1. The price of a car is thought to depend on the horsepower of the engine and the country where the car is made. The variable Country has four categories: USA, Japan, Germany and Others. To include the variable Country in a regression equation, three indicator variables are created, one for USA, another for Japan, and the third for Germany. In addition, there are three interaction variables between the horsepower and each of the three Country categories(HP*USA, HP*Japan, HP*Germany). Some regression outputs when fitting three models to the data is how in Table 5.16. The usual regression assumptions hold.

(a) Compute the correlation coefficient between the price and the horsepower.

(b) What is the least squares estimated price of an American car with a 100 horsepower engine?

(c) Holding the horsepower fixed, which country has the least expensive car? Why?

(d) Test whether there is an interaction between Country and horsepower. Specify the null and alternative hypotheses, test statistics, and conclusions.

(e) Given the horsepower of the car, test whether the Country is an important predictor of the price of a car. Specify the null and alternative hypotheses, test statistics, and conclusions.

(f) Would you recommend that the number of categories of Country be reduced? If so, which categories can be joined together to form one category?

(g) Holding the horsepower fixed, write down the formular for the test statistics for testinf the equality of the price of American and Japanese cars?

Table 5.16   Some Regression Outputs When Fitting Three Models to the Car Data

Model 1

Source	Sum of Squares	df	Mean Square	F-Test
Regression	4604.7	1	4604.7	253
Residual	1604.44	88	18.2323	

Variable	Coefficient	s.e.	t-Test	p-value
Constant	−6.107	1.487	−4.11	0.0001
Horsepower	0.169	0.011	15.9	0.0001

Model 2

Source	Sum of Squares	df	Mean Square	F-Test
Regression	4818.84	4	1204.71	73.7
Residual	1390.31	85	16.3566	

Variable	Coefficient	s.e.	t-Test	p-value
Constant	−4.117	1.582	−2.6	0.0109
Horsepower	0.174	0.011	16.6	0.0001
USA	−3.162	1.351	−2.34	0.0216
Japan	−3.818	1.357	−2.81	0.0061
Germany	0.311	1.871	0.166	0.8682

Model 3

Source	Sum of Squares	df	Mean Square	F-Test
Regression	4889.3	7	698.471	43.4
Residual	1319.85	82	16.0957	

Variable	Coefficient	s.e.	t-Test	p-value
Constant	−10.882	4.216	−2.58	0.0116
Horsepower	0.237	0.038	6.21	0.0001
USA	2.076	4.916	0.42	0.6740
Japan	4.755	4.685	1.01	0.3131
Germany	11.774	9.235	1.28	0.2059
HP*USA	−0.052	0.042	−1.23	0.2204
HP*Japan	−0.077	0.041	−1.88	0.0631
HP*Germany	−0.095	0.066	−1.43	0.1560