fit.
9. **When you have a satisfactory result, re-write the equation using the experimental concepts and the correct units for each of the a, b, c numbers. Write neatly and box this model.**

F: Filling a list using a formula

Often your independent variable data follows an easy to calculate pattern (e.g. 1, 2, 3, 4 ... or 5, 10, 15, 20). If you have many data points, you may find it faster and more accurate (less chance of a typo) to enter it using a formula. This example creates a sequence of numbers that follow the pattern described by a math expression. There are other keys in Step 3 that will process other operations.

1. Type [2nd] [STAT] to get [LIST]
2. [▶] to get to OPS menu (for OPERATIONS)
3. Press 5 for seq(
4. The display will show seq(
5. Key in the following (with commas between them): your expression (e.g. 2*x), the variable your function uses (usually x), the starting value of the variable, the ending value of the variable, the amount to increment the variable --usually 1--) [STO▶] [2nd] 1 --1 the number of the list you wish to store the results in -- [ENTER].
6. The screen will display the results of the first few calculations.
   a. If you get an error message, select GOTO and check your formula in step 5 above.
   b. See Figure 4 for a sample sequence and its results.

Other formulas:

1. You can also type [2nd] 1 --then the List you want to calculate from-- x 2 --or any other formula-- [STO▶] [2nd] 2 --the list you want to store into-- [ENTER].
   a. This example takes the List1 values, multiplies them by 2, and stores the results in List2.

G: Filling a list using a formula that includes another list

In some cases you will want to make calculations that include data already in a list (in this example, the difference between the each data point)

1. Type [2nd] [STAT] to get [LIST]
2. [▶] to get to OPS menu (for OPERATIONS)
3. Press 7 for ▵List(
4. The display will show ▵List(
5. Type [2nd] 2 --or the number of the list you want the differences of--) [STO▶] [2nd] --then 3 or the number of the list to store in-- [ENTER].

H: Plotting Residuals

Plot a graph of the difference (absolute value) between your data and the equation's data.

The difference between your "y" data and the equation's "y" data for any given "x" point is called the "residual" at that point. Plotting residuals can help you to see if the differences are "random" (some positive, some negative, no visible pattern) or if there is a pattern. A pattern suggests that the equation may not be in the correct format (e.g. you plotted a linear equation and a quadratic equation would fit better).

1. Create a column to put the calculated residuals in.
   a. Press [STAT] 1 to display the lists. Move the curser to the right and up into the header for L3.
   b. Press [2nd] 6 to insert a new column between L2 and L3. The Name= prompt appears in the bottom entry line, and caps lock is activated. Type R E S I D (for residual) using the letter keys, then press [ENTER].
2. Press [▼] repeatedly to examine the residuals. If you see any patterns, record it in your lab book.
3. Press [2nd], 2 to get the Stat Plots editor.

Notes

- If you are missing any lists, enter the following key sequence to unhide the lists: [STAT] [5] then [ENTER].
- To set your calculator to display r (correlation) and r^2 values of linear regressions: Press [2nd] [0] to get [CATALOG], then D to jump down to the catalog commands that start with D. Next find and highlight DiagnosticsOn, the press [ENTER] twice.
- Turn on the grid: [2nd] [ZOOM] for [FORMAT] Then highlight GridOn and hit [ENTER].

Write other notes you develop below: