Multiple Representations of Slope with the TI-84CE

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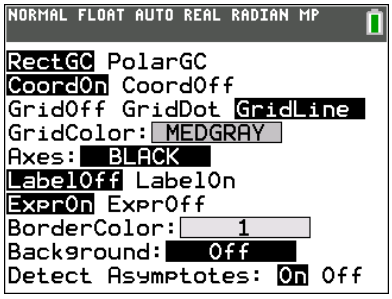
In this activity we will use the TI-84 CE to create multiple representations of slope.

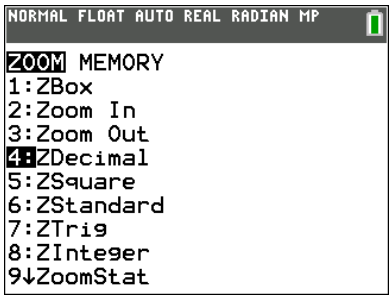
In addition, we will find the formula of a line which passes through the point (2, 3) with slope $\frac{4}{5}$.

Before beginning, reset the defaults by going to [2nd] [+] (mem) 7:Reset… 2:Defaults… 2:Reset.

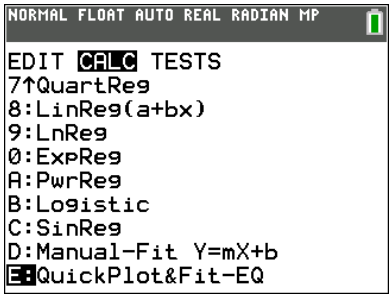
1. Press [2nd] [zoom] (format) to access the Format menu.
   Highlight Gridline and press [enter].



2. Press [zoom] and select **4:ZDecimal**.
   Press [enter] to create a decimal window.

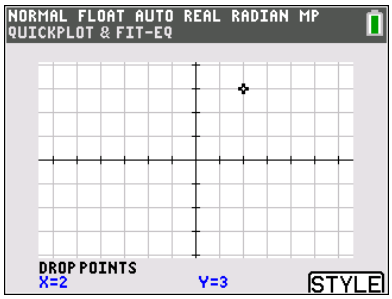


3. Press [stat] [▶] to reach the Stat Calc menu.
   Press [▲] and select **E:QuickPlot&Fit-EQ**.
   Press [enter].



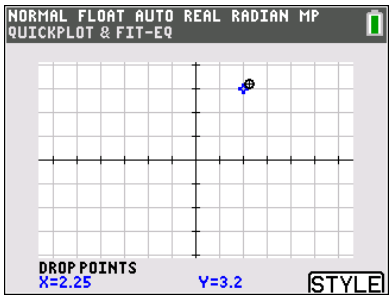
4. Use the arrow keys to move your cursor to the point (2, 3).
   Press [enter] to interactively plot the point on the graph screen.

   If desired, press [alpha] [graph] (f5) for the STYLE soft key to change the color of the plotted points.

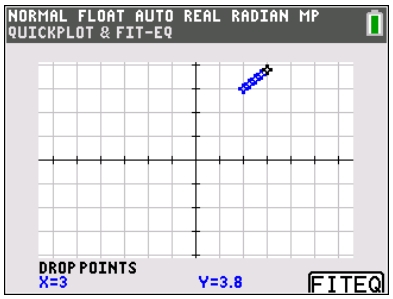


   Since the slope is $\frac{4}{5}$, press [▲] four times, press [▶] five times, then press [enter] to plot the point. Repeat as desired.

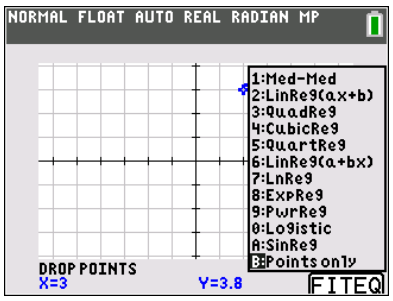
   In this window, each press of [▲] and [▶] moves the cursor 0.1 steps.
   TIP: [2nd] [▶] will move the cursor five steps at a time.



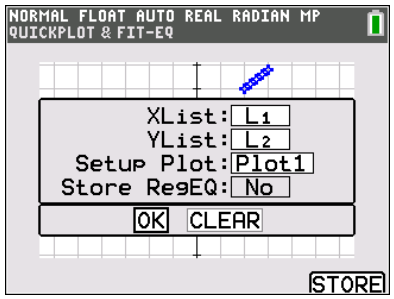
5. Discuss with students: if you press [▲] 8 times,
how many times must you press [▶] so that your point is on the line?
Use the calculator to check.



6. Press [alpha] [graph] (f5) for the FITEQ soft key to access the Fit Equation menu.
Press [▲] to select **B:Points only**.

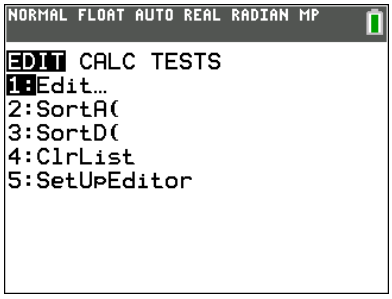


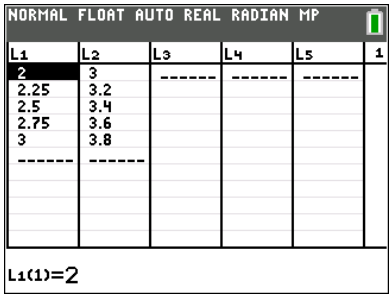
In the spinner use the settings to the right.
Highlight OK and press [enter].



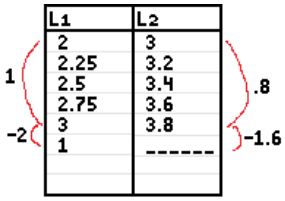
The points will be stored in the lists L1 and L2
(as well as in the named lists QPX and QPY.)

Press [stat] **1:Edit** to access the lists in
the Statistics Editor.



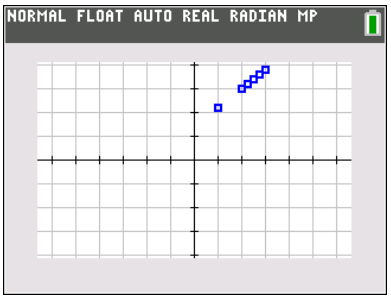


7. Ask students to find the change in L1, or ΔL1.
Similarly, ask for the change in L2, or ΔL2.
Use ΔL1 and ΔL2 and proportional reasoning to find additional points in the table.
Enter 1 in the first column and ask students to "walk the table"
to find the value in the second column.

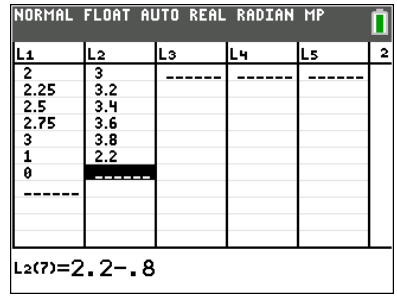


One possible strategy is to use the ratio of Δy to Δx: $\frac{4}{5} = \frac{0.8}{1} = \frac{-1.6}{-2}$
If we walk from the point $x = 3$ to $x = 1$, then $3 + \Delta x = 1$ requires $\Delta x = -2$.
(See above table.) If $\Delta x = -2$, then $\Delta y = -1.6$ through proportional reasoning.
Thus we have $3.8 + \Delta y = 3.8 + -1.6 =$ **2.2**.

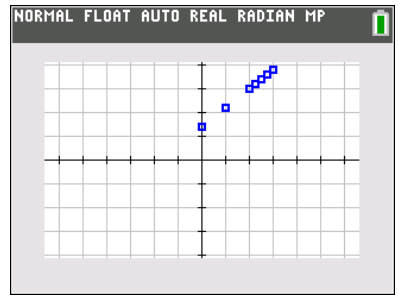
Press [graph] to confirm this point is in line with the others.



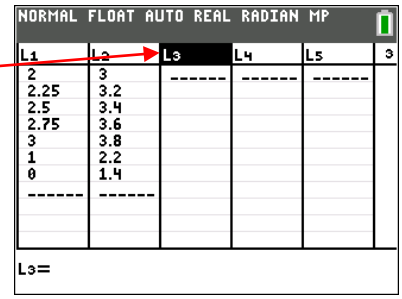
8. In a similar way, students can walk the table to find the y-intercept:
Strategy: Walk from $x = 1$ to $x = 0$. Therefore $1 + \Delta x = 0$ if $\Delta x = -1$.
By proportional reasoning, if $\Delta x = -1$, then $\Delta y = -0.8$.
So $2.2 + \Delta y = 2.2 + -0.8 =$ **1.4**.



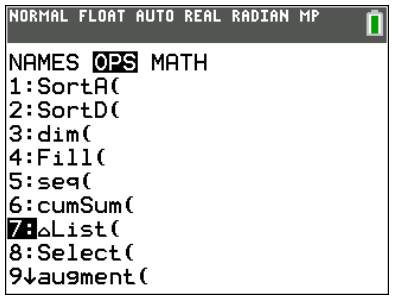
Press [graph] to confirm.

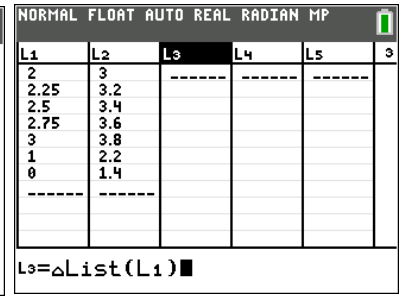


9. Optional: We can calculate consecutive values of Δx in L3.
Return to the Statistics Editor (press [stat] **1:Edit**) and position your cursor to the top shelf of L3.

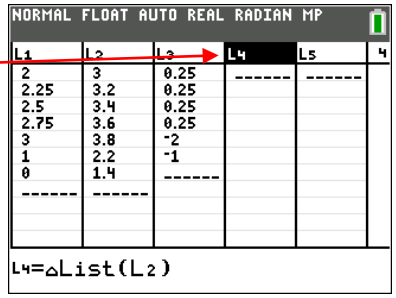


Press [2nd] [stat] [▶] to access the List Operations menu.
Select **7: Δ List(** and press [enter].
Press [2nd] [1] [)] [enter].

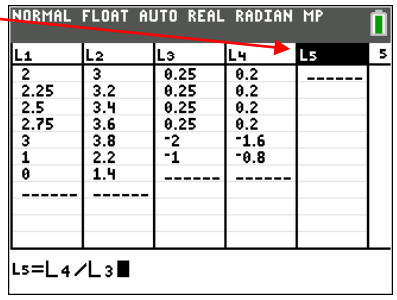


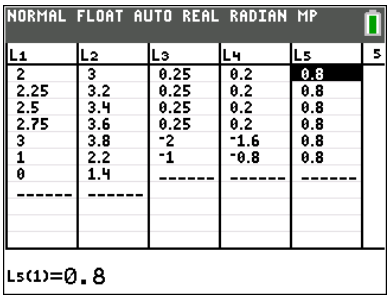


Similarly calculate consecutive values of Δy.
Position your cursor to the top shelf of L4.
Press [2nd] [stat] [▶].
Select **7: Δ List(** and press [enter].
Press [2nd] [2] [)] [enter].



Position your cursor to the top shelf of L5 to calculate the ratio $\frac{\Delta y}{\Delta x} = \frac{L4}{L3}$.
Press [2nd] [4] [÷] [2nd] [3] [enter].



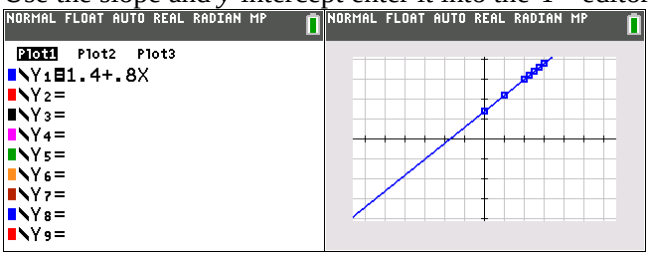


10. Cast the problem into a context such as the following.

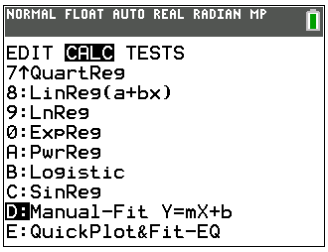
After 2 hours you must pay $3.00 to park at an inner city library.
For each additional hour you must pay $0.80.

From this point we have several ways students can find the formula.

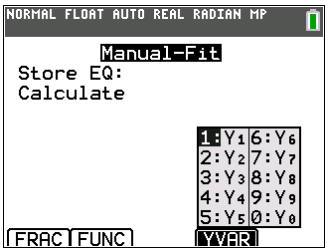
- Use the slope and *y*-intercept enter it into the Y= editor.



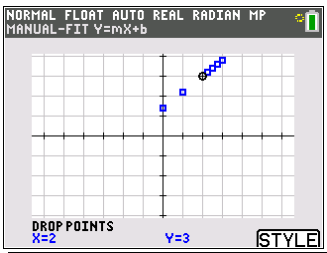
- Use the Manual-fit line. Press [stat] [▶] to reach the Stat Calc menu. Press [▲] and select **D:Manual-Fit Y=mX+b**. Press [enter].



Press [alpha] [trace] (f4) for the [YVAR] soft key to access the Y-variables short cut menu. Select Y1 in **Store EQ**.
Highlight **Calculate** and press [enter].

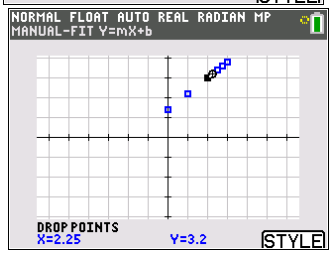


Use the arrow keys to position your cursor at the point (2, 3). Press [enter].

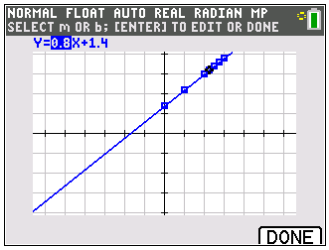


Position your cursor to another point on the line.

Press [enter].



Press [alpha] [graph] (f5) to press the [DONE] soft key.



Extensions

1. Ask students for the x-intercept of the line $y = 0.8x + 1.4$.
   Compare their strategies. Below are two possibilities.
   - Solve $0.8x + 1.4 = 0$ using algebra. We have $x = \frac{-1.4}{0.8} = -1.75$

   - Use the strategy of "walking the table" with the slope.
     Since the point (0, 1.4) is on the graph,
     if $\Delta y = -1.4$,
     then $0.8 = \frac{-1.4}{\Delta x}$ so solve for Δx.
     $0.8 = \frac{-1.4}{\Delta x}$
     $\Delta x = \frac{-1.4}{0.8} = -1.75$

L1	L2
2	3
2.25	3.2
2.5	3.4
2.75	3.6
3	3.8
1	2.2
0	1.4
------	0

? -1.4

Enter the coordinates of the point $(-1.75, 0)$ in the Statistics Editor and press graph (f5) to confirm.

2. Instead of the previous example, suppose you have the following:

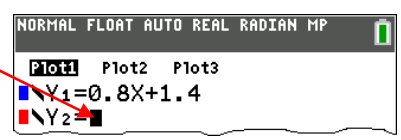
   For the first hour or less you pay a flat fee of $2.20 to park at an inner city library.
   For each additional hour you must pay $0.80.

   Change the coordinates in the Stat Editor appropriately.
   For example, see the last three rows:

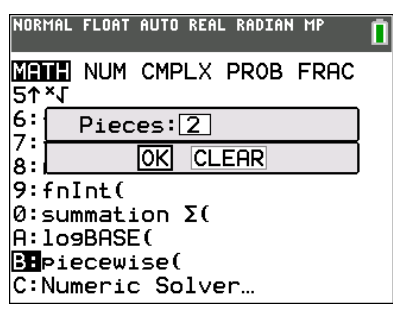
L1	L2
2	3
2.25	3.2
2.5	3.4
2.75	3.6
3	3.8
1	2.2
0	2.2
0.5	2.2
------	------

In the Y= editor, highlight the equals sign for Y1 and press enter to deselect the equation.

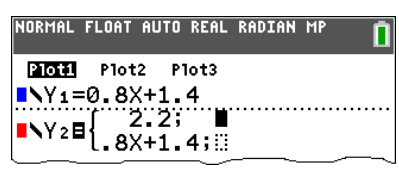
Place your cursor after the equals sign for Y2.
There we will paste a 2-part piecewise template, $\begin{cases} \square; \square \\ \square; \square \end{cases}$,
which we can find in the Math menu
by pressing math ▲ ▲ **B:piecewise(.**



In the spinner, choose 2 pieces.
Highlight OK and press enter.

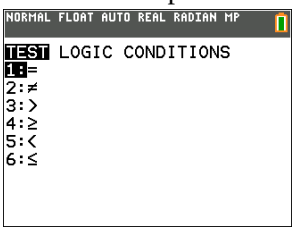


For the first condition,
we can use either `0≤X≤1` or
`0≤X and X≤1` in this template.

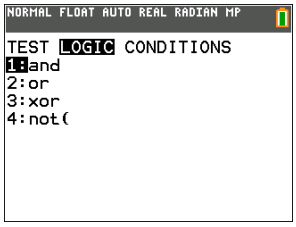


In the TEST menu (2nd math) are relational operators, Boolean operators, and, new to the TI-84OS 5.3, the CONDITIONS Menu. All of these tokens can be pasted anywhere (Y=, programs, home screen, etc.) but the conditions were primarily created for faster entry of intervals in the new piecewise function template.

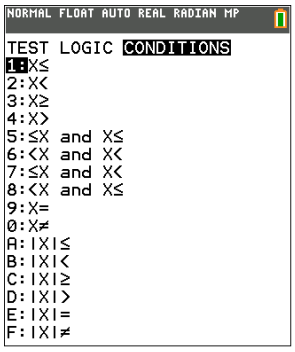
Relational operators



Boolean operators

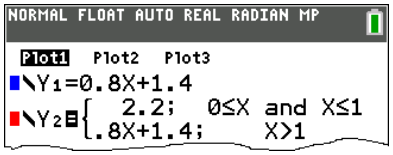


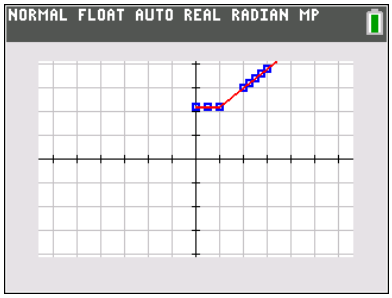
Conditions



Note: In the CONDITIONS Menu, selections 5 through 8 are ≤X and X≤, <X and X<, ≤X and X<, <X and X≤ and are **not** written as ≤X≤, <X<, ≤X<, <X≤ for a reason. Even though the shorthand notation 0≤X≤1 that appears in textbooks is supported as a condition statement in a piecewise template, it has a different (and unexpected) meaning if outside of the template.

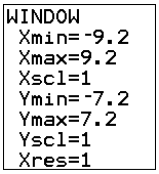
If you paste the condition 0≤X and X≤1 in the template use 2nd del if necessary to insert.

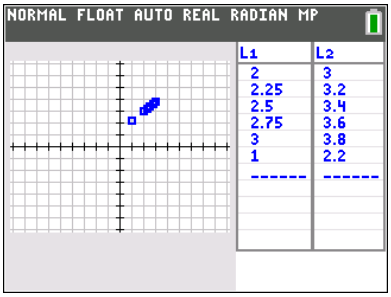




See ***TI-84 Plus CE graphing calculator tips and tricks for working with expressions and equations*** for more information on piecewise functions (at *users.pfw.edu/lamaster/technology*).

3. This activity could be done in Graph-Table mode to connect representations. Press mode and change to Graph-Table.
   Use this viewing window:





For more help with Graph-Table mode see the following at *users.pfw.edu/lamaster/technology*.

- ***The Top Ten+Overlooked Features of the TI-84 Plus Family***
- ***Patterns with Rectangular Numbers from Multiple Perspectives***
- ***TI-84 Plus CE graphing calculator tips and tricks for working with expressions and equations***