STA 6207 – Fall 2002 – Exam 1

Print Name: _____ **SSN:** _____

All questions are based on the Completely Randomized Design with normally and independently distributed errors with zero mean and constant variance

1) A study was conducted to compare the effects of five brands of nicotine patches in delivering nicotine to the bloodstream. A sample of 50 healthy volunteers are obtained and each is randomly assigned to one of the brands, in a manner such that each brand has an equal number of replicates. The sample means and standard deviations are given in the following table, where the responses are areas under the concentration-vs-time curve (AUC).

Brand	$\overline{y}_i$	s_i
1	420	25
2	480	30
3	360	30
4	540	35
5	450	20

a) Write out the cell means model, based on the usual assumptions. Define all terms.

b) Give least squares estimates of all parameters in this model, as well as an unbiased estimate of the error variance.

c) Give the Analysis of Variance Table.

d) Test whether the true mean AUC values differ at the $\alpha = 0.05$ significance level. Clearly state all aspects of the test, and sketch the P-value, clearly defining all parts of sketch.

e) Give the critical differences and decision rules for comparing all pairs of means based on Bonferroni's and Tukey's methods with experimentwise error rates of $\alpha = 0.05$.

f) Use Hartley's F_{max} test to test for equality of variances. Clearly state all elements of the test.

2) A clothing manufacturer is interested in comparing breaking strengths of three types of fabric. Fabrics A and B are made of natural fibers, while fabric C is made of a synthetic fiber. The sample means and MSE are given below, based on 15 replicates per fabric type.

$$\overline{y}_A = 65.0 \quad \overline{y}_B = 60.0 \quad \overline{y}_C = 85.0 \quad MSE = 900$$

a) Give orthogonal contrasts that compare (i) the average of the natural fibers with the synthetic fiber and (ii) the two natural fibers.

b) Give the sums of squares for these two contrasts and show that they sum to the treatment sum of squares.

c) Give simultaneous 95% confidence intervals for the two contrasts in a) based on Bonferroni's method.

3) A marketer is interested in comparing 4 types of advertisements (humor, celebrity endorsement, comparison, and testimonial). She measures product liking scores among potential consumers after exposure to the advertisements. She has done a pilot study to determine the (common) standard deviation among scores within each type of advertisement, and it is $s = 15.0$. If she wishes to be able to detect a effects $\{\tau_i = \mu_i - \mu\}$ of magnitudes (-10,0,0,10), give a procedure to obtain replicate sizes that have a power of 0.90 to detect her desired effects based on a test with $\alpha = 0.05$. State specifically what each relevant value would be at each iteration.

4) Four treatments are to be compared. Treatments 1 and 2 are very similar and treatments 3 and 4 are very similar. Use the general linear test approach (assuming equal replicate sizes) to set up a test to determine whether the means of treatments 1 and 2 are equal and the means of treatments 3 and 4 are equal with $\alpha = 0.05$. Give all elements of the test, being as specific as possible on all elements and notation.

5) A study is conducted among 3 treatments with 3 replicates per treatment. Derive the expected value of expected mean square for treatments based on the completely randomized design.