Statistics 601, Fall 2006
Lab 5 Notes

In this lab we will write an Splus or R function to compute generalized least squares estimates using what is often called the Gauss-Newton Algorithm. I suppose that, technically, what we will have is a modified Gauss-Newton algorithm, G-N usually referring to this procedure used with a constant variance nonlinear regression model in which the weights \( w_i(\beta^{(j)}) = y_i^2(x_i^T, \beta^{(j)}, \theta) \) are not updated at each iteration. Regardless, we want to write a function that will compute values following the algorithm for generalized least squares given in the course notes in Section 8.2.2. We will write this algorithm directly but, if you’re into computing, you might decide to add QR decomposition to make a more numerically stable algorithm for your own use.

You will be given two functions, one that computes generalized least squares estimates, and the other that uses the first function and adds a number of quantities useful in nonlinear regression (standard errors, residuals, etc.). We will illustrate the use of these functions with the enzyme reaction data of Example 7.1 taken from the nonlinear regression text of Bates and Watts.
Statistics 601, Fall 2005
Lab 4 Assignment

Both of the data sets needed for this lab assignment are available on the course web page. Using the function we write in lab (cleaned up and modified to your own tastes), or your own function you might write from scratch,

1. Fit a nonlinear regression with constant variance to the enzyme reaction data of Example 7.1, using the Michaelis-Menton equation as the expectation function. Produce plots for the control (0 in the first column) data and the treatment (1 in the first column) with fitted curves. Give 90% approximate interval estimates for the expectation function parameters. Then compute 95% point-wise confidence bands for the fitted functions.

2. Fit a linear regression with nonconstant variance to the air travel times of Example 7.3, using one of the possible values for the variance function parameter $\theta$ we discussed in lecture. Produce plots and interval estimates of the expectation function parameters. Compare to what you would get from an ordinary least squares fit (linear constant variance model). Present and examine residual plots and decide whether the model you fitted should be preferred to a constant variance model.