# AP Stats Practice Linear Regression & Counts

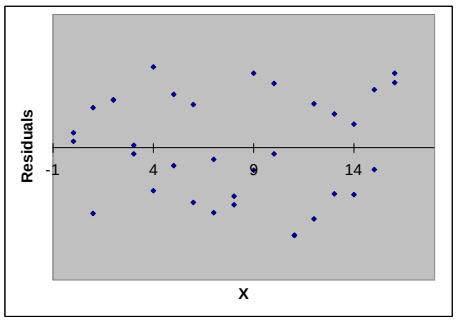
1. Which of the following is <u>not</u> an assumption that must be met when running a linear regression *t*-test?

(A) The residuals must be approximately normally distributed.
(B) The population *y* values must be normally distributed at any value of *x*.
(C) The population *x* values must be normally distributed.
(D) The residuals must have a mean of zero.
(E) The residuals must have a constant variance at any level of *x*.

2. In simple linear regression, a significant relationship exists between the variables if:

(A) The *y*-intercept is significantly different from zero
(B) The slope is significantly different from zero
(C) The correlation between the variables exceeds 0.3
(D) The standard error of the slope exceeds 0.3
(E) The residual plot shows random scatter

3. A regression of *y* on *x* is run and the following residual plot results:




Which of the following assumptions for regression inference has been violated?

(A) Normality
(B) Independence
(C) Equal Variances
(D) Linearity
(E) None of the above

***Use the following information for the next 6 questions:***
Jon David's parents are concerned that he seems short for his age. Their pediatrician has recorded Jon David's age and height on eight consecutive office visits. These data were entered into a worksheet, and Jon David's height (in inches) was regressed on his age (in years). Part of the computer output is shown below:

| Predictor | Coef | SE Coef | T | P |
|---|---|---|---|---|
| Constant | 71.950 | 1.053 | 68.3 | 0.000 |
| Age | 0.38333 | 0.20415 | ttt | ppp |

s = 0.3873 R-sq = 98.9% R-sq(adj) = 98.6%

4. Which of the following is an appropriate interpretation of the slope of the least squares regression line?

(A) For each additional year of age, Jon David's height increases by 0.38333 inches, on average.
(B) For each additional inch of height, Jon David's age increases by 0.38333 years, on average.
(C) When Jon David's height is zero inches, his predicted age is 0.38333 years.
(D) When Jon David's age is zero years, his predicted height is 0.38333 inches.
(E) None of the above

5. What is the typical vertical distance between a point on the scatterplot of these data and the *x* coordinate's predicted value on the least squares regression line?

(A) 1.053 inches
(B) 0.20415 years
(C) 0.20415 inches
(D) 0.3873 years
(E) 0.3873 inches

6. Suppose we were to sample eight more consecutive office visits where we collect Jon David's height and age and perform a least squares regression on the data. By how much should these new data's slope differ from the slope in the regression shown above?

(A) 1.053
(B) 0.20415
(C) 0.3873
(D) 0.989
(E) 0.986

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7. Which of the following represents the test statistic 'ttt' missing from the output?

(A) 68.3
(B) 0.989
(C) 1.878
(D) 0.5326
(E) None of the above

8. Which of the following could have been the p-value 'ppp' missing from the output?

(A) 0.012
(B) 0.023
(C) 0.078
(D) 0.124
(E) 0.337

9. Which of the following represents a 90% confidence interval for the slope parameter?

(A) (–0.0115, 0.7782)
(B) (0.0475, 0.7992)
(C) (–0.0168, 0.7835)
(D) (1.125, 2.265)
(E) (0.225, 0.338)

10. A chi-square goodness-of-fit test is used to test whether a 0 to 9 is "fair" (that is, the outcomes are all equally likely). The spinner is spun 100 times, and the results are recorded. The degrees of freedom for the test will be

a) 8 b) 9 c) 10 d) 99 e) None of these

Refer 12-13 to the following setting: Recent revenue shortfalls in a midwestern state led to a reduction in the state budget for higher education. To offset the reduction, the largest state university proposed a 25% tuition increase. It was determined that such an increase was needed simply to compensate for the lost support from the state. Separate random samples of 50 freshmen, 50 sophomores, 50 juniors, and 50 seniors from the university were asked whether or not they were strongly opposed to the increase, given that it was the minimum increase necessary to maintain the university's budget at current levels. The results are given in the following table.

| **Strongly** | **Year** | | | |
|---|---|---|---|---|
| **Opposed?** | **Freshmen** | **Sophomores** | **Juniors** | **Seniors** |
| Yes | 39 | 36 | 29 | 18 |
| No | 11 | 14 | 21 | 32 |

12. Which hypotheses would be appropriate for performing a chi-squared test?

a) The null hypothesis is that the closer students get to graduation, the less likely they are opposed to tuition increases. The alternative is that how close students are to graduation makes no difference in their opinion.
b) The null hypothesis is that the mean number of students who are strongly opposed is the same for each of the four years. The alternative is that the mean is different for at least two of the four years.
c) The null hypothesis is that the distribution of student opinion about the proposed tuition increase is the same for each of the four years at this university. The alternative is that the distribution is different for at least two of the four years.
d) The null is that year in school and student opinion about tuition increase in the sample is independent. The alternative is that these variables are dependent.
e) The null hypothesis is that there is an association between year in school and opinion about the tuition increase at this university. The alternative hypothesis is that these variables are not associated.

13. The conditions for carrying out the chi-square test above are

I. Separate random samples from the population of interest.
II. Expected counts are large enough.
III. The samples themselves and the individual observations in each sample are independent.

Which of the conditions is (are) satisfied in this case?

a) I only b) II only c) I and II only d) II and III only e) I, II, and III

Refer 14-16 to the following setting: A random sample of traffic tickets given to motorists in a large city is examined. The tickets are classified according to the race of the driver. The results are summarized in the following table:

| **Race:** | White | Black | Hispanic | Other |
|---|---|---|---|---|
| **# of tickets:** | 69 | 52 | 18 | 9 |

The proportion of this city's population in each of the racial categories listed above is as follows:

| **Race:** | White | Black | Hispanic | Other |
|---|---|---|---|---|
| **Proportion:** | 0.55 | 0.3 | 0.08 | 0.07 |

We wish to test $H_o$: The racial distribution of traffic tickets in the city is the same as the racial distribution of the city's population.

14. Assuming $H_o$ is true, the expected number of Hispanic drivers who would receive a ticket is

a) 8 b) 10.36 c) 11 d) 11.84 e) 12

15. We compute the value of the chi-square statistic to be 6.58. Assuming that the conditions for inference are met, the p-value of our test is

a) greater than 0.20 b) between 0.10 and 0.20 c) between 0.05 and 0.10
d) between 0.01 and 0.05 e) less than 0.01

16. The category that contributes the largest component to the chi-square statistic is

a) White b) Black c) Hispanic d) Other e) The answer cannot be determined

Refer 17-20 to the following setting: All current-carrying wires produce electromagnetic (EM) radiation, including the electrical wiring running into, through, and out of our homes. High-frequency EM radiation is thought to be a cause of cancer. The lower frequencies associated with household current are generally assumed to be harmless. To investigate this, researchers visited the addresses of a random sample of children who had died of some form of cancer (leukemia, lymphoma, or some other type) and classified the wiring configuration outside the dwelling as either a high-current configuration (HCC) or a low-current configuration (LCC). Here are the data:

| | **Leukemia** | **Lymphoma** | **Other cancers** |
|---|---|---|---|
| HCC | 52 | 10 | 17 |
| LCC | 84 | 21 | 31 |

Computer software was used to analyze the data. The output is given below. It includes the cell counts, some of the expected counts, and the value of the $\chi^2$ statistic. In the table, expected counts are printed below observed counts and enclosed within parentheses.

| | **Leukemia** | **Lymphoma** | **Other cancers** | **Total** |
|---|---|---|---|---|
| HCC | 52 | 10 | 17 | 79 |
| | (49.97) | | (17.64) | |
| LCC | 84 | 21 | 31 | 136 |
| | (86.03) | | (30.36) | |
| Total | 136 | 31 | 48 | 215 |

**$\chi^2 = 0.082 + 0.170 + 0.023 + 0.048 + 0.099 + 0.013 = 0.435$**

17. The appropriate degrees of freedom for the $\chi^2$ statistic is

a) 1 b) 2 c) 3 d) 4 e) 5

18. The expected count of cases with lymphoma in homes with an HCC is

a) $\frac{79 \cdot 31}{215}$ b) $\frac{10 \cdot 31}{215}$ c) $\frac{79 \cdot 31}{10}$ d) $\frac{136 \cdot 31}{215}$ e) None of these.

19. Which of the following may we conclude, based on the results?

a) There is strong evidence of an association between wiring configuration and the chance that a child will develop some form of cancer.
b) HCC either causes cancer directly or is a major contributing factor to the development of cancer in children.
c) Leukemia is the most common type of cancer among children.
d) There is not much evidence of an association between wiring configuration and the type of cancer that caused the deaths of children in this study.
e) There is weak evidence that HCC causes cancer in children.

20. A Type I error would occur if we conclude that
    a) HCC wiring caused cancer when it actually did not.
    b) HCC wiring did not cause cancer when it actually did.
    c) there is no association between type of wiring and the form of cancer when there actually is an association.
    d) there is an association between type of wiring and the form of cancer when there actually is no association.
    e) the type of wiring and the form of cancer have a positive correlation when they actually do not.

Refer 21-26 to the following setting: To determine property taxes, Florida reappraises real estate every year, and the county appraiser's Web site lists the current "fair market value" of each piece of property. Property usually sells for somewhat more than the appraised market value. Data was collected on the appraised market values x and actual selling prices y (in thousands of dollars) of a random sample of 16 condominium units. A scatterplot of the data shows a fairly strong positive linear relationship between the variables. Here is part of the Minitab output from a least-squares regression analysis using these data.

| Predictor | Coef | SE Coef | T | P |
|---|---|---|---|---|
| Constant | 127.27 | 79.49 | 1.60 | 0.132 |
| appraisal | 1.0446 | 0.1126 | 9.29 | 0.000 |
| S = 69.7299 | R-Sq -= 86.1% | R-Sq (adj) = 85.1% | | |

21. The equation of the least-squares regression line for predicting selling price from appraised value is
    a) Price = 79.49 + 0.1126(appraised value)
    b) Price = 0.1126 + 1.0466(appraised value)
    c) Price = 127.27 + 1.0466(appraised value)
    d) Price = 1.0466 + 127.27(appraised value)
    e) Price = 1.0466 + 69.7299(appraised value)

22. What is the correlation between selling price and appraised value?
    a) 0.1126 b) -0.861 c) -0.928 d) 0.861 e) 0.928

23. The slope β of the population regression line describes
    a) the exact increase in the selling price of an individual unit when its appraised value increases by $1000
    b) the average increase in the appraised value in a population of units when selling price increases by $1000.
    c) the average increase in selling price in a population of units when appraised value increases by $1000.
    d) the average selling price in a population of units when a unit's appraised value is 0.
    e) the average increase in appraised value in a sample of 16 units when selling price increases ny $1000.

24. Is there significant evidence that selling price increases as appraised value increases? To answer this question, test the hypotheses
    a) $H_o$: β = 0 versus $H_a$: β > 0
    b) $H_o$: β = 0 versus $H_a$: β < 0
    c) $H_o$: β = 0 versus $H_a$: β ≠ 0
    d) $H_o$: β > 0 versus $H_a$: β = 0
    e) $H_o$: β = 1 versus $H_a$: β > 1

25. Confidence intervals and tests for these data use the *t* distribution with degrees of freedom
    a) 9.29 b) 14 c) 15 d) 16 e) 30

26. A 95% confidence interval for the population slope β is
    a) 1.0466 ± 149.5706
    b) 1.0466 ± 0.2415
    c) 1.0466 ± 0.2387
    d) 1.0466 ± 0.1983
    e) 1.0466 ± 001126