

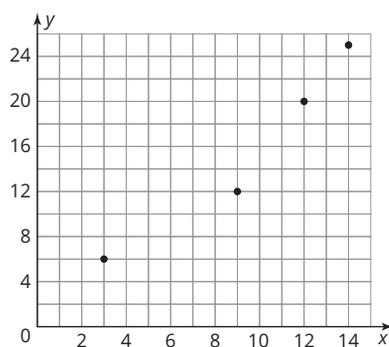
# 4

## BAC Is BAD News

### Choosing a Function to Model Data

#### Warm Up

1. Is the scatter plot shown best represented by a linear or exponential function? Explain your answer.
2. Determine a regression equation that best fits this data.



#### Learning Goals

- Determine the appropriate regression equation for a data set.
- Solve a complex problem using the mathematical modeling process.
- Reflect upon the mathematical modeling process.

You can determine a regression equation for a data set. How can you use this knowledge to solve a real-world problem?

## Drinking and Driving Don't Mix

A BAC of 0.08 means that 0.08 percent of a person's blood is alcohol.

Blood Alcohol Content (BAC) is a way of measuring the amount of alcohol in a person's blood stream. BAC levels are measured in percentages.

A recent study shows that a person with no alcohol in the blood system has a 1.8% chance of causing a car accident.

There is a relationship between the relative probability of a driver causing a car accident and a driver's BAC. The relative probability is the number of times more likely a driver with alcohol in their blood system is to cause a car accident than a driver with no alcohol in their blood system. For example, a relative probability of 2 for a driver with a BAC of 0.06% means that a car accident is twice as likely to occur as for a driver with a BAC of 0.00.

**1. Explain the difference in meaning between probability and relative probability using the values in this scenario.**

**2. Use the likelihood of a person with no alcohol in their blood system causing a car accident to answer each question.**

**a. There is a relative probability of 2 that a person with a BAC of 0.06% causes an accident. What is the probability that this person will cause a car accident?**

It is illegal for anyone over the age of 21 to drive once their BAC reaches 0.08. For drivers under 21, any BAC level above 0.00 is illegal!

**b. There is a relative probability of 5 that a person with a BAC of 0.10% causes an accident. What is the probability that this person will cause a car accident?**

**c. There is a relative probability of 25 that a person with a BAC of 0.16% causes an accident. What is the probability that this person will cause a car accident?**

**3. Examine your answers from Question 2. What do you notice about the rate at which alcohol affects a person's ability to drive?**





Different factors affect a person's BAC, including weight, gender, the duration of consuming alcohol, and the amount of food the person eats. According to the Virginia Tech Alcohol Abuse Prevention website, a typical 140-pound male who has one drink over a 40-minute period will have a BAC of 0.03%. If he has another drink over the next 40 minutes, his BAC rises to 0.05%. If he has one more drink over the next 40-minute period, his BAC rises to 0.08%, which means he legally cannot drive.

BAC Level (percent)	Relative Probability of Causing an Accident (percent)
0.02	1
0.06	2
0.10	5
0.16	25

Use this data to create a model to predict the likelihood of a person causing an accident based on their BAC. Include a table, a graph, and an equation in your model. Be sure to define your variables.

Include these elements in your analysis.

- Describe why the function type you chose is appropriate for this situation. How do you know that it's a good fit?
- Predict the probability that drivers with different BACs will cause an accident. Show all your work.
- How can your graph be used to write guidelines around when a person is safe to drive, even if they can legally drive?





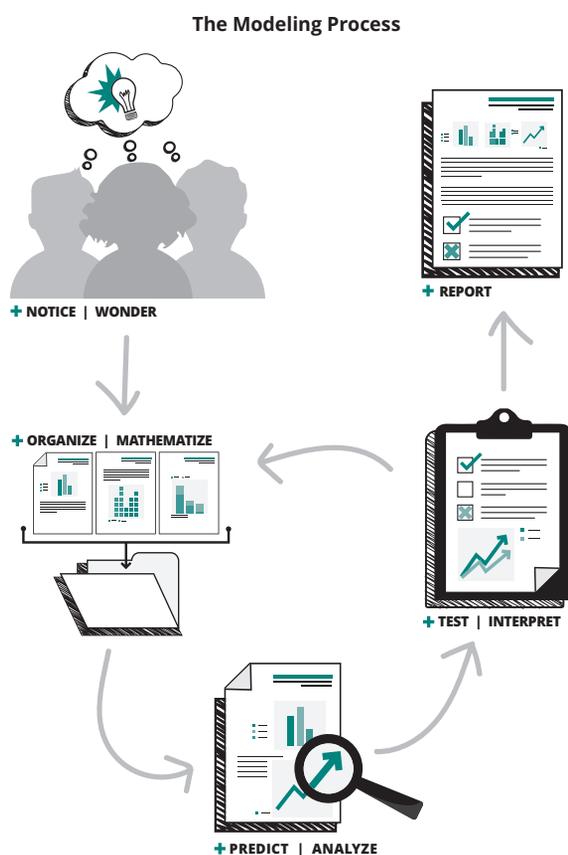
Write an article to report your conclusions for the newsletter of the local chapter of S.A.D.D. (Students Against Destructive Decisions) that stresses the seriousness of drinking and driving. Include tables and/or graphs to help the reader make sense of the issue. You may want to include facts about the rate at which a driver's probability of causing an accident increases as their BAC increases, the definitions of legal limits in your state, and how a driver's motor skills are affected by alcohol.

# TALK the TALK

## What Have I Done?

By solving the problem in this lesson, you intuitively engaged in the mathematical modeling process.

1. Reflect on your process by referencing the diagram and noting the type of thinking and work you engaged in next to each step.



2. Were there instances where you looped back in the process? Explain how you knew you needed to loop back and how you changed the direction in your thinking.



# Assignment

## Write

Describe the mathematical modeling process in your own words.

## Remember

Determining and using a regression equation is sometimes a step in the process of solving a more complex mathematical problem, rather than the final solution.

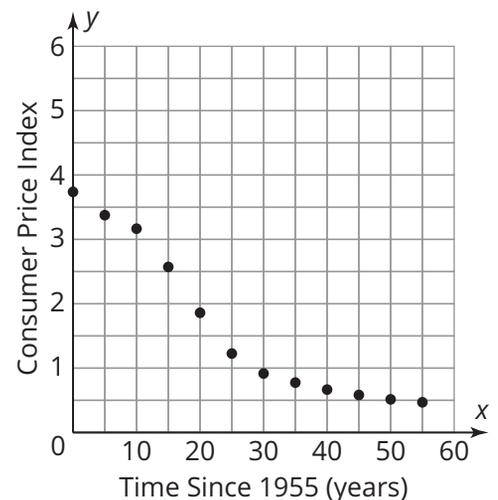
## Practice

The table shows the purchasing value of the dollar, or the consumer price index, for consumers in the United States from 1955 to 2010. The table uses the year 1982 as a base period, so the consumer price index written in dollars and cents in 1982 is 1.00. For instance, in 1955 the consumer price index was 3.73. This means that a dollar in 1955 was worth 3.73 times what it was worth in 1982. Similarly, a dollar in 2010 was worth 0.46 times what it was worth in 1982.

Year	Consumer Price Index	Year	Consumer Price Index
1955	3.73	1985	0.93
1960	3.37	1990	0.77
1965	3.17	1995	0.66
1970	2.57	2000	0.58
1975	1.86	2005	0.51
1980	1.22	2010	0.46

The scatter plot shows the data in the table where  $x$  represents the number of years since 1955 and  $y$  represents the consumer price index.

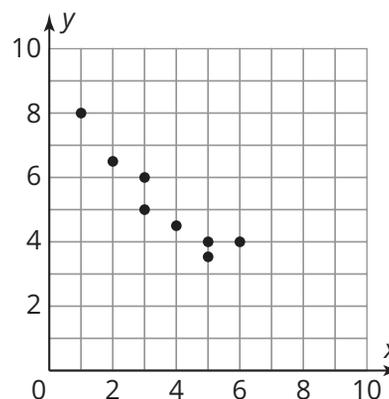
1. Describe how the consumer price index changes over time.
2. What type(s) of function(s) model this situation?  
Explain your reasoning.



3. Analyze the data and scatter plot.
  - a. Determine the regression equation for the model that best represents the data. Explain how you determined your answer. Then, graph the model on the same grid as the scatter plot.
  - b. Predict the consumer price index in 2025. Explain what your answer means in terms of the problem situation.
  - c. Mr. Kratzer asks his students to calculate what the consumer price index was in 1950. Melina says that you must evaluate the function at  $x = 5$  to determine the consumer price index in 1950. Dominique argues you must evaluate the function at  $x = -5$  to determine the consumer price index in 1950. Who is correct? Explain your reasoning.
  - d. Calculate the consumer price index for 1950. Show your work.
  - e. The consumer price index in 1950 was actually 4.15. Compare this to the answer you calculated in part (d). Explain why these answers differ.

## Stretch

1. Analyze the scatter plot shown.
  - a. Determine the function that best models the graph.
  - b. Plot the point  $(8, 6)$  on the graph. Does your answer to part (a) change? Why or why not?
  - c. If you were doing research and a situation arose in which a data point that gets added to the graph changes the model, what is one thing you might do to investigate further?



## Review

1. A home recently experienced an infestation of insects. The insect population over time is shown in the table. Write the function that represents the insect population over time.

Insect Population	
Day	Number of Insects
1	240
2	360
3	540
4	810

2. Solve each system of linear equations.

a. 
$$\begin{cases} 2x - 3y = 4 \\ 4x + y = 8 \end{cases}$$

b. 
$$\begin{cases} -5x + 6y = 10 \\ 2x - 3y = 15 \end{cases}$$

3. Solve each equation for  $x$ .

a.  $8^{3x} = 262,144$

b.  $2^{-x} = 1,048,576$