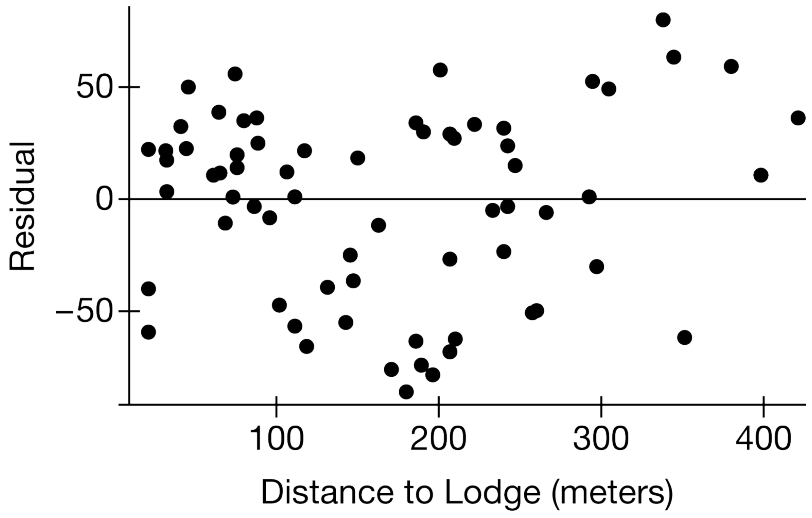
Justifying a Claim About the Slope of a Regression Model Based on a Confidence Interval Quiz

1. 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 movement patterns of animals are believed to be affected by their physiological states (such as hunger), predation risk, and other factors such as whether they are searching for food for their young. Optimal foraging theory predicts that foragers (animals searching for food) with a central home location should move faster the farther they are from home.

American beavers are foragers with a central home location that make foraging trips from their lodge and then return. To test the optimal foraging theory, researchers trapped and radio-tagged a random sample of 67 American beavers from the population in a certain region and recorded their movements over the course of about a year. The researchers fit a least-squares regression line to the data, where the explanatory variable was distance to lodge, in meters, and the response variable was speed, in meters per hour. The resulting residual plot of the regression analysis is shown.



(a) Is a linear model appropriate to use for these data? Justify your response by referencing the residual plot.

The computer output from the regression analysis and the boxplot of the residuals are shown.

	Estimate	Error	T	P
Intercept	-16.462	9.726	-1.693	0.0953
Distance	0.849	0.049	17.177	0.0000
$S = 41.025$		$R\text{-sq} = 0.819$		

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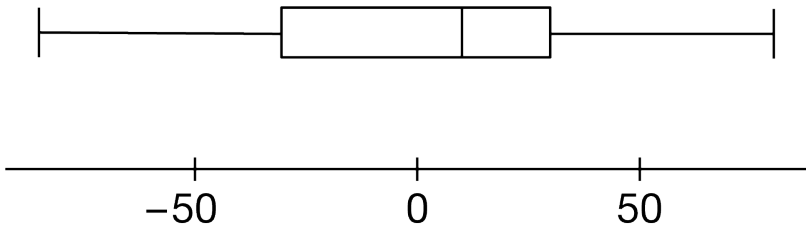

(b) Identify the intercept of the least-squares regression line and interpret it in the context of the data.

(c) The researchers plan to calculate a 95 percent confidence interval for the population slope. Identify and check the conditions for the appropriate confidence interval for the population slope.

(d) The 95% confidence interval for the population slope was calculated as $(0.751, 0.947)$. Based on the confidence interval, do the data provide convincing statistical evidence that foragers with a central home location move faster the farther they are from home? Justify your response.

2. A zoologist selected 12 black bears in a Canadian habitat at random to examine the relationship between the age in years, x, and the weight in tens of pounds, y.

The 95 percent confidence interval for estimating the population slope of the linear regression line predicting weight in tens of pounds based on the age in years is given by 1.272 ± 0.570.

Assume that the conditions for inference for the slope of the regression equation are met. Which of the following is the correct interpretation of the interval?

(A) We are 95 percent confident that the mean increase in the weight of a black bear for each one-year increase in the age of the bear is between 7.0 and 18.4 pounds.

(B) We are 95 percent confident that an increase of one year in the age of an individual black bear will result in an increase in the black bear's weight of between 7.0 and 18.4 pounds.

(C) We are 95 percent confident that for every one-year increase in the age of black bears in the sample, the average increase in the weights of those black bears is between 7.0 and 18.4 pounds.

(D) We are 95 percent confident that the mean increase in the age of a black bear for each one-pound increase in the weight of the black bear is between 7.0 and 18.4 years.

(E) We are 95 percent confident that any sample of 12 black bears will produce a slope of the regression line between 7.0 and 18.4.

3. Biologists are interested in how temperature changes might affect the frequency of mating calls of frogs. Twenty gray tree frogs are randomly chosen for a study. For each frog, the temperature of its habitat (in degrees Celsius) and the frequency of its mating call (in tones per second) are recorded.

The 96 percent confidence interval for estimating the population slope of the linear regression line predicting mating call frequency based on habitat temperature is given by 2.341 ± 0.768.

Assume that the conditions for inference for the slope of the regression line have been met. Which of the following is the correct interpretation of the calculated confidence interval?

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(A) We are 96 percent confident that the increase in mating call frequency of an individual frog when its habitat temperature increases by 1 degree Celsius is between 1.573 and 3.109 tones per second.

(B) We are 96 percent confident that the average increase in mating call frequency in the sample of frogs when habitat temperature increases by 1 degree Celsius is between 1.573 and 3.109 tones per second.

(C) We are 96 percent confident that the average increase in mating call frequency in the population of frogs when habitat temperature increases by 1 degree Celsius is between 1.573 and 3.109 tones per second.

(D) We are 96 percent confident that the average increase in habitat temperature in the sample of frogs when mating call frequency increases by one tone per second is between 1.573 and 3.109 degrees Celsius.

(E) We are 96 percent confident that the average increase in habitat temperature in the population of frogs when mating call frequency increases by one tone per second is between 1.573 and 3.109 degrees Celsius.

4. A high school basketball coach wants to see whether there is a linear relationship between player height, x, and the number of points scored in a game by basketball players in the coach's state, y. The 96 percent confidence interval to estimate the slope of the linear regression line relating player height to points scored in a game is calculated to be $(-0.432, 1.844)$.

Assume all conditions for inference for the slope of a regression line were met. Based on the confidence interval, which of the following claims is supported by the confidence interval?

(A) Each player scored at most 1.844 points in a game.

(B) The average difference between actual points scored and predicted points scored is between -0.432 and 1.844.

(C) There is a positive linear relationship between player height and number of points scored for basketball players in the coach's state.

(D) There is a negative linear relationship between player height and number of points scored for basketball players in the coach's state.

(E) It cannot be determined whether the linear relationship between player height and number of points scored for basketball players in the coach's state is positive or negative.

5. To investigate the relationship between the selling price of a house, y, in dollars, and the size of the house x, in square feet, a local builder collected data on a random sample of 120 houses from a certain region. Assume that the conditions for inference for the slope of a regression line are met. The resulting 95 percent confidence interval for the population slope of the regression line relating price and size is given by $(62, 99)$.

The local builder claims that the selling price of houses from the region increases by $104 for every extra square foot of space in the house. Which of the following best describes the conclusion that can be reached about this claim based on the confidence interval?

(A) The claim is supported by the interval, since the interval does not contain the value 0.

(B) The claim is supported by the interval, since all values in the interval are positive.

(C) The claim is supported by the interval, since the interval does not contain the value 104.

(D) The claim is not supported by the interval, since the interval does not contain the value 0.

(E) The claim is not supported by the interval, since the interval does not contain the value 104.

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6. An international organization is investigating the relationship between the life expectancies of men and women in nonindustrialized countries. A random sample of such countries was selected, and life expectancies, in years, were determined for both men and women. A check of the conditions necessary for inference on the slope of a regression line shows that they are met.

A 98 percent confidence interval for the slope of the regression line relating life expectancy for men, x, and women, y, is given by $(1.01, 1.34)$. Based on the interval, which of the following claims is supported?

(A) Since the interval does not contain 0, it can be concluded that there is no linear relationship between the life expectancies of men and women in nonindustrialized countries.

(B) Since the interval does not contain 1, it can be concluded that there is no linear relationship between the life expectancies of men and women in nonindustrialized countries.

(C) Since the values in the interval are greater than 0, it can be concluded that the life expectancies of women are greater than the life expectancies of men in nonindustrialized countries.

(D) Since the values in the interval are positive, it can be concluded that there is an increase, on average, in the life expectancies of women for each 1-year increase in the life expectancy of men in nonindustrialized countries.

(E) Since the values in the interval are positive, it can be concluded that there is a decrease, on average, in the life expectancies of women for each 1-year increase in the life expectancy of men in nonindustrialized countries.

7. Peggy constructed the 95 percent confidence interval $(4.8, 5.2)$ to estimate the slope of a regression model for a set of bivariate data with 24 data values. Peggy claims that the width of the confidence interval will increase if a sample size of 30 is used, all other things remaining the same. Quincy claims that the width of the confidence interval will decrease if a sample size of 30 is used. Which statement is true about the claims made by Peggy and Quincy?

(A) Peggy's claim is correct.

(B) Quincy's claim is correct.

(C) Both Peggy's claim and Quincy's claim are correct.

(D) Neither Peggy's claim nor Quincy's claim is correct.

(E) There is not enough information to determine whether the claims are correct.

8. A 95 percent confidence interval for the slope of the regression line relating the number of grams of carbohydrates and the number of kilocalories per 100-gram sample of various raw foods is given by $(2.505, 6.696)$. The confidence interval is based on a random sample of n raw foods. A check of the conditions for inference on the slope shows they are reasonably met.

Which of the following is a correct interpretation of the interval?

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(A) Ninety-five percent of all such samples of size n will produce a sample slope between 2.505 and 6.696 for the regression line relating grams of carbohydrates and kilocalories per 100-gram sample of various raw foods.

(B) The probability is 0.95 that the true slope of the regression line relating grams of carbohydrates and kilocalories per 100-gram sample of various raw foods is between 2.505 and 6.696.

(C) We are 95 percent confident that the slope of the regression line for the random sample of n raw foods is between 2.505 and 6.696.

(D) We are 95 percent confident that the predicted number of kilocalories per 100-gram sample will be between 2.505 and 6.696.

(E) We are 95 percent confident that the true slope of the regression line relating grams of carbohydrates and kilocalories per 100-gram sample of various raw foods is between 2.505 and 6.696.

9. A statistician constructed the 95 percent confidence interval $(2.3, 3.7)$ to estimate the slope of a regression model for a set of bivariate data with 24 data values.

If the sample size n changes but all other things remain the same, which of the following claims about the confidence interval is true?

(A) The interval becomes narrower if $n = 20$.

(B) The interval width remains the same if $n = 20$.

(C) The interval becomes wider if $n = 28$.

(D) The interval becomes narrower if $n = 28$.

(E) The interval width remains the same if $n = 28$.

10. A researcher was interested in the relationship between the number of texts sent in a day and the number of e-mails sent in a day by employees at a certain company. Using 15 data values, a 90 percent confidence interval for the slope of a regression model was found to be $(2.31, 3.47)$. The researcher claims that the interval would have been narrower with a different sample size if all other things remained the same.

Which of the following sample sizes would make the researcher's claim NOT true?

(A) 14

(B) 16

(C) 20

(D) 30

(E) 100