Statistics 5200 Fall 2020 Homework 5

Assignment Due (by 11:59 P.M.): Fri 13 Nov

Directions: You may discuss the exercises with other students and with the instructor, but the work you turn in must be your own. Note that neatness and format (including SAS code in appendix) will contribute 10 points to the total score. This assignment will be graded out of 60 points. Note that the starter code provided with Homework 4 will be useful here.

Exercises:

1. Based on textbook Problem 8.1 (page 198; data on page 166; recall # 1 of Homework 4). The square root transformation was applied to the response to meet model assumptions. The interaction plot below (on the last page) suggests that the difference between Water levels 1 and 2 might not be the same in Week levels 1 and 4 (or equivalently, that the difference between Week levels 1 and 4 might not be the same in Water levels 1 and 2). Use a contrast to test this, referring to Week as factor A (first in CLASS statement of PROC GLM) and Water as factor B (second in CLASS statement). (The null hypothesis is that the [square-root] germination difference between Water levels 1 and 2 is the same in Week level 1 as it is in Week level 4.) Report the following:

   (a) (8 points) A brief description of how you calculated your CONTRAST coefficients. (Construction using a matrix (or table) form might be helpful here.)

   (b) (2 points) Your contrast ψ, as a linear combination of parameters AB_{ij} (do not include any AB_{ij}'s with zero coefficients).

   (c) (5 points) The F-statistic (should be 2.42) and p-value corresponding to H_0: $\psi = 0$.

   (d) (5 points) Briefly discuss what you conclude from this test of significance, and how it compares to what was suggested by the interaction plot.

2. Refer again to Problem 8.1 (as above) and the interaction plot below (on the last page). It appears that the mean response (the germination rate) for both Water levels at Week level 1 (both lines at left edge) may be different from the mean response for Water level 2 at Week level 5 (lower line at right edge). Test this using a single CONTRAST statement in PROC GLM, again referring to Week as factor A and Water as factor B. (The null hypothesis is that average [square-root] germination rate at Week level 1 (across both Water levels) is the same as the average [square-root] germination rate at the Week level 5 / Water level 2 combination.) Report the following:

   (a) (8 points) A brief description of how you calculated your CONTRAST coefficients.

(b) (2 points) Your contrast ψ, as a linear combination of parameters μ, A_i, B_j, and AB_{ij} (do not include any parameters with zero coefficients).

(c) (5 points) The F-statistic (should be 5.24) and p-value corresponding to H_0: $\psi = 0$.

(d) (5 points) Briefly discuss what you conclude from this test of significance, and how it compares to what was suggested by the interaction plot.

3. Suppose someone repeats the experiment referred to in Problem 8.1 (as above), but without replication. That is, they perform a 5 by 2 factorial design with 1 replicate at each factor level combination (rather than the 3 replicates at each factor level combination as in the original experiment).

(a) (5 points) In terms of statistical analysis, summarize briefly what these new researchers will need to do differently than what you did for #1 of Homework 4, and why.

(b) (2 points) What must these researchers assume in order to do this?

(c) (3 points) Referring back to the analysis of the original experiment (as in # 1 of Homework 4), what evidence is there that the assumption in part (b) might be valid?

Appendix: (10 points) Include SAS code used for this assignment.