STA 6207 – Fall 2001 – Exam 2

Print Name: SSN:

Instructions: This is a take–home exam. Do not consult with anyone concerning the work you are asked to do. **Due Time: Wednesday, November 14, 8:30AM**. A penalty of 10% will be assessed for late exams. **Show all hand calculations for problems 1 and 2, and show work (tables) for problem 3**. It is highly recommended you run SAS on problems 1 and 2 to check your answers.

1) A university is interested in three programs to prepare students for the GMAT exam (entrance exam for graduate students in business). They are considering three preparation programs (3–hour review, 1–day program, and 10–week course). Further, they are interested in undergraduate students from three colleges within the university (Business, Engineering, and Arts&Sciences). These are the only preparation programs and colleges of interest. They randomly sample six students from each college who plan to apply to graduate school in business, and randomly assign two to each preparation program. The response measured is the score on the GMAT exam after the preparation program is completed (with a maximum score of 800). They expect that the effects of the preparation programs may vary among students from the various colleges. **Use 2 decimal places in all calculations**.

a) Give the statistical model, labelling all terms.

b) Based on your sample, obtain the Analysis of Variance, obtain estimates for all model parameters, and perform all relevant tests (at $\alpha = 0.05$ significance level).

c) Give simultaneous 95% confidence intervals, comparing the simple effects of all preparation programs among engineering students.

d) On graph paper, give a plot, summarizing the sample means, using preparation program as the variable on the horizontal axis, and mean GMAT score on the vertical axis, with separate "lines" for each college.

2) An oceanographer is interested in variation in surface temperature of a square lake over the course of a summer month. She randomly selects three 100 yard North–South ranges, two 100 yard East–West ranges (placing markers at their intersections), and two days. She obtains two readings at each location/day combination. She does not know what to expect, so she will include all two– and three–factor interactions in the model. **Use 3 decimal places in all calculations**.

a) Give the statistical model, labelling all terms.

b) Based on your sample, obtain the Analysis of Variance, obtain estimates for all model parameters, and perform all relevant tests (at $\alpha = 0.05$ significance level).

c) What is your estimate of the total variation in water temperatures across the lake and across the month?

d) Assuming normality, sketch the estimated distribution of temperatures across the lake and across the month.

3) A fabric producer purchases **yarn** from various **yarn producers**. They use various **weaving methods** to produce the fabric by making use of a pair of **loom types**. Further, they employ various **operators**, who are each trained to operate one type of loom, exclusively. The following table gives relevant information on each factor.

Factor Name	Levels	Type	Level Labels
Yarn Type	2	Fixed	Filament, Spun
Yarn Producer	R_1	Random	
Weaving Method	3	Fixed	Plain, Twill, Satin
Loom Type	2	Fixed	Cam, Dobby
Operator(Cam)	R_2	Random	
Operator(Dobby)	R_3	Random	

Three samples (replicates) of fabric are obtained at each combination of factor levels.

a) Give the statistical model (containing all interactions), labelling all terms.

b) Based on the methods of Section 7.5, write out the "table of coefficients", and give the ANOVA table, labelling sources of variation, degrees of freedom and expected mean squares.

4) Give a non–textbook example of a 2–factor mixed effects model, describing **briefly** an example where the analysis could be used. Describe factors, their types, levels, replicates, and give the ANOVA table, containing sources of variation, degrees of freedom, and expected mean squares. Feel free to include any type of setting (e.g. terrorism, sports, popular culture, your academic area, etc). Just please keep it brief and concise.