Stat 581 Problem Set # 4

1. The insulating life of protective fluids at an accelerated load is being studied. The experiment has been performed for four types of fluids, with $n = 5$ trials per fluid type. Suppose fluid types 1 and 2 are from manufacturer A, and that fluid types 3 and 4 are from manufacturer B. The data is available on Blackboard as an Excel File.

(a)

(i) Perform a test of the global null hypothesis $H_o : \mu_1 = \mu_2 = \mu_3 = \mu_4$. Compute the F_o statistic, and the p-value.

(ii) Comment on the additional information provided by the p-value, beyond a determination of statistical significance alone.

(b) Consider the orthogonal contrasts

$$\begin{aligned} \Gamma_1 &= \mu_1 - \mu_2 \\ \Gamma_2 &= \mu_3 - \mu_4 \\ \Gamma_3 &= (\mu_1 + \mu_2) - (\mu_3 + \mu_4) \end{aligned}$$

(i) Compute SS_C for each contrast. Describe a general property for the sums of squares of orthogonal contrasts. Why is this property desirable?

(ii) Perform a test of $H_o : \Gamma = 0$ for each of the contrasts. Compute the F_o statistics, and the p-values.

(iii) Provide an interpretation, stated in the context of the problem. Again, note the additional information provided by the p-value, beyond a determination of statistical significance alone.

2. A product developer is investigating the tensile strength of a new synthetic fiber. A completely randomized design with five levels of cotton content is performed, with $n = 5$ specimens per level. The data is available on Blackboard as an Excel File.

(a) Perform pairwise comparisons using the Fisher LSD method, and the Tukey method. Provide grouping information for each method.

(b)

(i) Describe the defining characteristics for each of the above pairwise comparison methods.

(ii) Compute the margin of error and the comparison-wise error rate for the Tukey method in this problem.

(iii) Compute the margin of error and the family-wise error rate for the Fisher LSD method in this problem

(c) Comment on the seemingly contradictory nature of a pairwise comparisons analysis.