Stat 526 Homework #5 Due: Friday, February 24, 2017.

1. A land rehabilitation experiment was designed to compare the mean grass coverage for 6 fertilizer combinations of (A, B, C, D, E and F) applied to a strip mined site. The reclamation site was divided into six strip plots with 20 feet left untreated between each plot. Each strip plot was divided into 6 subplots with 4 untreated feet between each subplot. Within each strip plot the 6 fertilizers were assigned to the 6 subplots. The diagram shows the experimental layout with the fertilizer and percent coverage listed in each subplot. Plots 1 to 6 are oriented from north to south. SAS code to read in the data set will be sent to you.

Row 1	A 61	C 59	E 49	F 53	B 50	D 59
Row 2	D 64	E 51	B 55	A 59	C 58	F 50
Row 3	F 55	A 63	C 59	B 55	D 62	E 47
Row 4	C 62	B 60	D 67	E 50	F 51	A 57
Row 5	E 53	D 69	F 59	C 60	A 61	B 51
Row 6	B 62	F 59	A 66	D 68	E 50	C 56

(a) (2pt) You are told to analyze the experimental results assuming a randomized complete block design (RCBD) was run. Prepare an ANOVA table to test the hypotheses regarding fertilizers. Using an $\alpha = .05$ level, what do you conclude?

(b) (2pt) Perform Tukey's test on the fertilizer means. What do you conclude?

(c) (1pt) Make a normal probability plot of the residuals and a plot of residuals vs predicted values. Comment on the results.

(d) (5pt) Unfortunately, the experiment was set up by another researcher who used a a latin square design with plot column as the second blocking variable. Reanalyze the data as a latin square design by answering questions (a), (b), and (c) again.

(e) (1pt) Identify any significant changes that occurred between analyses.

(f) (2pt) Calculate the row block and column block means. In terms of a physical context, interpret any patterns (if they exist) across the row and column means.

2. (4pt) For the following four cases, what are the model matrix X the parameter vector θ for the RCBD in Problem 4.8 on page 177.

- I: Where X has $a+b+1$ columns and assuming constraints $\sum \tau_i = 0$ and $\sum \beta_j = 0$
- II: Where X has $a+b-1$ columns and assuming constraints $\sum \tau_i = 0$ and $\sum \beta_j = 0$
- III: Where X has $a+b+1$ columns and assuming constraints $\tau_1 = 0$ and $\beta_1 = 0$
- IV: Where X has $a+b-1$ columns and assuming constraints $\tau_1 = 0$ and $\beta_1 = 0$

3. Answer the following for the design and data in Problem 4.8, page 177.

   (a) (2pt) Set up the normal equations for μ, each τ_i, and each β_j. No constraints are assumed at this stage.

   (b) (2pt) Solve these equations assuming $\tau_1 = 0$ and $\beta_1 = 0$.

   (c) (1.5pt) **For Stat 541 students**: Can the normal equations be solved assuming $\beta_4 = 0$ and $\sum \tau_i = 0$? If so, what are the parameter estimates? If no, why not?

   (d) (1.5pt) **For Stat 541 students**: Can the normal equations be solved assuming $\mu = 0$ and $\tau_1 = 0$? If so, what are the parameter estimates? If no, why not?

4. (2pt) For the design and data in Problem 4.8, page 177 set up the normal equations for μ, each τ_i, and each β_j assuming $y_{11} = 250$ and $y_{22} = 525$ are missing. You do not have to solve the system of equations. No constraints are assumed at this stage.