Assignment #10

Linear Mixed Models

READING - Faraway Chapters 10, 11 and 13

0. (5 pts) Name

- 1. (8 pts) A school superintendent is concerned about the development of technology skills for research in high school. Since there are four high schools in his district, all of which go about this instruction differently, he decided to assess if there were any differences across schools. He first compiled a long list of "tech skills" and randomly selected four to be used in his study. He then randomly selected 24 students from each school and assigned each to one of the four tasks so that there were six students per task per school. Each student then performed the skill and was scored using a 0-100 numeric scale.
 - a) If a two-way ANOVA is to be used for the analysis, should it be treated as a fixed effects, random effects, or mixed effects model? State the model you would use and its assumptions.
 - b) Complete the following ANOVA table and determine which effects are significant at the $\alpha = .05$ level. State your conclusions, making sure to estimate all variances and describing any additional mean comparisons you'd like to perform.

Source	DF	\mathbf{SS}	MS	\mathbf{F}
School		222.0		
Skill		96.0		
$\mathrm{School}\times\mathrm{Skill}$		135.0		
Error		450.0		

- c) If the grand skill level of the high schools (average over the four schools) is of interest, describe how one would construct a 95% confidence interval.
- 2. (15 pts) Nurse practitioners (NPs) are becoming the health partner choice for many Americans. A group of researchers study the performance of NPs in three specialties (neonatal care, women's health and oncology). They randomly selected four cities, and recorded competency scores of four nurses randomly selected within each specialty and city. The scores are on a continuous scale and shown below:

	City 1		City 2		City 3		City 4		Mean
Neonatal	71.5	58.9	68.5	64.8	59.1	67.1	77.2	75.2	
	72.9	67.9	71.2	74.2	62.2	62.5	84.7	67.3	69.075
Women's	83.8	76.9	70.5	65.6	71.0	75.7	72.4	81.6	
	73.2	79.3	74.0	78.2	63.5	65.0	79.6	81.2	74.469
Oncology	77.0	82.7	80.4	79.6	62.3	81.6	91.5	89.4	
	90.4	85.3	66.5	79.8	64.3	88.6	84.5	94.3	81.138
	76.650		72.775		68.575		81.575		74.894

a) State the linear mixed model that is appropriate for these data, as well as all the model assumptions. Also make sure to specify why each factor in your model is either random or fixed.

- b) Provide the estimates of the fixed effects in your model. Make sure to specify the parametrization restriction you are using.
- c) Using the partial R output below, perform the appropriate F tests for the main effects and interaction. For each test, make sure to specify the null and alternative hypotheses.

- d) Estimate the error variance and any other variances found significantly different from zero in the previous part.
- e) Using the table summary and previous calculations, test whether there is a difference between the average competency score for Neonatal care and for Women's health. Use the 0.05 significance level. There is no need for an multiple comparison adjustment.
- f) Compute a 95% confidence interval for the average competency among the RN's.
- g) Use your variance estimates from part d) to estimate 1) the correlation between two observations from the same city and specification, 2) the correlation between two observations from the same city but different specifications, and 3) the correlation between two observations from the same specification but different cities.
- 3. (12 pts) Faraway Chapter 11 Exercise 1
- 4. (10 pts) Faraway Chapter 13 Exercise 1