Review for Final

You are not required to write any SAS code for this exam, however, you will be answering questions based on the SAS output (with certain key values removed). The missing values can be calculated from the values provided. Think about the questions that were asked to interpret the results on the homework problem sets.

Topic 7: Two-way ANOVA

- 1. Write the cell means model and factor effects model for a particular situation.
- 2. Be able to interpret an interaction plot to determine information about the main effects and interaction terms.
- 3. Be able to fill in the ANOVA table, using your knowledge of the degrees of freedom, the fact the total sum of squares equals the sum of all of the individual sum of squares, the equations for the mean squares and the F test statistic.
- 4. Be able to write down the assumptions used and given the appropriate plots determine if the assumptions are valid or not.
- 5. Be able to state the procedure for performing a two-way ANOVA calculation. This includes the following (this is not an exclusive list):
 - a. diagnostics
 - b. remedial actions
 - c. hypothesis tests and the order in which to perform them interaction terms first
 - d. how to complete the analysis with and without interaction terms multiple comparison tests if no interaction terms
- 6. Be able to estimate the parameters in the cell means model and the parameters in the factor effects model using both the zero-sum constraint system (conceptual) and the constraint system used in SAS given either the means (factors and each cell) or estimators from one of the factor effects models.
- 7. Be able to interpret the results of the calculation in terms of the context of the example for two-way and three-way ANOVA. (This objective could be asked for each section whether it is explicitly included or not.)
- 8. Given the appropriate data, be able to calculate the confidence intervals for individual cells and for each type of contrast.
- 9. State the problems that occur when there is only one observation per cell and how they are overcome.
- 10. State the model for the Tukey test for additivity and be able to perform the hypothesis test (state the hypothesis, test statistics, degrees of freedom, p-value and conclusion in the context of the problem).

Topic 8: Two-way ANOVA, Three-way ANOVA

- 11. State the differences between two-way ANOVA with a balanced design and an unbalanced design.
- 12. State how each of the different sum of squares in SAS (Type I, Type II, Type III, Type IV) is defined and in which situations each is used.
- 13. Explain the differences between two-way ANOVA and three-way ANOVA for the following things:
 - a. creation and interpretation of the scatterplot
 - b. procedure of analysis
 - c. analysis if there are interaction terms
 - d. hypothesis tests
- 14. Be able to perform Objectives 1 7 for three-way ANOVA.

Topic 9: Random vs. Fixed Effects

- 15. Describe the differences in the models when using fixed effects versus random effects.
 - a. Be able to state the parameters when using random effects and mixed effects.
 - b. Be able to calculate and interpret the intraclass correlation coefficient in terms of the problem.
- 16. Describe the differences in the interpretation when using fixed effects versus random effects.
- 17. Be able to analyze calculations via hypothesis tests and confidence intervals using one-way ANOVA with random effects, two-way ANOVA with random effects and two-way ANOVA with mixed effects.
 - a. In the mixed effects model, be able to interpret both the fixed part and the random part.
- 18. Be able to state the difficulties in using random effects with higher order (three-way or higher) ANOVA.

Topic 10: ANCOVA

- 19. Be able to state what a covariate is and why covariates are sometimes necessary in ANOVA calculations.
- 20. State the model that is used in ANCOVA.
- 21. Be able to state the assumptions to determine whether a variable is an appropriate covariate or not.
- 22. State the assumptions used in ANCOVA (for the covariate and ANOVA) and be able to interpret the appropriate plots and/or hypothesis tests to determine if they are valid or not.
- 23. Be able to state how the procedures and analysis are different when using ANCOVA versus using ANOVA.
 - a. The changes that occur because of the introduction of the covariate
 - b. LSMEANS vs MEANS in proc glm.
- 24. Be able to state and interpret the results from ANCOVA.