Final Exam

1. In Lake Marion, one-year old fish were collected at each of three separate sites in each month for April through August; fish were collected from Lake Moultrie at each of two sites in the same months as well; the Day of Year (DOY) was recorded rather than Month. The fish’s species was recorded (Striped Bass, White Perch, American Shad) and they were measured for length. It is possible that the sample in worksheet Q1 includes recaptured fish, though captured fish were not marked or tagged in any way, so this information is unavailable in the attached worksheet.

(a) Plot length vs DOY by species separately for each site. Comment. Use these graphs to inform your model choices below.

(b) Since fish at a given site may not be independent, develop a reasonable model that could account for correlation among fish within the same site (how would you test this?). Discuss model output.

(c) Now assume Site(Lake) is fixed. Compute LSMEANs for Site(Lake), Species and Lake; explain how the LSMEANs for Lake could be computed from the LSMEANs for Site(Lake).

2. Consider the crossover design below.

<table>
<thead>
<tr>
<th>Period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A=11.4</td>
<td>C=5.7</td>
<td>C=6.8</td>
<td>B=9.9</td>
<td>B=12.2</td>
<td>A=7.3</td>
</tr>
<tr>
<td>2</td>
<td>B=13.1</td>
<td>B=10.3</td>
<td>A=5.4</td>
<td>A=6.7</td>
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<td>A=7.3</td>
<td>B=8.8</td>
<td>C=7.0</td>
<td>A=8.4</td>
<td>B=9.7</td>
</tr>
</tbody>
</table>

(a) Is it balanced for residual treatment effects? Is it balanced for treatment sequence?

(b) Test the model for treatment and residual treatment effects; discuss your findings.

(c) Yandell suggested that a test for treatment sequence was not possible without replication. Make a simplifying assumption so that treatment and treatment sequence can both be tested. Compare your analysis for residual treatment effects in (b) to your analysis of treatment sequence.

3. A tire company is testing four steel-belt designs for one of their tire brands. From five popular car models, it randomly chooses three cars of each model. Each steel-belt design is randomly assigned one position on each car (Left Front, Right Front, Left Rear, Right Rear); the cars are driven 10,000 miles and a measure of tread wear is recorded.

(a) Explain why this can be viewed as a split plot design. Identify whole plot, whole plot factor, split plot, and split plot factor. Write a model for this design, identifying model terms and model assumptions.

(b) Using the data in worksheet Q3, test the whole plot factor, split plot factor, and whole plot factor by split plot factor interaction, using appropriate error terms for each.

(c) Suppose Design A is actually a control, and you wanted to test the mean wear for the control against the mean wear for the other designs ($\alpha=.05$). Write a contrast $L$ that would test this hypothesis.
(d) The noncentrality parameter for a test of $L$ would be

$$\delta^2 = \frac{anL^2}{\sigma^2 \sum c_i^2},$$

if $a$ is the number of whole plot factor levels and $n$ is the number of whole plots nested in each whole plot factor level. For $L=.3$, construct a power curve as a function of $n$; use an appropriate estimate of $\sigma^2$ from your analysis. How many whole plots do we need for each whole plot factor level to detect $L=.3$ with 80% power?