Name _____ Date _____

CHAPTER 9 Using Regression Models

A regression model can be a useful tool in making future predictions about a set of data. In statistics, such a prediction is called an **extrapolation**.

There are three regression models that you will need to be familiar with: linear, exponential, and quadratic. The use of each will depend on the data that you are working with. You will use your graphing calculator to find a regression model given a set of data.

A regression model does not always provide an accurate prediction. For example, if a young boy is 48 inches tall and is now growing at a rate of about 2 inches per year, a linear model would predict that he would be about 9 feet tall by the time he was 24 years old! The linear model is accurate only when the boy is young and growing.

EXAMPLE 1 Use a model to predict

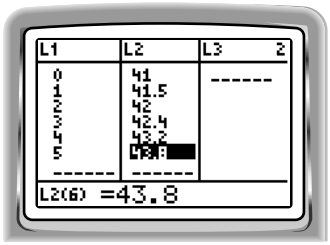
A sports stadium was designed to hold up to 46,000 fans at a time. The table below shows the average attendance at the stadium from the year 1999 to the year 2004.

Year	1999	2000	2001	2002	2003	2004
Average Attendance (Thousands)	41	41.5	42	42.4	43.2	43.8

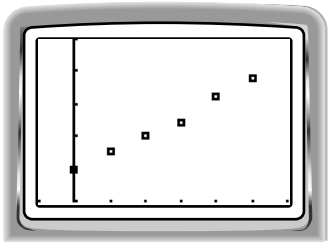
Use a graphing utility to predict when the average attendance will exceed the capacity of the stadium.

Solution:

Enter the data into two lists. (Let $x = 0$ represent 1999.)



Next, make a scatter plot. The scatter plot shows a linear trend.



Use the linear regression feature to obtain the model $y = 0.56x + 40.9$. According to this model, the average attendance at the stadium will exceed capacity by the year 2009. ■

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EXAMPLE 2 Choose an appropriate regression model

The population of a colony of insects is decreasing due to consumption of an insecticide.

Day	1	2	3	4	5	6
Number of Insects	1280	670	310	140	70	20

Find a quadratic model and an exponential model for this data using a graphing utility. Which model best fits the data?

Solution:

Use a graphing calculator to create a scatter plot of the data. From the scatter plot, you may think that either an exponential model or a quadratic model could fit the data.

The quadratic model $y = 71x^2 - 731x + 1902$ fits the data fairly well for the first few days, but shows a population increase after about day 5.

The exponential model $y = 3297(0.44)^x$ also fits the data well. Unlike the quadratic model, the exponential model shows a continued population decrease over time.

The exponential model best fits the data, since it predicts a continued decline in population. ■

Practice

Use a graphing utility to answer questions 1–3.

1. The table shows the value of a property over a four year period.

Year	2000	2001	2002	2003
Value (in dollars)	98,000	104,000	112,500	147,000

a. Find an exponential model for the data in the table. (Let $x = 0$ represent the year 2000.)

b. Use the model from part a) to predict the value of the property in the year 2020.

c. How reasonable is your prediction from part b)?

2. The table shows the height of a palm tree for the first 5 years since it was planted.

Year	1	2	3	4	5
Height (in feet)	4	6.5	8.2	11	13.4

a. Find a linear model for the data in the table.

b. Use the model from part a) to predict the height of the tree in 30 years.

c. How reasonable is your prediction from part b)?

3. The table shows the height of an airplane taking off from a runway. The height of the airplane is recorded in terms of its time (in minutes) from the runway.

Minutes from Runway	0.5	1	1.5	2
Height (in meters)	75	200	400	650

a. Find an exponential model for the data in the table.

b. Use the model from part a) to predict the height of the plane when it is 5.5 minutes after take off.

c. How reasonable is your prediction from part b)?