Final Project

PSTAT122: Design and Analysis of Experiments

Fall 2025

STUDENT NAME

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Due Date

Due Date: Monday, December 8, 2025, 11:59 PM

1 Introduction

Reaction time - Clear statement of the objective or research question. - Brief context or motivation.

2 Experimental Design

- Description of factors and treatment structure.
- Clearly state what you are measuring and the units. Examples: Number of words recalled (count), reaction time (seconds), taste rating (1–5 scale).
- Identify which factors are fixed vs. random.
- Description of design type (CRD, RCBD, factorial, etc.).
- Explain how randomization, replication, and (if used) blocking were implemented.
- Sample size: Provide number of observations per condition. Guideline: 5–10 per treatment for CRD, 3–5 blocks for RCBD, total feasible within 1 hour.

(You are encouraged to explore more resources for determining the sample size)

3 Data Collection

- **Procedure**: Describe how and when the experiment was conducted (e.g., location, date, steps taken).
- **Challenges/Adjustments**: Mention any difficulties or changes made during data collection (e.g., technical issues, time adjustments).
- **Data Presentation**: Display the collected data in tables or graphs, summarizing key measures like mean and standard deviation..

4 Analysis

- **Exploratory Data**: Start with basic statistics (mean, SD) and visualizations (e.g., boxplots) to understand the data.
- **Hypothesis Testing**: Test your hypothesis with an appropriate statistical test (e.g., ANOVA).
- **Tables, Figures, & Code**: Include key results (ANOVA table, post-test) and relevant `R` code excerpts where needed.
- Use `R` to analyze the data.

5 Conclusions

- Summarize key findings.
- Comment on limitations and possible improvements.

6 References

(If needed.)

7 Appendices

- `R` code.

  • Factor A: Lights Levels: off / on • Factor B: Music Levels: no / yes • Factor C: Time of day Levels: morning / evening • Blocks: subject (4 people) • Design type: 3-factor factorial with blocking on subject • Treatments: $2 \times 2 \times 2 = 8$ treatment combinations • Experimental units: each subject will complete all 8 conditions • Total experimental units: 4 subjects × 8 conditions = 32 • Trials per unit: 8 trials of reaction time per condition • Total recorded trials: $4 \times 8 \times 8 = 256$ • Randomization: randomize the order of the 8 conditions within each subject

This is equivalent to an RCBD with a 2×2×2 factorial treatment structure, exactly what is covered in PSTAT 122.

This is the only feasible and statistically valid way to include 3 factors with 4 subjects.

Setting up Randomization part

```r
library(dplyr)

subjects <- 1:4

lights_levels <- c("off", "on")        # A
music_levels  <- c("no", "yes")        # B
time_levels   <- c("morning", "evening")  # C

design_grid <- expand.grid(
  subject = subjects,
  lights  = lights_levels,
  music   = music_levels,
  time    = time_levels
)

set.seed(123)

random_schedule <- design_grid %>%
  group_by(subject) %>%
```

```r
  slice_sample(n = 8) %>%              # 8 treatment combinations per subject
  mutate(order = row_number()) %>%
  arrange(subject, order)

random_schedule
```

```
# A tibble: 32 x 5
# Groups:   subject [4]
   subject lights music time    order
     <int> <fct>  <fct> <fct>   <int>
 1       1 off    yes   evening     1
 2       1 on     yes   evening     2
 3       1 off    yes   morning     3
 4       1 on     no    evening     4
 5       1 on     no    morning     5
 6       1 on     yes   morning     6
 7       1 off    no    evening     7
 8       1 off    no    morning     8
 9       2 off    no    evening     1
10       2 on     yes   morning     2
# i 22 more rows
```