

# **BME 5703 Statistical Methods for BME**

Fall, 2021

Tuesday: **MSB 6120** 10:40 AM - 11:30 AM

Thursday: **MSB 2-200** 10:40 AM - 12:35 PM

## **Catalog Description:**

This course covers statistical methods needed for experimental biomedical engineering research. Students will be acquainted with a variety of techniques for analyzing and modeling data arising in molecular, cellular, physiological, and pathological systems encountered in typical laboratory and clinical settings.

**Credits: 03**

## **Prerequisites and Expectations:**

Knowledge of linear algebra and basic statistics is required. A previous course in statistical methods is expected, but not explicitly required.

On the 1<sup>st</sup> day, a pre-requisite quiz will be provided. If your performance on the pre-requisite quiz is not in the high A range and/or your understanding of the review material is deficient, it is imperative that you catch up quickly. The course is predicated on a basic knowledge of statistics and will not be diluted to an undergraduate level. Additional material (see Section 0) is provided to assist in this process, but it is incumbent upon the student to manage and execute that process.

Prior experience with programming is expected. Section 1 is focused on foundational R programming using the tidyverse framework and data visualization methods therein. Please take Section 1 seriously as all subsequent projects and homework will rely heavily on the knowledge developed therein. As above, our expectation is that graduate students in engineering will have foundational knowledge of programming principles (i.e., common variable structures, typing, control structures, functions, etc.). Students who do not have a solid foundation with computing and programming language(s) are expected to catch up during Section 1.

Students are expected to have a computer capable of running the required statistical software and to have internet access. Be aware that, especially if you use a VPN, firewall, pi-hole, etc., you may run into connectivity issues with CRAN or LaTeX repos. Special or complex OS/software configurations are the student's responsibility to overcome. The tools and frameworks we will use reliably work on MS Windows, OSX and various Linux distros.

## **Course Information:**

**Instructor:** Damon G. Lamb, Ph.D.

**Office:** Zoom/virtual and MBI L4-116

**Office Hours:** MBI L4-101 Tuesday Noon-1pm; Thursday 1-2pm and by appointment

**Email:** Via Canvas or [dlamb@ufl.edu](mailto:dlamb@ufl.edu) (Please include BME5703 in the subject line in order for your email to be caught and organized by my email filters. Failure to do this may delay my response by several days or even weeks!)

**Supervised Teaching Student:** Robert Claar

**Office:** Zoom/virtual

**Office Hours:** By appointment

**Email:** Via Canvas or [robert727@ufl.edu](mailto:robert727@ufl.edu) (Please include BME5703 in the subject line in order for your email to be caught and organized by my email filters. Failure to do this may delay my response by several days or even weeks!)

## **Class Meeting:**

The philosophy is ‘see it, do it, test it’. We dedicate significant portions of class time to practice executing and thinking about the material. As such, students must come prepared to engage fully by completing all assigned reading, practicing on their own, proactively completing homework assignments. Please silence phones, log out of email, and avoid using any applications or webpages which are not directly relevant to the course and material in consideration for that day.

- Tuesday Period 4 (10:40 AM - 11:30 AM) **MSB 6120**
- Thursday Periods 4-5 (10:40 AM - 12:35 PM) **MSB 2-200**

## **Required Textbook, Documentation and Software (free):**

- *R for Data Science* by Wickham and Grolemund, <https://r4ds.had.co.nz/> (free online)
- *A Layered Grammar of Graphics*, Wickham <http://vita.had.co.nz/papers/layered-grammar.pdf>
- R version 4.0.2 (64 bit preferred) <https://cran.r-project.org/>
- RStudio Desktop/Free version 1.3.1056 (or more recent) <https://rstudio.com/>
- A LaTeX compiler, e.g. MikTeX or MacTeX or TeXShop
- The tidyverse documentation (<https://www.tidyverse.org/>) especially the cheat sheets and reference sections for each subcomponent, e.g. <https://ggplot2.tidyverse.org/reference/index.html>.
- R Markdown documentation (<https://rmarkdown.rstudio.com/>)

## **Resources and Recommended Texts (not necessarily free, but not required):**

- Statistics
  - *Applied Regression Analysis and Generalized Linear Models*, John Fox
  - *A second course in statistics: Regression analysis*, Mendenhall and Sincich
- Data Visualization
  - *The Grammar of Graphics*, Wilkinson
  - *The Visual Display of Quantitative Information*, Tufte
  - *Beautiful Evidence*, Tufte
- R language and libraries
  - RDocumentation <https://www.rdocumentation.org/>

Introductory texts if you need to brush up on the basics

- *A Concise Guide to Statistics – Ebook*, Hans-Michael Kaltenbach
- *Statistics for Non-statisticians – Ebook*, Birgir Madsen

## Anti-resources (Not Recommended):

Dr. Google, stackoverflow, stackexchange, Quora, etc., can be very useful resources; however, there are risks to relying on these resources. The most significant is that you will find many, many simply wrong answers, or answers which will lead you astray but are technically correct within their scope. This situation is exceptionally common in this course: the context matters to the statistics you are running. Furthermore, these tools have changed and evolved over time; some old solutions no longer even functional (code will not run), or are since proven to be incorrect.

Finally, the R community is large and there are almost countless libraries which may help you achieve all manner of objectives. This can be great for research, but we simply cannot manage all possible R solutions for a class of this size. It is brutal on our graders and us when you venture outside of the libraries we are using. To keep this course focused, and to ensure you build a solid foundation, we are limiting the libraries and approaches you may use in the context of this course. If you venture outside of these libraries without approval, it will negatively affect your grade.

## Important Teaching Philosophy Note:

This is a graduate level course. Graduate students are expected to be highly motivated, proactive, and engaged participants in their continued education. It is important that students take a leading role and make a major effort to further their education—to be deliberate and intentional learners. Please engage in the forums, in class discussions, office hours, and other avenues that we provide to communicate, teach, and mentor.

In addition, it is impossible to cover all of statistics for BME in a single semester. Our broad goal is to ensure all students are prepared with fundamentals of both the statistical theory and application of some of the most common statistics techniques. This is to prepare students to extend into new domains of data analysis to meet the challenges they will face in their graduate training and beyond (see our data science, machine learning, and other related classes).

## Format and Grade Determination:

This class is intended to focus on applied statistics with an emphasis on HOW things are done with a reasonable theoretical framing. In class activities will be given to test a student's understanding of these principles; homework will be given to test a student's ability to apply those principles; projects will be assigned to identify a student's ability to explain choices and interpretations of complex data.

Grade Breakdown

60% Homework

30% Projects

10% Class Participation / In-class activities. Note: attendance is not sufficient for participation. This category will consist of in-class problems, discussions, problem-based-learning assignments, quizzes, or other activity during the scheduled course time. Attendance will not be taken, but if you fail to show up to class, you will miss opportunities to get participation credits, see attendance policy below.

## Grading Scale

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
90.0-100	87.0-89.9	84.0-86.9	81.0-83.9	78.0-80.9	75.0-77.9	72.0-74.9	69.0-71.9	66.0-68.9	63.0-65.9	60.0-62.9	0-59.9

N.B: We will round your grade to the nearest tenth of a point; then, your letter grade will be assigned based on the above table. We very rarely curve grades, but reserve the right to do so at our discretion. Typically, if the majority of the class is unable to answer a question, we will review the question and throw it out if it was unnecessarily difficult or confusing.

## Course Policies:

### Policy on Working Together and Group Work:

As peer-to-peer learning enhances learning, students are highly encouraged to ask general questions both in class and through the canvas discussion boards and are explicitly directly expected to work together for the final project. However, with the exception of group projects, work that is handed in for grading must be the individual's work. Direct copying is against the honor code of this institution and is not allowed. If identified, all students involved—those that copied and those that allowed the copying to take place—will receive a grade of zero and will be reported to the university for review.

To facilitate questions, we will set up Canvas discussion boards. Questions should be posted on Canvas to the relevant discussion (e.g., homework 1 questions under homework 1). Questions should be well structured and students should endeavor to use the provided resources prior to asking their questions. Students are highly encouraged to both ask and to answer questions from other students, and may be rewarded with up to 3 bonus points (3%) on each homework assignment for providing good answers on Canvas. These bonus points will be assigned at the discretion of the professors. Good answers provide the thought process behind and analysis of the issue at hand, as well as steps to achieve an objective or goal including appropriate references to the relevant documentation. Answers should not merely consist of code or a numerical answer (with rare exceptions).

On the final project, working together is defined as each and every student contributing intellectually to all sections of the report. Every student should be able to explain or recreate on their own the entirety of the final project. Dividing the work amongst the group is strictly against the intent of this policy. Work with and be fair with your group. Strive to be neither a martyr nor slacker. The report will be graded for the team as a collective; however, a survey of group dynamics and the effort of your teammates will be part of the assignment.

### Policy on Attendance

We expect students to attend the class regularly. However, attendance in class is not strictly required for full credit in the participation section of the course. Absences do need to be excused by the professors—please ask. We understand that, in this environment, you may have additional constraints to manage. Conferences, complex experiments, and other research demands are a high priority during your graduate career. Review your semester schedule and work with us well in advance of any known or planned conflicts. We will work with you to the best of our ability, but we also need to respect the training that we've been tasked to provide to the students in our department and college. As such, we expect students to be in class, ready to learn, engaged, and overall contributors to the learning environment. This is clearly not possible if you cannot regularly attend class.

### Policy on the Course Evaluation

Part of our job as instructors is to constructively evaluate you as a student. Part of your job as a student is to constructively evaluate us as instructors. The only metric we can see before grades are due is percentage of the students that evaluated the course—we cannot see scores, comments, or any other content until grades are submitted. Thus, you should write your honest, constructive opinion of the course. We value this feedback and this feedback is used by our department, college, and university.

### Policy on Late Coursework

Turn in your work early and ensure your submission is complete. Unless *prior arrangements* have been made with an instructor, students will be deducted 15% (i.e., 1.5 letter grades) per day (24h) for late coursework, with deductions occurring at the time associated with the due date. E.g., If the due date is Sunday at 23:59 and you turn in Monday at 1:00, your grade will be reduced by 15%. If you turn in an assignment 24.001 hours after the due date and time, your grade will be reduced by 30% (3 letter grades!). There is neither penalty nor bonus for

early submission. **If you are sick**, please contact the instructor as soon as is reasonable. With proper documents from health professionals, we will can reverse this policy.

## **Policy on Grade Corrections**

**Students have 1 week after receiving a grade to challenge errors or grading mistakes.** 1 week after students have been informed of their grade, the grade will become final and will not be changed. Do not wait for the end of the semester; we will not adjust your grade for assignments that are beyond this deadline!

**To challenge a grade:** Students must attach a cover page to the front of the assignment, explaining what they want to be re-graded. We may make mistakes when grading, and we will gladly correct those errors, but we will not participate in verbal debates over grades. We will regrade when we have adequate time, space, and focus to assess the issue. We also reserve the right to re-grade the entire assignment, if needed. Again, mistakes can and will occur—we all make them—and they may be either a benefit or detriment to your grade. **This policy is strictly enforced—no exceptions.**

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

## **Campus Resources:**

### Health and Wellness

#### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](mailto:title-ix@ufl.edu), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.