Stat 581 Problem Set # 6

1. A soft drink bottler is interested in studying the effects on a filling process. A factorial experiment is run using three factors: percent carbonation (in %), operating pressure (in psi), and line speed (in bpm). The response variable is deviation from the target fill height. The experiment consists of $n = 2$ runs for each of the $abc = 12$ treatment combinations. The data is available on Blackboard as an Excel File.

(a) Perform tests for all main effects and for all interaction effects. State the F-statistic and p-value for each of the main effect tests, and for the test of an interaction between carbonation and pressure.

(b) Explain how an interaction plot is used in studying an interaction effect.

(c) Determine fitted values for the main effects model, as well as fitted values for the model including the carbonation / pressure interaction. Plot the fitted values for each model using an interaction plot. Comment on the decision of whether or not to include the interaction term.

(d) Create box plots showing the main effects. Provide an overall conclusion, stated in the context of the problem.

2. An engineer is interested in the effects of cutting speed, tool geometry, and cutting angle on the life (in hours) of a machine tool. Two levels of each factor are set, and $n = 3$ runs of a 2^3 design are completed. The data is available on Blackboard as an Excel File.

(a) Perform tests for all main effects and for all interaction effects. State the F-statistic and p-value for each test of an effect deemed to be important.

(b) Fit a reduced model with the main effects, and the statistically significant interaction effect.

(i) Create a plot for the interaction effect. Provide an interpretation, stated in the context of the problem.

(ii) Create a box plot showing the main effect for the remaining factor. Provide an interpretation, stated in the context of the problem.

(iii) Create a plot of the fitted values for the reduced model. Which setting of the factors should be used if the goal is to maximize tool life. Explain how this result follows from the interaction plot and the main effects plot.