STAT 514 Homework#5 (Due Thursday 10/1/15 BEFORE CLASS)

1. A sociologist is interested in studying the IQs of teachers from low income areas of a major city. Six schools were randomly chosen from low income areas and from each of these schools, five teachers were randomly chosen. The following table summarizes the mean IQ for each of these schools (NOTE: These numbers are all made up and are not intended to reflect teachers' true IQ scores).

School	1	2	3	4	5	6
Mean	97	99	94	109	98	103

- (a) If $MS_E=40$, is there significant variability in average IQ among schools in low income areas (use $\alpha = .01$)?
- (b) Estimate all variance components, and construct the 95% confidence interval of each variance component.
- (c) How much power does this study have if the true variances were such that $2\sigma_{\tau}^2 = \sigma^2$ and *n* were increased to 10?
- (d) Suppose the national average IQ for teachers is 105. Test the null hypothesis that the average IQ of these teachers is not **lower** than the national average ($\alpha = .05$).
- 2. You want to compare 3 treatments using a one-way fixed effects model. In designing your experiment you decide you want at least 80% power (at the 5% significance level) if the treatment means were as different as 100 Δ, 100, and 100 + Δ. Suppose that Δ = 5 and σ² = 10. How large must n be?
- 3. Suppose that the experiment in Problem 2 will use n = 4 observations from each group. Staying with 5% significance and an 80% chance of rejecting the null, how small a difference can this experiment detect?
- 4. A clay tile company is interested in studying the effect of cooling temperature on strength. The company has five ovens which produce the tiles, four tiles were baked in each oven and then randomly assigned to one of the four cooling temperatures. The data are shown below.

Cooling			Oven			
Temp	1	2	3	4	5	Mean
5	3	10	7	4	3	5.40
10	3	8	12	2	4	5.80
15	9	13	15	3	10	10
20	7	12	9	8	13	9.80
Mean	5.50	10.75	10.75	4.25	7.50	7.75

- (a) Which type of design was employed? Describe how the fundamental principles of experimental design were followed in this design.
- (b) If $MS_E = 6.275$, compute the *F*-statistic to determine if there is a difference among the four cooling temperatures (use $\alpha = 5\%$).
- (c) If there is a difference among the four temperatures, perform pairwise comparisons using Tukey's procedure, please calculate by hands first, then use SAS to verify your calculations.
- (d) Suppose the company believes there is a jump in the strength at 12.5° but otherwise cooling temperature has no effect, that is, 5° and 10° are not different, neither are 15° and 20°, but these two groups of temperatures have different effects. Find a set of orthogonal contrasts that would allow you to test this.
- (e) Test these contrasts using SAS (or by hand). State your conclusions.