c. Construct a 99% interval estimate of the expected amount of insurance held by a household with $100,000 income. The estimated covariance between the intercept and slope coefficient is −0.746.

d. One member of the management board claims that for every $1000 increase in income the average amount of life insurance held will increase by $5000. Let the algebraic model be $INSURANCE = \beta_1 + \beta_2 INCOME + e$. Test the hypothesis that the statement is true against the alternative that it is not true. State the conjecture in terms of a null and alternative hypothesis about the model parameters. Use the 5% level of significance. Do the data support the claim or not? Clearly, indicate the test statistic used and the rejection region.

e. Test the hypothesis that as income increases the amount of life insurance held increases by the same amount. That is, test the null hypothesis that the slope is one. Use as the alternative that the slope is larger than one. State the null and alternative hypotheses in terms of the model parameters. Carry out the test at the 1% level of significance. Clearly indicate the test statistic used, and the rejection region. What is your conclusion?

3.7.2 Computer Exercises

3.19 The owners of a motel discovered that a defective product was used during construction. It took 7 months to correct the defects during which approximately 14 rooms in the 100-unit motel were taken out of service for 1 month at a time. The data are in the file *motel*.

a. Plot *MOTEL_PCT* and *COMP_PCT* versus *TIME* on the same graph. What can you say about the occupancy rates over time? Do they tend to move together? Which seems to have the higher occupancy rates? Estimate the regression model $MOTEL\_PCT = \beta_1 + \beta_2 COMP\_PCT + e$. Construct a 95% interval estimate for the parameter β_2. Have we estimated the association between *MOTEL_PCT* and *COMP_PCT* relatively precisely, or not? Explain your reasoning.

b. Construct a 90% interval estimate of the expected occupancy rate of the motel in question, *MOTEL_PCT*, given that $COMP\_PCT = 70$.

c. In the linear regression model $MOTEL\_PCT = \beta_1 + \beta_2 COMP\_PCT + e$, test the null hypothesis $H_0: \beta_2 \leq 0$ against the alternative hypothesis $H_0: \beta_2 > 0$ at the $\alpha = 0.01$ level of significance. Discuss your conclusion. Clearly define the test statistic used and the rejection region.

d. In the linear regression model $MOTEL\_PCT = \beta_1 + \beta_2 COMP\_PCT + e$, test the null hypothesis $H_0: \beta_2 = 1$ against the alternative hypothesis $H_0: \beta_2 \neq 1$ at the $\alpha = 0.01$ level of significance. If the null hypothesis were true, what would that imply about the motel's occupancy rate versus their competitor's occupancy rate? Discuss your conclusion. Clearly define the test statistic used and the rejection region.

e. Calculate the least squares residuals from the regression of *MOTEL_PCT* on *COMP_PCT* and plot them against *TIME*. Are there any unusual features to the plot? What is the predominant sign of the residuals during time periods 17–23 (July, 2004 to January, 2005)?

3.20 The owners of a motel discovered that a defective product was used during construction. It took seven months to correct the defects during which approximately 14 rooms in the 100-unit motel were taken out of service for one month at a time. The data are in the file *motel*.

a. Calculate the sample average occupancy rate for the motel during the time when there were no repairs being made. What is the sample average occupancy rate for the motel during the time when there were repairs being made? How big a difference is there?

b. Consider the linear regression $MOTEL\_PCT = \delta_1 + \delta_2 REPAIR + e$, where *REPAIR* is an indicator variable taking the value 1 during the repair period and 0 otherwise. What are the estimated coefficients? How do these estimated coefficients relate to the calculations in part (a)?

c. Construct a 95% interval estimate for the parameter δ_2 and give its interpretation. Have we estimated the effect of the repairs on motel occupancy relatively precisely, or not? Explain.

d. The motel wishes to claim economic damages because the faulty materials led to repairs which cost them customers. To do so, their economic consultant tests the null hypothesis $H_0: \delta_2 \geq 0$ against the alternative hypothesis $H_1: \delta_2 < 0$. Explain the logic behind stating the null and alternative hypotheses in this way. Carry out the test at the $\alpha = 0.05$ level of significance. Discuss your conclusions. Clearly state the test statistic, the rejection region, and the *p*-value.

e. To further the motel's claim, the consulting economist estimates a regression model $(MOTEL\_PCT - COMP\_PCT) = \gamma_1 + \gamma_2 REPAIR + e$, so that the dependent variable is the difference in the occupancy rates. Construct and discuss the economic meaning of the 95% interval estimate of γ_2.