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2023

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

Stephen Strain  
*University of Memphis*

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**Hello! I am Dr. Strain.** Welcome to BIOM 2720. We will meet in ES 311. Please feel free to contact me with any questions, concerns, etc. that you might have.

**I look forward to hearing from you!**

For class business, use University email only—I cannot record verbal discussions after class, so if, for instance, you have an issue with attendance or assignment due dates, send an email. Do not send messages through other students, but communicate directly with me by email. My address is [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu). Please include “BIOM 2720” in the subject line when you write.

### **Instructor**

Dr. Stephen Strain

[sfstrain@memphis.edu](mailto:sfstrain@memphis.edu)

Office: ET308

Virtual Office: <https://memphis.zoom.us/j/3271381594?pwd=VW9FYThrS293d0FwYUZ2TVFyeVJLdz09>

Office hours: Monday-Wednesday 2:15-3:30P, or email for appointment

**Teaching Assistants:** Shannon Wallace ([swllace8@memphis.edu](mailto:swllace8@memphis.edu))  
Solomon Mesfin ([shmesfin@memphis.edu](mailto:shmesfin@memphis.edu))

**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 ENGR 1010.

This course is required for the Biomedical Engineering Degree Program.

### **Required Materials:**

- Internet Access
- Desktop Computer, Laptop, or Tablet
- Canvas ([memphis.instructure.com](https://memphis.instructure.com))

University resources to support online learning:

<https://www.memphis.edu/uofmglobal/students/online-intro.php>

### **Textbook (optional)**

*Numerical and Statistical Methods for Bioengineering: Applications in MATLAB*, MR King, NA Mody, Cambridge University Press, Cambridge, UK, 2011

**A personal computer is required. A laptop with MS Windows 10 or higher is highly recommended.**

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

**A free MATLAB download is available for UM students through the university's site license at**  
<https://www.mathworks.com/academia/tah-portal/university-of-memphis-40714972.html>

**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**

Competencies for this course have been established by the Biomedical Engineering department, as these skills will be required for all future BME courses. Detailed guidance on how to achieve these competencies will be provided during this course. Students should strive to assume personal responsibility for reaching these important learning goals for the course.

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 (see above) will be evaluated and graded as part of submitted lab reports.

Letter grades will be determined as below, with plus/minus modifiers for A, B, or C grades and plus modifier for D grade. Modifiers (eg A+ or C-) 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**

In order to be successful in this class, attendance is MANDATORY. You are allowed at most three unexcused absences.

If you have a health condition that prevents you from regular class attendance, you MUST register with Disability Resource Services (see **Student Accommodations** below) and contact me to discuss an alternative plan ASAP.

- 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.**
- Absences will be excused **at my discretion** 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. Email me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu) if you wish an absence to be considered for excusal.

### **Honors Section**

If you are enrolled in BIOM 2720-350, you are in the Honors section. If you are enrolled in BIOM 2720-001, you are enrolled in the regular (non-Honors) section. Honors students must complete the course

requirements listed above as well as an additional activity that will be assigned towards the end of the term. The assignment will be graded on a pass-fail basis. If the honors assignment is not completed or if it receives a failing grade, the maximum final grade in the course will be B-.

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

1. Attendance is **REQUIRED**. See above for attendance policy.
2. You are responsible for all material, whether covered in class or as part of an assignment.
3. If you miss a class, you are responsible for obtaining any material covered in class.
4. 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.
5. I will often use Zoom to record a class lecture, but this is **NOT** for remote attendance. Unless university policy changes, you must attend class face to face. For questions, contact me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu).
6. 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.
7. Except when collaboration and teamwork is specifically encouraged or required, any work submitted for a grade **must be your own original work**. Do **NOT** share files or copy/paste from the work of others. Working together on homework is certainly acceptable, but each person must work through the problem individually. Do not simply copy someone else's solution.
8. Assignments must be turned in by the due date in Canvas. All assignments must be submitted via Canvas unless otherwise stated—I cannot accept assignments by email. You may contact me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu) regarding late assignments. Based on our communication, and at my discretion, I may decide to accept a late assignment. However, if I am not contacted, if the lateness is part of an ongoing pattern, or for other reasons as I may deem applicable, I will not accept it. In cases where late acceptance is not granted, the late/missing assignment will receive a grade of zero.
9. No make-up exams will be given. If your absence from an exam is officially excused (documentation required), an alternate exam grade (eg final exam grade) will be substituted for the missing exam. A grade of zero will be assigned for a missed exam in all other cases.
10. Academic dishonesty of any form will not be tolerated. See the "Code of Student Rights & Responsibilities" in the Student Handbook (<http://www.memphis.edu/saos/pdfs/csrr.pdf>) for further details.
11. You are responsible for determining the availability of the computing resources used in this class and for scheduling your work accordingly.
12. 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.
13. 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.
14. 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/>. 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.

**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>.

**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](mailto:drs@memphis.edu). (<https://www.memphis.edu/drs/index.php>).

**Student Resources**

Students who need additional resources can contact the Dean of Students Office at <https://www.memphis.edu/deanofstudents/crisis/index.php>.

**TENTATIVE** Schedule (likely to be changed; consult in-class and Canvas announcements for confirmed dates)

Date		Topic	Reference
January	18	MS Word Demo, begin Exploring and Summarizing Data, Part 1: Descriptive Stats and Tables	
	23	Exploring and Summarizing Data, Part 1 (cont'd): Descriptive Stats and Tables	King & Mody 3.1-3.2
	25	Exploring and Summarizing Data, Part 2: Frequency/Bar Charts/Boxplots	
	30	Exploring and Summarizing Data, Part 2 (cont'd): Frequency/Bar Charts/Boxplots	
February	1	ICE STORM	
	6	From Data to Inference, Probability Models	
	8	Normal Distribution, Z-scores	King & Mody 3.5.4-3.5.5
	13	Confidence Intervals	King & Mody 3.5.5-3.5.6
	15	Confidence Intervals (cont'd) & Central Limit Theorem	King & Mody 3.5.5-3.5.6
	20	<b>EXAM 1</b> Descriptive stats, tables, graphs	
	22	Homework 3 Review & Confidence Intervals Review (Prep for HW4)	
	27	Hypotheses and Experimental Design	King & Mody 4.1-4.2
March	1	Tylenol Lab – Preparation/Discussion	
	6	<b>SPRING BREAK</b>	
	8	<b>SPRING BREAK</b>	
	13	Hypothesis Testing, p-value and Error	King & Mody 4.2.2-4.3.2
	15	Types of data, Normality plots	King & Mody 4.3.3-4.4
	20	Z-tests	King & Mody 4.5
	22	Z-tests (cont'd)	King & Mody 4.5
	27	T-tests	King & Mody 4.6
	29	<b>EXAM 2</b> - Normal Curves, Confidence Intervals, Central Limit Theorem	
April	3	T-tests (cont'd) and 2-mean Confidence Intervals	King & Mody 4.6
	5	ANOVA	King & Mody 4.8
	10	ANOVA (cont'd)	
	12	Post-hoc Tests	King & Mody 4.8
	17	Post-hoc Tests (cont'd)	
	19	Non-parametric Tests	King & Mody 4.10
	24	Non-parametric Tests	
	26	<b>Review for Final Exam</b>	
May	3	<b>Final</b> 10:00a – 12:00p	<b><u>CUMULATIVE</u></b>