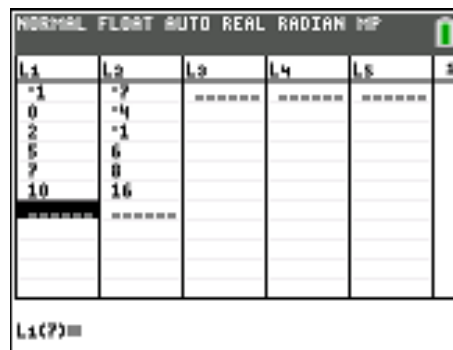


In this activity, you will investigate a residual plot for a set of data after selecting a regression model. The residual plot is used to justify the choice of a function model based on an analysis of the residuals.



Discussion Points and Possible Answers

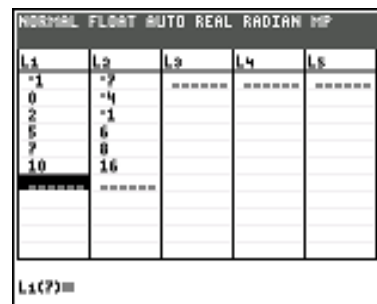
Tech Tip: If data exists in the lists of the Stats Editor, advise students to press the up arrow until L1 (or any other lists) is highlighted. Select `clear` and `enter` to delete the data. An alternate method is given in Part 2.

Part 1

Use the following data set in Part 1.

x	-1	0	2	5	7	10
y	-7	-4	-1	6	8	16

- To enter the data, select `stat` 1: Edit... Enter the x values in [L1] and the y values in [L2].



Tech Tip: Students must press enter or the down arrow after the last value is entered. If the students gets a Dimension Mismatch error, they should check their data to make sure all the data has been entered.



To run a linear regression, select $\boxed{\text{stat}}$ and use the right arrow to highlight CALC.

Select 4: LinReg (ax + b). Make sure the Xlist: is set to L1 and the Ylist: is set to L2. Arrow down to Store RegEQ: and press $\boxed{\alpha}\boxed{\text{trace}}$ to select 1: Y1. Arrow down to Calculate and press $\boxed{\text{ENTER}}$. The linear regression is calculated and is also stored in Y1.

What is your linear regression equation?

Answer: The linear regression equation is

$$y = ax + b$$

$$a = 2.003669725$$

$$b = -4.680733945$$

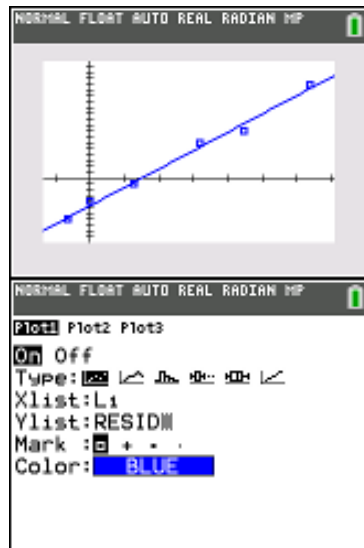
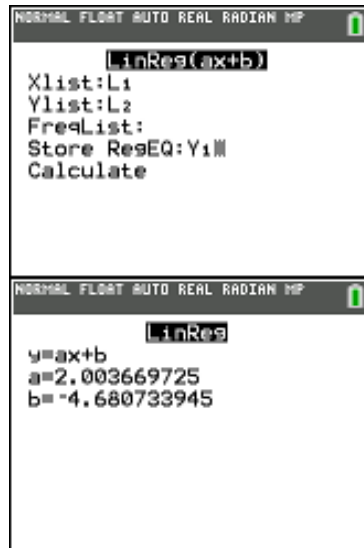
2. To view the scatter plot, press $\boxed{2\text{nd}}\boxed{Y=}$ to access STAT PLOTS.

Select 1: Plot 1 and press $\boxed{\text{ENTER}}$. Use the arrow keys to change the settings to match the screen to the right.

Select $\boxed{\text{ZOOM}}\boxed{9}$: ZoomStat.

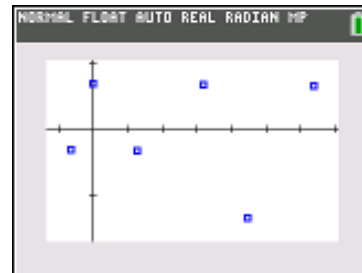
Note: To hide the graph of the linear regression equation, select $\boxed{Y=}$, use the left arrow key to place it on the = sign and press enter. Select $\boxed{\text{graph}}$ to view the scatter plot.

The residual is the actual value minus the predicated value. A regression model is justified as appropriate for a data set if the residuals of a regression, the residual plot, appear without pattern. To view the residual plot, press $\boxed{2\text{nd}}\boxed{Y=}$ and edit the settings of Plot 1 to match the screen to the right. Note: Resid is found by pressing $\boxed{2\text{nd}}\boxed{\text{stat}}$. Select $\boxed{\text{ZOOM}}\boxed{9}$: ZoomStat.

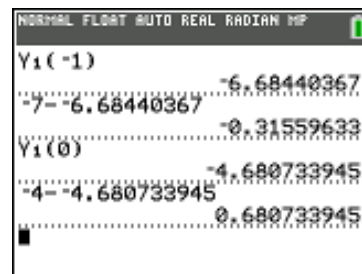


Does your residual plot have a pattern? Would a linear regression be appropriate for this data set?

Answer: The residual plot does not have a pattern. A linear regression is appropriate for this data set.



3. To evaluate the predicted values, press α trace to select 1: Y_1 . Calculate $Y_1(-1)$ and then calculate the residual when x is -1 . Calculate $Y_1(0)$ and then calculate the residual when x is 0 . Notice that one residual value is negative and one is positive. What does this tell us about the predicted value as being an underestimate or an overestimate?



Answer:

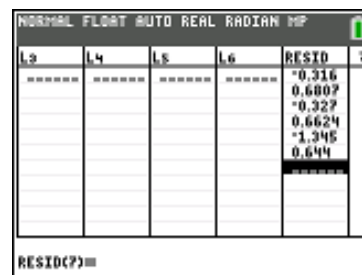
$Y_1(-1) = -6.68440367$; Residual = -0.31559633

$Y_1(0) = -4.680733945$; Residual = 0.680733945

If the residual is positive, the predicted value is an underestimate.

If the residual is negative, the predicted value is an overestimate.

Note: To view the residual list for all of the data points, select stat 1: Edit... Arrow to the right until you get to L6. Press the Up arrow and then the right arrow. Open the List Editor by selecting 2^{nd} stat . Select 7: RESID and press ENTER .



Teacher Note: The graph of the scatter plot with the regression equation may be helpful to visualize the overestimate or underestimate.

Part 2

Use the following data set in Part 2.

x	-1	0	1	2	4	5
y	0.2	0.6	0.9	2.1	7.9	16.2

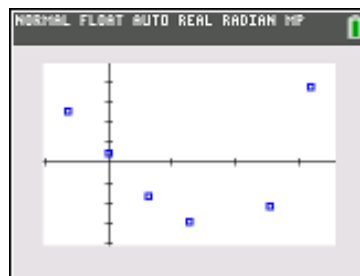
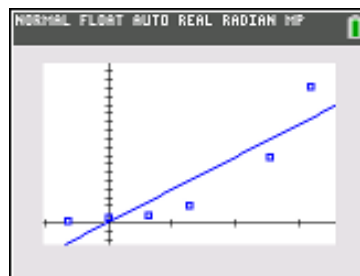
Tech Tip: To clear the data and residuals from the previous problem, select `[stat]` and 4: ClrList, then add L1, L2, LRESID separated by commas.

4. Follow the steps in Part 1. Enter the data in L1 and L2. Compute a linear regression, view the scatter plot, and view the residual plot. Does your residual plot have a pattern? Would a linear regression be appropriate for this data set?

Answer: The residual plot appears to have a pattern. A linear regression is not appropriate for this data set.

L1	L2	L3	L4	L5	2
-1	0.2	*****	*****	*****	
0	0.6				
1	0.9				
2	2.1				
4	7.0				
5	16.2				

L2(?)=

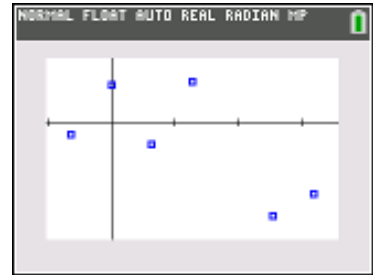
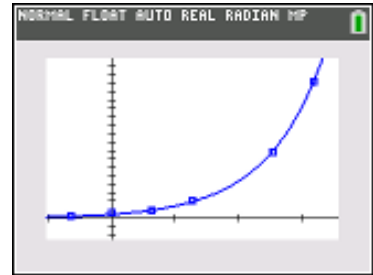


5. Now compute an exponential regression which is 0: ExpReg in the Stats Calc menu. View the scatter plot, and the residual plot. Does your residual plot have a pattern? Would an exponential regression be appropriate for this data set?





Answer: The residual plot does not appear to have a pattern. An exponential regression is appropriate for this data set.



Extensions

1. Find a data set that models a quadratic and ask the students to follow the steps for a quadratic regression. Observe the scatter plot and the residual plot.

Wrap Up

Upon completion of the lesson, the teacher should ensure that students are able to understand:

- How to input data in the Stats Editor.
- How to compute linear, quadratic, and exponential regressions.
- How to plot residuals and determine if the residual plot has a pattern.