3.2 The general manager of an engineering firm wants to know whether a technical artist's experience influences the quality of his or her work. A random sample of 24 artists is selected and their years of work experience and quality rating (as assessed by their supervisors) recorded. Work experience (*EXPER*) is measured in years and quality rating (*RATING*) takes a value of 1 through 7, with 7 = excellent and 1 = poor. The simple regression model $RATING = \beta_1 + \beta_2 EXPER + e$ is proposed. The least squares estimates of the model, and the standard errors of the estimates, are

$$\begin{array}{lcccc} \widehat{RATING} & = & 3.204 & + & 0.076\,EXPER \\ (\text{se}) & & (0.709) & & (0.044) \end{array}$$

(a) Sketch the estimated regression function. Interpret the coefficient of *EXPER*.
(b) Construct a 95% confidence interval for β_2, the slope of the relationship between quality rating and experience. In what are you 95% confident?
(c) Test the null hypothesis that β_2 is zero against the alternative that it is not using a two-tail test and the $\alpha = 0.05$ level of significance. What do you conclude?
(d) Test the null hypothesis that β_2 is zero against the one-tail alternative that it is positive at the $\alpha = 0.05$ level of significance. What do you conclude?
(e) For the test in part (c), the p-value is 0.0982. If we choose the probability of a Type I error to be $\alpha = 0.05$, do we reject the null hypothesis, or not, just based on an inspection of the p-value? Show, in a diagram, how this p-value is computed.

3.4 Consider a simple regression in which the dependent variable *MIM* = mean income of males who are 18 years of age or older, in thousands of dollars. The explanatory variable *PMHS* = percent of males 18 or older who are high school graduates. The data consist of 51 observations on the 50 states plus the District of Columbia. Thus *MIM* and *PMHS* are "state averages." The estimated regression, along with standard errors and t-statistics, is

$$\begin{array}{lcccc} \widehat{MIM} & = & (a) & + & 0.180PMHS \\ (\text{se}) & & (2.174) & & (b) \\ (t) & & (1.257) & & (5.754) \end{array}$$

(a) What is the estimated equation intercept? Show your calculation. Sketch the estimated regression function.

(b) What is the standard error of the estimated slope? Show your calculation.
(c) What is the p-value for the two-tail test of the hypothesis that the equation intercept is zero? Draw a sketch to illustrate.
(d) State the economic interpretation of the estimated slope. Is the sign of the coefficient what you would expect from economic theory?
(e) Construct a 99% confidence interval estimate of the slope of this relationship.
(f) Test the hypothesis that the slope of the relationship is 0.2 against the alternative that it is not. State in words the meaning of the null hypothesis in the context of this problem.

3.5 A life insurance company wishes to examine the relationship between the amount of life insurance held by a family and family income. From a random sample of 20 households, the company collected the data in the file *insur.dat*. The data are in units of thousands of dollars.

(a) Estimate the linear regression with dependent variable *INSURANCE* and independent variable *INCOME*. Write down the fitted model and draw a sketch of the fitted function. Identify the estimated slope and intercept on the sketch. Locate the point of the means on the plot.
(b) Discuss the relationship you estimated in (a). In particular,
    (i) What is your estimate of the resulting change in the amount of life insurance when income increases by \$1,000?
    (ii) What is the standard error of the estimate in (i), and how do you use this standard error for interval estimation and hypothesis testing?
(c) One member of the management board claims that for every \$1,000 increase in income, the amount of life insurance held will go up by \$5,000. Choose an alternative hypothesis and explain your choice. Does your estimated relationship support this claim? Use a 5% significance level.
(d) Test the hypothesis that as income increases the amount of life insurance increases by the same amount. That is, test the hypothesis that the slope of the relationship is one.
(e) Write a short report (200–250 words) summarizing your findings about the relationship between income and the amount of life insurance held.

3.7 Consider the capital asset pricing model (CAPM) in Exercise 2.10. Use the data in *capm4.dat* to answer each of the following:

(a) Test at the 5% level of significance the hypothesis that each stock's "*beta*" value is 1 against the alternative that it is not equal to 1. What is the economic interpretation of a *beta* equal to 1?

(b) Test at the 5% level of significance the null hypothesis that Mobil-Exxon's "*beta*" value is greater than or equal to 1 against the alternative that it is less than 1. What is the economic interpretation of a *beta* less than 1?

(c) Test at the 5% level of significance the null hypothesis that Microsoft's "*beta*" value is less than or equal to 1 against the alternative that it is greater than 1. What is the economic interpretation of a *beta* more than 1?

(d) Construct a 95% interval estimate of Microsoft's "*beta*." Assume that you are a stockbroker. Explain this result to an investor who has come to you for advice.

(e) Test (at a 5% significance level) the hypothesis that the intercept term in the CAPM model for each stock is zero, against the alternative that it is not. What do you conclude?

3.9* Reconsider the presidential voting data (*fair4.dat*) introduced in Exercise 2.14. Use the data from 1916 to 2008 for this exercise.

(a) Using the regression model $VOTE = \beta_1 + \beta_2 GROWTH + e$, test (at a 5% significance level) the null hypothesis that economic growth has no effect on the percentage vote earned by the incumbent party. Select an alternative hypothesis and a rejection region. Explain your choice.

(b) Using the regression model in part (a), construct a 95% interval estimate for β_2, and interpret.

(c) Using the regression model $VOTE = \beta_1 + \beta_2 INFLATION + e$, test the null hypothesis that inflation has no effect on the percentage vote earned by the incumbent party. Select an alternative hypothesis, a rejection region, and a significance level. Explain your choice.

(d) Using the regression model in part (c), construct a 95% interval estimate for β_2, and interpret.

(e) Test the null hypothesis that if $INFLATION = 0$ the expected vote in favor of the incumbent party is 50%, or more. Select the appropriate alternative. Carry out the test at the 5% level of significance. Discuss your conclusion.

(f) Construct a 95% interval estimate of the expected vote in favor of the incumbent party if $INFLATION = 2\%$. Discuss the interpretation of this interval estimate.