STAT 644

Homework Set 4

Due: Thursday, March 20

*NOTE: If asked to “fit a model” in these problems, be sure to write out the fitted model in your answer. Also, be sure to explain how you obtained your starting values. In problems 1 and 2(b) only, you are required to write out the expressions for the derivatives (even if you choose not to type these in your SAS code).

1. Exercise 9.1, pages 445-446 in the text. Use the Gauss-Newton procedure with fractional increments. Write out the expressions for the derivatives (even if you choose not to type these in your SAS code).

2. See Exercise 9.2, pages 446-447 in the text.
   (a). Use the Marquardt procedure to fit the nonlinear model given in part (a) in the textbook.
   (b). Use the Marquardt procedure to fit the logistic growth model $y_i = \frac{\alpha}{1 + \beta e^{-\gamma x_i}} + \epsilon_i$. Write out the expressions for the derivatives (even if you choose not to type these in your SAS code).
   (c). Compare the two models in parts (a) and (b) in terms of mean square error, average width of the confidence intervals on the mean response, and diagnostics such as studentized residuals, HAT diagonals, and DFFITS.

3. Consider the fabric failure data found in Table 7.4 on page 329 in the text. Using iteratively reweighted nonlinear least squares (Marquardt procedure, without fractional increments), fit the logistic model $P(x_i) = \frac{1}{1 + e^{-\beta_1 + \beta_2 \ln(x_i)}}$. Notice the use of $\ln(x)$ instead of just $x$. Also, note that your response data (“y” = $P(x_i)$) in this model is the proportion of specimens that failed. Input the data as it is given in Table 7.4 (three variables), but create a “y” variable (call it PROP for ‘proportion’) to use as the response variable in your model. I.e., create $PROP = (#\text{ failures } R)/(#\text{ specimen } N)$ for each of the five ‘observations’ (rows in the table). Compare the results to the results on pages 329 (Table 7.6) and 330 (results for Log Load) in the text, in which maximum likelihood estimation was used to fit the model. Include in your comparisons the parameter estimates, standard errors, and predicted (fitted) values.