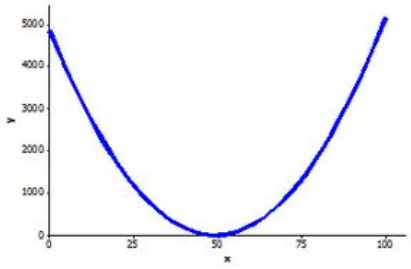
Lesson 2.2.2: Using Relationships to Make Connections

Targets:

1. I can identify which type of relationship each scatter plot has.
2. I can use an equation that fits the relationship of the scatter plot to make decisions.

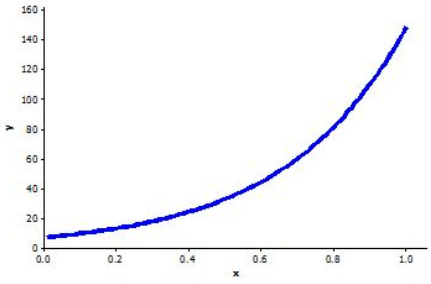
Lesson Introduction



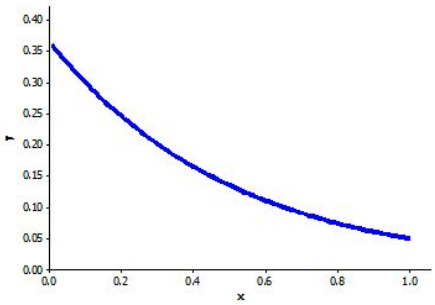
Sometimes the pattern in a scatter plot will look like the graph of a **quadratic function** (with the points falling roughly in the shape of a U that opens up or down), as in the graph to the right::

In other situations, the pattern in the scatter plot might look like the graphs of **exponential functions** that either are upward sloping (Graph 1) or downward sloping (Graph 2):

Graph 1: Exponential – upward sloping



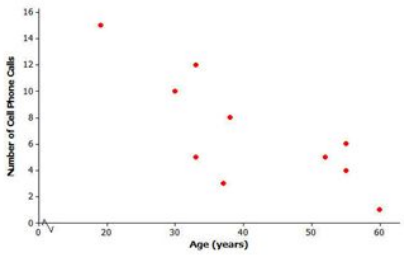
Graph 2: Exponential – downward sloping



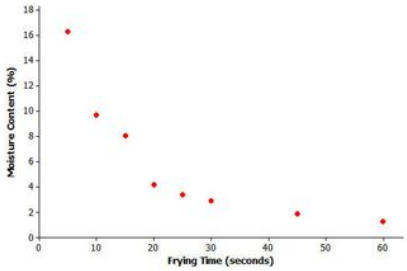
Practice 1

- Which scatter plot could be reasonably described as Linear?
- Which scatter plot could be reasonably described as Quadratic?
- Which scatter plot could be reasonably described as Exponential?
- Which scatter plot has no relationship?

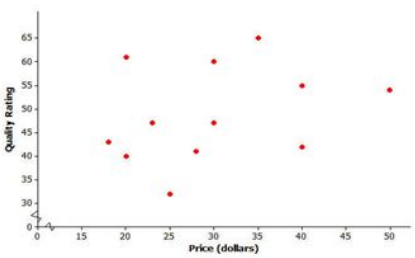
Scatter Plot 1:



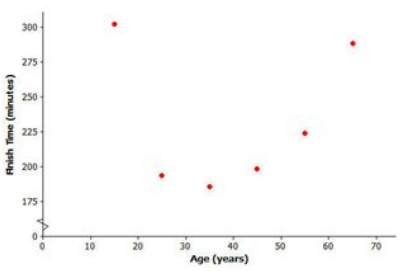
Scatter Plot 2:



Scatter Plot 3:

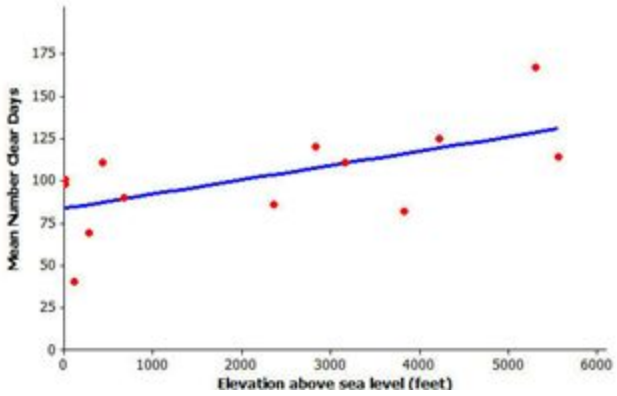


Scatter Plot 4:



Practice 2

Let's revisit the data on elevation (in feet above sea level) and mean number of clear days per year. The scatter plot of this data is shown below. The plot also shows a straight line that can be used to model the relationship between elevation and mean number of clear days.



The equation of this line is $y = 83.6 + 0.008x$.

1. Assuming that the 14 cities used in this scatter plot are representative of cities across the United States, should you see more clear days per year in Los Angeles, which is near sea level, or in Denver, which is known as the mile-high city? Justify your choice with a line showing the relationship between elevation and mean number of clear days.

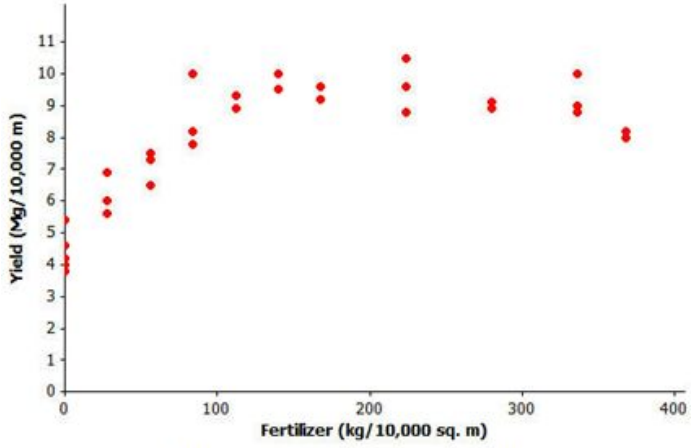
2. One of the cities in the data set was Albany, New York, which has an elevation of 275 feet. If you did not know the mean number of clear days for Albany, what would you predict this number to be based on the line that describes the relationship between elevation and mean number of clear days?

3. Another city in the data set was Albuquerque, New Mexico. Albuquerque has an elevation of 5,311 feet. If you did not know the mean number of clear days for Albuquerque, what would you predict this number to be based on the line that describes the relationship between elevation and mean number of clear days?

4. Was the prediction of the mean number of clear days based on the line closer to the actual value for Albany with 69 clear days or for Albuquerque with 167 clear days? How could you tell this from looking at the scatter plot with the line shown above?

Practice 3: Quadratic Model

Farmers sometimes use fertilizers to increase crop yield, but often wonder just how much fertilizer they should use. The data shown in the scatter plot below are from a study of the effect of fertilizer on the yield of corn.



Data Source: *Agronomy Journal*, 1990

Complete Exercises 1-3 on the next page:

1. The researchers who conducted this study decided to use a quadratic curve to describe the relationship between yield and amount of fertilizer. Explain why they made this choice.

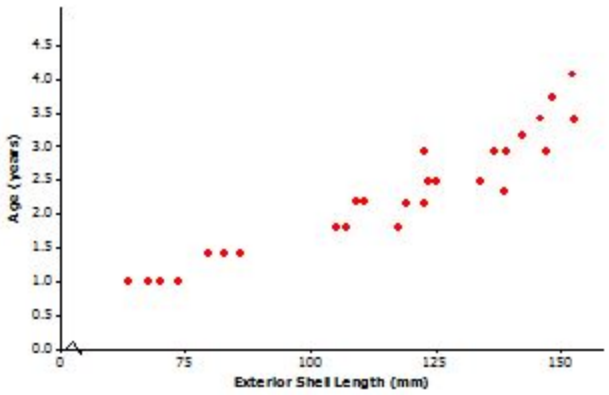
2. The model that the researchers used to describe the relationship was: $y = 4.7 + 0.05x - 0.0001x^2$, where x represents the amount of fertilizer (kg per 10,000 sq m) and y represents corn yield (Mg per 10,000 sq m). Use this quadratic model to complete the following table. Then sketch the graph of this quadratic equation on the scatter plot on the previous page.

x	y
0	
100	
200	
300	
400	

3. Based on this quadratic model, how much fertilizer per 10,000 square meters would you recommend that a farmer use on his cornfields in order to maximize crop yield? Justify your choice.

Practice 4: Exponential Model

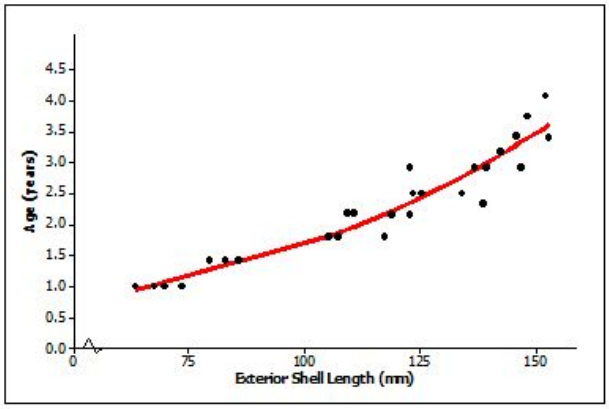
How do you tell how old a lobster is? This question is important to biologists and to those who regulate lobster trapping. To answer this question, researchers recorded data on the shell length of 27 lobsters that were raised in a laboratory and whose ages were known.



Data Source: *Biological Bulletin*, 2007

1. The researchers who conducted this study decided to use an exponential curve to describe the relationship between age and exterior shell length. Explain why they made this choice.

2. The model that the researchers used to describe the relationship is: , where x represents the exterior shell length (mm) and y represents the age of the lobster (years). The exponential curve is shown on the scatter plot below. Does this model provide a good description of the relationship between age and exterior shell length? Explain why or why not.



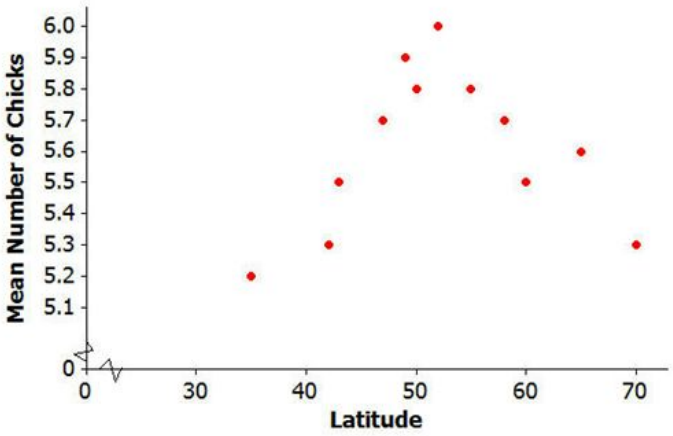
Continue exercises 3 and 4 on the next page:

3. Based on this exponential model, what age is a lobster with an exterior shell length of 100 mm?

4. Suppose that trapping regulations require that any lobster with an exterior shell length less than 75 mm or more than 150 mm must be released. Based on the exponential model, what are the ages of lobsters with exterior shell lengths less than 75 mm? What are the ages of lobsters with exterior shell lengths greater than 150 mm? Explain how you arrived at your answer.

Exit Ticket

Biologists conducted a study of the nesting behavior of a type of bird called a flycatcher. They examined a large number of nests and recorded the latitude for the location of the nest and the number of chicks in the nest.



Data Source: *Ibis*, 1997

1. What type of model (linear, quadratic or exponential) would best describe the relationship between latitude and mean number of chicks?

2. One model that could be used to describe the relationship between mean number of chicks and latitude is: $y = 0.175 + 0.21x - 0.002x^2$, where x represents the latitude of the location of the nest and y represents the number of chicks in the nest. Use the quadratic model to complete the following table. Then sketch a graph of the quadratic curve on the scatter plot above.

x	y
30	
40	
50	
60	
70	

3. Based on this quadratic model, what is the best latitude for hatching the most flycatcher chicks? Justify your choice.