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

A Data Set

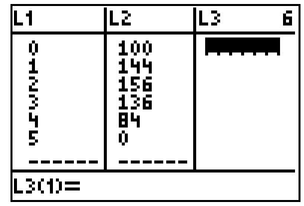
A ball is thrown upward at 60 ft/sec from a 100 ft tall building. Its height (ft) at various times (sec) is recorded in the following table.

t	H(t)
0	100
1	144
2	156
3	136
4	84
5	0

We want to plot the data and then find an appropriate algebraic model $H = H(t)$ for this event. Ideally, H(t) should pass through each data point.

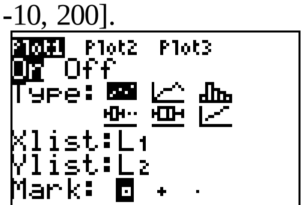
Plotting the Data Points

(1) Determine which variable is the independent variable, x, and which is the dependent variable, y. Here we choose 'x' as the time and 'y' as the height. 'x' should always be the first list variable.

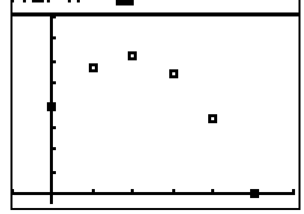


(2) Enter the Data into Calculator: (a) STAT (b) EDIT
(c) Use existing L_1 & L_2 or create alternate variable names. Here we used L_1 & L_2. Note: The data must align in pairs. That is, the length of L_1 & L_2 must be equal. *Why?*

(3) Manually set the viewing Window or use ZOOM, 9:ZoomStat. We used $[-1, 6] \times [-10, 200]$.



(4) Setup the Data Plot: (a) 2nd, STATPLOT, 1:Plot1…
(b) On- *turns on the data plot*; Type-*we chose non-connected*; Xlist- *x-variable is in* L_1; Ylist- *y-variable is in* L_2; Mark- *shape of point marker.*



(5) Plot: GRAPH

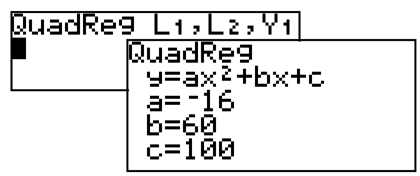
This data is clearly non-linear. *Why?*

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

Curve Fitting

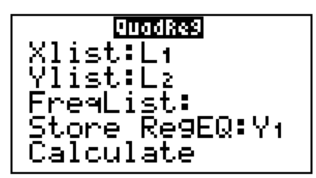
From a review of function shapes, it appears this data may best fit a parabola, i.e. $y = ax^2 + bx + c$.

(1) STAT, CALC, 5:QuadReg, ENTER

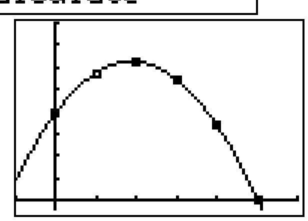


(2) x = L_1 and y = L_2. L_1 & L_2 are the defaults and may be omitted. We chose to have our result automatically placed in the y-variables listing. Here we used Y_1. To access Y_1, use VARS, Y-VARS, 1:Function… This saves unnecessary typing later.

If you have the newer operating system fill in the screen as shown here. : To access Y_1, use VARS, Y-VARS, 1:Function… Select 'Calculate' and press ENTER



(3) Now, press GRAPH to plot both the original data and the quadratic equation we computed and stored in Y_1. In this case we get a perfect fit which validates our choice of choosing a quadratic to fit the data.
So, $H(t) = -16t^2 + 60t + 100$. *Why?*



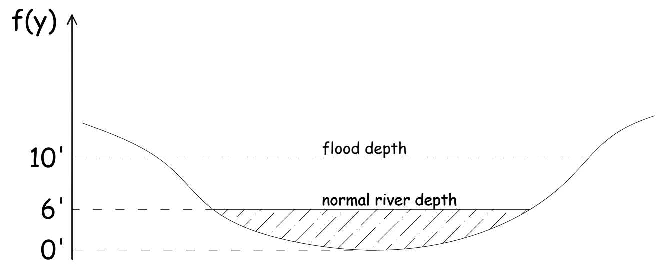
(4) Run *Cubic Regression* and see what you get for an equation. Are you surprised?

(5) Run Linear Regression and Plot the result. Are you surprised?

An Application

Under normal conditions, Little Creek (LC) flows at ~1,000 cfs. There is a depth gauge located on LC and at normal flows the gauge reads ~6 ft.

When Little Creek reaches 10 ft on the gauge, the creek is officially in flood.



On April 12th, there was a huge thunderstorm that began at noon. Use the following data to complete this analysis.

	Time	12:00	12:30	1:00	1:30	2:00
	Gauge (ft)	6.0	8.0	9.75	11.0	11.5

	Flow (cfs)	11	65	180	375	610
	Gauge (ft)	1.0	2.0	3.0	4.0	5.0

(a) For the Time vs. Gauge data, which should be x, which should be y? ______________________________

(b) Graph the data. Choose an appropriate regression. Write the result here: _______________________

(c) At what <u>time</u> and at what <u>gauge reading</u> is the peak flood predicted? ___________________________

(d) At what <u>time</u> is the flow expected to return to normal (6')? _________________________________

(e) Let the Gauge depend upon the Flow and enter the data into your TI. Graph the data.

(f) Although the data suggests a quadratic, explain why the relation between the Gauge & Flow readings <u>cannot</u> be quadratic.

(g) For Guage vs. Flow choose a power regression ($y = ax^b$). Write the result here: ____________________

(h) Using $y = ax^b$, what is the predicted gauge reading at 1000 cfs? ______________________________

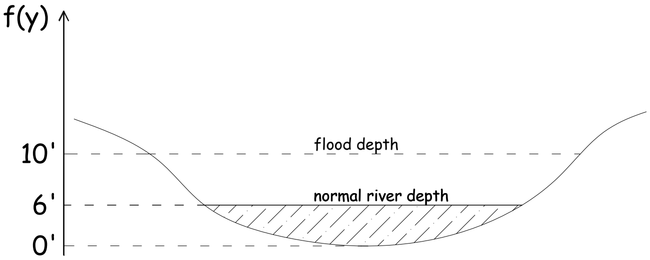
(i) Using $y = ax^b$, at what flow is the creek expected to reach flood level (10')? ______________________

ANSWER KEY

An Application

Under normal conditions, Little Creek (LC) flows at ~1,000 cfs. There is a depth gauge located on LC and at normal flows the gauge reads ~6 ft.

When Little Creek reaches 10 ft on the gauge, the creek is officially in flood.



On April 12th, there was a huge thunderstorm that began at noon. Use the following data to complete this analysis.

x	Time	12:00	12:30	1:00	1:30	2:00
y	Gauge (ft)	6.0	8.0	9.75	11.0	11.5

x	Flow (cfs)	11	65	180	375	610
y	Gauge (ft)	1.0	2.0	3.0	4.0	5.0

(a) For the Time vs. Gauge data, which should be x, which should be y? ______________

The Gauge reading depends upon time and y depends on x so y = gauge and x = time.

(b) Graph the data. Choose an appropriate regression. Write the result here: $y = -1.0x^2 + 4.8x + 5.95$

(c) At what time and at what gauge reading is the peak flood predicted? @ 2.4 (2:24 pm, 11.7 ft)

(d) At what time is the flow expected to return to normal (6')? 4.79 (4:47 pm)

(e) Let the Gauge depend upon the Flow and enter the data into your TI. Graph the data.

(f) Although the data suggests a quadratic, explain why the relation between the Gauge & Flow readings cannot be quadratic.

A quadratic will go up and then down. However, as the river rises the gauge will continue to rise albeit slower due to the widening of the channel. Thus, a quadratic is unrealistic while a power function makes more sense.

(g) For Guage vs. Flow choose a power regression ($y = ax^b$). Write the result here: $y = 0.3821x^{0.3982}$

(h) Using $y = ax^b$, what is the predicted gauge reading at 1000 cfs? 6.0 ft

(i) Using $y = ax^b$, at what flow is the creek expected to reach flood level (10')? ~3639 cfs