

Plotting Data Points on the TI-83/84 and Finding the Best-Fit Line (Linear Regression)

Let's see how the TI-83/84 can be used to generate a linear function which best approximates a set of data points.

Organizing a Data Set



Snow depths are recorded during the month of April. To organize the data, we must decide which variable is independent (x) and which is dependent (y). Since snow depth depends on the date (not visa-versa) snow depth is y , date is x . Thus, the chart shows that on April Fool's Day, the snow depth was 118". We do not know the exact snow depth on Tax Day (Apr, 15).

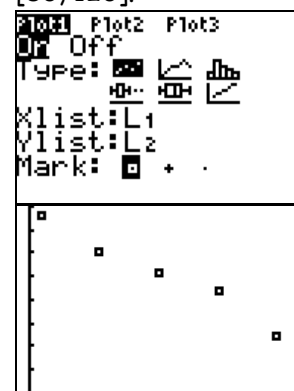
x	$y(x)$
1	118
6	110
11	106
16	102
21	92

Plotting the Data Points

- Enter the Data into your Calculator: **STAT**, EDIT. The data must align in pairs. Use existing L_1 & L_2 or create alternate variable names. Here we used L_1 & L_2 . Note: If L_1 , L_2 is missing use **STAT**, SetUpEditor to reset the list variables.
- Manually set the viewing Window or use **ZOOM**, 9:ZoomStat. I used $[-1, 23] \times [80, 120]$.
- Setup the Data Plot: **2nd**, STATPLOT, 1:Plot1...
- Manually set the viewing Window or use **ZOOM**, 9:ZoomStat. I used $[-1, 23] \times [80, 120]$.
- Plot: **GRAPH**

L_1	L_2	L_3	3
1	118		
6	110		
11	106		
16	102		
21	92		
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$L_3(t) =$



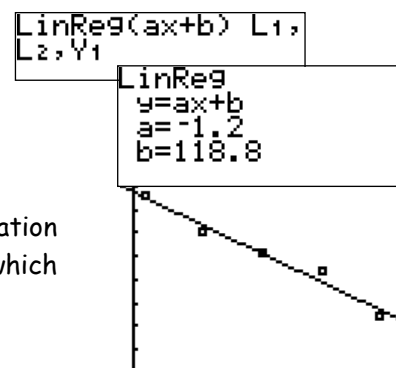
This data is approximately linear. *Why?*

We can now use the calculator's built-in curve fitting capability to obtain an approximating linear equation. This is called *linear regression*.

Curve Fitting

Since each individual might draw a slightly different line to build a liner model for this data, using the calculator's curve fitting feature is preferred because each person will obtain the identical model.

- Begin with: **STAT**, CALC, 4:LinReg(ax+b), **ENTER**
- Set the parameters: $x = L_1$, $y = L_2$. L_1 & L_2 are the defaults and may be omitted. We chose to have our result automatically placed in the Y-listing. Here we used Y_1 . To access Y_1 , use **VAR**, Y-VARS, 1:Function... This saves unnecessary typing later.
- Now, press **GRAPH** to plot both the original data and the linear equation we computed and stored in Y_1 . In this case we get a good fit which validates our choice of choosing a linear model to fit the data.
So, $Y(t) = -1.2x + 118.8$



Using the Model

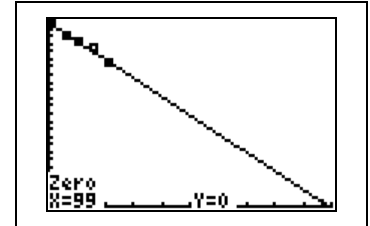
How do we interpret the slope?

$$m = \frac{\text{rise}}{\text{run}} = \frac{\text{y-units}}{\text{x-units}} = \frac{\text{Inches of Snow}}{\text{Number of Days}} \quad \text{Hence, the snow is melting an average of } 1.2''/\text{day}$$

Now that we have our model, we can create a Friendly Window and use the graphing features to analyze the model or we can use Algebra to analyze the model.

To (Graphically) find the date when the snow will be entirely melted, we must find a window which shows the root. Then we use CALC, zero.

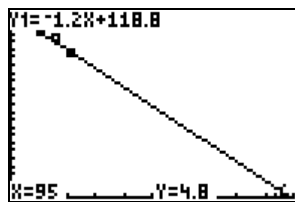
I used $[0, 100] \times [0, 120]$ for a friendly window. According to the model, the snow will be entirely melted on the 99th day from April 1st (July, 8)



To (Algebraically) find the date when the snow will be entirely melted, we must recognize that $y = 0$ corresponds to zero snow. We set $y = 0$ and solve for x .

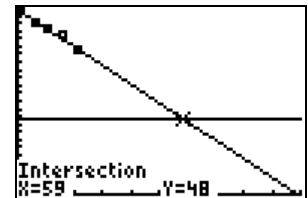
Thus, when $y=0$, $x = 99$ so the snow will be entirely melted on the 99th day from April 1st (July, 8).

$$\begin{aligned} y &= -1.2x + 118.8 \\ 0 &= -1.2x + 118.8 \\ 1.2x &= 118.8 \\ x &= 118.8/1.2 = 99 \end{aligned}$$



To (Graphically) predict the snow level on July 4th, ($x = 95$) we use CALC, value. We see that 4.8" of snow are expected on July, 4th.

To predict the date when the snow level will drop to 4' (48"), we set $Y_2 = 48$ and then find the intersection of the two lines. We see that the snow level is expected to drop to 4' on the 59th day (May 29).



To (Algebraically) predict the snow level on July 4th, ($x = 95$) we set $x = 95$ and solve for y . We see that 4.8" of snow are expected on July, 4th.

$$\begin{aligned} y &= -1.2x + 118.8 \\ y &= (-1.2)(95) + 118.8 \\ y &= 4.8 \end{aligned}$$

To (Algebraically) predict the date when the snow level will drop to 4' (48"), we set $y = 48$ and then solve for x . We see that the snow level is expected to drop to 4' on the 59th day (May 29).

$$\begin{aligned} y &= -1.2x + 118.8 \\ 48 &= -1.2x + 118.8 \\ 48 - 118.8 &= -1.2x \\ x &= -70.8/-1.2 = 59 \end{aligned}$$

Limits of the Model

Clearly, we cannot have snow levels less than zero. ($y \geq 0$) Thus, the model clearly breaks down for $x > 99$.

On the other hand, if we were to use the model to predict the snow level one year ago ($x = -365$) the model is clearly unrealistic. It is possible that the snow first began melting only on Apr 1. Then model's Domain would be $[1, 99]$. However, assuming the last snow fall was days earlier and the snow began melting after that, the actual domain would be (last day of snow fall, 99].