

STAT 512 HW9

See Canvas calendar for the due date.

34 points Total, 2 points per question unless otherwise noted.

Questions 1 through 8: For this problem use the data described in Ott & Longnecker problem 19.23 (p 1080 in the 7th Edition). We will verify that this is a BIBD in parts A, B. Note that Person acts as the blocking variable.

1. Identify t , r , b and k . (4 pts) Hint: Use the table() function.
2. Compute λ (and make sure it is an integer).

Questions 3 through 5: Treat Person (block) as fixed.

3. Fit an appropriate model (using lm()) and include the Type 3 ANOVA table (using Anova(, type = 3)) in your assignment.
4. Calculate emmeans and Tukey adjusted p-values for their differences. Summarize using a cld display and include it in your assignment. (4 pts)
5. Calculate Tukey's HSD value by hand. Hint: See the ExpDesign 3 slide 104. Recall that you can check your calculation using the SE value from the previous question.

Questions 6 through 8: Treat Person (block) as random.

Note: Be sure to detach the emmeans package. Then load the lme4, lmerTest, pbkrtest and emmeans packages.

6. Fit an appropriate model (using lmer() from lme4 package) and include the Type 3 ANOVA table (using anova(, ddf="Kenward-Roger"))
7. Calculate emmeans and Tukey adjusted p-values for their differences. Summarize using a cld display and include it in your assignment. (4 pts)
8. Comparing your results from #4 and #7, you should find that the emmeans are not the same. Is the ranking of the treatments the same? Are the conclusions about significant differences the same?

Questions 9 through 14: In a variety trial, a total of 7 varieties (Var) of wheat are considered. For each variety, n=3 reps are randomly assigned to positions in a single field. The response variable is the Yield at the end of the trial. The data is available from Canvas as "**Varieties.csv**". Note: You may need to detach the emmeans package and then reload it for this group of questions.

Questions 9 through 11: Treat Variety as fixed and fit a one-way ANOVA model using lm().

9. Fit an appropriate model and construct the ANOVA table (using Anova(, type = 3))
10. In the ANOVA table, you should find a test corresponding to Variety. Specifically, $F = 18.26$ and $p\text{-value} < .0001$. State the null hypothesis for this test.
11. Give the emmeans for each variety.

Questions 12 through 14: Treat Variety as random and fit a one-way random effects model using lmer().

12. Fit an appropriate model and include "Random Effects" table (giving the variance component estimates) in your assignment.
13. Use the rand() function to get a test corresponding to Variety. Specifically, $\text{Chi.sq} = 19$ and $p\text{-value} < 0.0001$. State the null hypothesis for this test.
14. Give the BLUPs for each variety. Remember to include the intercept in the BLUP estimation.