5.5 This question is concerned with the value of houses in towns surrounding Boston. It uses the data of Harrison, D., and D. L. Rubinfeld (1978), "Hedonic Prices and the Demand for Clean Air," *Journal of Environmental Economics and Management*, 5, 81–102. The output appears in Table 5.8. The variables are defined as follows:

VALUE = median value of owner-occupied homes in thousands of dollars
CRIME = per capita crime rate
NITOX = nitric oxide concentration (parts per million)
ROOMS = average number of rooms per dwelling
AGE = proportion of owner-occupied units built prior to 1940

Table 5.8 Output for Exercise 5.5

Dependent Variable: *VALUE*
Included observations: 506

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	28.4067	5.3659	5.2939	0.0000
CRIME	−0.1834	0.0365	−5.0275	0.0000
NITOX	−22.8109	4.1607	−5.4824	0.0000
ROOMS	6.3715	0.3924	16.2378	0.0000
AGE	−0.0478	0.0141	−3.3861	0.0008
DIST	−1.3353	0.2001	−6.6714	0.0000
ACCESS	0.2723	0.0723	3.7673	0.0002
TAX	−0.0126	0.0038	−3.3399	0.0009
PTRATIO	−1.1768	0.1394	−8.4409	0.0000

5.9 When estimating wage equations, we expect that young, inexperienced workers will have relatively low wages and that with additional experience their wages will rise, but then begin to decline after middle age, as the worker nears retirement. This life-cycle pattern of wages can be captured by introducing experience and experience squared to explain the level of wages. If we also include years of education, we have the equation

$$WAGE = \beta_1 + \beta_2 EDUC + \beta_3 EXPER + \beta_4 EXPER^2 + e$$

(a) What is the marginal effect of experience on wages?
(b) What signs do you expect for each of the coefficients β_2, β_3, and β_4? Why?
(c) After how many years of experience do wages start to decline? (Express your answer in terms of β's.)
(d) The results from estimating the equation using 1000 observations in the file *cps4c_small.dat* are given in Table 5.9 on page 204. Find 95% interval estimates for

   (i) The marginal effect of education on wages
   (ii) The marginal effect of experience on wages when $EXPER = 4$
   (iii) The marginal effect of experience on wages when $EXPER = 25$
   (iv) The number of years of experience after which wages decline

5.12 The file *cocaine.dat* contains 56 observations on variables related to sales of cocaine powder in northeastern California over the period 1984–1991. The data are a subset of those used in the study Caulkins, J. P. and R. Padman (1993), "Quantity Discounts and Quality Premia for Illicit Drugs," *Journal of the American Statistical Association*, 88, 748–757. The variables are

$PRICE$ = price per gram in dollars for a cocaine sale
$QUANT$ = number of grams of cocaine in a given sale
$QUAL$ = quality of the cocaine expressed as percentage purity
$TREND$ = a time variable with 1984 = 1 up to 1991 = 8

Consider the regression model

$$PRICE = \beta_1 + \beta_2 QUANT + \beta_3 QUAL + \beta_4 TREND + e$$

(a) What signs would you expect on the coefficients β_2, β_3, and β_4?
(b) Use your computer software to estimate the equation. Report the results and interpret the coefficient estimates. Have the signs turned out as you expected?
(c) What proportion of variation in cocaine price is explained jointly by variation in quantity, quality, and time?
(d) It is claimed that the greater the number of sales, the higher the risk of getting caught. Thus, sellers are willing to accept a lower price if they can make sales in larger quantities. Set up H_0 and H_1 that would be appropriate to test this hypothesis. Carry out the hypothesis test.

(e) Test the hypothesis that the quality of cocaine has no influence on price against the alternative that a premium is paid for better-quality cocaine.
(f) What is the average annual change in the cocaine price? Can you suggest why price might be changing in this direction?

5.13 The file *br2.dat* contains data on 1,080 houses sold in Baton Rouge, Louisiana, during mid-2005. We will be concerned with the selling price ($PRICE$), the size of the house in square feet ($SQFT$), and the age of the house in years (AGE).

(a) Use all observations to estimate the following regression model and report the results

$$PRICE = \beta_1 + \beta_2 SQFT + \beta_3 AGE + e$$

(i) Interpret the coefficient estimates.

(ii) Find a 95% interval estimate for the price increase for an extra square foot of living space—that is, $\partial PRICE/\partial SQFT$.

(iii) Test the hypothesis that having a house a year older decreases price by 1000 or less ($H_0 : \beta_3 \geq -1000$) against the alternative that it decreases price by more than 1000 ($H_1 : \beta_3 < -1000$).

(b) Add the variables $SQFT^2$ and AGE^2 to the model in part (a) and re-estimate the equation. Report the results.

(i) Find estimates of the marginal effect $\partial PRICE/\partial SQFT$ for the smallest house in the sample, the largest house in the sample, and a house with 2300 $SQFT$. Comment on these values. Are they realistic?

(ii) Find estimates of the marginal effect $\partial PRICE/\partial AGE$ for the oldest house in the sample, the newest house in the sample, and a house that is 20 years old. Comment on these values. Are they realistic?

(iii) Find a 95% interval estimate for the marginal effect $\partial PRICE/\partial SQFT$ for a house with 2300 square feet.

(iv) For a house that is 20 years old, test the hypothesis

$$H_0 : \frac{\partial PRICE}{\partial AGE} \geq -1000 \text{ against } H_1 : \frac{\partial PRICE}{\partial AGE} < -1000$$

(c) Add the interaction variable $SQFT \times AGE$ to the model in part (b) and re-estimate the equation. Report the results. Repeat parts (i), (ii), (iii), and (iv) from part (b) for this new model. Use $SQFT = 2300$ and $AGE = 20$.

(d) From your answers to parts (a), (b), and (c), comment on the sensitivity of the results to the model specification.