

# MAST30025: Linear Statistical Models

## Week 10 Lab

1. Consider again the data from Question 5 from the Week 8 lab. In a manufacturing plant, filters are used to remove pollutants. We are interested in comparing the lifespan of 5 different types of filters. Six filters of each type are tested, and the time to failure in hours is given in the dataset **filters** (on the website, in **csv** format).
  - (a) Calculate  $s^2$ .
  - (b) Calculate a 95% confidence interval for the difference in lifespan between filter types 3 and 4.
  - (c) Show that the hypothesis that the filters all have the same lifespan is testable.
  - (d) Test this hypothesis, using matrix theory.
  - (e) Test the same hypothesis using the **linearHypothesis** function from the **car** package.
2. Derive a formula for a prediction interval for  $\mathbf{t}^T\boldsymbol{\beta}$  in the less than full rank model.
3. Consider a one-way classification model with three levels. To test  $\tau_1 = \tau_2 = \tau_3$  we could use either of the following matrices:

$$C_1 = \begin{bmatrix} 0 & 1 & -1 & 0 \\ 0 & 1 & 0 & -1 \end{bmatrix}, C_2 = \begin{bmatrix} 0 & 1 & -1 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix}.$$

Show that the test statistics formed using these two matrices are the same.

Hint: find  $A$  such that  $AC_1 = C_2$ .

4. An industrial psychologist is investigating absenteeism among production-line workers, based on different types of work hours: (1) 4-day week with a 10-hour day, (2) 5-day week with a flexible 8-hour day, and (3) 5-day week with a structured 8-hour day. A study is conducted and the following data obtained of the average number of days missed:

	Work plan		
	1	2	3
Mean	9	6.2	10.1
Number	100	85	90

They also find  $s^2 = 110.15$ .

- (a) Test the hypothesis that the work plan has no effect on the absenteeism.
- (b) Test the hypothesis that work plans 1 and 3 have the same rate of absenteeism.

