Perform Regressions

MATHEMATICAL PRACTICES

Use appropriate tools strategically.

QUESTION How can you use a graphing calculator to find models for data?

You have used a graphing calculator to perform linear regression on data to find a linear model for the data. A graphing calculator can also be used to perform exponential regression and quadratic regression.

EXAMPLE 1 Use exponential regression to find a model

The table shows the sales (in millions of dollars) of organic milk, organic half and half, and organic cream in the U.S. each year for the period 1996–2000. Find an exponential model for the data.

Year	1996	1997	1998	1999	2000
Sales (millions of dollars)	15.8	30.7	46	75.7	104

STEP 1 *Enter data*

Enter the data into two lists. Let $x = 0$ represent 1996.


```
    L1    L2    L3
   0     15.8
   1     30.7
   2     46
   3     75.7
   4     104
  L2(4)=104
```
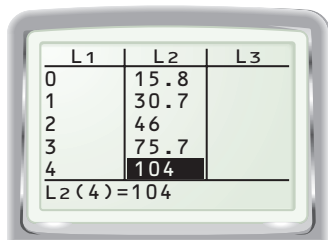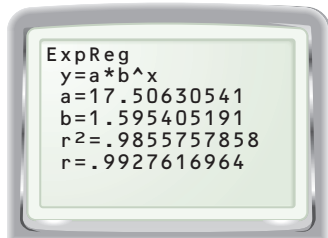
STEP 2 *Make scatter plot*

Make a scatter plot of the data. Notice that the points show an exponential trend.
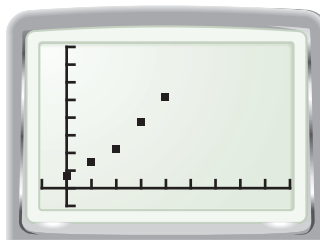
STEP 3 *Perform regression*

Use the exponential regression feature to obtain the model $y = 17.5(1.6)^x$.

```
ExpReg
 y=a*b^x
 a=17.50630541
 b=1.595405191
 r²=.9855757858
 r=.9927616964
```

STEP 4 *Check model*

Check how well the model fits the data by graphing the model and the data.
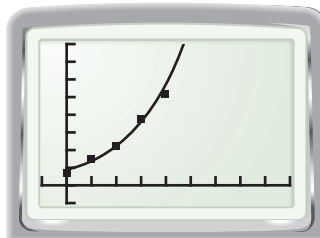
PRACTICE

1. The table shows the value of a car over time. Find an exponential model for the data. Use the model to estimate the value of the car after 7 years.

| Age of car (years)	0	1	2	3	4	5
Value (dollars)	15,600	13,510	11,700	10,132	8774	7598

EXAMPLE 2 Use quadratic regression to find a model

The table shows the number of subscribers to the first U.S. digital satellite radio service for various months after its launch. Find a quadratic model for the data.

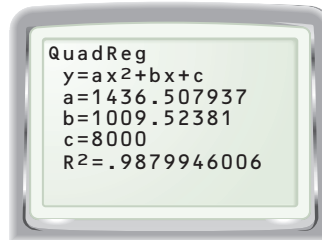| Months after launch	0	3	6	9	12	15
Subscribers	500	31,000	76,000	135,500	201,500	360,000

STEP 1 *Make scatter plot*
Enter the data into two lists and make a scatter plot. Notice the quadratic trend in the data.
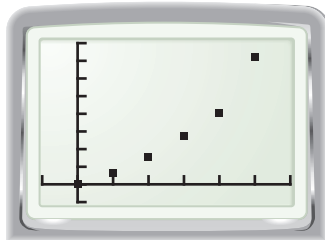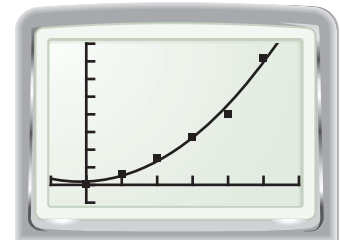
STEP 2 *Perform regression*
Use the quadratic regression feature to obtain the model $y = 1440x^2 + 1010x + 8000$.

STEP 3 *Check model*
Check how well the model fits the data by graphing the model and the data.


```
QuadReg
y=ax2+bx+c
a=1436.507937
b=1009.52381
c=8000
R2=.9879946006
```

PRACTICE

2. The table shows the maximum weight that can be supported by a 16 foot floor beam of different depths. Find a quadratic model for the data.

Depth (inches)	6	7.5	9	10.5	12	13.5
Weight (pounds)	68	137	242	389	586	838

DRAW CONCLUSIONS

3. The table shows the temperature (in degrees Fahrenheit) of a cup of hot chocolate over time. Find an exponential model and a quadratic model for the data. Make a scatter plot of the data and graph both models. Which model fits the data better? *Explain*.

Time (minutes)	0	10	20	30	40	50	60
Temperature (°F)	200	157	128	109	99	92	90

4. DATA COLLECTION For this exercise, you will need a collection of pennies. Use a compass to draw 7 or 8 circles with diameters d ranging in size from 8 centimeters to 20 centimeters. Count the number n of pennies you need to (**a**) surround each circle completely and (**b**) cover each circle completely. For each set of ordered pairs (d, n), find a linear model, an exponential model, and a quadratic model, and tell which model fits the data best.

9.8 Compare Linear, Exponential, and Quadratic Models **637**