

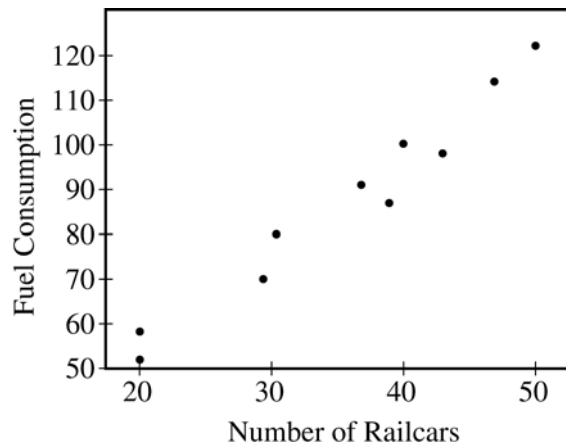
## 2005 AP<sup>®</sup> STATISTICS FREE-RESPONSE QUESTIONS

3. The Great Plains Railroad is interested in studying how fuel consumption is related to the number of railcars for its trains on a certain route between Oklahoma City and Omaha.

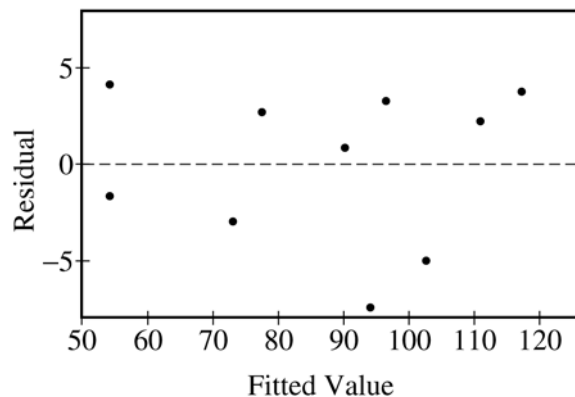
A random sample of 10 trains on this route has yielded the data in the table below.

Number of Railcars	Fuel Consumption (units/mile)
20	58
20	52
37	91
31	80
47	114
43	98
39	87
50	122
40	100
29	70

A scatterplot, a residual plot, and the output from the regression analysis for these data are shown below.



RESIDUALS VERSUS THE FITTED VALUES



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The regression equation is  
Fuel Consumption = 10.7 + 2.15 Railcars

Predictor	Coef	StDev	T	P
Constant	10.677	5.157	2.07	0.072
Railcar	2.1495	0.1396	15.40	0.000

S = 4.361 R-Sq = 96.7% R-Sq(adj) = 96.3%

- (a) Is a linear model appropriate for modeling these data? Clearly explain your reasoning.
- (b) Suppose the fuel consumption cost is \$25 per unit. Give a point estimate (single value) for the change in the average cost of fuel per mile for each additional railcar attached to a train. Show your work.
- (c) Interpret the value of  $r^2$  in the context of this problem.
- (d) Would it be reasonable to use the fitted regression equation to predict the fuel consumption for a train on this route if the train had 65 railcars? Explain.
4. Some boxes of a certain brand of breakfast cereal include a voucher for a free video rental inside the box. The company that makes the cereal claims that a voucher can be found in 20 percent of the boxes. However, based on their experiences eating this cereal at home, a group of students believes that the proportion of boxes with vouchers is less than 0.2. This group of students purchased 65 boxes of the cereal to investigate the company's claim. The students found a total of 11 vouchers for free video rentals in the 65 boxes.
- Suppose it is reasonable to assume that the 65 boxes purchased by the students are a random sample of all boxes of this cereal. Based on this sample, is there support for the students' belief that the proportion of boxes with vouchers is less than 0.2? Provide statistical evidence to support your answer.
5. A survey will be conducted to examine the educational level of adult heads of households in the United States. Each respondent in the survey will be placed into one of the following two categories:
- Does not have a high school diploma
  - Has a high school diploma
- The survey will be conducted using a telephone interview. Random-digit dialing will be used to select the sample.
- (a) For this survey, state one potential source of bias and describe how it might affect the estimate of the proportion of adult heads of households in the United States who do not have a high school diploma.
- (b) A pilot survey indicated that about 22 percent of the population of adult heads of households do not have a high school diploma. Using this information, how many respondents should be obtained if the goal of the survey is to estimate the proportion of the population who do not have a high school diploma to within 0.03 with 95 percent confidence? Justify your answer.
- (c) Since education is largely the responsibility of each state, the agency wants to be sure that estimates are available for each state as well as for the nation. Identify a sampling method that will achieve this additional goal and briefly describe a way to select the survey sample using this method.