Section 3.2: Building Linear Models from Data

Learning Objectives:

1. Draw and Interpret Scatter Diagrams (p. 136)
2. Distinguish between Linear and Nonlinear Relations (p. 137)
3. Use a Graphing Utility to Find the Line of Best Fit (p. 138)

Data Analysis Using the TI-83/84

A. Entering data for a scatter plot

1) Go the STAT menu and select EDIT. Your calculator has 6 built in lists to use for data storage: L1, L2, L3, L4, L5, L6. If there is data in L1 or L2 you can clear it by selecting the name of the list and then keying CLEAR (ENTER)
2) Enter the first column (x values) in L1 and the second column (y values) in L2. Simply type in the numbers and hit ENTER and the calculator will automatically advance to the next line. BOTH LISTS MUST BE THE SAME LENGTH

B. Graphing the Scatter Plot

1) Access the StatPlot menu (2nd Y=). Choose Plot1 and ENTER. Make sure the plot is turned ON, the first plot type is selected and the Xlist is L1 and Ylist is L2. The first mark (the box) is the easiest to see. You may adjust the window settings yourself using the WINDOW menu or use the ZOOMSTAT option on the ZOOM menu.
2) Now hit the GRAPH key and your scatter plot should appear. If you know that the settings for Plot1 are correctly set up to graph L1 versus L2 then you may turn Plot1 (and similarly Plots 2 and 3) on and off from the y= menu by simply moving the cursor up to the name of the plot and hitting ENTER to toggle between ON and OFF (The type is in reverse if the plot is on.)

C. Finding a Regression Equation

1) From the STAT menu select the CALC menu.
2) Choose the type of regression equation that is appropriate for your data and hit ENTER. For linear models for example it is LinReg(ax +b). This puts the command on the main screen. You may hit ENTER to accept the default values of using L1 for X values and L2 for Y values. Alternately you can type L1,L2,Y1 after the command to use L1 and L2 and store the equation in Y1. So you would have a command like this: LinReg(ax+b) L1,L2,Y1 Note: L1 and L2 are available as the 2^{nd} function of the 1 and 2 keys.
3) To get Y1 you select VARS and then the Y-VARS menu and then the Function option. If you prefer to take the default values by hitting ENTER it will create the equation but not store it in Y1. To store it in Y1 go to the y= menu and select VARS, STATISTICS, the EQ menu, and finally RegEQ.

Note: In order to use this you must actually run the regression routine. Don't just put the data in the lists and go straight to this or you will get the regression equation from the last time you ran a regression.

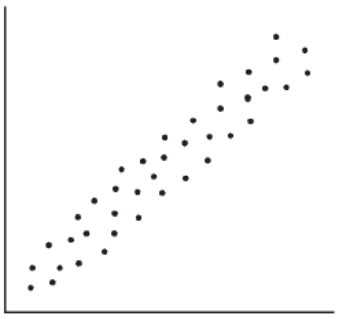
EXAMPLE Drawing and Interpreting a Scatter Diagram

Team	On-Base Percentage, x	Runs Scored, y	(x, y)
Atlanta	33.7	849	(33.7, 849)
St. Louis	33.7	781	(33.7, 781)
Colorado	34.1	813	(34.1, 813)
Houston	33.2	735	(33.2, 735)
Philadelphia	34.7	865	(34.7, 865)
San Francisco	32.4	746	(32.4, 746)
Pittsburgh	32.7	691	(32.7, 691)
Florida	33.1	758	(33.1, 758)
Chicago Cubs	31.9	716	(31.9, 716)
Arizona	33.1	773	(33.1, 773)
Milwaukee	32.7	730	(32.7, 730)
Washington	33.8	746	(33.8, 746)
Cincinnati	33.6	749	(33.6, 749)
San Diego	33.2	731	(33.2, 731)
NY Mets	33.4	834	(33.4, 834)
Los Angeles	34.8	820	(34.8, 820)

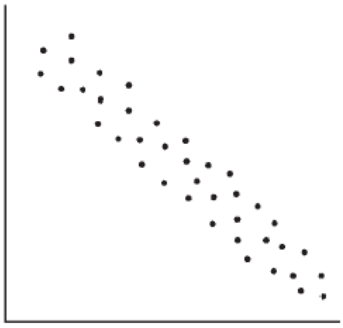
(a) Draw a scatter diagram of the data, treating on-base percentage as the independent variable.

(b) Use a graphing utility to draw a scatter diagram.

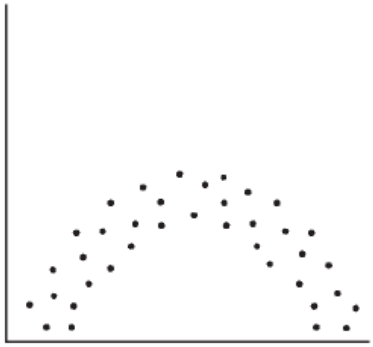
(c) Describe what happens to runs scored as the on-base percentage increases.



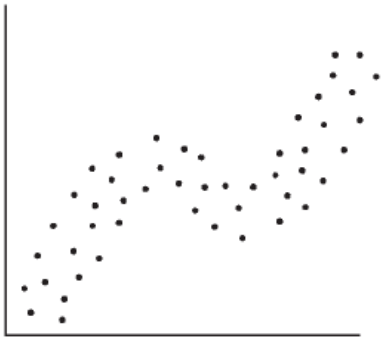
(a) Linear
$y = mx + b, m > 0$



(b) Linear
$y = mx + b, m < 0$



(c) Nonlinear



(d) Nonlinear

Section 3.4: Building Quadratic Models from Verbal Descriptions and from Data

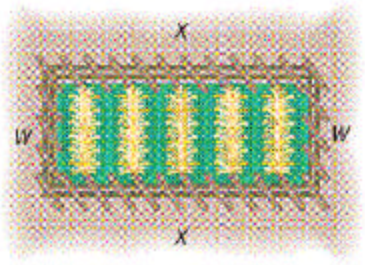
Learning Objectives:

1. Build Quadratic Models from Verbal Descriptions (p. 155)
2. Build Quadratic Models from Data (p. 158)

EXAMPLE

Maximizing the Area Enclosed by a Fence

A farmer has 800 yards of fence to enclose a rectangular field. What are the dimensions of the rectangle that encloses the most area?



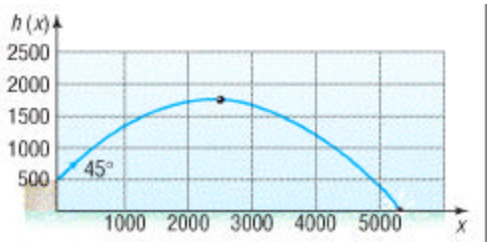
EXAMPLE

Analyzing the Motion of a Projectile

A projectile is fired from a cliff 500 feet above the water at an inclination of 45° to the horizontal, with a muzzle velocity of 400 feet per second. In physics, it is established that the height h of the projectile above the water is given by

$$h(x) = \frac{-32x^2}{(400)^2} + x + 500$$

where x is the horizontal distance of the projectile from the base of the cliff.



(a) Find the maximum height of the projectile.

(b) How far from the base of the cliff will the projectile strike the water?

EXAMPLE The Golden Gate Bridge

The Golden Gate Bridge, a suspension bridge, spans the entrance to San Francisco Bay. Its 746-foot-tall towers are 4200 feet apart. The bridge is suspended from two huge cables more than 3 feet in diameter; the 90-foot-wide roadway is 220 feet above the water. The cables are parabolic in shape* and touch the road surface at the center of the bridge. Find the height of the cable at a distance of 1000 feet from the center.