

ST 518 Fall 2022 Semester Project:

You are assigned to groups of 3-4 to work on this project. It is important that group members establish expectations regarding individual roles in completing the project and hold to these standards. Every individual is expected to contribute to the submitted work.

Situation

The “Effervescent Experiment” was run to compare dissolving times of two different brands (name brand, store brand) of cold medicine tablets at three different equally spaced water temperatures (6°C, 23°C, 40°C). A complete block design with $b = 2$ blocks was selected with $n = 4$ observations on each of the treatment combinations in each block. In Block I, the liquid was stirred using a magnetic stirring plate at 350 revolutions per minute. In Block II, the liquid was not stirred.

The dissolving time was measured from the time a tablet was dropped (from a fixed height) into 60mL of water to the time the tablet was completely dissolved. The recorded observation was taken as an average of the times as measured by four experimenters and the data -- along with the run order for each observation -- are contained in the file `effervescense.csv`.

Assignment

- (a) Exploratory Analysis: Make appropriate plots of the data and comment on any interesting features/associations you observe. You may also want to augment your visualizations with numerical computations (summary stats, correlation coefficients, etc.)
- (b) Model Fitting/Selection: Fit several models to the data and determine which model you think is the best fit to the data; this should include models with and without the blocking variable, and you should try to use the run order variable `Order` as a covariate (note: there may or may not be a linear or non-linear association of `Order` with `Time`; you should determine how to use `Order` if at all in your model). Criteria for model evaluation should include (i) checking validity of assumptions using diagnostic plots and (ii) statistically significant minimization of the standard error (i.e., the error standard deviation estimate).
- (c) Analysis: Investigate the appropriate effects on the dissolving time due to the different temperatures and brands, including pairwise comparisons as well as linear and quadratic trends. You should use the appropriate contrasts to compute your estimates and to test significance and, when appropriate, use a multiple comparison technique.
- (d) Stirred: In this experimental setup, `Stirred` has been used as a blocking variable. Do you think this is appropriate? (Alternatives are to omit the variable from your model completely or treat it as an effect you want to evaluate along with `Brand` and `Temp`). Explain your reasoning.

Deliverables

Your team will generate a written report of no more than 10 pages using the following format:

Executive Summary: A one or two paragraph summary that includes a description of the experiment, significant results (including any interesting numerical results), and any conclusions you draw. The reader should be able to glean all the important aspects of your work from the executive summary.

- I. Introduction: Explain what you are trying to learn from the experiment -- you may borrow heavily from my description.
- II. Experimental Design: Include a description of the experiment and the data that was collected -- you may borrow heavily from my description.
- III. Exploratory Analysis: You should describe the results of your exploratory analysis of the data in this section, including any important potential associations you observed and supporting visualizations/computations.
- IV. Analysis and Results: Describe your models or analysis techniques, and where appropriate, results of (a) diagnostics, (b) ANOVA/regression model estimates, (c) and effects tests, including any diagrams, tables or plots that will help illustrate your findings. This section will be the meat of your report.
- V. Conclusions: Restate your final model and important results of your effects tests. Include any recommendations or insights you gained from your analysis, including any suggestions on how to treat Stirred differently (as opposed to using it as a blocking variable).

You should submit a pdf of your report along with executable files containing the SAS or R code used to perform the analyses.