Activity 2.1: ANOVA & Statistical Model for a CRD

Traffic Signals

> **Note**
>
> Submit via Gradescope, don't forget to assign pages to the questions in the outline!

A traffic engineering study was conducted to investigate traffic delay at urban intersections. Three types of traffic signals were studied: pretimed, semi-actuated, and fully actuated. Each signal type is independently and randomly assigned to five intersections. The response variable was the average stopped time per vehicle (seconds) at each intersection.

The following data is provided in `traffic_data.csv`:

ID	TrafficSignal	AvgStopTime_secs
1	Pretimed	36.6
2	Pretimed	37.1
3	Semi-actuated	18.7
4	Fully actuated	15.0
5	Fully actuated	18.9
6	Fully actuated	15.2
7	Pretimed	39.2
8	Semi-actuated	17.5
9	Pretimed	30.4
10	Semi-actuated	25.7
11	Fully actuated	10.4
12	Fully actuated	10.5
13	Semi-actuated	22.0
14	Pretimed	34.1
15	Semi-actuated	20.6

a. Study Structure

Describe the following components of the study.

- Treatment structure

- Design structure

- Response variable

b. Complete the skeleton ANOVA table below

Make sure to use context of the data!

Source of Variation (SV)	DF: Total = _____

c. ANOVA Table

Use the data provided to calculate the following (you can use R/JMP to obtain summary tables):

$\bar{y}_{..}$ = _____

$\bar{y}_{1.}$ = _____

$\bar{y}_{2.}$ = _____

$\bar{y}_{3.}$ = _____

for $i = 1$ (Pretimed), $i = 2$ (Semi-actuated), $i = 3$ (Fully actuated)

- Show (by hand, using a calculator) how the SSE is calculated:

Then, use your SSE calculation and the provided information to fill out the ANOVA table below. *You can check your answers by running the ANOVA in JMP/R, but know where the values come from.*

Source	DF	SS	MS	F	Prob > F
					<0.0001
Total	14	1340.45			

d. Statistical Model

Write the *effects model* for this study, make sure to provide the index values, assumptions, and clearly define each term in context.

e. Using JMP/R, obtain the parameter/coefficient estimates for the following:

Warnings if using R!

If using R, you need to change the default settings to use "sum to zero":

```
options(contrasts = c("contr.sum", "contr.poly"))
mod <- lm()
```

Also, be careful of order! The following may be useful for manipulating your data.

```
mutate(TrafficSignal = factor(TrafficSignal, levels = c("Pretimed", "Semi-
actuated", "Fully actuated")))
```

Then check your factor order with:

```
levels(data$TrafficSignal)
```

- $\hat{\mu} =$ _____
- $\hat{\tau}_1 =$ _____
- $\hat{\tau}_2 =$ _____
- $\hat{\tau}_3 =$ _____

for $i = 1$ (Pretimed), $i = 2$ (Semi-actuated), $i = 3$ (Fully actuated).

f. Interpret Parameter Estimates

In context of the data, provide an interpretation for $\hat{\tau}_1 = 12.02$. It may be helpful to think about what $\bar{y}_{1\cdot}$ was from (c).

g. Provide a conclusion

In context of the data, write out your conclusion from the overall ANOVA F-test from (c). Make sure to provide all evidence – (F = , df = , p =).