Stat 581 Problem Set # 7

1. A paired comparisons design is used to study the effect of machine operator on the measured running time (in secs.) of a fuse. A sample of $n = 10$ fuses is selected, and both operators provide a measurement of the running time on each of the selected fuses. The data is available on Blackboard as an Excel File.

(a) Test for a systematic difference in the measurements of the two operators. Compute the t_o statistic, and the p-value. Provide an interpretation, stated in the context of the problem.

(b) Compute the sample mean $\overline{D}$ and sample standard deviation s_D for the paired differences. Compute a 95% confidence interval estimate for the mean difference between operator measurements.

(c) Run the analysis as a randomized complete block design. Compute the F_o statistic and the p-value. Explain how the statistical results are equivalent.

(d) Create an interaction plot to display the operator effect on measured running time.

2. A randomized complete block design is used to study the effect of machine tip on the measured hardness (in Rockwell C-scale units) of a metal specimen. A sample of $b = 4$ metal specimens is randomly selected, and each of $a = 4$ machine tips produces a measurement on each of the selected metal specimens. The data is available on Blackboard as an Excel File.

(a) Write the model and distributional assumptions for a randomized complete block design.

(b) Provide the algebraic formulas for $MStr, MSbl$, and MSE. State the expected value for each of the mean squares.

(c) Explain why it makes sense for an interaction effect to serve as a measure of error variance.

(d) Test for systematic differences in the measurements provided by the machine tips. Compute the F_o statistic, and the p-value. Provide an interpretation, stated in the context of the problem.

(e) Perform pairwise comparisons using the Fisher LSD method to investigate differences between the machine tips. Provide the grouping information. Create box plots to display the tip effect on hardness measurement.

(f) Compute estimates of the variance components. Explain when a block design is better than a completely randomized design.

(g) Compute estimates of the fixed effect parameters.

(i) Explain why block effects are modeled differently than treatment effects in this design.

(ii) Explain what treatment effect is estimatable in this design.