

Setting Up a Test for the Slope of a Regression Model Quiz

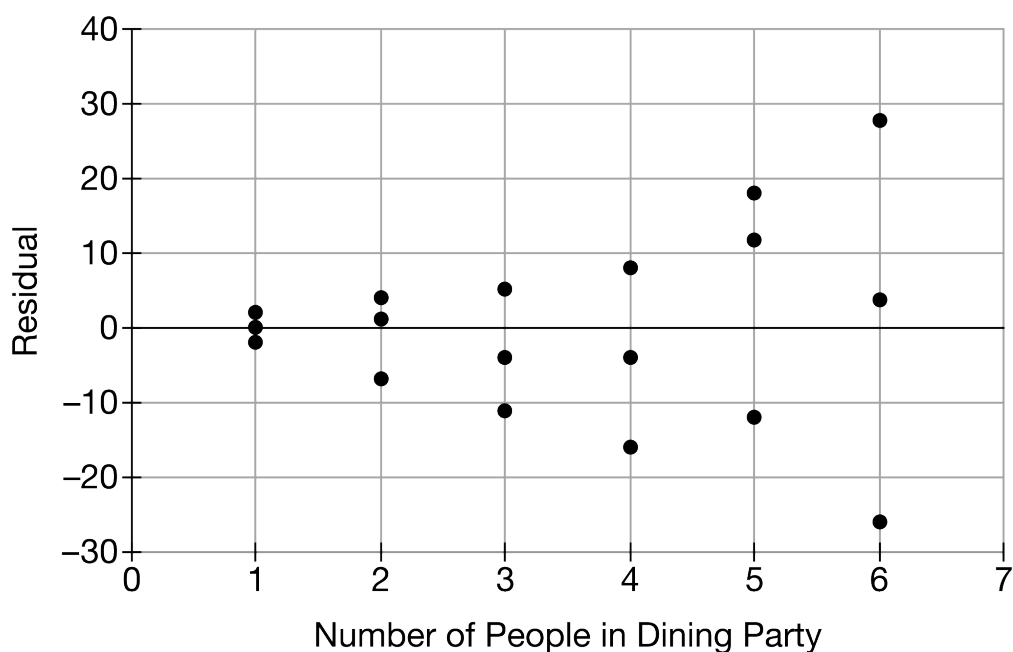
1. A seafood festival organizer is interested in whether there is a relationship between the number of ingredients in the clam chowders that are entered in the festival's clam chowder contest and the ratings given to the chowders by the judges. The organizer requires each of the twelve restaurants in the competition to list all of its chowder's ingredients and requires each judge who tastes the clam chowders to rate each chowder from one through ten on a note card. The organizer then randomly selects twenty-five note cards. Assuming that all conditions for inference are met, which of the following significance tests should be used to investigate whether having more ingredients in the chowders is associated with a reduction in the ratings given to the chowders by the judges?
- (A) A chi-square test of independence
 - (B) A two-sample t -test for a difference between means
 - (C) A two-sample z -test for a difference between proportions
 - (D) A linear regression t -test for slope
 - (E) A matched pairs t -test for a mean difference

Answer D

Correct. The seafood festival organizer is interested in determining whether there is a linear relationship between the number of ingredients in the chowders and the ratings of the chowders. A linear regression t -test for slope is the most appropriate test.

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2. A reporter was interested in the relationship between the size of a dining party and the amount of time it takes for the dining party to be seated at a restaurant. The reporter selected a random sample of dining parties from a certain region. The resulting data were used to complete a linear regression analysis of the time, in minutes, it takes for a dining party to be seated versus the number of people in the dining party. The linear regression analysis produced the residual plot shown.



Based on the residual plot, which condition for inference for the slope of the regression line does not appear to be satisfied?

- (A) The sum of the residuals is equal to zero.
- (B) The standard deviation of the distribution of time to be seated is the same for each size of the dining party. ✓
- (C) The data were collected using a random sample or randomized experiment.
- (D) The sample size is less than or equal to 10 percent of the population size.
- (E) The residuals are approximately normally distributed.

Answer B

Correct. This condition has not been satisfied. As the number of people in the dining party increases, the variability in the residuals increases, indicating that the standard deviation is not constant for all values of the explanatory variable.

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3. A doctor recorded the number of miles walked each day by patients over age 60 and the number of doctor visits in a year for 40 patients. The resulting data were used to conduct a hypothesis test to determine whether there is a linear relationship between the number of miles walked and the number of doctor visits. What are the correct hypotheses for the test?
- (A) $H_0 : b_1 = 0$
 $H_a : b_1 \neq 0$
 - (B) $H_0 : \beta_1 = 0$
 $H_a : \beta_1 > 0$
 - (C) $H_0 : \beta_1 = 0$
 $H_a : \beta_1 < 0$
 - (D) $H_0 : \beta_1 \neq 0$
 $H_a : \beta_1 = 0$
 - (E) $H_0 : \beta_1 = 0$
 $H_a : \beta_1 \neq 0$ ✓

Answer E

Correct. This is the correct set of hypotheses for investigating whether there is a linear relationship between the number of miles walked and the number of doctor visits in the population. The null hypothesis is that there is no relationship ($\beta_1 \neq 0$).

4. A driving instructor is investigating whether the time a driver spends in a driver's education course improves their score on the driver's test. The instructor randomly selected 10 drivers from a driver's education course and recorded the number of hours each driver attended the driver's education course and their corresponding score on the driver's test. Assuming all conditions for inference are met, which of the following significance tests should be used for the investigation?
- (A) A chi-square test of independence
 - (B) A two-sample t -test for a difference between means
 - (C) A two-sample z -test for a difference between proportions
 - (D) A linear regression t -test for slope ✓
 - (E) A matched pairs t -test for a mean difference

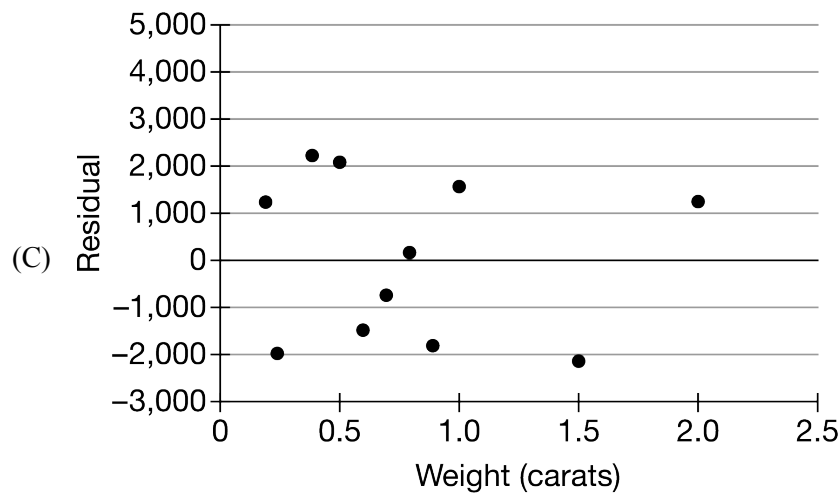
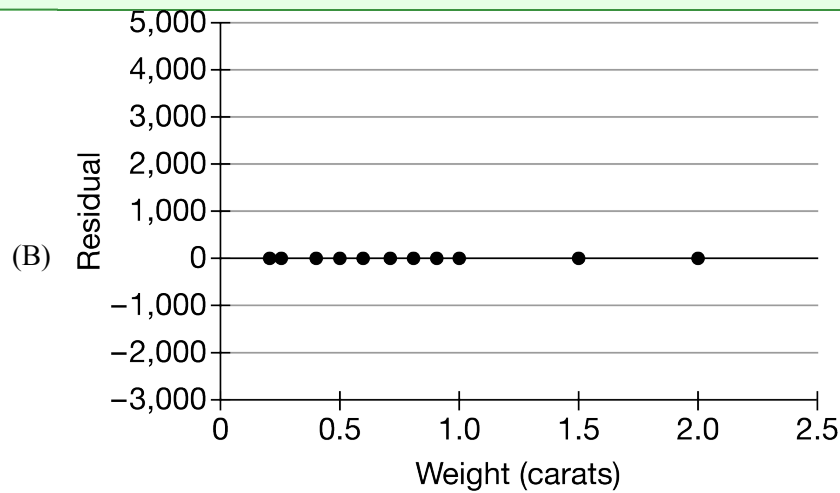
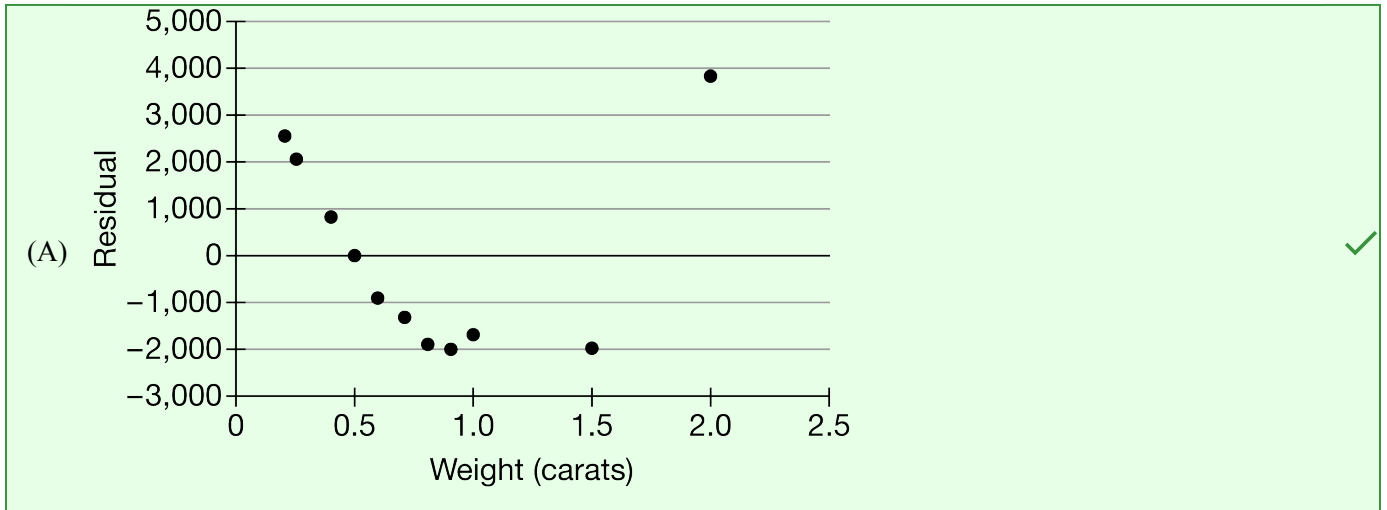
Answer D

Correct. The instructor is interested in whether the time a driver spends in a driver's education course improves their score on the driver's test. A linear regression t -test for slope is the most appropriate test.

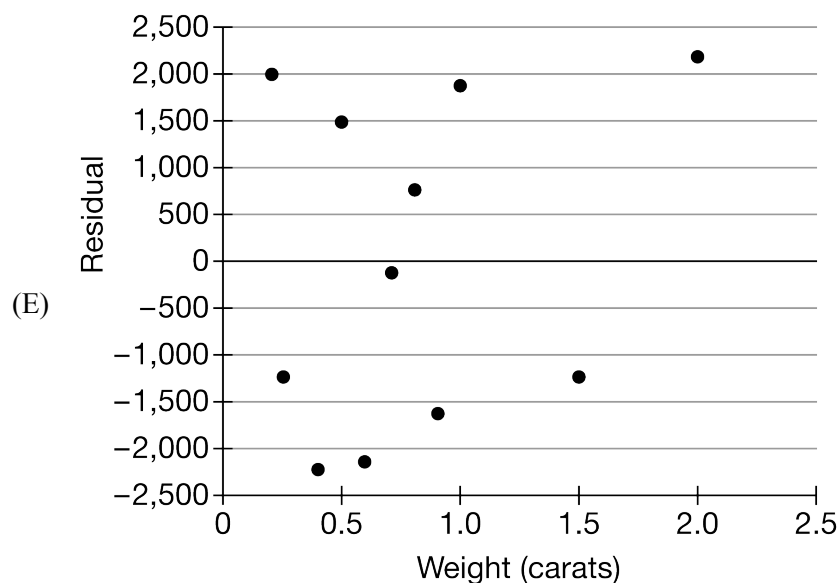
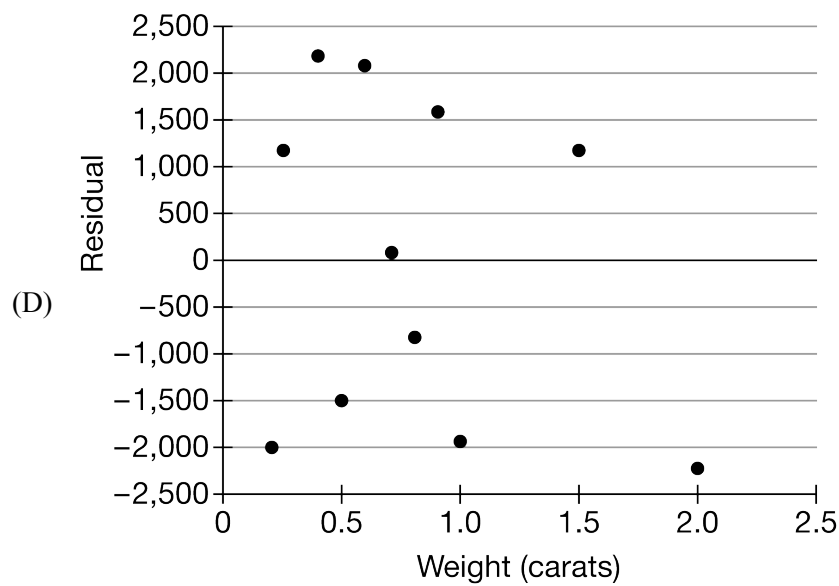
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5. A jeweler was interested in the relationship between the weight of a diamond, in carats, and the market price of the diamond, in dollars. The jeweler selected a random sample of diamonds with the same cut and quality and recorded the weight and market price of each diamond. Which of the following residual plots provides evidence that the condition that there is a linear relationship between weight and market price has not been met?

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**Answer A**

Correct. The residual plot provides evidence that the true relationship is not linear because the residual plot displays a pattern.

6. Which of the following would be an indication that the normality condition has been met for a t -test for the slope of a regression model?
- I. A residual plot with no apparent pattern in the residuals
 - II. A histogram of the residuals that is centered at 0, unimodal, and symmetric
 - III. A dotplot of the residuals that is centered at 0 and strongly skewed to the left with outliers

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- (A) I only
- (B) II only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

**Answer B**

Correct. Any graphical representation of residuals should be centered at 0, free from strong skewness, and without outliers. Therefore the histogram described provides evidence that the normality condition has been met, but the dotplot does not. A residual plot is used to check the conditions for a linear relationship and constant variance, not the condition for normality.

7. A scientist selected a random sample of seven varieties of peach ice cream to investigate the relationship between the density, in pounds per cubic inch, of the varieties of ice cream and the percent concentration of peaches in the ice cream. Assuming all conditions for inference are met, which of the following significance tests should be used to investigate whether there is convincing evidence at the 0.05 level of significance that a greater percent of peaches in the ice cream is associated with an increase in the density of the ice cream?
- (A) A two-sample t -test for a difference between means
 - (B) A chi-square test of independence
 - (C) A linear regression t -test for slope
 - (D) A two-sample z -test for a difference between proportions
 - (E) A matched pairs t -test for a mean difference

**Answer C**

Correct. The scientist is interested in determining whether there is a linear relationship between the percent of peaches in the ice cream and the density of the ice cream. A linear regression t -test for slope is the most appropriate test.

8. A researcher recorded the total number of minutes that 25 people spent looking at either a computer, phone, or television screen during a day and the number of minutes of sleep that they slept that night. The resulting data were used to conduct a hypothesis test to investigate whether there is a negative linear relationship between the total number of minutes spent looking at a screen and the number of minutes of sleep. What are the correct hypotheses for the test?

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(A) $H_0 : b_1 = 0$

$H_a : b_1 \neq 0$

(B) $H_0 : \beta_1 = 0$

$H_a : \beta_1 > 0$

(C) $H_0 : \beta_1 = 0$

$H_a : \beta_1 < 0$

(D) $H_0 : \beta_1 < 0$

$H_a : \beta_1 = 0$

(E) $H_0 : \beta_1 = 0$

$H_a : \beta_1 \neq 0$

Answer C

Correct. This is the correct set of hypotheses to use to investigate whether the linear relationship between number of minutes spent looking at a screen and number of minutes of sleep is negative in the population. The null hypothesis is that there is no relationship ($\beta_1 = 0$), and the alternative hypothesis is that there is a negative relationship ($\beta_1 < 0$).

9. An education researcher recorded the number of books students read over the last year and the number of vocabulary words that students defined correctly on a test of 100 vocabulary words. The resulting data were used to conduct a hypothesis test to investigate whether there is a positive linear relationship between the number of books read and the number of vocabulary words defined correctly. What are the correct hypotheses for the test?

(A) $H_0 : b_1 = 0$

$H_a : b_1 \neq 0$

(B) $H_0 : \beta_1 = 0$

$H_a : \beta_1 > 0$

(C) $H_0 : \beta_1 = 0$

$H_a : \beta_1 < 0$

(D) $H_0 : \beta_1 \neq 0$

$H_a : \beta_1 = 0$

(E) $H_0 : \beta_1 = 0$

$H_a : \beta_1 \neq 0$

Answer B

Correct. This is the correct set of hypotheses to use to investigate whether the linear relationship between

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the number of books students read and the number of vocabulary words defined correctly is positive in the population. The null hypothesis is that there is no relationship ($\beta_1 = 0$), and the alternative hypothesis is that there is a positive relationship ($\beta_1 > 0$).