Statistics 3540
Assignment #2: Jan. 30, 2008
Due Date: Feb. 8, 2008

All problem numbers are from the textbook *Forecasting, Time Series and Regression, 4th edition.*

If a problem is not specific on whether it should be done by hand or using a statistical software package (like Minitab), the choice is up to you.

1. Consider the following linear regression model with a quadratic term:

$$y_i = \beta_1 x_i^2 + \epsilon_i, \quad i = 1, \ldots, n$$

where $\epsilon_i \sim N(0, \sigma)$ are independent. Find the least–squares estimator of β_1.

Hint: Write down the sum of squares expression you need to minimize, take the derivative with respect to β_1, etc.

2. For the simple linear regression model $y_i = \beta_0 + \beta_1 x_i + e_i$, show that $\sum_i \hat{y}_i = \sum_i y_i$.

NOTE: Do not use the fact that $\sum_i e_i = 0$.

3. Refer to the data in Table 5.7, p. 264. Complete the following:

   (a) Fit the model
   $$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \epsilon$$
   and report the equation of the least squares line.

   (b) Interpret R^2 in this problem.

   (c) Plot either the residuals or standardized residuals vs. the $\hat{y}$ values, and interpret the plot.

   (d) Construct and interpret a QQ-plot of the residuals (or standardized residuals).

4. Data on the closing values of the Dow Jones Industrial Average (DJIA) for the years 1970–1994 is available on the course website

   `www.math.mun.ca/~sneddon/st3540`

   under the link **djia.mtw** (this is a Minitab file).

   (a) Plot the DJIA versus time. Describe the relationship, and suggest a model that would be reasonable for this relationship.

   (b) Fit the model
   $$y_t = \beta_0 + \beta_1 t + \epsilon_t$$
   and test if there is a positive relationship between time and the DJIA. Base your conclusion on the p-value of the appropriate test.

   (c) Find a 95% prediction interval for the value of the DJIA in 1996. **Do this by hand**, and using Minitab. You may use the fact that $SS_{xx} = 2030$.
   The actual closing value in 1996 was 6448.27. How does your interval compare to this observation?

   (d) Plot the residuals (or standardized residuals) versus time. Interpret this plot.

   (e) Test at $\alpha = 0.10$ if the errors are autocorrelated.