This is a 2-day take-home test, with 3 questions, each carrying equal weight. The test will be available after the end of class on Wednesday, April 9 and you must return it to me by Friday, April 11. Please sign this page and attach it to your answers. Your test paper will not be accepted without the signed cover page.

Note: You will submit your answers to this test for grading; by signing below, you acknowledge that you are familiar with the course policy on graded material and the university policy on academic integrity, cited in the course syllabus. In particular, your signature means that this is your own individual work, and that you neither gave nor received unauthorized aid.

SIGNATURE: ______________________

Include all code (for example, SAS programs and R scripts), but be
selective in including computer output. Do not turn in unedited output from SAS procedures.

All data may be retrieved from files in:
http://www.stat.ncsu.edu/people/bloomfield/courses/st731/

1. Investigators measured the size of the pterygomaxillary fissure in the jaws of 27 children at the ages of 8, 10, 12, and 14 years. The data, together with an indicator of each child’s gender (0 = female, 1 = male), are in dental.txt.

   (a) Similar studies indicated that the mean dimension for boys is:

<table>
<thead>
<tr>
<th>Age</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>22.6</td>
<td>24.2</td>
<td>25.8</td>
<td>27.3</td>
</tr>
</tbody>
</table>

   Test the null hypothesis that the mean dimension for the population from which the boys in this study were drawn is the same as in this table; use \( \alpha = .05 \).

   (b) Test for equality of the population mean vectors for boys and girls, also with \( \alpha = .05 \).

   (c) Justify your use of normal theory methods for these data.

2. Consider the data of Question 1 as repeated measures.

   (a) Plot the mean vectors for boys and girls as sample profiles on a single graph. What does the graph show?

   (b) Test for parallel profiles with \( \alpha = 0.05 \).

   (c) If the profiles appear to be parallel, test for coincident profiles, also with \( \alpha = 0.05 \).

   (d) If the profiles appear to be coincident, test for level profiles, also with \( \alpha = 0.05 \).

   (e) What conclusions can be drawn from this analysis, and how do they relate to the features that you identified in the graph of the sample profiles?
3. Table 6.20 (wrap/JandW/T06-20.dat) contains 16 measurements of a bivariate response (Assessment Time and Implementation Time, in hours), measured under 8 different experimental conditions. (The table contains a third response, Total Resolution Time, which is the sum of the other two responses.) The 8 treatments consist of all combinations of 3 factors (Problem Severity, Problem Complexity, and Engineer Experience), each with 2 levels.

(a) Perform a MANOVA including main effects and all interactions. Report the Wilks’ Lambda test statistic and significance level for each effect.

(b) Repeat the analysis, but including only those effects that are significant at the 5% level in the full analysis.

(c) Based on the reduced analysis, give 95\% Bonferroni simultaneous confidence intervals for the main effects of Engineer Experience on the two responses.

(d) The investigators stated in their summary that “Novices took about 8 hours longer than Gurus to resolve the typical problem”. Do the confidence intervals you found in part (c) support that statement?