STA 674 **Regression Analysis and Design of Experiments** **Assignment #5**

Experimental Design #2 **Treatment Comparisons and Multiple Factor Experiments**

Submission:

You must format your assignments as a pdf. Handwritten assignments will not be accepted.

When are ready to submit your assignment, copy your R (or RStudio work) or SAS code and paste it at the end of your document. *Don't forget to address the "software initiative" portion of this assignment, via comments to help the grader follow your work, re-doing variable names, etc.* Collaboration during the process of solving the problems is not only allowed but encouraged; that said, the submissions are each expected to be an individual effort reflecting the individual's work. Identical submissions or even submissions found to be **"too close to be coincidental" will be flagged and given no credit**.

Problems are worth the indicated points. Please submit it to your instructor **at or before 11:59 pm of the due date on Canvas** via electronic submission on Canvas.

Homework Questions

1. (10 points) Mosquito-borne diseases are a significant concern in many parts of the world and so research is continually being conducted to find better pesticides. In one experiment, four new pesticides were compared with a control (pesticde 1). Two of the new pesticides (pesticides 2 and 3) were classified as organophosphate pesticides and two were classified as organochlorine pesticides (pesticides 4 and 5). In the experiment, 100 mosquitoes were put into each of 15 tanks and three tanks were treated with each of the pesticides. The response is the percent of mosquitoes killed in each tank—the kill rate.
    a. (2) Write down the cell means model for this study and explain the components.
    b. (2) Compute the estimated kill rate for each of the pesticides and construct 95% confidence intervals without adjustment for multiple comparisons. If the experiment was repeated many times and confidence intervals were constructed in this manner, what proportion of the time would all 5 confidence intervals cover the true kill rates? Explain why this is not satisfactory.
    c. (3) Compute simultaneous confidence intervals for the kill rates of the 5 pesticides using Bonferroni's correction to obtain an experiment-wise error rate of 5%. Compare the width of these intervals with the width of the intervals in the previous part, and provide an interpretation for these intervals.
    d. (3) Suppose that the object of the experiment was to identify the pesticide with the highest kill rate. Conduct appropriate tests with a 5% experiment-wise error rate and comment on your results.

2. (10 points) Exercise 6.6 of the Kuehl text describes a 3 factor experiment to study the effects of different treatments on the durability of fabric. The fabric is padded with a filler and the three factors considered were the type of filler used to pad the fabric, the proportion of whichever filler was chosen, and the type of surface treatment (called S1 and S2). The original experiment included 2 types of fillers with 3 proportions, but I have modified the data by removing the middle proportion to construct a $2 \times 2 \times 2$ factorial design. There are two observations for each treatment and the response is weight loss in mg after an abrasion test. Less loss means that the fabric is more durable. The fabric manufacturers would like to increase the proportion of filler to make a softer fabric, but they are concerned that this may decrease the durability of the fabric. They would also like to know if there is a difference in durability between the fabrics given the two surface treatments, since S1 is a much cheaper treatment. Data for this question is available on Canvas in the file *kuehl_6_6_b.csv*.
    a. (2) Write down the cell means model for the data and identify the components.
    b. (4) Fit the ANOVA model and compute least squares estimates of the mean yield for each treatment with Bonferroni corrected simultaneous 95% confidence intervals.
    c. (4) Assess the assumptions of the model and comment on any potential problems.