MA 2612 Test 4 B '03

NAME: _____

1. Moisture in stored lumber is a concern for lumber manufacturers. One manufacturer wanted to conduct a study of the effect of five different storage conditions on lumber moisture content. At a management meeting to discuss the experiment, Wilbur (who had slept through his college statistics classes) suggested that they randomly choose 5 boards from production to assign to each storage condition. Orville (who had excelled in his college statistics courses), suggested that since there was a great deal of variation from tree to tree, that the experiment be conducted by taking a random sample of five logs of the same grade, and then randomly choosing five boards of the same type cut from each log. He suggested that each of the five boards from the same log be assigned to a different condition, the assignment to be done at random. His suggestion was adopted.[1]

   (a) **(10 points)** Explain why Orville's design is an RCBD. Be sure to state what the blocks, treatments and experimental units are.

   (b) **(10 points)** Why is this a better design than Wilbur's?

[1] The company's chairman was so impressed with Orville's statistical expertise, that he made him company president, and later his successor as chairman, thus proving the benefits of not sleeping in statistics classes.

2. **(20 points)** Write out an additive model for Orville's experiment. Explain what each parameter means.

3. **(10 points)** The following is the ANOVA table for the model fitted to Orville's experimental data:

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Stat	Prob > F
Board	4	7.396	1.849	42.26	< 0.0001
Condition	4	2.404	0.601	13.74	< 0.0001
Error	16	0.700	0.044		
C Total	24	10.500			

In terms of mean moisture percentage, are there significant differences among storage conditions? Justify your answer.

4. **(20 points)** The following is SAS output for the Tukey multiple comparisons of the storage conditions. What does it tell you? Be specific.

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        Tukey's Studentized Range (HSD) Test for moisture

 Comparisons significant at the 0.05 level are indicated by ***.
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condition Comparison	Difference Between Means	Simultaneous Level .95 Confidence Limits		
4 - 2	0.6200	0.2147	1.0253	***
4 - 5	0.6200	0.2147	1.0253	***
4 - 3	0.7400	0.3347	1.1453	***
4 - 1	0.9200	0.5147	1.3253	***
2 - 5	0.0000	-0.4053	0.4053	
2 - 3	0.1200	-0.2853	0.5253	
2 - 1	0.3000	-0.1053	0.7053	
5 - 3	0.1200	-0.2853	0.5253	
5 - 1	0.3000	-0.1053	0.7053	
3 - 1	0.1800	-0.2253	0.5853	

5. Suppose Wilbur's design had been carried out: That is, the design was a CRD.

   (a) **(20 points)** Reanalyze the data in problem 2 as if it had been obtained from a CRD, by constructing the ANOVA table that results from ignoring the blocking. Here is one number for your table: the p-value of the F test is 0.2443.

   (b) **(10 points)** Do the results in (a) demonstrate that the blocking has been useful for these data? Explain.