Activity Lab

Technology

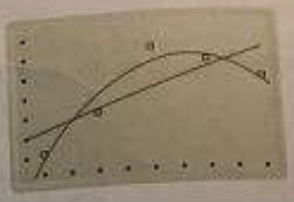
Modeling Using Residuals

FOR USE WITH LESSON 5-1

You can use more than one model for a set of data. You can determine which is a better model by analyzing the differences between the y-values of the data and the y-values of each model. These differences are called residuals. The better model will have residuals that are closer to zero.

ACTIVITY

The calculator screen shows the graphs of a linear model and a quadratic model for the data below. Which model better fits the data?



Participation in Backpacking or Wilderness Camp Activities

Year (1990 = 0)	1995	1997	1999	2001	2003
Millions of Participants	10.2	12.0	15.3	14.5	13.7

Source: National Sporting Goods Association

Step 1 Press STAT ENTER to enter the data in L_1 and L_2. Then use the LinReg and QuadReg features to find linear and quadratic models.

Step 2 Enter the linear model as Y_1 and the quadratic model as Y_2.

Step 3 To find the residuals of the linear model and store the differences in L_3, enter L_2 − VARS ▶ 1 1 (L_1) STO▶ L_3 ENTER.

Step 4 Find the residuals of the quadratic model. Store the differences in L_4.

Step 5 Compare the residuals in L_3 and L_4. The values in L_4 are closer to zero, so the quadratic model is the better fit.

EXERCISES

For each set of data, find a linear model and a quadratic model. Which model is the better fit? Justify your reasoning.

1. Money Spent in the U.S. on Personal Technology

Year (0 = 1970)	0	10	20	22	24	26
Billions of Dollars	8.8	17.6	53.8	61.2	78.5	89.7

2. Fishing Licenses Sold

Year (0 = 1970)	0	5	10	15	20	25	30
Millions Sold	31.1	34.7	35.2	35.7	36.9	37.9	37.6

3. For each of Exercises 1 and 2, state whether the situation is discrete and describe a reasonable domain and range. Explain your responses.

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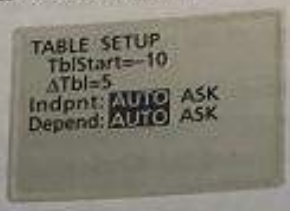
Quadratic Inequalities

For Use With Lesson 5-8

You can solve quadratic inequalities using graphs, tables, and algebraic methods. Indeed, the most effective way may be a combination of methods.

1 ACTIVITY

To find which of $x^2 - 12$ or $3x + 6$ is greater, enter the two functions as Y_1 and Y_2 in your graphing calculator, you could use the TABLE option to compare the two functions for various values of x, as shown below.



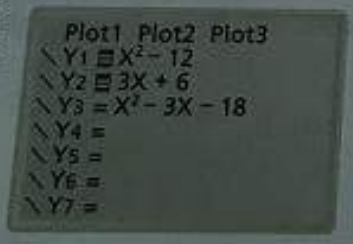
1. For which values of x in the table is $x^2 - 12 > 3x + 6$?
2. For which values of x in the table is $x^2 - 12 < 3x + 6$?
3. Does this table tell you all values of x for which $x^2 - 12 < 3x + 6$? Explain.
4. In the TBLSET (TABLE SETUP) menu, change TblStart to -9 and ΔTbl to 3. Display the table again. Does the table with this setup give you more information? Why?

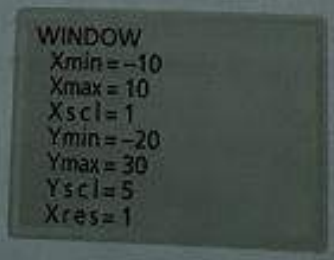
You can compare functions more efficiently by making one side of the inequality 0.

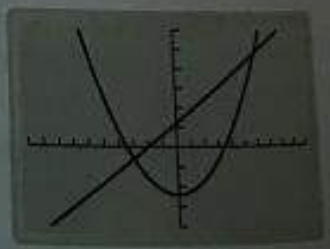
5. Show that $x^2 - 12 < 3x + 6$ is equivalent to $x^2 - 3x - 18 < 0$.
6. Enter $x^2 - 3x - 18$ as Y_3 in your graphing calculator. Place the cursor on the = sign after Y_1 and press ENTER. This operation turns off the display of the equation Y_1. Turn off Y_2 as well, and then display the table. You will see the screen shown at the right. For which values of x in the table is $x^2 - 3x - 18 < 0$?

2 ACTIVITY

For a visual model, look at the same inequalities graphically. Turn off Y_3 and turn on Y_1 and Y_2. Begin by graphing the two functions in the original inequality as shown in the screens below.







7. Which graph represents the function $f(x) = x^2 - 12$? Which graph represents $f(x) = 3x + 6$? How can you tell?