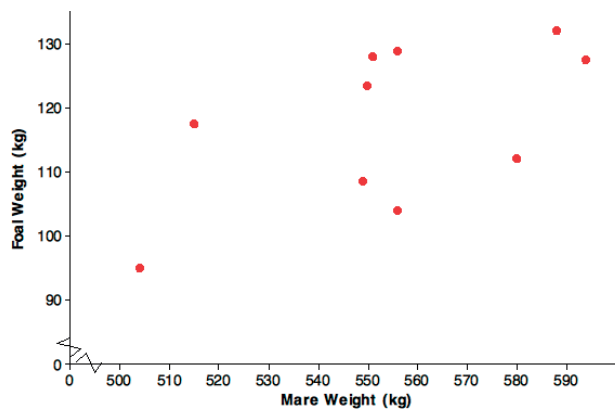NAME: _____ PERIOD: _____ DATE: _____

# Homework Problem Set

Consider the scatterplot at the right for Problems 1 and 2.



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Source: Elissa Z. Cameron, Kevin J. Stafford, Wayne L. Linklater, and Clare J. Veltman, "Suckling behaviour does not measure milk intake in horses, equus caballus," *Animal Behaviour*, 57 (1999): 673.

1. A mare is a female horse, and a foal is a baby horse. Is there a relationship between a foal's birth weight and a mare's weight, or are the data points scattered?

   *yes, there is a relationship.*

2. If there is a relationship between baby birth weight and mother's weight, does the relationship look linear?

   *The relationship looks linear.*
   *As the mare's weight increases, the foal's birth weight tends to increase.*

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


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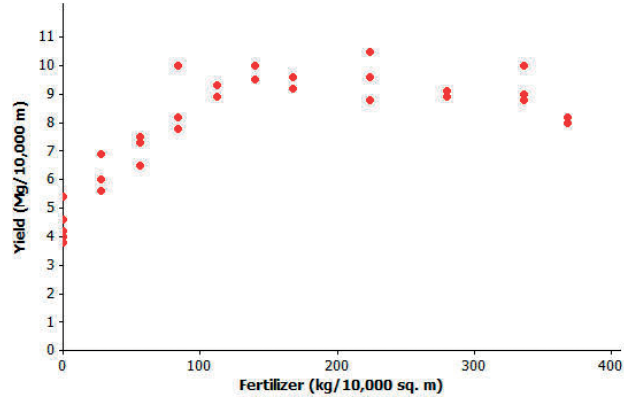


Source: M.E. Cerrato and A.M. Blackmer, "Comparison of Models for Describing Corn Yield Response to Nitrogen Fertilizer" *Agronomy Journal*, 82 (1990): 138.

3. 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.

*In the beginning, as the amount of fertilizer (x) increases, so does the yield.*

*At around 250 kg the yield decreases as amount of fertilizer increases.*

4. **Challenge:** 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). Based on this quadratic model, how much fertilizer per 10,000 sq.m would you recommend that a farmer use on his cornfields in order to maximize crop yield? Justify your choice.

*CAN USE GRAPH*

*≈ 200-250 kg (based on graph)*

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.



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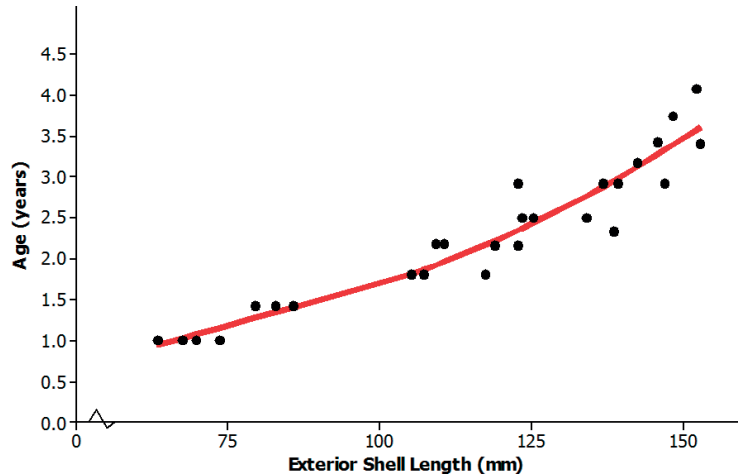
Source: Kerry E. Maxwell, Thomas R. Matthews, Matt R.J. Sheehy, Rodney D. Bertelsen, and Charles D. Derby, "Neurolipofuscin is a Measure of Age in *Panulirus argus*, the Caribbean Spiny Lobster, in Florida" *Biological Bulletin,* 213 (2007): 55.

5.  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.

As the length of the exterior shell increases, the age of the lobster tends to increase.

\* The change in age is greater as shell length increases, suggesting exponential model.

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.

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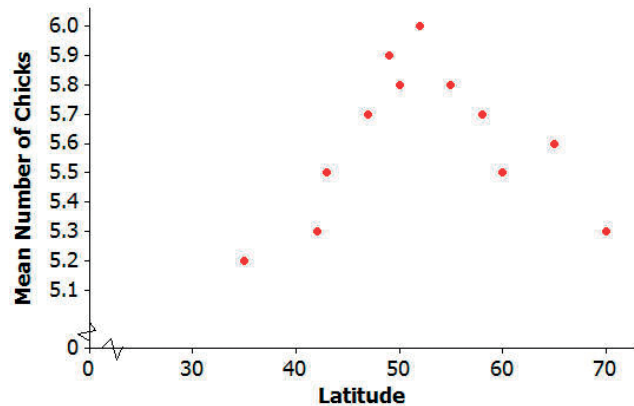
Source: Juan José Sanz, "Geographic variation in breeding parameters of the pied flycatcher *Ficedula hypoleuca*" *Ibis,* 139 (1997): 107.

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

   *The relationship between latitude in degrees & mean number of chicks is best described as a quadratic model.*

9. **Challenge:** 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. Based on this model, what is the best latitude for hatching the most flycatcher chicks? Justify your choice.

Suppose that social scientists conducted a study of senior citizens to see how the time (in minutes) required to solve a word puzzle changes with age. The scatterplot at the right displays data from this study. Let *x* equal the age of the citizen and *y* equal the time (in minutes) required to solve a word puzzle for the seven study participants.


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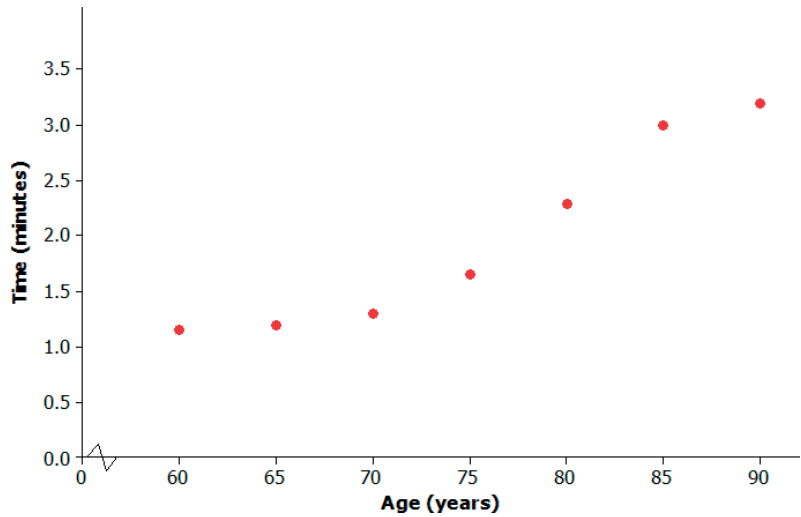
10. What type of model (linear, quadratic, or exponential) would you use to describe the relationship between age and time required to complete the word puzzle?

Exponential

11. What time would you predict for a person who is 78 years old?

Based on the graph, about 2 min.