

ECE 608: QUANTITATIVE METHODS IN BIOMEDICAL ENGINEERING

Spring 2021

Course Description and Aims

This biomedical engineering core course aims to equip students with the practical quantitative methods to analyze and solve biomedical problems. The concepts of hypothesis testing, statistical analysis, and experimental design strategies will be introduced. One major focus of this course is to familiarize students with the statistical programming language R and various statistical tools such as t-test, ANOVA, and regressions. This course also aims to demonstrate how these tools can be appropriately applied to analyze biomedical datasets quantitatively and, in turn, draw conclusions that are justified with numbers.

Teaching Staff

Billy Y. S. Yiu, Ph.D.

Instructor, Department of Electrical and Computer Engineering

E-mail: billy.yiu@uwaterloo.ca

Office: XXXXXXXXXX

Reference Materials

- S. Kuiper and J. Sklar, *Practicing Statistics: Guided Investigations for the Second Course*. Boston: Pearson Education Inc., 2013. ISBN 0-321-58601-8.
- G. Golemund and H. Wickham. *R for Data Science*. O'Reilly Media, 2017. [Available online, free, at r4ds.had.co.nz]

Course Learning Outcomes

By the end of this course, students should be able to demonstrate a threshold level of mastery of the following learning outcomes:

1. Form a hypothesis in a biomedical problem and design experiments to collect data
2. Conduct appropriate statistical analyses on data using **R** to test hypotheses
3. Interpret and present statistical results scientifically

Course Teaching and Learning Activities

This course will be taught mostly using the synchronous online lecturing format. There will be two online classes every week, to be held on Mondays and Fridays (10am to 11:20am Eastern time). The tentative course contents for each week are listed below.

Week of May 10:	Basic concepts of quantitative methods
Week of May 17:	Parametric test: assumptions and comparison of means
Week of May 24:	One way analysis of variance (ANOVA) and post-hoc test
Week of May 31:	Repeated measures one way ANOVA
Week of June 7:	Sample size and power
Week of June 14:	Correlation and simple linear regression
Week of June 21:	Multiple linear regression and assumption checking
Week of June 28:	Logistic regression
Week of July 5:	Reliability and validity
Week of July 12:	Sensitivity, specificity and receiver operating characteristics
Week of July 19:	Survival rate and hazardous ratio analysis

Week of July 26: Non-parametric test and its applications

Week of Aug 1: Bootstrapping: random sampling with replacement

Grade Breakdown

Online quiz on LEARN 10%

- Multiple choice questions revisiting the concepts covered in-class
- Due dates: May 21, June 4, June 18, July 2, July 16

Problem sets × 3 25%

- Three problem sets to help you practice the statistical methods covered in-class
- Due dates: May 31, June 21, and July 12

Literature review 15%

- Critical thinking essay on an assigned article related to application of quantitative methods in biomedical engineering research
- Due date: July 26

Final assignment 50%

- Combination of true-or-false questions, multiple choice questions, and statistical analysis questions
- Due date: Aug 15