DEPARTMENT OF MECHANICAL & INDUSTRIAL ENGINEERING
UNIVERSITY OF TORONTO

MIE 1402: Analytical Methods in Human Factors Experimental Design and Statistics

Fall 2024

CLASS TIMES: Friday 3-6pm
(between September 6, 2024 and December 13, 2024)
Location: TBD

INSTRUCTOR: Mark Chignell

TEACHING ASSISTANT: TBD

Tutorial: TBD

COURSE OBJECTIVES: The course is intended to give students thorough training in design of experiments and statistical analysis of experimental data with additional insights into data mining and evaluation of machine learning. The course will use the R statistical package. However, the main principles of data analysis that are learned can then be applied to any other statistical package once the appropriate command language and user interface is learned for that package. After the completion of this course, a student should be able to:

1. Understand the main issues in designing experiments
2. Understand the basic ideas of statistical analysis as a model fitting exercise.
3. Carry out a range of statistical analyses using R
4. Understand the basic ideas behind the general linear model of statistics.
5. Carry out a range of analyses of variance and regression analyses
6. Understand a range of key statistical concepts including degrees of freedom, confidence intervals, tests of statistical assumptions, use of contrasts and post hoc analyses, and use of dummy variable coding.
7. Design and analyze experiments and report on the statistical results obtained
8. Carry out statistical evaluation of machine learning methods
9. Understand the basics of data mining, feature extraction, and segmentation

Required Text: **Discovering Statistics using R**, Andy Field. Jeremy Miles, and Zoe Field, Sage, 2012. I haven't ordered the textbook at the UofT bookstore (although they may have copies if they haven't been sent back from previous courses). The text can be ordered online and here is the Amazon link. https://www.amazon.ca/Discovering-Statistics-Using-Andy-Field/dp/1446200469/

Required Software ***R (open source) (installation instructions are in the textbook)***

Hint: There is a lot of reading in this course, but it is a fun textbook to read. But you should start reading early as it is a fast-paced course.

COURSE MARKING SCHEME

Course Assignments	20 percent of course (2 assignments worth 10% each)
Individual Project	20 percent of course
Group Project	30 Percent of course
Final Test	20 percent of course
Class Participation	10 percent of course

LECTURE STRUCTURE

The class sessions will generally consist of lectures, but I would like them to be highly interactive. Questions and comments are encouraged if they are on topic. We will normally finish lectures around 5pm to be followed by a tutorial with the TA. You are responsible for reading the assigned textbook chapters for each lecture or other assigned readings BEFORE that lecture. On November 8, and November 29, we will have the individual and group project presentations, respectively. The participation mark for this course will reflect student interaction and engagement throughout the course. It is not a mark for showing up. The final test will be held on December 6 and the group project report will be due on December 13. Note that there will be no lecture on November 1 (Fall study week).

COURSE OUTLINE (chapter numbers are for the textbook)

Date	Lecture/Session	Reading	Deliverable
Sept 6	Lecture 1. Introduction to Experiments and R. Statistical Assumptions, Sampling, Power, and Correlations, Visualization.	Chapters 1-6 Handouts	Install R and get it running
Sept 13	Lecture 2. Experimental Design Bootcamp. Propensity Scoring for Experimental interpretation of existing data	Experimental Design Handouts	Individual Project Handed Out. Intro to BrainTagger Games
Sept 20	Lecture 3. Feature Extraction and Segmentation: Factor Analysis, Cluster Analysis, and KNN, Clustering Evaluation	Chapter 17 Handouts	(Assignment 1 Handed Out for Examples of Using R)
Sept 27	Lecture 4. Logistic Regression and Non-parametric Statistics	Chapter 8, 15, 18	
Oct 4	Lecture 5. T-tests. Basic and Factorial ANOVA. Introduce Individual Project	Chapter 9, 10, 12	Assignment 1 Due

Oct 11	Lecture 6. Linear and Multiple Regression, Diagnostics and Evaluation Metrics	Chapter 7 Handout	Assignment 2 Handed out
Oct 18	Lecture 7. Repeated Measures, mixed ANOVA, and ANCOVA (analysis of covariance)	Chapter 11, 13, 14	Group Project Handed out.
Oct 25	Lecture 8. Multilevel Linear Models Guest Lecture by Prof Jed Meltzer.	Chapter 19	Assignment 2 Due
Nov 1	Fall Study Week (No Lecture)		
Nov 8	Individual Project Presentations		Individual Project Report Due
Nov 15	Lecture 9. Multivariate Analysis of Variance (MANOVA) and Discriminant Analysis	Chapter 16	
Nov 22	Lecture 10. Evaluation of Machine Learning Experiments. Guest Lecture by Professor Lu Wang	Handout	
Nov 29	Group Project Presentation		
Dec 6	Final Test	Review all readings	Final Test
Dec 13	No Lecture		Group Project Report Due

KEY DATES

Assignment 1 Due	September 27
Assignment 2 Due	October 25
Individual Project Report Due	November 8
Individual Project Presentation	November 8
Group Project Presentation	November 29
Final Test	December 6
Group Project Report Due	December 13