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
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Reference Materials

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.

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