Spring 16 – AMS256 Homework 5

1. (Taken from Ronald Christensen, Exercise 4.3.1) An experiment was conducted to see which of four brands of blue jeans were most resistant to wearing out while students knelt before their linear models instructor begging for additional test points. In a class of 32 students, 8 students were randomly assigned to each brand of jeans Before being informed of their test scores, each student was required to fall into his/her knees and crawl 3 meters to the instructor's desk. This was done after each of 5 mid quarter and 3 final examples. (The jeans were distributed along with each of the 8 test forms and were collected again 36 hours after grades were posted.) A fabric wear score was determined for each pair of jeans. The scores are in a .txt file.

   (a) Give an ANOVA table for these data, and perform and interpret the F test for the differences between brands.

   (b) Brands 2 and 3 were relatively inexpensive, while Brands 1 and 4 were very costly. Based on these facts, determine an appropriate set of orthogonal contrasts to consider in this problem. Find the sums of squares for the contrasts.

   (c) What conclusions can be drawn from these data? Perform any additional computations that may be necessary.

   (d) Compare all pairs of means. Use the following methods:

      i. the LSE method, $\alpha = 0.01$
      ii. the Bonferroni method, $\alpha = 0.0012$.
      iii. Tukey's HSD method, $\alpha = 0.01$

2. (Taken from Mendenhall & Sinich) In the oil industry, water that mixes with crude oil during production and transportation must be removed. Chemists have found that oil can be extracted from the water/oil mix electrically. An experiment was conducted to study the factors that influence the voltage (y) required to separate the water from oil. The seven independent variables investigated were: disperse phase volume in kg/cm (x_1), percentage of salinity (x_2), temperature in centigrades (x_3), time delay in hours (x_4), percentage in surfactant concentration, span:triton (x_6) and percentage of solid particles (x_7). Sixteen water/oil mixtures were prepared using different combinations of the independent variables; then each emulsion was exposed to a high electric field. In addition, three mixtures were tested when all independent variables were set to 0. The data for all 19 experiments are available on line.

   (a) Fit the model with all seven independent variables and interpret the estimates.

   (b) Fit the following model:

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_5 + \beta_4 x_1 x_2 + \beta_5 x_1 x_5.$$

   Discuss how the interaction terms affect the hypothetical relationship between y and x_1. Produce a graph that supports your answer. Does this model seem to fit the data better than the full model with no interactions? Interpret the β estimates of the interaction model.