2021

BIOM 2720: Experimental Design and Analysis for Biomedical Engineering (Syllabus)

Stephen Strain

University of Memphis

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BIOM 2720 Experimental Design and Analysis for Biomedical Engineering  
Spring 2021  
Monday-Wednesday 12:40-2:05P

Instructor  
Dr. Stephen Strain  
sfstrain@memphis.edu  
Office: ET308  
Virtual Office:  
https://memphis.zoom.us/j/3271381594?pwd=VW9FYThrS293d0FwYUZ2TVFyeVJLdz09  
(NOTE: THIS IS NOT THE LINK TO CLASS!!)  
Office hours: Friday 1:30-3:30P, or email for appointment

Teaching Assistant:  Ezzuddin Abuhussein (bhssein2@memphis.edu)

Required Materials for Remote Access:
- Internet Access,  
- Desktop Computer, Laptop, or Tablet  
- eCourseware (elearn.memphis.edu)  
- Zoom (memphis.edu/umtech/teaching/ummedia/zoom.php)  
See eCourseware for the link to connect to the online class during regular class hours.  
Preferred is a combination laptop/tablet.  
University resources to support online learning:
https://www.memphis.edu/umtech/teaching/ecwstudent.php

Course Description
Application of probability, statistics, error analysis, uncertainty in design and performance of biomedical engineering experimentation; discussion and evaluation of common experimental designs for medical device development. PREREQUISITE: BIOM 1720 and MATH 1910.

This course is required for the Biomedical Engineering Degree Program.

Textbook (optional)

A personal computer is required.

Required software: MATLAB, Microsoft Word, and Microsoft Excel.

A free MATLAB download is available for UM students through the university’s site license at

MS Word & Excel is available for UM students through the university’s technology access program at
https://www.memphis.edu/umtech/solutions/software/software.php

Objectives
1. To teach students to present data and compute summary statistics in biomedical engineering using computer programs  
2. To teach students basic concepts and commonly used methods of experimental design and analyses.  
3. To teach students how to perform and interpret basic statistical analyses used in biomedical engineering design and testing.
Competencies

1. Make well organized tables and graphs. This requires appropriate table titles and figure legends, correct units and axis labels (including formatting and significant digits) clear indication of types of descriptive statistics, sample sizes and overall labeling and organization.

2. Clearly state statistical hypotheses.

3. Correctly perform statistical tests of significance.

4. Correctly interpret results of statistical tests of significance.

Grading

10% Attendance/pop-quizzes/in-class participation

15% Homework

30% Exams

25% Final

20% Labs/Reports*

*Competencies will be evaluated and graded as part of submitted lab reports. Passing competencies will constitute 11 points of the final lab report grade. Students will have 3 chances to pass competencies in each lab.

Letter grades will be determined as below, with plus/minus modifiers for A, B, or C grades and plus modifier for D grade. Modifiers are applied if numerical grade is above X7.5% or below X2.5%. I reserve the right to round up or down or otherwise adjust the final grade based on other factors such as attendance, effort, and engagement inside and out of class.

A: (90-100); B (80-89); C (70-79); D (60-69); F (<59)

Attendance

For the first two weeks, class will be held remotely. After that, if possible, hybrid classes will be held. The link for online attendance can be found on eCourseware. Attendance at all class meetings is required. **You are allowed three unexcused absences. A fourth unexcused absence will result in an “F” for the course.** Excused absences for circumstances such as illness, personal/family emergency, academic/professional commitments, etc. must be documented via an email to Dr. Strain. Student athletes may provide scheduled absences for athletic events per usual methods.

Policies (Note: Policies may be revised during the term at the instructor’s discretion)

1. You are responsible for all material, whether covered in class or as part of an assignment.

2. If you miss a class, you are responsible for obtaining any material covered in class.

3. You are expected to come to class prepared and to participate actively in class. This participation may include, but not be limited to, explanation or demonstration of concepts, in-class problem solving, or discussion of assignments. Volunteers for participation may be solicited, or you may be called upon.

4. There will be regular assignments, and many of them will be collected and graded. You are expected to complete and understand all assignments, whether they are graded or not.

5. Except when collaboration and teamwork is specifically encouraged or required, any work submitted for a grade must be your own original work. Working together on homework is certainly acceptable, but each person must work through the problem individually. Do not simply copy someone else’s solution.

6. Homework assignments must be turned in by the due date in eCourseware. Assignments cannot be submitted by email. No late assignments will be accepted.
7. No make-up exams will be given. If your absence from an exam is officially excused (documentation required), an alternate exam time may be scheduled at the discretion of the instructor. A grade of zero will be assigned for a missed exam in all other cases.

8. Make-up lab assignments will be given at the discretion of the instructor(s).


10. You are responsible for determining the availability of the computing resources used in this class and for scheduling your work accordingly.

11. You must fully comply with all university guidelines and applicable laws regarding the use of computing facilities and software that may be provided for this course.

12. Please show up on time for class. Attendance is taken at the beginning of class and if you are not present, you will be marked as absent.

13. These policies may be revised or augmented as required during the term.

**Academic Integrity**
The University of Memphis expects all student to behave honestly. The Code of Student Rights & Responsibilities explains what constitutes a violation of our Academic Integrity policy. Please see the website for more information: [https://www.memphis.edu/osa/](https://www.memphis.edu/osa/). Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students who violate the academic misconduct policy, either directly or indirectly, through participation or assistance, are immediately responsible to the instructor of the class in addition to other possible disciplinary sanctions which may be imposed through the regular institutional disciplinary procedures.

**COVID-19 Health and Safety Policy - Masks and Social Distancing**
All students, faculty and staff will wear masks in all public spaces, including our classroom (lab) per the COVID-19 policy. The first time a student enters a classroom without wearing a face covering, the student will be asked to leave the class until they return a covering. Further violations will be referred to the Office of Student Accountability. Students who repeatedly or flagrantly violate these community expectations may be referred for discipline under the Student Code and, if appropriate, immediately removed from campus by the Dean of Students.

**Student Health**
Students who are experiencing symptoms such as sneezing, coughing or a higher than normal temperature should inform me by email so they can be excused from class and should stay home. Students should contact their health care provider or the Student Health Center at https://www.memphis.edu/health/. Students who have a positive COVID-19 test should contact the Dean of Students at deanofstudents@memphis.edu.

**Student Accommodations**
Students with accessibility issues or learning accommodation issues due to a disability should contact Disability Resources for Students (DRS) to submit an official request for course accommodations. Contact DRS at 901.678.2880 or at drs@memphis.edu. ([https://www.memphis.edu/drs/index.php](https://www.memphis.edu/drs/index.php)). If and when we return to class, students seeking to remain remote for health or other serious reasons should discuss their options with me.

**Student Resources**
Students who need additional resources can contact the Dean of Students Office at [https://www.memphis.edu/deanofstudents/crisis/index.php](https://www.memphis.edu/deanofstudents/crisis/index.php).
## TENTATIVE Schedule (likely to be changed; consult in-class and eCourseware announcements for confirmed dates)

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reference</th>
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<tbody>
<tr>
<td>January</td>
<td>20 Introduction, Vocabulary, Excel/MATLAB Primer/Review</td>
<td>King &amp; Mody 3.1-3.2</td>
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<tr>
<td></td>
<td>25 Exploring and Summarizing Data, Part 1: Descriptive Stats and Tables</td>
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<tr>
<td>February</td>
<td>1 Exploring and Summarizing Data, Part 2: Frequency/Bar Charts/Boxplots</td>
<td>King &amp; Mody 3.5.4-3.5.5</td>
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<td>3 Normal Distribution, Z-statistic and Confidence Intervals</td>
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<td>8 <strong>EXAM 1</strong> Descriptive stats, tables, graphs</td>
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<td>10 Normal Distribution, Z-scores</td>
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<td>15 Confidence Intervals Part 1</td>
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<td>17 <strong>Lab 1 - Pipetting lab</strong></td>
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<td>22 Review Pipetting Lab Data &amp; Exploring and Summarizing Data, Part 2: Frequency/Bar Charts/Boxplots (cont'd)</td>
<td>King &amp; Mody 3.5.5-3.5.6</td>
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<td>24 Confidence Intervals (cont'd) &amp; Central Limit Theorem</td>
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<td>March</td>
<td>1 Homework 4 &amp; Confidence Intervals Review</td>
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<tr>
<td></td>
<td>3 <strong>EXAM 2</strong> - Normal Curves, Confidence Intervals, Central Limit Theorem</td>
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<td>10 <strong>Lab 2 – Electrochem Sensor for Acetaminophen– Part 1 - Data Collection</strong></td>
<td>Wellness break March 8-9</td>
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<td>15 <strong>Lab 2 – Electrochem Sensor for Acetaminophen– Part 2 - Data Analyses</strong></td>
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<td>17 Hypotheses and Experimental Design</td>
<td>King &amp; Mody 4.1-4.2</td>
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<td>22 Hypothesis Testing, p-value and Error</td>
<td>King &amp; Mody 4.2.2-4.3.2</td>
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<td>24 Types of data, Normality plots</td>
<td>King &amp; Mody 4.3.3-4.4</td>
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<td>29 Z-tests</td>
<td>King &amp; Mody 4.5</td>
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<td>31 <strong>Lab 3 – Hydrophilic Characterization of Biomaterials and Protein Adsorption</strong></td>
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<td>April</td>
<td>5 T-tests</td>
<td>King &amp; Mody 4.6</td>
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<td>7 T-tests (cont’d) and 2-mean Confidence Intervals</td>
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<td>12 <strong>EXAM 3</strong> – Hypotheses, Experimental Design, p-value, and Z-tests</td>
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<td>14 ANOVA and Post-hoc Tests</td>
<td>King &amp; Mody 4.8</td>
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<td>19 ANOVA and Post-hoc Tests (cont’d)</td>
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<td>21 Non parametric Tests</td>
<td>King &amp; Mody 4.10</td>
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<td>26 Review</td>
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<td>May</td>
<td>5 <strong>Final</strong></td>
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