

**Table 5.4** Data for Exercise 5.1

$y_i$	$x_{i1}$	$x_{i2}$	$x_{i3}$
1	1	0	1
2	1	1	-2
3	1	2	1
-1	1	-2	0
0	1	1	-1
-1	1	-2	-1
2	1	0	1
1	1	-1	1
2	1	1	0

## 5.7 Exercises

Answers to exercises marked \* appear in Appendix D at the end of book.

### 5.7.1 PROBLEMS

5.1\* Consider the multiple regression model

$$y_i = x_{i1}\beta_1 + x_{i2}\beta_2 + x_{i3}\beta_3 + e_i$$

with the nine observations on  $y_i, x_{i1}, x_{i2}$  and  $x_{i3}$  given in Table 5.4.

Use a hand calculator to answer the following questions:

(a) Calculate the observations in terms of deviations from their means. That is, find

$$x_{i2}^* = x_{i2} - \bar{x}_2, \quad x_{i3}^* = x_{i3} - \bar{x}_3, \quad y_i^* = y_i - \bar{y}$$

(b) Calculate  $\sum y_i^* x_{i2}^*$ ,  $\sum x_{i2}^{*2}$ ,  $\sum y_i^* x_{i3}^*$ ,  $\sum x_{i2}^* x_{i3}^*$ , and  $\sum x_{i3}^{*2}$ .

(c) Use the expressions in Appendix 5A to find least squares estimates  $b_1$ ,  $b_2$ , and  $b_3$ .

(d) Find the least squares residuals  $\hat{e}_1, \hat{e}_2, \dots, \hat{e}_9$ .

(e) Find the variance estimate  $\hat{\sigma}^2$ .

(f) Use equation (5.9) to find the sample correlation between  $x_2$  and  $x_3$ .

(g) Find the standard error for  $b_2$ .

(h) Find  $SSE$ ,  $SST$ ,  $SSR$ , and  $R^2$ .

5.2\* Use your answers to Exercise 5.1 to

(a) Compute a 95% interval estimate for  $\beta_2$ .

(b) Test the hypothesis  $H_0: \beta_2 = 1$  against the alternative that  $H_1: \beta_2 \neq 1$ .

5.3 Consider the following model that relates the proportion of a household's budget spent on alcohol  $WALC$  to total expenditure  $TOTEXP$ , age of the household head  $AGE$ , and the number of children in the household  $NK$ .

$$WALC = \beta_1 + \beta_2 \ln(TOTEXP) + \beta_3 AGE + \beta_4 NK + e$$

The data in the file *london.dat* were used to estimate this model. See Exercise 4.10 for more details about the data. Note that only households with one or two children are being considered. Thus,  $NK$  takes only the values 1 or 2. Output from estimating this equation appears in Table 5.5.