

Confidence Intervals for the Slope of a Regression Model Quiz

1. A scientist is investigating whether percent concentration can be used to predict density in apple juice. A scientist selected a random sample of 12 apple juice varieties and recorded the density, in pounds per cubic inch, and the percent concentration of each apple juice variety. The scientist wants to estimate the mean change in the density, in pounds per cubic inch, for each increase of 1 percent concentration of apple juice.

Assuming the conditions for inference have been met, which of the following inference procedures is most appropriate for this investigation?

- (A) A linear regression t -interval for slope ✓
- (B) A matched-pairs t -interval for a mean difference
- (C) A two-sample t -interval for a difference between means
- (D) A one-sample t -test for means
- (E) A two-sample z -interval for a difference between proportions

Answer A

Correct. The scientist is interested in using percent concentration to predict density. A linear regression t -interval for slope is the most appropriate inference procedure.

2. The number of shots taken and points scored by 8 players in a basketball game are shown in the table.

Number of shots taken	1	4	7	8	10	11	11	14
Number of points scored	0	4	8	9	14	12	15	22

A basketball coach is investigating whether the number of shots taken can be used to predict the mean number of points scored. Assuming the conditions for inference have been met, which of the following inference procedures is the most appropriate to estimate the mean change in the number of points scored for each increase of 1 shot taken?

- (A) A one-sample t -interval for means
- (B) A linear regression t -interval for slope ✓
- (C) A two-sample t -interval for a difference between means
- (D) A matched-pairs t -interval for a mean difference
- (E) A two-sample z -interval for a difference between proportions

Answer B

Correct. The number of shots taken is used to predict the mean number of points scored. A linear

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regression t -interval for slope is the most appropriate inference procedure.

3. A teacher conducted a regression analysis to investigate the relationship between student height and femur length. Computer output from the linear regression analysis is shown in the table. The analysis was performed on a sample of 24 students.

Term	Coef	SE Coef
Constant	28.34	0.945
Femur length	1.73	0.023

Assume that the conditions for inference for the slope of the regression equation have been met. Which of the following defines the margin of error for a 99.5 percent confidence interval for the slope of the least-squares regression equation?

- (A) $3.104(0.023)$
(B) $3.104(1.73)$
(C) $3.119(0.023)$ ✓
(D) $3.119(0.945)$
(E) $3.119(1.73)$

Answer C

Correct. The standard error of the slope (0.023) is the standard error coefficient in the computer output for the femur length variable. The critical value 3.119 is from a t -distribution with $n - 2 = 22$ degrees of freedom.

4. A random sample of 15 college soccer players were selected to investigate the relationship between heart rate and maximal oxygen uptake. The heart rate and maximal oxygen uptake were recorded for each player during a training session. A regression analysis of the data was conducted, where heart rate is the explanatory variable and maximal oxygen uptake is the response variable.

If a 95 percent confidence interval is constructed for the slope of the population regression line, which of the following is a condition that must be checked?

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- (A) The true relationship between heart rate and maximal oxygen uptake is linear. ✓
- (B) The correlation between heart rate and maximal oxygen uptake is not equal to zero.
- (C) The confidence interval is not biased.
- (D) The point (\bar{x}, \bar{y}) falls on the regression line.
- (E) The slope is not equal to zero.

Answer A

Correct. This is a condition that must be checked.

5. A computer engineer is investigating whether the amount of installed RAM (random access memory) can be used to predict the mean cost of a laptop with the operating system. The computer engineer collected a sample of 20 laptops with the same operating system. The engineer wants to estimate the mean change in the cost, in dollars, for each increase of 1 gigabyte of installed RAM.

Assuming the conditions for inference have been met, which of the following inference procedures is the most appropriate for such an investigation?

- (A) A two-sample z -interval for a difference between proportions
- (B) A two-sample t -interval for a difference between means
- (C) A matched-pairs t -interval for a mean difference
- (D) A one-sample t -test for means
- (E) A linear regression t -interval for slope ✓

Answer E

Correct. The engineer is interested in using the amount of installed RAM to predict the mean cost of a laptop with the operating system. A linear regression t -interval for slope is the most appropriate inference procedure.

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6. Twenty members of an athletic club are studying the relationship between the time it takes an individual athlete to reach a given level of fatigue during exercise (time to fatigue, measured in minutes) and athletic performance. For each member, time to fatigue and a performance score were recorded. The computer output of the regression analysis is shown in the table.

Term	Coef	SE Coef	T
Constant	39.88	4.24	9.41
Time to fatigue	3.92	0.71	5.52

Which of the following is a 90 percent confidence interval for the slope of the regression line relating performance score and time to fatigue? Assume that the conditions for inference are met.

(A) $3.92 \pm 1.645(0.71)$

(B) $3.92 \pm 1.729(0.71)$

(C) $3.92 \pm 1.734(0.71)$



(D) $39.88 \pm 1.729(4.24)$

(E) $39.88 \pm 1.734(4.24)$

Answer C

Correct. The point estimate of the slope b_1 is the coefficient of the time-to-fatigue variable, 3.92, in the computer output. The critical value, 1.734, is the value at the 95th percentile (which would represent a 90 percent confidence interval) of a t -distribution with $n - 2 = 20 - 2 = 18$ degrees of freedom. From the computer output, the standard error of the slope is 0.71. The 90 percent confidence interval is $3.92 \pm 1.734(0.71)$.

7. A linear regression model was fit to a set of data containing 18 observations. The computer output of the regression analysis is shown in the table.

Term	Coef	SE Coef	T
Constant	12.00	5.43	2.210
x	0.694	0.241	2.880

Assume the conditions for regression are met. Which of the following defines the margin of error when a 95 percent confidence interval for the slope of the least-squares regression line is calculated?

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- (A) $(1.75)(0.241)$
- (B) $(1.75)(0.694)$
- (C) $(1.96)(0.241)$
- (D) $(2.12)(0.241)$
- (E) $(2.12)(0.694)$

**Answer D**

Correct. The formula for margin of error is $t^*(SE_{b_1})$. The critical value ($t^* = 2.12$) is the t -value at the 97.5th percentile (which would represent a 95 percent confidence interval) with $n - 2 = 16$ degrees of freedom. From the computer output, the standard error of the slope is 0.241.

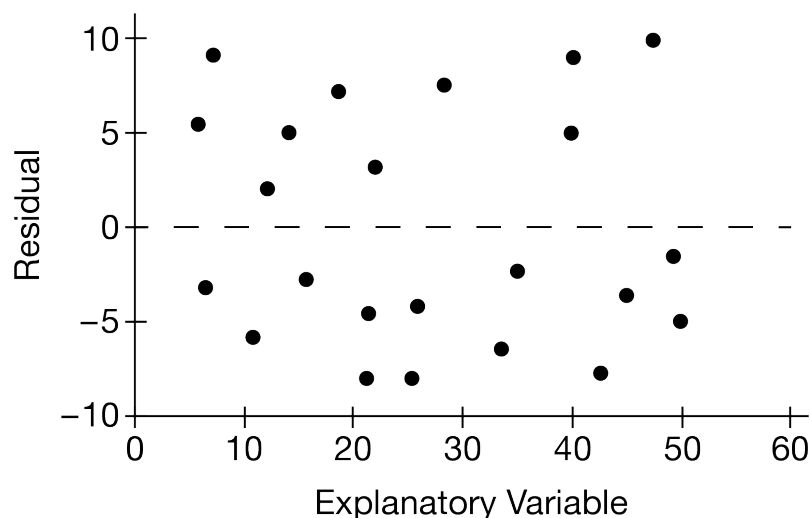
8. When computing a confidence interval for the slope of a regression line, a plot of the residuals versus the fitted values can be used to check which of the following conditions?
- (A) The variables x and y are inversely related.
 - (B) The standard deviation of y does not vary as x varies.
 - (C) The correlation is not equal to zero.
 - (D) The observations are independent.
 - (E) The confidence interval contains zero.

**Answer B**

Correct. Analysis of residuals may be used to check for approximately equal standard deviations for all x .

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9. Eliza plans on constructing a confidence interval for the slope of a regression line. She creates the residual plot shown to check the conditions for creating the interval. Which of the following conditions appear to be met based on the residual plot?



- I. The true relationship between x and y is linear.
 - II. The standard deviation of y is constant for different levels of x .
 - III. The value of 0 is contained in the confidence interval.
- (A) I only
(B) II only
(C) III only
(D) I and II only
(E) II and III only

Answer D

Correct. Statement I is correct, since there is no evident pattern in the residuals. Statement II is correct, since as x increases, the spread of the residuals neither increases nor decreases.