# STAT 8670 - Computational Methods in Statistics

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# **Preface**

### **Description**

Topics included are optimization, numerical integration, bootstrapping, cross-validation and Jackknife, density estimation, smoothing, and use of the statistical computer package of S-plus/R.

### **Prerequisites**

Math 4752/6752, and the ability to program in a high-level language.

#### Instructor

Chi-Kuang Yeh, I am a postdoctoral scholar at the Department of Statistics and Actuarial Science, McGill University.

- Office: M3–3102 Desk 10, but I hold office hour at M3 2101 Desk 1, 9:30-10:30 on Tuesday.
- Email: chi-kuang.yeh@mail.mcgill.ca

### Office Hour

[Online link will be provided later]

### **Midterms**

□ Midterm 1: Date and topics TBA
□ Midterm 2: Date and topics TBA
□ Midterm 3: Date and topics TBA

# **Chapters and Associated Lectures**

Those chapters are based on the lecture notes. This part will be updated frequently.

Chapter	Lecture Covered
1. TBA	L1

# 1 Introduction

This is a book created from markdown and executable code.

See Knuth (1984) for additional discussion of literate programming.

1 + 1

[1] 2

# 2 Summary

In summary, this book has no content whatsoever.

1 + 1

[1] 2

# References

Knuth, Donald E. 1984. "Literate Programming." Comput.~J.~27~(2): 97–111. https://doi.org/10.1093/comjnl/27.2.97.

# Part I Appendix

# Appendix: Why R?

### A.1 R and RStudio

For conducting analyses with data sets of hundreds to thousands of observations, calculating by hand is not feasible and you will need a statistical software.  $\mathbf{R}$  is one of those.  $\mathbf{R}$  can also be thought of as a high-level programming language. In fact,  $\mathbf{R}$  is one of the top languages to be used by data analysts and data scientists. There are a lot of analysis packages in  $\mathbf{R}$  that are currently developed and maintained by researchers around the world to deal with different data problems. And most importantly,  $\mathbf{R}$  is free. In this book, we will learn how to use  $\mathbf{R}$  to conduct basic statistical analyses.

### A.2 RStudio Layout

RStudio consists of several panes: - Source: Where you write scripts and markdown documents. - Console: Where you type and execute R commands. - Environment/History: Shows your variables and command history. - Files/Plots/Packages/Help/Viewer: For file management, viewing plots, managing packages, accessing help, and viewing web content.

### A.3 R Scripts

R scripts are plain text files containing R code. You can create a new script in RStudio by clicking File > New File > R Script.

### A.4 R Help

Use ?function\_name or help(function\_name) to access help for any R function. For example:

?mean
help(mean)

### A.5 R Packages

Packages extend R's functionality. Install a package with:

```
install.packages("package_name")
```

Load a package with:

```
library(package_name)
```

### A.6 R Markdown

R Markdown allows you to combine text, code, and output in a single document. Create a new R Markdown file in RStudio via File > New File > R Markdown....

### A.7 Vectors

Vectors are the most basic data structure in R.

```
x \leftarrow c(1, 2, 3, 4, 5)
```

### [1] 1 2 3 4 5

You can perform operations on vectors:

```
"r
x * 2
## [1] 2 4 6 8 10
```

### A.8 Data Sets

Data frames are used for storing data tables. Create a data frame:

```
df <- data.frame(Name = c("Alice", "Bob"), Score = c(90, 85))
df

## Name Score
## 1 Alice 90</pre>
```

You can import data from files using read.csv() or read.table().

This appendix is adapted from Why R?.

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## 2

Bob