Quiz 2

MAL2040: Design and Analysis of Experiments Date: 2026-04-06

Duration: 45 minutes Total: 10 points

Name: _____ **Roll No.:** _____

Instructions:

- Submit your answers in a `.txt` file.
- Save your `R` files, image outputs, and the final answer text file in a single folder named with your roll number.

Problem 1. **[5 points]**

A civil engineer is interested in determining whether four different methods of estimating flood flow frequency produce equivalent estimates of peak discharge when applied to the same watershed. Each method is applied six times, and the resulting data are provided in the accompanying file named `Flood.csv`.

(a) Draw a box-plot of the data and interpret it with respect to the following:
   i. Are there noticeable differences in the medians across the methods?
   ii. Does the variability appear to be similar across the methods?

(b) Fit a one-way ANOVA model in `R` and present the ANOVA table.
Based on the p-value, what is your conclusion regarding whether there is a significant difference in the mean peak discharge estimates among the four methods at the 1% significance level?

(c) Construct a plot of residuals versus fitted values, and comment on the model assumptions based on this plot.

(d) Compare your conclusions from parts (b) and (c) with the observations from the box-plot in part (a).

Problem 2. **[5 points]**

An industrial engineer is investigating the effect of four assembly methods (`A`, `B`, `C`, `D`) on the assembly time of a color television component. Four operators and the order of assembly are considered as blocking factors. The data (assembly time) are provided in the accompanying `Assembly.csv` file, with columns `Time`, `Method`, `Order`, and `Operator`.

(a) Fit an appropriate ANOVA model for a Latin square design in `R` (treating `Order` and `Operator` as blocking factors) and present the ANOVA table.

(b) At the $\alpha = 0.01$ level, test whether there is a significant difference among the assembly methods. State your conclusion based on the p-value.

(c) Identify which blocking factors (operator and order of assembly) are significant, and justify your conclusion.

(d) Fit a one-way ANOVA model ignoring the blocking factors. Compare the p-value for `Method` with that obtained in part (b), and state whether your conclusion about the methods changes.

End of Quiz