Instructional team contact information:

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Meeting link: TBD
Office hours: TBD
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Course Teaching Assistants:

TBD

Course structure:
Course webpage: We will use Canvas® for communication and posting information. Please check canvas regularly, we will post EVERYTHING course related there.
Course MS teams: For office hours and also synchronous remote sessions we use this site. You can find the link here: TBD.

Class format:
Synchronous remote sessions: for some class sessions (marked in your class schedule), the class meets synchronously via MS teams (TBD) Participation in these sessions is required and all activities will be graded. Please see the course schedule for the list of synchronous remote sessions.
Hybrid sessions: In hybrid format of class, 50% of class population will meet in person in our lecture hall. You will be assigned to section A or section B. The lectures are pre-recorded, and the videos will be available on canvas so the not participating section can watch them synchronously or asynchronously. Pre-recording of lectures seemed to be more effective in comparison of the live broadcasting of the classroom. The students who are participating in the in-person session, will participate in some class activities. Please check the course schedule for the list of hybrid sessions.

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Schedule

Note: All assignments must be submitted via Canvas unless otherwise noted.

Wk	Content	Assignments Due
1	Course Introduction, Data Collection, Types of Data, Population vs. Sample, excel	Homework 1
2	Probability, Random Variables, Sampling, Distributions, Descriptive Statistics	Homework 2
3	Bayes theorem, Bayes formula, sensitivity, specificity, and implications	Homework 3
4	Revisiting distributions, excel skills development, research questions, guest speaker	Homework 4 / Test 1
5	fundamentals of hypothesis testing, degrees of freedom, t-tests and their many variations	Homework 5
6	ANOVA's and Z-tests	Homework 6 / Project 1
7	goodness of fits and non-parametric, data visualization, project check-ins and sharing	Homework 7 / Test 2
8	Correlation, regression, multiple regression, logistic regression	Homework 8
9	sample size, effect size, power, confidence and prediction intervals	Homework 9
10	Putting it all together, data management, wrap-up, flex time	Homework 10 / Project 2
Exam Week		Test 3

Health and safety:
Each of us has a responsibility to ourselves and our fellow Yellow Jackets to be mindful of our shared commitment.

We are all required to wear a face covering while inside any campus facilities/buildings, including during in-person classes, and to adhere to social distancing of at least 6 feet. If an individual forgets to bring a face covering to class or into any indoor space, there will be a clearly marked supply of these in each building. If a student fails to follow Georgia Tech's policies on social distancing and face coverings, they will initially be reminded of the policy and if necessary, asked to leave the class, meeting, or space. If they still fail to follow the policy, they may be referred to the Office of the Dean of Students. Information on the Institute's policy on face coverings.

Students are expected to sit in assigned seats and to come to class only on days that are assigned to them. Papers, projects, tests, homework, and other assignments will only be accepted in electronic form unless the assignment is a physical artifact. Additional information is available in the Student Guidebook. Please see the following link for institute's instruction:
 https://health.gatech.edu/coronavirus/campus-guidelines

Instructor Illness or Exposure to Covid-19: During the fall 2020 semester, some faculty members may be required to quarantine due to exposure or isolate due to a Covid-19 diagnosis. Some disruption to classes or services is inevitable, but Georgia Tech is making every effort to ensure continuity of operations. As is the case in any semester, faculty may cancel a class if they have an illness or emergency situation and cover any missed material at their own discretion. If an instructor needs to cancel a class, they should notify students as early as possible.

Student Illness or Exposure to Covid-19: During the semester, you may be required to quarantine or self-isolate to avoid the risk of infection to others. Quarantine is the separation of those who have been exposed to someone with Covid-19 but who are not ill; isolation is the separation of those who have tested positive for Covid-19 or been diagnosed with Covid-19 by symptoms.

If you have not tested positive but are ill or have been exposed to someone who is ill, please follow the Covid-19 Exposure Decision Tree for reporting your illness.

During the quarantine or isolation period you may feel completely well, ill but able to work as usual, or too ill to work until you recover.

Remote courses and remote class sessions during hybrid courses. Unless you are too ill to work, you should be able to complete your remote work while in quarantine or isolation.

In-person courses and in-person class sessions during hybrid courses. When in isolation or quarantine you will be unable to attend in-person course sessions but your instructor may require you either to participate in the course remotely, complete some complementary work that parallels what you are missing in class, or make up some class work when you return.

If you are ill and unable to do course work this will be treated similarly to any student illness. The Dean of Students will have been contacted when you report your positive test or are told that it is necessary to quarantine and will notify your instructor that you may be unable to attend class events or finish your work as the result of a health issue. Your instructor will not be told the reason. We have asked all faculty to be lenient and understanding when setting work deadlines or expecting students to finish work, and so you should be able to catch up with any work that you miss while in quarantine or isolation. Your

instructor may make available any video recordings of classes or slides that have been used while you are absent, and may prepare some complementary asynchronous assignments that compensate for your inability to participate in class sessions. Ask your instructor for the details.

CARE Center, Counseling Center, Stamps Health Services, and the Student Center: These uncertain times can be difficult, and many students may need help in dealing with stress and mental health. The CARE Center and the Counseling Center, and Stamps Health Services will offer both in-person and virtual appointments. Face-to-face appointments will require wearing a face covering and social distancing, with exceptions for medical examinations. Student Center services and operations are available on the Student Center website. For more information on these and other student services, contact the Vice President and Dean of Students or the Division of Student Life.

Technology and platforms:
The use of following technologies and platforms are **required** during our class:
Canvas: We will use canvas for official announcements, direct communication, sharing assignment files, test files, sharing supplementary materials, posting and submission of all graded assignments, grade reporting, and sharing of links to instructional videos and demo session recordings. Please make sure you check the Canvas website and familiarize yourself with all of its features.

Turning point: You are expected to participate all during-class activities in both remote and in person sessions. Often this will include participating in a "Turning Point" quiz or survey. You can access Turning Point both from your canvas website and the Turning point application. You should create an account or activate your existing account in this application, before the first day of classes. When the instructors ask you to participate in a class activity, you should enter the session code in your application, and then participate in the class activities. Please contact the in-class TAs if you have faced any error while you are dealing with the Turning point.

Microsoft Teams: MS Teams is the platform that we are using for our synchronous remote sessions. Your PSS problems for each week and the plan for that PSS session can be found in MS Teams general channel files section. You will find multiple channels in your section's MS Teams site. We will start each PSS session with everyone in that section participating a video meeting in the General channel. This is where the plan for that day's PSS session will be shared and section-wide surveys will be administered. Often, you will then be asked to go to your team's channel (you will receive an email about the name of your table group). You will receive a set of instruction for how to set up your MS Teams site by the first day of class, including how you should turn on the notifications of the general channel in your MS Teams application. You are expected to be present, with your video not muted, in all video calls held during the PSS session. If you face any issues, you should contact the TAs immediately via MS Teams chat section.

OneNote: We will have a class OneNote notebook and within that you will have a notebook section for your group. All the instructions for the PSS session can be found in the class OneNote. Also, you are responsible to update your group's notebook section. We suggest you create one section for each PSS session, and within that section create one page for each problem or activity that you do in the PSS session. During PSS we will periodically join your group to discuss your work. You can also request us to join. To request that we visit your team, mention us in your table group channel by @PROFESSOR_NAME (or TAs name).

HonorLock: All the exams will be taken synchronously at the designated time based on the class schedule. We will use HonorLock as our proctoring application. All students must have a designated private place to take the quiz or exam, reliable internet, a laptop or desktop with a webcam and microphone, and a smart

phone that you can scan your work with at the end of the exam and post it to Canvas. To start the exam or quiz with HonorLock you need have your Buzzcard ready for authentication.

Audio and video set up: Please always have your webcam on. Please mute our microphone during entire section discussions but unmute when you are participating in discussions with your PSS team (of four students).

Browsers and internet connection: You need to make sure you have internet connection during demo sessions and PSS sessions. Since some of the activities require your fast response, make sure you contact your TAs the moment you face any difficulties. You must use Chrome when using HonorLock, and you must install the HonorLock Chrome extension. In addition, we've found Chrome is the most reliable browser when it comes to work with the technologies described here.

Textbooks:
Required: Engineering Biostatistics: An Introduction using MATLAB
URL for a FREE PDF copy: http://statbook.gatech.edu/statb4.pdf

Software support:
The course will require the use of Microsoft Excel or another spreadsheet tool that allows iterative solutions (PRIMARY) and MATLAB (SECONDARY).

Prerequisites: (Undergraduate Semester level MATH 1501 Minimum Grade of C or
Undergraduate Semester level MATH 1511 Minimum Grade of C or
Undergraduate Semester level MATH 1552 Minimum Grade of C) and
Undergraduate Semester level CS 1371 Minimum Grade of D

Course description:
This course is a biomedical engineering specific introduction to statistics, probability, and inference. It is also an introduction to the related skills that are needed to employ statistics, probability, and inference in biomedical engineering contexts. It is primarily concerned with the use of statistical tools for modeling, analysis, and (MOST IMPORTANTLY) making sense of data in biomedical engineering research. The primary focus is practical and applied rather than theoretical but will be theoretical when such understanding is necessary to properly understand the methods covered. Basically, it is an engineering course. Closer to 2110 and 2250 than to whatever flavor of calculus you took.

Concepts list
- Data, data types, and descriptive statistics
- Distributions as models for observations
- Normal and other distributions
- Estimation and testing statistical hypothesis
- One- and Two-way ANOVA.
- Some non-parametric procedures
- Tables and Chi-Square Theory
- Linear and Logistic correlation and regression
- Statistics in scientific journalism and the media

Course learning objectives:
Core
- Translate real life inferential problems to proper statistical models.
- Use Bayes theorem in the context of medical testing: sensitivity, specificity, positive predicted value, and ROC curves.
- Identify and employ basic probability tools to assess frequencies or likelihood of occurrence of independent and dependent events.
- Perform the following statistical test: T-test, ANOVA, Z-Test, Regression, Correlation, Multiple Regression, Non-parametric tests, Chi-square tests
- Formulate, formally state, and identify appropriate tests to serve research goals
- Summarize and describe data, identify parameters and calculate their point and interval estimates.
- Make meaning from statistical tests

Complementary
In addition to the core learning objectives, we have a set of 'complimentary' learning objectives that round out the core learning objectives to ensure comprehensive preparedness of young engineering-statisticians. These include:
- Read, interpret, and validate statistical analysis in BME papers and media
- Prepare professionally appropriate reports on data analysis
- Make and execute data collection and analysis plans
- Work effectively in teams

Policies and expectations for our learning environment:
This section details the overarching policies, expectations, and guidelines we ask all members of the course community to participate in. They apply equally to the every member of the instructional team and all of the students.

Diversity, inclusion, and equity
We want our classroom to be a place where you, and everyone else, are treated with respect. Our class will welcome individuals of all backgrounds, beliefs, and identities both visible and invisible. All members of this class are expected to cooperate in the creation of a respectful, welcoming, and inclusive environment for every other member of the course. If there are things the teaching team or others have done to degrade that environment we encourage you to bring them to my attention and we will work to correct them.

Basic needs statement
Any student who has difficulty affording or accessing sufficient food to eat every day or who lacks a safe and stable place to live, and believes this may affect their performance in the course, is urged to contact the Dean of Students for support and direction to available resources. Furthermore, if you are comfortable doing so, please talk to me. This will enable me to direct you towards any resources that we are aware of or that are within my control. While we strongly believe in the importance of education, we also believe that your success in this course is contingent on having your basic personal safety and needs met. Research has shown that addressing these issues are necessary precursors to effective learning. They are also personally important to me because we are all human beings first.

Disability and accommodations
We all need some accommodations in education because we each learn differently. If you are a person with circumstances that you believe may affect your learning experience (e.g., visual, hearing, learning disabilities) please let me know as soon as possible so that we can collaborate on appropriate

accommodations. You should also contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your needs and to obtain an accommodation letter.

Preferred name / pronouns
We will gladly use an alternate name or gender pronoun of your choice. Please advise a member of the teaching team of this preference as early as possible so that we may make appropriate changes to our records. At your preference, we will do so privately and/or publicly.

Collaboration and group work policy
Each assignment is explicitly indicated as either collaborative or individual work. If you are unclear about the definitions or boundaries of academic misconduct in regards to individual or academic work, it is explicitly your responsibility to seek clarification in advance.

Individual assignments should be your own work. What that means is that the intellectual output should be yours and yours alone, in your words, completed by you and you alone. On individual assignments, learning or getting help from peers is acceptable – submitting others' (in or out of this class) work, in part or whole, as yours is not. If, under this policy, you have questions on or need help with appropriate citation of others' work, just ask.

For collaborative assignments, we expect all group members to participate in the intellectual labor of assignments. Students choosing not to effectively and meaningfully collaborate on such assignments should not expect to receive credit for the work of their teammates.

Academic integrity
Academic misconduct, including plagiarism and completing others' work for them, hurt you and your classmates and will not be tolerated in this course. Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards and Tech's Academic Honor Code (http://www.catalog.gatech.edu/policies/honor-code/).

As a member of the Georgia Tech community, we assume that you have read and understood the Academic Honor Code. By rule, we am required to report any student suspected of cheating or plagiarizing on a quiz, exam, or assignment to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations. Specifically, we will submit any cases where there is significant evidence of academic misconduct and am then constrained to the results of that process.

Examples of honor code violations:
•   Using unauthorized notes or "cheat sheets" during an exam.
•   Looking at another individual's exam while the test is in progress.
•   Communicating electronically (e.g., texting or surfing the web) during any exam.
•   Uploading to, or using course material from, content sharing websites such as coursehero.com
•   Completing a problem (HW or any other kind of problem) using a solution key prepared by someone else, regardless of where the solution key is acquired: from the publisher's website, from the course's CANVAS website, from a previous student, from content sharing websites, or from a textbook. Homework should be your original work.

Attendance Policy
Attendance and participation in class is expected. While we will post slides, they will not include any work on the board or the performance of any examples in class. Further, your presence in class not only supports your own learning and growth, it supports the learning and growth of your course peers and instructor as well. Every study that we are aware of shows a strong correlation between course attendance

and final grade. You will learn in this course that correlation is not causation, but it does point a flashing red arrow towards what may be the cause.

However, we also believe in treating you as professionals – because you are. Therefore, we will not be taking formal attendance. That being said, we will use multiple factors, including daily clicker questions and engagement in in class activities, to assign a grade for class participation. Part of your role in the course is helping your peers learn – both as a part of our community and because it helps you learn as well. That necessitates active engagement.

Finally, out of fairness to your classmates, we are hesitant to reschedule in class assignments such as tests. However, we are also empathic about the things that happen in your life. If you must miss an assignment please let me know as soon as possible so we can jointly work out a plan. It is helpful if you tell us in advance, and even more helpful if you propose a plan on how you want to make up the assignment. In the end, unless overridden by university policy, the decision is mine on how to address missed assignments. However, we are sympathetic.

Emergency Procedures
In the event of a fire alarm, everyone must immediately evacuate the building until given the all clear by the fire department. In the event of an all hazards siren, everyone should immediately seek shelter in a safe location. In both cases, you should solicit additional clarifying information by all possible means: Georgia Tech Homepage, TV, radio, email, etc. Additional information about campus preparedness is available at http://www.gatech.edu/emergency/

In the event of a major campus emergency, including severe weather, course requirements, deadlines, and grading totals we may need to revise the course. If that happens, we will work together to balance our learning objectives, constraints, and students' needs. Information about course changes related to campus emergencies will be made available via Canvas and will also be distributed via email as soon as is practical.

How to succeed in this course
The creation of the learning environment that we hope to have requires a set of expectations for how both the instructors and students will act. Therefore, we hope that you, and we, will do the following 5 shared things:
1.   Attend and fully engage in all classes
2.   Come prepared for class
3.   Be honest about what you understand, what you do not, and what you need help with
4.   Provide a supportive environment that fosters mutual success of everyone in our classroom
5.   Honor and respect each other and each other's interests

Based on my prior experience as an engineering student, engineer, and professor, I feel it useful to list some techniques that you may find helpful to succeed in the course I have found that the most successful students:
- Engage with the wide range of resources available to you on campus, including the Writing Center, Tutoring Center, and Academic Advising Center. (i.e., get help when you need it)
- Carefully document your work, thinking, and activities so that they become a resource when creating the deliverables for your assignments (i.e., keep detailed notes as you work)
- Start all deliverables early and create drafts that are thoughtful and intentional to structure your work and documentation (i.e., keep the goal in mind). This will allow you to step away from and come back to assignments to ensure they are complete and high quality.
- Think deeply about their intended learning outcomes of the course and their relation to your activities (i.e., remember why we are here)
- Be open to new ways of thinking about learning and thinking.

Office hours

It is important to us that you have a positive learning experience in this course. Your regular and active participation in office hours is a great way to help make sure this happens. Office hours are a scheduled opportunity for you to meet with your professor or teaching assistants one-on-one, or in a small group setting, to discuss course topics and concepts. In fact, feel free to chat with us about *anything* that interests you or concerns you. We want to help you have a good experience in this course and as a student at Tech – please give us the opportunity to do so by attending office hours!

Miscellaneous

- Parental inquiries. Based on the Family Educational Rights and Privacy Act (FERPA) (http://www.ed.gov/policy/gen/guid/fpco/ferpa/index.html), the performance of students in class and their grades cannot be legally discussed with the parents of undergraduate students.
- Email etiquette. Please only use your official Georgia Tech e-mail account. To help ensure a speedy response to your email, please use a subject line with the below format: BMED2400- *your name - reason why you are writing*.
- If any class meetings conflict with a religious event, please let us know during the first week of classes

Assessments in this course

In an attempt to reduce the impact of any one assignment on your grade, we have spread out your grade over multiple assignments. This has its positives and negatives – e.g., we are conscious of keeping the workload of each individual assignment reasonable. The course assignments are as follows:

Assignment	Count	% Total	Notes
Homework	10	15% (1.5 % each)	Homework will typically be assigned on a Thursday and due the following Thursday. Will usually require excel and/or Matlab. They will each be scored out of 10 points. Based on feedback workload is being adjusted.
Tests	3	60% (20% each)	Midterms will cover content from the previous module (see colors in schedule). You will not be tested on something without a homework covering it first. Tests are open books, open notes, open internet, but not open classmate. They will each be scored out of 10 pts.
Projects	2	20% (10% each)	The project will consist of two parts. Both are individual assignments.
Course participation	N/A	5%	During the synchronous remote sessions, you will be asked to participate in some turning point surveys or Qualtrics surveys.
Extra credit	1	1%	**1% Bonus if >90% CIOS completion.** There <u>may</u> also be extra points on assignments.

Grading

Homework grading scale

Every worked homework problem will be graded on a 3 point scale as detailed below. The scale is meant to highlight the three key components of a working with statistical data. This section outlines the grading scheme and describes the components.

Setup – The first part of any statistical work is preparing yourself to do the math. In my experience, this is the area where most mistakes are made. During the setup you need to figure out precisely what question

you are asking, what data you have or need, what analyses you need to run, what your dependent and independent variables are, and what assumptions you are making implicitly and explicitly.

Calculation – With the setup complete, you need to actually run your analyses properly. That includes identifying correctly the formulas, selecting the right options for any formulas, calculating the results, and reporting the results. That includes things like arithmetic but also includes things like reporting the correct number of significant digits.

Interpretation – With the setup and the calculation in hand, you need to make sense of what you have found out. That includes synthesizing the results and communicating them to whoever is reading your assignment – e.g., stating whether a hypothesis was accepted or rejected or suggesting a decision based on your results. Just getting the calculation right isn't the end of the problem, you have to articulate what the answer means. Most importantly, you must draw the conclusions from your calculations and your setup.

Pts.	Setup	Calculation	Interpretation	Notes
3	Correct	Correct	Correct	To get 3/3, you really need to get all three components correct. Whether your calculation is by hand, in excel, or in Matlab you have to set the problem up right, do the correct math correctly, *and* then properly interpret your results. Mistakes at any of these phases can, and has, created major problems in the use of statistics.
2	Correct	Correct	Incorrect	Option A for a 2/3 involves getting the setup and answer closely approximate to our answer (e.g., 4.24 instead of 4.22) but interpreting it incorrectly.
		Incorrect	Correct	Option B for a 2/3 involves getting the setup right but the calculation wrong. However, if you provide a correct interpretation of your calculated results, you still get 2 points.
1	Correct	Incorrect	Incorrect	If you get the setup right you are on the way to getting the whole problem right. You get a point for that, but need to get at least one of the other two pieces right to get more points.

A final note on homework. You should expect most homeworks to include a small thing – such as a formula – that was not covered in class. That is intentional and by design. That content will not be on the test, but the process is designed to help you practice your research skills.

Test revisions
In this class you will be able to revise and resubmit both test one and test two to improve your grade. Revising and resubmitting assignments is an important opportunity to reassess what you understand and check back in with that material to improve knowledge. Here is how the process works:

- You have one week from when an assignment is **returned to you** to re-submit the correct assignment for regrading.
- You must work independently from other students on the test corrections – but office hours are fair game for some questions. We just won't solve them for you.
- You must include your original and revised assignment – with the revised stapled to the front.
- We are not responsible for providing the stapler.
- The grade for your original and revised assignment will be averaged together.
- As noted, this offer only applies to tests 1 and 2 because of time to grade constraints.

- We want to post homework solutions quickly so we are not offering the revisions on the homework this year.
- This will not be applied to the **MAKE UP** tests.

Final Grade Scale
Your final grade will be converted to a letter grade using the following formula and table. Grades are individual and based on mastery – rather than relative or a 'bell curve'. In plain English, that means that there are no limits on how many people can earn a specific grade. Theoretically, and hopefully, everyone can get an A in the course.

Grade	Minimum Final$_{Avg.}$
A	90 %
B	80 %
C	70 %
D	60 %

Calculated final averages will be rounded at the first decimal place to the nearest integer value. Because about portions of your grade is based purely on submitting work on time, because there is the opportunity to earn up to extra credit, and because of the test revisions, we will not entertain requests to further roll up grades.

Grading detritus: Late assignments, re-grading, etc.
- Each homework will have 1 point out of 10 points that is awarded for turning the assignment in on time and making a sincere attempt at each problem.
- The only assignments that will be accepted 'late' are homework. Late homework will be accepted up to 24 hours later than it is due. If turned in late, you will lose 1 point out of 10 points.
- **Regrades:** The number of points awarded for each part of an assignment is decided by the instructors. However, if you believe, using the grading rubric designed by the instructors, that you should have been awarded more points than you were, please submit a typed regrade request to the person who graded the assignment within one week after receiving the graded assignment. Please do not discuss regrade requests orally with your TA or instructor. Instead, take the time to carefully compare your graded work to the published solutions and grading rubric. Then, if you find a mistake has been made and your overall grade is lower than it should be, please by all means write up your observations and submit the typed written request. Please know that whenever an assignment is regraded, the entire assignment is regraded. These processes are to help ensure the regrade process results in a fair grade.