STA 101 Spring 2018
Homework 7 - Due Wednesday, June 6^{th}

1. A study was interested in the effect that a person "making strong eye contact", and the gender of a person had on the ratings that an interviewer gave. The data is online as `contact.csv`, with the following columns:

   Column 1: `Rating`: The rating the subject was given, on a scale of 0 (failure) to 20 (success).

   Column 2: `Eye`: Whether strong eye contact was made (`present`) or not (`absent`). Consider this to be factor A.

   Column 3: `Gen`: The gender of the subject (`Male` or `Female`). Consider this to be factor B.

   Data source: Applied Linear Models, Fifth Edition, Kutner, Nachtsheim, Neter, Li.

   (a) Create an interaction plot. Does it suggest significant interactions are present?

   (b) Test for interaction effects, using $\alpha = 0.10$. State the null, alternative, test-statistic, p-value, and your conclusion in terms of the problem.

   (c) Consider the no-interaction model your "larger" model (regardless of your results from (b)), and test for factor A effects using $\alpha = 0.10$. State the null, alternative, test-statistic, p-value, and your conclusion in terms of the problem.

   (d) Consider the no-interaction model your "larger" model (regardless of your results from (b)), and test for factor B effects using $\alpha = 0.10$. State the null, alternative, test-statistic, p-value, and your conclusion in terms of the problem.

2. Continue with problem 1. Choose the most appropriate model from your findings.

   (a) What is the combination of factors that appears to have the highest rating?

   (b) Find the estimates of α_i.

   (c) Find the estimates of β_j.

   (d) Find the estimates of $(\alpha\beta)_{ij}$.

3. Continue with problem 1.

   (a) Find the 90% pairwise confidence intervals comparing all means for factor A.

   (b) Is there a significant factor effect for A based on (a)? Explain.

   (c) Find the 90% pairwise confidence intervals comparing all means for factor B.

   (d) Is there a significant factor effect for B based on (c)? Explain.

   (e) Find the 99% confidence interval comparing the average rating for females who made eye contact to males who made eye contact.

   (f) Interpret your confidence interval from (e) in terms of the problem.

4. A nutritionist was interested in testing if there is a significant difference in the sodium levels of 6 popular beers. The data is stored in `salt.csv` and has the following columns:

   Column 1: `Sodium`: The grams of sodium in the beer.

   Column 2: `Brand`: The brand of the beer, with levels `A` through `F`

   Data source: Applied Linear Models, Fifth Edition, Kutner, Nachtsheim, Neter, Li.

   (a) What about the description of the problem may suggest that a random effects model for One-Way ANOVA is appropriate?

   (b) Fit the random effects ANOVA model, and report back your estimates of σ_A and σ_ϵ.

   (c) Calculate the proportion of variance in sodium explained by the beer brand, and interpret it in terms of the problem.

   (d) State the null, alternative, test-statistic, and p-value for testing if a random effect is necessary.

   (e) State your conclusion to (d) in terms of the problem.

5. Consider an instructor that randomly selected three of their students to take vitamins, and also measure their sodium intake per week.The data is stored in `sodium.csv` and has the following columns:

   Column 1: `Sod`: The amount of sodium in a week (in grams).

   Column 2: `Sub`: The randomly selected student, with levels I, II, or III. Consider this to be factor A.

   Column 3: `Sup`: The supplement taken, with levels A, B, C. Consider this to be factor B.

   For all the following problems, use $\alpha = 0.05$.

   (a) Explain why both student and supplement may be considered a random effect.

   (b) Fit a model with a random effect for student, and a fixed effect for supplement. Report back the estimates of σ_A^2, σ_ϵ^2, and the estimated variance for Y.

   (c) Fit a model with a random effect for supplement, and a fixed effect for student. Report back the estimates of σ_B^2, σ_ϵ^2, and the estimated variance for Y.

   (d) Fit a model with a random effect for student and supplement, but no interactions. Report back the estimates of σ_A^2, σ_B^2, σ_ϵ^2, and the estimated variance for Y.

   (e) Test to see if the model in (b) is statistically better than the model in (d). State the null, alternative, test-statistic, p-value, and conclusion.

   (f) Test to see if the model in (c) is statistically better than the model in (d). State the null, alternative, test-statistic, p-value, and conclusion.