

ECO240 Homework Questions for Chapter 11 (Two Variable Regression Analysis)

Q1 (11.1) Complete the following for the (x, y) pairs of data points (1,5), (3,7), (4, 6), (5, 8) and (7,9):

- Prepare a scatter plot of these data points.
- Compute b_1 .
- Compute b_0 .
- What is the equation of the regression line?

Q2 (11.3) A random sample of data for 7 days of operation produced the following (price, quantity) data values:

Price per Gallon of Paint X	Quantity Sold, Y
10	100
8	120
5	200
4	200
10	90
7	110
6	150

- Prepare a scatter plot of the data.
- Compute and interpret b_1 .
- Compute and interpret b_0 .
- How many gallons of paint would you expect to sell if the price is \$7 per gallon?

Q3 (11.4) A large consumer goods company has been studying the effect of advertising on total profits. As part of this study, data on advertising expenditures and total sales were collected for a 6-month period and are as follows: (10, 100) (15, 200) (7, 80) (12, 120) (14, 150)

The first number is advertising expenditures and the second is total sales.

- Plot the data
- Does the plot provide evidence that advertising has a positive effect on sales?
- Compute the regression coefficients, b_0 and b_1 .

Q4 (11.9) Given the regression equation $Y = 43 + 10X$

- What is the change in Y when X changes by + 8?
- What is the change in Y when X changes by - 6?
- What is the predicted value of Y when X = 11?
- what is the predicted value of Y when X = 29?
- Does this equation prove that a change in X causes a change in Y?

Q5 (11.12) As a new Market manager for Blue Crunches breakfast cereal you are asked to estimate the demand for next month using regression analysis. Two months ago the target market has 20,000 families and sales were 3780 boxes, one month ago the target market was 40,000 families and sales were 5349 boxes. Next month you plan to target 75,000 families. How would you respond to the request to use regression analysis to estimate sales next month?

Q6 (11.21) A corporation administers an aptitude test to all new sales representatives. Management is interested in the extent to which this test is able to predict sales representatives' eventual success. The accompanying table records average weekly sales (in thousands of dollars) and aptitude test scores for a random sample of eight representatives.

Weekly sales	10	12	28	24	18	16	15	12
Test score	55	60	85	75	80	85	65	60

- Estimate the linear regression of weekly sales on aptitude test scores.
- Interpret the estimated slope of the regression line.

Q7 (11.26) Compute SSR, SSE, s_e^2 and the coefficient of determination, given the following statistics computed from a random sample of pairs of X and Y observations:

- $\sum_{i=1}^n (y_i - \bar{y})^2 = 100,000, R^2 = 0.50, n = 52$
- $\sum_{i=1}^n (y_i - \bar{y})^2 = 90,000, R^2 = 0.70, n = 52$
- $\sum_{i=1}^n (y_i - \bar{y})^2 = 240, R^2 = 0.80, n = 52$
- $\sum_{i=1}^n (y_i - \bar{y})^2 = 200,000, R^2 = 0.30, n = 74$
- $\sum_{i=1}^n (y_i - \bar{y})^2 = 60,000, R^2 = 0.90, n = 40$

Q8 (11.29) Find and interpret the coefficient of determination for the regression of DVD system sales on price, using the following data:

Sales	420	380	350	400	440	380	450	420
Price	98	194	244	207	89	261	149	198

Q9 (11.35) Given the simple regression model $Y = \beta_0 + \beta_1 X$ and the regression results that follow, test the null hypothesis that the slope coefficient is 0 versus the alternative hypothesis of greater than zero using probability of Type I error equal to 0.05, and determine the two-sided 95% and 99% confidence intervals.

- A random sample of size $n = 38$ with $b_1 = 5, s_{b_1} = 2.1$
- A random sample of size $n = 46$ with $b_1 = 5.2, s_{b_1} = 2.1$
- A random sample of size $n = 38$ with $b_1 = 2.7, s_{b_1} = 1.87$
- A random sample of size $n = 29$ with $b_1 = 6.7, s_{b_1} = 1.8$

Q10 (11.37) Mumbai Electronics is planning to extend its marketing region from the western United States to include the Midwestern states. In order to predict its sales in this new region the company has asked you to develop a linear regression of DVD system sales on price, using the following data supplied by the marketing department:

Sales	418	384	343	407	432	386	444	427
Price	98	194	231	207	89	255	149	195

- Use an unbiased estimation procedure to find an estimate of the variance of the error terms in the population regression.
- Use an unbiased estimation procedure to find an estimate of the variance of the least squares estimator of the slope of the population regression line.
- Find a 90% confidence interval for the slope of the population regression line.

Q11 (11.38) A fast-food chain decided to carry out an experiment to assess the influence of advertising expenditure on sales. Different relative changes in advertising expenditure, compared to the previous year, were made in eight regions of the country, and resulting changes in sales levels were observed. The accompanying table shows the results.

Increase in advertising expenditure(%)	0	4	14	10	9	8	6	1
Increase in sales (%)	2.4	7.2	10.3	9.1	10.2	4.1	7.6	3.5

- Estimate by least squares the linear regression of increase in sales on increase in advertising expenditure.
- Find a 90% confidence interval for the slope of the population regression line.

Q12 (11.43) Given a simple regression analysis, suppose that we have obtained a fitted regression model $\hat{y}_i = 14 + 7x_i$ and also $s_e = 7.45$, $\bar{x} = 8$, $n = 25$, $\sum_{i=1}^n (x_i - \bar{x})^2 = 300$. Find the 95% confidence interval and 95% prediction interval for the point where $x = 11$.

Q13 (11.47) Doctors are interested in the relationship between the dosage of a medicine and the time required for a patient's recovery. The following table shows, for a sample of ten patients, dosage levels (in grams) and recovery times (in hours). These patients have similar characteristics except for medicine dosages.

Dosage level	1.2	1.3	1.0	1.4	1.5	1.8	1.2	1.3	1.4	1.3
Recovery time	25	28	40	38	10	9	27	30	16	18

- Estimate the linear regression of recovery time on dosage level.
- Find and interpret a 90% confidence interval for the slope of the population regression line.
- Would the sample regression derived in part (a) be useful in predicting recovery time for a patient given 2.5 grams of this drug? Explain your answer.

Q13 (11.48) For a sample of 20 monthly observations a financial analyst wants to regress the percentage rate of return (Y) of the common stock of a corporation on the percentage rate of return (X) of the Standard and Poor's 500 index. The following information is available:

$$\sum_{i=1}^{20} y_i = 22.6, \sum_{i=1}^{20} x_i = 25.4, \sum_{i=1}^{20} x_i^2 = 145.7, \sum_{i=1}^{20} x_i y_i = 150.5, \sum_{i=1}^{20} y_i^2 = 196.2$$

- Test the null hypothesis that the slope of the population regression line is 0 against the alternative that it is positive.
- Test against the two-sided alternative the null hypothesis that the slope of the population regression line is 1.

Q14 (11.88) Based on a sample 25 observations, the population regression model $y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$ was estimated. The least squares estimates obtained were as follows: $b_0 = 15.6$ and $b_1 = 1.3$. The total and error sums of squares were as follows: $SST = 268$ and $SSE = 204$.

- Find and interpret the coefficient of determination.
- Test against a two-sided alternative at the 5% significance level the null hypothesis that the slope of the population regression line is 0.
- Find a 95% confidence interval for β_1