Overview

Max Turgeon

STAT 4690–Applied Multivariate Analysis

Course details

- Time: MWF 10:30am–11:20am
- Office: 373 Machray Hall
- Office Hours:
  - Tuesday 9:30am–11am
  - Thursday 1pm–2:30pm
  - Or by appointment
- Course Website:

  `https://maxturgeon.ca/f19-stat4690`

Textbook

- Johnson & Wichern, *Applied Multivariate Statistical Analysis*. Prentice Hall (2007)
  - Recommended, but not required
  - A copy is available on reserve at the Science Library
- There are plenty of other textbooks on applied multivariate statistics available. See course website for some recommendations.

Assessments

- Two assignments each worth 15% of the final grade
- One midterm (tentatively scheduled October 31 outside of class hours) worth 30% of the final grade
- There is **no** final exam
- There is a class project worth 40% of the final grade

IN THE CASE OF A FIRE ALARM:

- REMAIN CALM
- IF IT IS SAFE, EVACUATE THE CLASSROOM OR LAB
- GO TO THE CLOSEST FIRE EXIT
- DO NOT USE THE ELEVATORS

IF YOU NEED ASSISTANCE TO EVACUATE THE BUILDING, INFORM YOUR PROFESSOR OR INSTRUCTOR NOW!!!

- IF DURING A BUILDING EVACUATION YOU NEED TO REPORT AN INCIDENT OR A PERSON LEFT BEHIND:
  - CONTACT ONE OF THE BUILDING FIRE WARDENS OR
  - CALL SECURITY SERVICES 204-474-9341

- DO NOT REENTER THE BUILDING UNTIL THE **"ALL CLEAR"** IS DECLARED BY A FIRE WARDEN, SECURITY SERVICES OR THE FIRE DEPARTMENT

Course Objectives

- Broad overview of techniques used in multivariate analysis, with emphasis on **Multivariate Linear Regression** and **Principal Component Analysis**.
    1. Make decisions on how and when to use the techniques discussed in class;
    2. Apply and assess multivariate methods on real data;
    3. Make sound statistical conclusions based on a multivariate analysis.
- Make you competent in the `R` statistical software.

Tentative topics i

- *Aspects of multivariate analysis* (Chapter 1)
- *Matrix algebra and random vectors* (Chapter 2)
- *Random Samples* (Chapter 3)
- *Multivariate normal distribution* (Chapter 4)
- *Inferences about a mean vector* (Chapter 5)
- *Multivariate linear regression* (Chapter 7)
- *Principal Component Analysis* (Chapter 8)
- *Factor Analysis* (Chapter 9)
- *Canonical Correlation Analysis* (Chapter 10)
- Kernel methods and Manifold Learning (if time permits)

Multivariate Data

- Multivariate data is **everywhere**
  - Multiple measurements collected a on given experimental unit
- Multivariate analysis is concerned with the relationship between those variables
- **Note**: Regression with a single outcome variable is *not* considered multivariate analysis.

Multivariate Methods

- One- or two-sample inference about multivariate data (think t-test)
- *MANOVA*: Generalization to several populations
- **Multivariate Linear Regression**: Linear model for multivariate response in terms of covariates

Multivariate Methods

- **Principal Component Analysis**: Reduce dimension of data by finding directions in data with maximal variance
- *Factor Analysis*: Understand variance in multivariate sample in terms of latent (i.e. unobserved) factors
- *Canonical Correlation Analysis*: Study correlations between two multivariate datasets

Multivariate Methods (not covered in STAT 4690)

- Methods for longitudinal data (e.g. mixed-effect models or GEEs)
- *Clustering*: Grouping "similar" observations based on their (multivariate) measurement (STAT 4600: Statistical Learning)
- *Classification and Discrimination*: Grouping observations and allocating new units to previously defined classes (STAT 4600: Statistical Learning)
    - The difference between the last two is whether or not we measured a class label for the observations.

Statistical analysis

- This is an *applied* course, so we will be analysing data
  - Although we also require a fair amount of theory
- We will mostly use `R`, and the datasets will be provided to you.
  - Code for in-class examples will also be provided
- For assignments and course project, students are *strongly* encouraged to use `Rmarkdown` or `knitr`.
  - Literate programming
  - Reproducibility