

Lesson Plan

by
Scott Drucker

Class: Math B

Time required: period to a period and a half

Title: Using linear regression analysis to predict earthquakes

Part I: Background information (Source: Amato, Ivan, "Parkfield Quakes Skip a Beat." Science, Vol. 259, February 19, 1993, 1120-1122

Seismologists, scientists who study earthquakes, have been trying to develop a method for predicting when and where earthquakes will occur. Most earthquakes happen along breaks in the earth's crust called faults. During earthquakes, parts of the earth's crust are either pushed together or pulled apart. The San Andreas Fault in California is a very long fault that has been carefully studied for many years. It is 960 kilometers long and 32 kilometers deep. The land west of the fault is slowly moving north while the land east of the fault is moving south. Allan Lindh and William Bakun are seismologists who have been studying a 25-kilometer section of the San Andreas Fault near Parkfield in central California. Data has been collected on Parkfield earthquakes since 1857. Six quakes with a magnitude of 6 have occurred along this section of the San Andreas Fault. The year of each earthquake is given in the chart below.

Quake #	1	2	3	4	5	6
Year	1857	1880	1902	1925	1945	1967

Exercises:

1. Graph the data in the chart using quake # for the x-axis and year for the y-axis. Start the y-axis at 1850 and mark every 10 years.
2. Draw a straight line through the points. All of your points may not be on the line, but move your straight edge around until you get the best fitting line.
3. Use your line to predict which year the next (7th) earthquake will occur.

***Discuss with them the limitations of their prediction**

4. Find the slope of your line.
5. What is the vertical intercept?
6. Write an equation of your line.
7. Use your equation to predict when the 7th. Did the 7th earthquake occur as predicted in #3?

8. Use the TI-83 to create a stat plot and find the regression equation for the data.

Discuss with them the limitations of their prediction and how technology can improve the prediction of events. Hand out the step-by-step ditto (see attached) on regression with the TI-83. Go through each step with the data from the earthquake ditto.

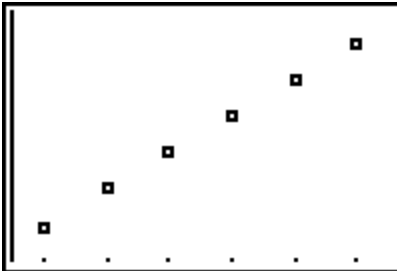
Step 1: Edit Data

L1	L2	
1	1857	
2	1880	
3	1902	
4	1925	
5	1945	
6	1967	
Name=		

Step2: Turn plot on and adjust settings

Plot1	Plot2	Plot3
On	Off	
Type:		
Xlist:	L1	
Ylist:	L2	
Mark:		.

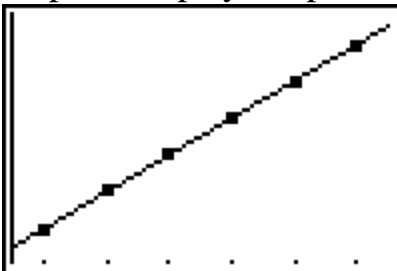
Step3: Zoom Stat



Step4: Find Regression equation

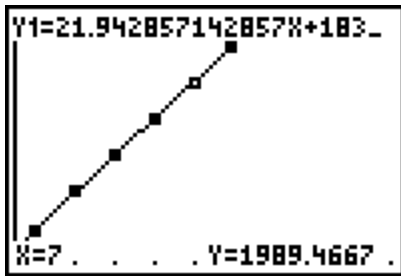
LinReg(ax+b) L1, L2,Y1	LinReg y=ax+b a=21.94285714 b=1835.866667 r ² =.9996113346 r=.9998056484	Plot1 Plot2 Plot3 Y1=21.942857142 857X+1835.866666 6667 Y2= Y3= Y4= Y5=
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Step 5: Display Graph

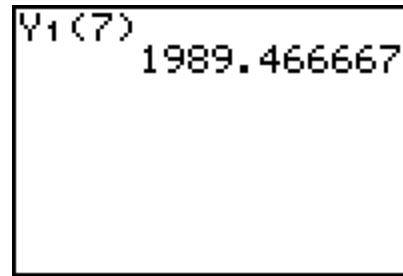


9. Find the regression equation and then use the equation to predict when the 7th earthquake occurred.

Make sure to adjust the window so that 7 is within the domain of the window. I adjusted my x-max to 10. Trace at $x = 7$. An alternative way is to evaluate the function in the calculator mode of the calculator.



or



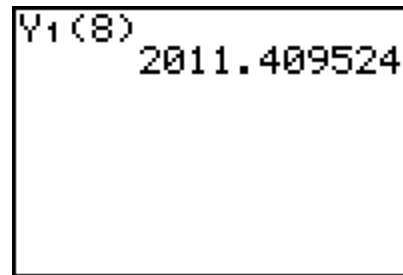
Ask them what major event occurred in that year. Show them the following website (<http://europe.cnn.com/resources/video.almanac/1989/Index3.html#quake>). Finally have the students predict when the 8th earthquake will occur.

10. Use the regression equation to predict when the 8th earthquake will occur.

Trace at $x = 8$.



or



One of the goals of this lesson is to show the students that finding regression equations with the TI-83 is a very powerful tool in the world of prediction.