Chapter 7

15-1. You are given the following estimated regression equation involving a dependent and two independent variables:

$$\hat{y} = 12.67 + 4.14x_1 + 8.72x_2$$

a. Interpret the values of the slope coefficients in the equation.
b. Estimate the value of the dependent variable when $x_1 = 4$ and $x_2 = 9$.

15-2. In working for a local retail store you have developed the following estimated regression equation:

$$\hat{y} = 22{,}167 - 412x_1 + 818x_2 - 93x_3 - 71x_4$$

where:
y = Weekly sales
x_1 = Local unemployment rate
x_2 = Weekly average high temperature
x_3 = Number of activities in the local community
x_4 = Average gasoline price
a. Interpret the values of $b1$, $b2$, and $b4$ in this estimated regression equation.
b. What is the estimated sales if the unemployment rate is 5.7%, the average high temperature is 61°, there are 14 activities, and gasoline average price is $1.39?

15-3. The following output is associated with a multiple regression model with three independent variables:

	df	*SS*	*MS*	*F*	Significance *F*
Regression	3	16,646.091	5,548.697	5.328	0.007
Residual	21	21,871.669	1,041.508		
Total	24	38,517.760			

	Coefficients	Standard Error	*t* Stat	*p*-value
Intercept	87.790	25.468	3.447	0.002
x_1	−0.970	0.586	−1.656	0.113
x_2	0.002	0.001	3.133	0.005
x_3	−8.723	7.495	−1.164	0.258

	Lower 95%	Upper 95%	Lower 90%	Upper 90%
Intercept	34.827	140.753	43.966	131.613
x_1	−2.189	0.248	−1.979	0.038
x_2	0.001	0.004	0.001	0.004
x_3	−24.311	6.864	−21.621	4.174

a. What is the regression model associated with these data?
b. Is the model statistically significant?
c. How much of the variation in the dependent variable can be explained by the model?
d. Are all of the independent variables in the model significant? If not, which are not and how can you tell?
e. How much of a change in the dependent variable will be associated with a one-unit change in x_2? In x_3?
f. Do any of the 95% confidence interval estimates of the slope coefficients contain zero? If so, what does this indicate?

15-4. The following correlation matrix is associated with the same data used to build the regression model in Problem1:

	y	x_1	x_2	x_3
y	1			
x_1	−0.406	1		
x_2	0.459	0.051	1	
x_3	−0.244	0.504	0.272	1

Does this output indicate any potential multicollinearity problems with the analysis?

15-5. Consider the following set of data:

x_1	29	48	28	22	28	42	33	26	48	44
x_2	15	37	24	32	47	13	43	12	58	19
y	16	46	34	26	49	11	41	13	47	16

a. Obtain the estimated regression equation.
b. Develop the correlation matrix for this set of data. Select the independent variable whose correlation magnitude is the smallest with the dependent variable. Determine if its correlation with the dependent variable is significant.
c. Determine if the overall model is significant. Use a significance level of 0.05.
d. Calculate the variance inflation factor for each of the independent variables. Indicate if multicollinearity exists between the two independent variables.

15-14. Consider the following regression model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

where:

$$x_1 = \text{A quantitative variable}$$

$$x_2 = \begin{cases} 1 \text{ if } x_1 < 20 \\ 0 \text{ if } x_1 \geq 20 \end{cases}$$

The following estimated regression equation was obtained from a sample of 30 observations:

$$\hat{y} = 24.1 + 5.8\, x_1 + 7.9\, x_2$$

a. Provide the estimated regression equation for instances in which $x_1 < 20$.
b. Determine the value of y when $x_1 = 10$.
c. Provide the estimated regression equation for instances in which $x_1 > 20$.
d. Determine the value of y when $x_1 = 30$.

15-15. A real estate agent wishes to estimate the monthly rental for apartments based on the size (square feet) and the location of the apartments. She chose the following model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

where:

$$x_1 = \text{Square footage of the apartment}$$

$$x_2 = \begin{cases} 1 \text{ if located in town center} \\ 0 \text{ if not located in town center} \end{cases}$$

This linear regression model was fitted to a sample of size 50 to produce the following regression equation:

$$\hat{y} = 145 + 1.2\, x_1 + 300 x_2$$

a. Predict the average monthly rent for an apartment located in the town center that has 1,500 square feet.
b. Predict the average monthly rent for an apartment located in the suburbs that has 1,500 square feet.
c. Interpret b_2 in the context of this exercise.

15-18. A real estate agent wishes to determine the selling price of residences using the size (square feet) and whether the residence is a condominium or a single-family home. A sample of 20 residences was obtained with the following results:

Price($)	Type	Square Feet	Price($)	Type	Square Feet
199,700	Family	1,500	200,600	Condo	1,375
211,800	Condo	2,085	208,000	Condo	1,825
197,100	Family	1,450	210,500	Family	1,650
228,400	Family	1,836	233,300	Family	1,960
215,800	Family	1,730	187,200	Condo	1,360
190,900	Condo	1,726	185,200	Condo	1,200
312,200	Family	2,300	284,100	Family	2,000
313,600	Condo	1,650	207,200	Family	1,755
239,000	Family	1,950	258,200	Family	1,850
184,400	Condo	1,545	203,100	Family	1,630

a. Produce a regression equation to predict the selling price for residences using a model of the following form:

$$y_i=\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

where

$$x_1 = \text{Square footage} \quad \text{and} \quad x_2 = \begin{cases} 1 \text{ if a condo} \\ 0 \text{ if a single-family home} \end{cases}$$

b. Interpret the parameters β_1, and β_2 in the model given in part a.

c. Produce an equation that describes the relationship between the selling price and the square footage of (1) condominiums and (2) single-family homes.

d. Conduct a test of hypothesis to determine if the relationship between the selling price and the square footage is different between condominiums and single family homes.