1. Test the equality of the covariance matrices used in Problem 6.8, page 338 in Johnson & Wichern (refer to homework #8).

2. Carry out a profile analysis the fish data from problem 2 from homework #8. For the profile analysis, only use methods 1 and 2.

3. Data Tatsuoka (1988), page 292:

An experiment was conducted for comparing three different approached to teaching math and language skills to fifth-grade students.

(1) Traditional $T$: lecture, discussion, and practice.

(2) Programmed $P$: entire course taught by programmed instruction.

(3) Eclectic $E$: a combination of the first two approaches (the teacher does the major classroom exposition, and exercises and self-tests are handled through programmed material.

Since it is believed that boys and girls of this age differ in their relative performance in these two subjects, gender was used as a second factor.

There were 60 boys and 60 girls randomly selected from the 5th grade of a larger school, and they were randomly assigned to one of the three teaching approaches (i.e., 20 students of each gender per approach).

At the end of 5 months of instruction, all 120 students were given a standardized achievement tests on math ($X_1$) and language skills ($X_2$).

The total scores for each of the 6 subgroups on the two tests (in the order of ($X_1, X_2$)) are given in the cells of the following table, which also shows the marginal and grand totals.

<table>
<thead>
<tr>
<th>Gender</th>
<th>$T$</th>
<th>$P$</th>
<th>$E$</th>
<th>Teaching Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>(514,453)</td>
<td>(524,473)</td>
<td>(536,490)</td>
<td>(1574,1416)</td>
</tr>
<tr>
<td>Girls</td>
<td>(458,507)</td>
<td>(473,518)</td>
<td>(494,571)</td>
<td>(1425,1596)</td>
</tr>
<tr>
<td></td>
<td>(972,960)</td>
<td>(997,991)</td>
<td>(1030,1061)</td>
<td>(2999,3012)</td>
</tr>
</tbody>
</table>
The within-cells SSCP matrix for these data was found to be

\[ W = \begin{pmatrix} 1795.39 & 1230.56 \\ 1230.56 & 1753 \end{pmatrix} \]

(a) Carry out a MANOVA to test the significance of the two main effects and the interaction effect on the vector of variables \( x' = (X_1, X_2) \). Use the 1% level of significance for all decisions.

(b) Interpret your results (substantively). If necessary, perform any additional analyses to help with interpreting what’s going on (e.g., separate ANOVAs, confidence intervals for contrasts/linear combinations of components of the treatment effect vectors, . . . ).