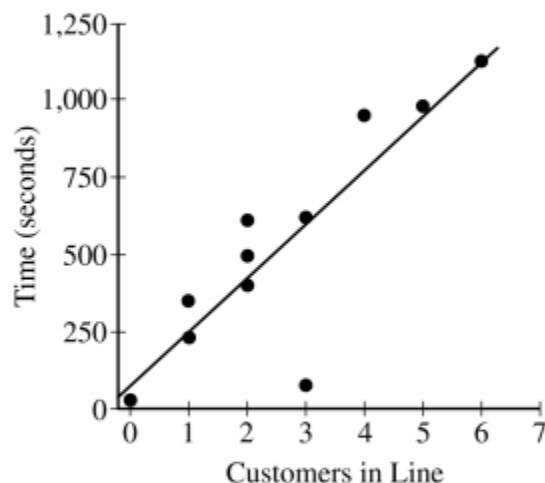


**Directions:** Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

- The manager of a grocery store selected a random sample of 11 customers to investigate the relationship between the number of customers in a checkout line and the time to finish checkout. As soon as the selected customer entered the end of a checkout line, data were collected on the number of customers in line who were in front of the selected customer and the time, in seconds, until the selected customer was finished with the checkout. The data are shown in the following scatterplot along with the corresponding least-squares regression line and computer output.



Predictor	Coef	SE Coef	T	P
Constant	72.95	110.36	0.66	0.525
Customers in line	174.40	35.06	4.97	0.001
S = 200.01		R-Sq = 73.33%		R-Sq (adj) = 70.37%

- Identify and interpret in context the estimate of the intercept for the least-squares regression line.

(b) Identify and interpret in context the coefficient of determination,  $r^2$ .

(c) One of the data points was determined to be an outlier. Circle the point on the scatterplot and explain why the point is considered an outlier.

2017 Question 1

1. Researchers studying a pack of gray wolves in North America collected data on the length  $x$ , in meters, from nose to tip of tail, and the weight  $y$ , in kilograms, of the wolves. A scatterplot of weight versus length revealed a relationship between the two variables described as positive, linear, and strong.

(a) For the situation described above, explain what is meant by each of the following words.

(i) Positive:

(ii) Linear:

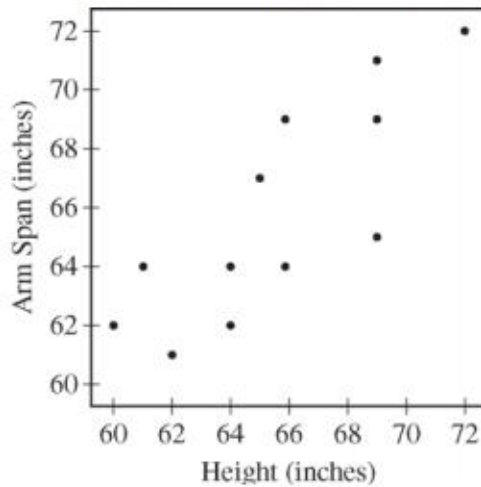
(iii) Strong:

The data collected from the wolves were used to create the least-squares equation  $\hat{y} = -16.46 + 35.02x$ .

(b) Interpret the meaning of the slope of the least-squares regression line in context.

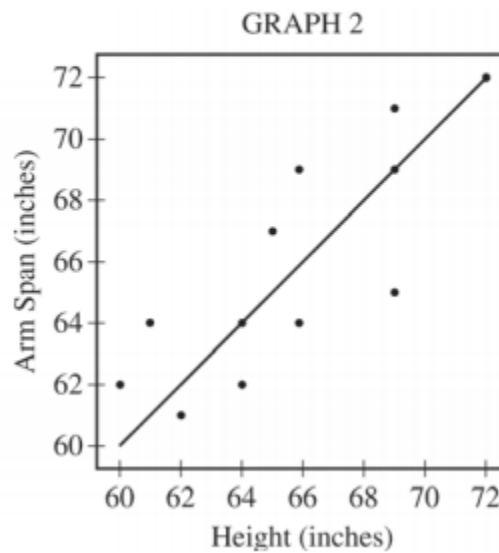
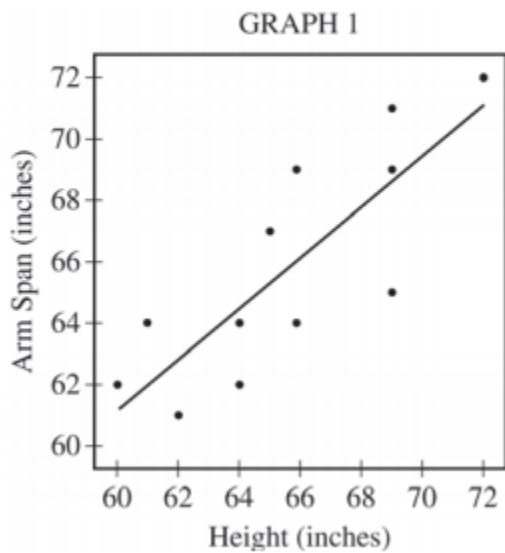
(c) One wolf in the pack with a length of 1.4 meters had a residual of  $-9.67$  kilograms. What was the weight of the wolf?

5. A student measured the heights and the arm spans, rounded to the nearest inch, of each person in a random sample of 12 seniors at a high school. A scatterplot of arm span versus height for the 12 seniors is shown.



- (a) Based on the scatterplot, describe the relationship between arm span and height for the sample of 12 seniors.

Let  $x$  represent height, in inches, and let  $y$  represent arm span, in inches. Two scatterplots of the same data are shown below. Graph 1 shows the data with the least squares regression line  $\hat{y} = 11.74 + 0.8247x$ , and graph 2 shows the data with the line  $y = x$ .



- (b) The criteria described in the table below can be used to classify people into one of three body shape categories: square, tall rectangle, or short rectangle.

Square	Tall Rectangle	Short Rectangle
Arm span is equal to height.	Arm span is less than height.	Arm span is greater than height.

- (i) For which graph, 1 or 2, is the line helpful in classifying a student's body shape as square, tall rectangle, or short rectangle? Explain.

- (ii) Complete the table of classifications for the 12 seniors.

Classification	Square	Tall Rectangle	Short Rectangle
Frequency			

- (c) Using the best model for prediction, calculate the predicted arm span for a senior with height 61 inches.

## 2011 Question #5

5. Windmills generate electricity by transferring energy from wind to a turbine. A study was conducted to examine the relationship between wind velocity in miles per hour (mph) and electricity production in amperes for one particular windmill. For the windmill, measurements were taken on twenty-five randomly selected days, and the computer output for the regression analysis for predicting electricity production based on wind velocity is given below. The regression model assumptions were checked and determined to be reasonable over the interval of wind speeds represented in the data, which were from 10 miles per hour to 40 miles per hour.

Predictor	Coef	SE Coef	T	P
Constant	0.137	0.126	1.09	0.289
Wind velocity	0.240	0.019	12.63	0.000
S = 0.237      R-Sq = 0.873      R-Sq (adj) = 0.868				

- (a) Use the computer output above to determine the equation of the least squares regression line. Identify all variables used in the equation.
- (b) How much more electricity would the windmill be expected to produce on a day when the wind velocity is 25 mph than on a day when the wind velocity is 15 mph? Show how you arrived at your answer.

(c) What proportion of the variation in electricity production is explained by its linear relationship with wind velocity?

(d) Is there statistically convincing evidence that electricity production by the windmill is related to wind velocity? Explain.



2010 Question #1

1. Agricultural experts are trying to develop a bird deterrent to reduce costly damage to crops in the United States. An experiment is to be conducted using garlic oil to study its effectiveness as a nontoxic, environmentally safe bird repellent. The experiment will use European starlings, a bird species that causes considerable damage annually to the corn crop in the United States. Food granules made from corn are to be infused with garlic oil in each of five concentrations of garlic—0 percent, 2 percent, 10 percent, 25 percent, and 50 percent. The researchers will determine the adverse reaction of the birds to the repellent by measuring the number of food granules consumed during a two-hour period following overnight food deprivation. There are forty birds available for the experiment, and the researchers will use eight birds for each concentration of garlic. Each bird will be kept in a separate cage and provided with the same number of food granules.

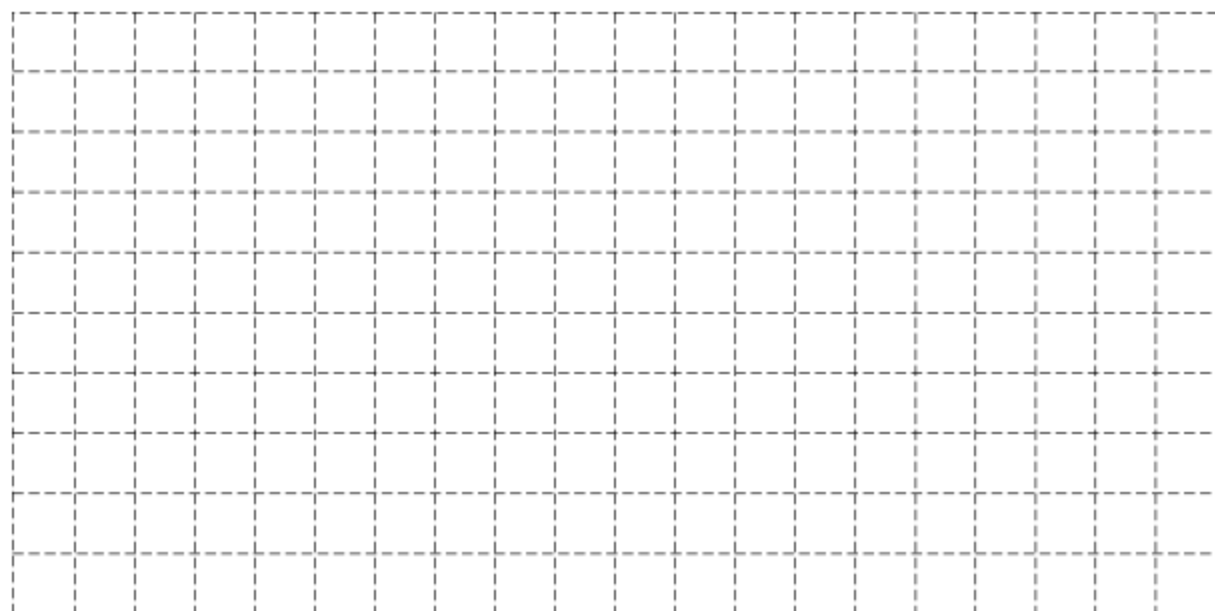
(a) For the experiment, identify

- i. the treatments
- ii. the experimental units
- iii. the response that will be measured

(b) After performing the experiment, the researchers recorded the data shown in the table below.

Garlic oil concentration	0%	2%	10%	25%	50%
Mean number of food granules consumed	58	48	29	24	20
Number of birds	8	8	8	8	8

- i. Construct a graph of the data that could be used to investigate the appropriateness of a linear regression model for analyzing the results of the experiment.



- ii. Based on your graph, do you think a linear regression model is appropriate? Explain.