Probability & Statistics II (MATH 4250), Spring 2023

Instructor: Dr. Jessie Oehrlein – call me **Dr. Oehrlein** (or-line) **or Dr. O!** I use **she/her** pronouns.

What is this class?

Course description: In some of y'all's words, ProbStat I was about "determining probabilities of scenarios," "why certain things are more likely to happen," "different distributions of random variables," and contexts like dice rolls, gambling, everyday life, and science. Broadly, probability tells how to get from a model of how something happens to predictions about the results we'll see.

The focus of this course is statistics, and in some ways it's the opposite. In statistics, we start with the data, what we actually observed, and we're trying to figure out some kind of general rule for how things happen. We'll do a variety of statistical analyses from two different perspectives, but we'll also be looking at the mathematics underlying statistics that explains why our statistical tools work.

What will class be like?: Class time will include work with peers on problems or proofs in small groups, mini-lectures, and presentations of work you did outside of class.

I want to know more about:

- [Course goals](#)
- [Assignments and grades](#)
- [Policies](#)

Key Information

Class meetings
36476: TR 8-9:15 AM, PERC 103

Student Hours
Edgerly 301E: R 2-3:15 PM, F 12:30-3:15 PM

These are times when I am available specifically to work with you. Please come by if you have questions, concerns, insights, or to say hello!

You can also stop by anytime my door is open, or set up an individual meeting [here](#). I am also always happy to answer questions by email.

How to contact me
Email: joehrlei@fitchburgstate.edu
Office: Edgerly Hall 301E
Be sure to read my [email responses policy](#).

Textbook and Materials
[Introduction to Probability, Statistics, and Random Processes](#) by Pishro-Nik (online or you can order a physical copy if you prefer). A physical copy will be on reserve in the library. We will also use *[Bayes Rules!](#)* by Johnson, Ott, and Dogucu (available online).

Course goals

Learning goals: There are **three overarching learning goals** for this course, each of which touches upon different aspects of your learning of statistical and mathematical content and skills. Below are the three goals and some explanation of what they entail.

Through this course you will…

- **Study populations using sample data and statistical tools such as parameter estimation, hypothesis testing, and regression.**

  Answering questions about whole populations when we only have data from a sample is what a key part of statistics, called statistical inference, was developed to do! These broad sets of tools let us estimate some property of the population that we don't know, answer yes/no questions about that property, and relate two different variables to each other.

- **Interpret notation, definitions, and statements in the process of proving mathematical results or doing statistical analyses.**

  Many of y'all identified this as a particularly challenging aspect of ProbStat I, so how we read mathematics is going to be a focus here!

- **Explain the mathematical underpinnings of frequentist and Bayesian statistical inference in symbolic, written, oral, and visual forms.**

  As opposed to the applied statistics content covered in the first goal, this is the mathematics side of the course. We'll be looking at statistical tools that are built up from two different philosophies, and we'll see how and why they are constructed in these ways. This will involve reading, explaining, and writing computations and proofs. And the communication of mathematics is as important as the mathematical content itself.

What assessments will there be?

The main goal of assessment in this course is inquiry, communication, and feedback. The different assessments will allow you to explore ideas in statistics, communicate with others about them, and be in conversation with me about your understanding.

Each one is described briefly here. See "**How do I earn a grade?**" for an explanation of how these contribute to your final grade. Our class schedule with topics and assessments is here.

- **Weekly surveys:** On weekly surveys, you will summarize key ideas and let me know how things are going (both in general and on the homework in particular). These are due **on Monday nights**. The surveys themselves will take **5-10 minutes to complete.**

- **Homework (weekly):** This is weekly homework, focused on providing practice with new ideas from class. **It is due on Monday nights** and **assessed on completeness.**

- **Write-ups (~every other week):** These are formal write-ups of one to three proofs or problems, with a focus on clear communication and appropriate use of notation and definitions.

- **Presentations (three total):** Three times in the semester, I will give you a short assignment to work on individually. These assignments will not be on core content of the course but will require synthesis and application of course ideas and working with definitions and notation. About a week after being assigned the topic, **you'll meet with me outside of class to go through your work** and to practice presenting it. Two weeks after being assigned the topic, **you will present your work in class**.

- **Mini-Projects (three total):** Mini-projects are more substantial applications of the statistical tools covered in the course, generally due two weeks after being assigned. These may involve working with real data and computational tools. (Some beginner-friendly options for this will be provided!)

How do I earn a grade?

Learning doesn't happen immediately. We often need to revisit and reflect on ideas in order to learn them well. In this class, your final grade will mainly reflect how well you *eventually understand and communicate* each topic. You can make mistakes, get feedback, and try again.

How your final grade is determined: Your final grade will be based on the criteria you fully satisfy in the list below. If you **fully** satisfy the requirements of a particular grade, you will have **at least** that grade. If you fulfill some but not all requirements of a particular grade but all the requirements of the grade below it, you will have some grade in between the two (+, +/-, -).

	D-level (1.0)	C-level (2.0)	B-level (3.0)	A-level (4.0)
Write-ups (E/M/I/U)	3 M	4 M and 1 I	2 E and 3 M	3 E and 3 M
Presentations (M/I/U)	3 total M+ Presentations & Mini-Projects	2 M	3 M	3 M
Mini-Projects (E/M/I/U)	(see above)	2 M	1 E and 2 M	2 E and 1 M
Homework and Weekly Surveys		Regular completion	Regular completion	Regular completion

I will set **+, +/-,** and - grades based on how close you are to the next higher (or lower) letter grade. For example, if you meet all the other criteria for an A but had 2E and 4M writeups, that

would be an A-.

Classroom Community and Policies

Well-being, Access, and Accommodations[1]

I am committed to building a learning environment with you in which all students can participate fully and succeed. My goal is to provide a variety of experiences and resources so that everyone has access to course content. Statistics is a human activity, and I aim to foster an environment that always recognizes your humanity and the inherent value in your ways of knowing, doing, and communicating.

If you have any access needs that I can better support by changing some aspect of my teaching, class procedures, or class culture, please let me know! Even if you aren't sure exactly what you need, that's a conversation I want to have with you. That can be in person (in public or private), over video/voice call, through a chat, or via email. Please talk to me if you need accommodations for your disabilities. I honor self-diagnosis, and I want this course to be as accessible as possible.

Disabled students may also officially register with Disability Services; more information is available on the Disability Services site ([link](#)).

If you are responsible for childcare on short notice, you are welcome to bring children to class with you. If you are a lactating parent, you may take breaks to feed your infant or express milk as needed. If I can support you in navigating parenting, coursework, and other obligations in any way, please let me know.

Your well-being is of utmost importance. If you are facing challenges to your mental/physical health or obstacles like food or housing insecurity, please don't hesitate to let me know so that we can find appropriate resources. For example, the Falcon Bazaar Necessities and Food Pantry is in Hammond G-23. (This is a new location!). And please do contact me if you have questions or concerns about the course, whether about content, format, or expectations. Together we can build a supportive learning community and environment where you can be successful.

Integrity and Respect[2]

Academic honesty: Mathematics as a discipline involves both individual and collaborative work, and this course incorporates both. I expect you to honestly represent your own learning and work. Here's what that looks like for the different types of assignments in this course:

- **Practice:** Collaborate and use sources freely! This is to improve your understanding.
- **Writeups and Mini-Projects:** You may work with others, use the textbooks and other sources, and talk to me, but your solutions or proofs should be in your own words and represent your understanding.
- **Presentations:** You may use the textbooks and other sources and talk to me, but your

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[1] Some language borrowed or adapted from Drs. Lydia X. Z. Brown, Melissa Cheyney, and Aunchalee Palmquist.
[2] Some language borrowed or adapted from Drs. Joshua Bowman, Spencer Bagley, David Clark, and Matt Boelkins.

presentations should be in your own words and represent your understanding. Feel free to talk to other students about concepts, but you likely won't collaborate much here.

- **Weekly surveys:** These should represent your thinking on your progress in the course and thus should be completed individually and in your own words.

This course is subject to the official Fitchburg State University guidelines in the Student Handbook.

Respect: Significant portions of this course involve group work and discussion in class. In particular, everyone will share mathematical ideas that will often not be fully polished. **So that everyone feels comfortable participating in these activities, we must listen to each other and treat each other with respect.** Diversity and individual differences are a source of strength in this classroom and community. Any attitude that one group of people is superior to another is not welcome here. One of the greatest failures of statistics, historically and in the present, has been exclusion of voices from the field. **Everyone here can learn from each other, and doing so is vital to the structure of the course.**

Attendance, Extensions, and Technology

Attendance: While attendance is not required, **class time gives you the best opportunities to engage with the material deeply alongside your classmates and the instructor**, so please attend when you can. If you know in advance that you will miss a class, please let me know. Otherwise, let me know as soon as possible. I do not need details about why you will be/were absent. I just want to work with you to make a plan that keeps your learning in the course moving forward.

Extensions: You are always allowed to ask for an extension on a writeup or mini-project by completing this form ([link here](#)). In most cases, I will grant such a request, and together we'll decide on a new deadline. This will generally be a date that you think is fair and feasible for you to complete the assignment. I**f you need more time on a presentation, please email me**; that requires a more logistically-complicated conversation. **Keep in mind that there are hard deadlines at midsemester and the end of the semester.**

Technology: You are allowed to use technology in the classroom. In fact, we will sometimes do so as part of in-class activities. Outside of those cases, I ask the following to avoid disturbing other students: that devices be on silent or vibrate-only during class, and that you step out of the room to make or take phone calls.

Getting Help

Student hours: Student hours are when I'm available to work specifically with you! The times are listed [here](#). Please come if you have questions, but also come by if you want some dedicated time and space to work on probability or if you just want to chat, say hi, or play with some puzzles.

Other meetings: If you can't make it to student hours or need to meet with me more privately, you can make an appointment by emailing me at joehrlei@fitchburgstate.edu or booking an appointment through https://calendly.com/joehrlei.

Email: I do my best to reply to emails promptly and helpfully. However, I receive a *lot* of email. To help both you and me, here are some specific expectations about emails:
- If you email me between 7:00 am and 5:00 pm on Monday through Friday, I'll reply to you on the *same* day.
- If you email me outside of those hours, I will reply to you by the *next* school day.
- If your question is much easier to discuss face-to-face, I may ask you to meet with me in my office or on Google Meet (at a time that works for both of us) rather than answering directly in an email.
- Include any relevant photos/screenshots, PDFs, or links if possible.

Schedule

This schedule is subject to change. Changes will be communicated in class and on Blackboard.

Dates	Topics	Class Days	Assignments Due (day)
1/17-1/22	Introduction Review Point Estimation (PC 8.2)	Tues, Thurs	
1/23-1/29	Point Estimation (PC 8.2)	Tues, Thurs	HW 1 (Mon) Survey 1 (Mon)
1/30-2/5	Interval Estimation (PC 8.3)	Tues, Thurs	HW 2 (Mon) Survey 2 (Mon) Write-up 1 (Thurs)
2/6-2/12	Interval Estimation (PC 8.3)	Tues, Thurs	HW 3 (Mon) Survey 3 (Mon)
2/13-2/19	Hypothesis Testing (PC 8.4)	Tues, Thurs	HW 4 (Mon) Survey 4 (Mon) Write-up 2 (Thurs) Group A presents (Thurs)
2/20-2/26	Hypothesis Testing (PC 8.4)	Tues, Thurs	HW 5 (Mon) Survey 5 (Mon) Mini-Project 1 (Thurs) Group B presents (Thurs)
2/27-3/5	Regression (PC 8.5)	Tues, Thurs	HW 6 (Mon) Survey 6 (Mon) Group C presents (Thurs)
3/6-3/12	SPRING BREAK	NONE	NONE
3/12-3/19	Regression (PC 8.5)	Tues, Thurs	**Cutoff for 1st attempts at**

			all assignments due before break (Fri)
3/20-3/26	Bayesian Models (BR 2)	Tues, Thurs	HW 7 (Mon) Survey 7 (Mon) Write-up 4 (Thurs) Group A' presents (Thurs)
3/27-4/2	Beta-Binomial (BR 3)	Tues, Thurs	HW 8 (Mon) Survey 8 (Mon) Group B' presents (Thurs)
4/3-4/9	Different Priors (BR 4 & 5)	Tues, Thurs	HW 9 (Mon) Survey 9 (Mon) Mini-project 2 (Thurs) Group C' presents (Thurs)
4/10-4/16	Bayesian Point Estimation (PC 9.1.2-9.1.6)	Tues, Thurs	HW 10 (Mon) Survey 10 (Mon) Write-up 5 (Thurs)
4/17-4/23	Bayesian Interval Estimation (BR 8.1, PC 9.1.9)	**Tues**	HW 11 (Mon) Survey 11 (Mon) Group A'' presents (Tues)
4/24-4/30	Bayesian Hypothesis Testing (BR 8.2, PC 9.1.8)	Tues, Thurs	HW 12 (Mon) Survey 12 (Mon) Group B'' presents (Thurs)
5/1-5/7	Bayesian Regression (BR 9 & 10)	Tues, Thurs	HW 13 (Mon) Survey 13 (Mon) Write-up 6 (Thurs) Group C'' presents (Thurs)
5/8-5/9	Wrap up	**Tues**	HW 14 (Mon) Survey 14 (Mon)
Finals Period (5/17)		**Wed 8-10 AM**	Mini-project 3 All assignments/revisions