

# STAT 311-002

## Introduction to Theory and Methods of Mathematical Statistics I

### Spring 2024

University of Wisconsin-Madison  
Department of Statistics, College of Letters and Science

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**Class Time & Location:** TR 11:00 AM - 12:15 PM, 5208 Sewell Social Sciences

**Modality:** In-person

**Instructor:** Miranda Rintoul (mrintoul@wisc.edu)

- **Office Hours:** T 3:00 - 4:30 PM @ 1274 Medical Sciences Center
  - To reach the room, take the south entrance into MSC (off of University Ave). Walk forward, and 1274 will be on the left, before the sign that says “Medical Alumni Anatomy Suite”.
- (or by appointment)

**TA:** Xiaobin Zhou (xiaobin.zhou@wisc.edu)

- **Office Hours:** W 12:00 - 2:00 PM @ 1219 Medical Sciences Center
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#### Credits

3 credits. This class meets for two, 75-minute class periods each week over the fall semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc) for about 3 hours out of the classroom for every class period.

#### Course Designations

Breadth - Natural Science

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

#### Instructional Mode

All lectures will be held in-person.

#### Course Description

Elements of probability, important discrete distributions, acceptance sampling by attributes, sample characteristics, probability distributions and population characteristics, the normal distribution, acceptance sampling plans based on sample means and variances, sampling from the normal, the central limit theorem, point and interval estimation.

#### Learning Outcomes

By completing this course, students will be able to:

- Comprehend the concept of probability; understand the principles of probability, including events, sample spaces, operations on events, Bayes' Rule, etc.; and apply these concepts and principles to calculate probabilities of events.
- Understand the concept of random variables, be able to obtain the probability distributions of random variables, and be able to utilize probability distributions to compute moments (mean, variance, etc.) of random variables.
- Identify and apply properties of various important families of probability distributions - including discrete families (e.g. Binomial, Poisson etc.) and continuous families (e.g. Uniform, Normal, Gamma,

etc.) - to solve problems in engineering and the sciences.

- Understand properties of joint distributions, apply joint distributions to calculate the probabilities of events involving multiple random variables, and evaluate covariance and correlation using joint distributions as well as interpret these quantities.
- Comprehend the concept of random samples, derive the exact sampling distributions of certain key statistics (such as the sample mean) calculated from random samples under certain conditions, and use the Central Limit Theorem to approximate the sampling distribution of the sample mean for large random samples.
- Understand the concept of point estimation, be able to apply methods of point estimation (such as maximum likelihood estimation) to estimate unknown population parameters, and be able to evaluate and compare the performances of point estimators.

### Prerequisites

MATH 234, 376, or concurrent enrollment or graduate/professional standing. Not open to students with credit for MATH/STAT 309 or MATH/STAT 431

### Regular and Substantive Student-Instructor Interaction

The regular and substantive student-instructor interaction requirement is met through in-person lectures, Canvas notifications, and regular weekly office hours.

### Course Webpage

The course content, including slides, homework, and exams, will be organized on Canvas.

- <https://canvas.wisc.edu/courses/392127>

Outside of lecture, the primary method of communication will be through Canvas announcements. It is strongly recommended that you allow email notifications for these announcements.

### Textbooks

The course has no required textbook, and the course content is defined by the material that is presented during lectures. All the material covered in lecture, and only the material covered in lecture, is eligible to be examined during the midterm and final.

However, a book by Devore is recommended for supplementary reading. The topics in 311 roughly correspond to chapters 1-6 of this book.

- *Probability and Statistics for Engineering and the Sciences* (9th Edition) by Jay Devore. Cengage Learning, 2016. ISBN-13: 978-1-305-25180-9

### Evaluation

The expected learning outcomes for this course will be assessed through homeworks, a midterm exam, and a comprehensive final exam. The percentage breakdown is as follows:

Homework	20%
Exam 1	25%
Exam 2	25%
Exam 3	30%

### Grades

Final course grades are assigned according to the following scale:

Grade	A	AB	B	BC	C	D	F
Percentage	[92, 100]	[88, 92)	[82, 88)	[78, 82)	[70, 78)	[60, 70)	[0, 60)

## Exams

Exam 1: Thursday, February 29th	Exam 2: Thursday, April 11th	Exam 3: Thursday, May 9th
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- The exams will be held in-person.
- Exams 1 and 2 will be held at our usual class time and location. The final exam will be held from 7:25 to 9:25 pm, and the location will be determined later.
- You should contact the instructor as soon as possible if you have any exam date conflicts that you believe warrant a reschedule.

## Homework

Homeworks are the primary method used to evaluate student performance in the course.

- All homeworks will be assigned and submitted through Canvas.
- Weekly homework assignments are due at 11:59pm each Thursday.
- Collaboration on homework assignments is encouraged, and your final write-up should include the names of whomever you worked with. Plagiarism and copying, however, is forbidden and considered a violation of the Honor Code.
- Late homework is not accepted and will receive a 0.
- The lowest homework grade will be dropped.
- You must contact the instructor as soon as possible if you believe you will need an extension on an assignment. These requests will be reviewed on an individual basis and the instructor reserves the right to deny these requests. You can only receive an extension of up to 2 days, so that the rubric and solutions can be posted.

## Academic Integrity

Students are expected to abide by the rules of academic honesty. So, all graded assignments and exams must be composed of your own work. If there are any doubts or confusion, you must seek guidance from the instructor before submitting work.

## Tentative Schedule

Week	Dates	Topics	HW Due
1	Jan 23, 25	Probability Fundamentals	
2	Jan 30, Feb 1	Counting	HW #1
3	Feb 6, 8	Conditional Probability and Independence	HW #2
4	Feb 13, 15	Random Variables	HW #3
5	Feb 20, 22		HW #4
6	Feb 27, 29	<b>Exam 1: 2/29</b>	
7	Mar 5, 7	Other Discrete Distributions	HW #5
8	Mar 12, 14		HW #6
9	Mar 19, 21	Continuous Probability	HW #7
10	Spring Break		
11	Apr 2, 4	Continuous Probability Distributions	HW #8
12	Apr 9, 11	<b>Exam 2: 4/11</b>	
13	Apr 16, 18	Multiple Random Variables	HW #9
14	Apr 23, 25	Sampling	HW #10
15	Apr 30, May 2	Estimation (if there is time)	

The dates corresponding to each topic are approximate and are subject to change as the course progresses. I will give you sufficient notice for any significant changes in policy or scheduling.

### **Piazza**

Students are encouraged to visit the course Piazza page for homework help and other questions about the course material. The page is visited regularly by the instructor and TAs, and serves as an open discussion forum for students in all sections. When posting a new thread, you can expect a response from the instructor or TA within one business day. The Piazza signup link can be found [here](#) or through Canvas.

### **Course Evaluations**

Students will be provided with an opportunity to evaluate their enrolled courses and their learning experience. Most instructors use HelioCampus Assessment and Credentialing (formerly AEFIS), a digital course evaluation survey tool. In most instances, students receive an official email two weeks prior to the end of the semester, notifying them that anonymous course evaluations are available. Student participation is an integral component of course development, and confidential feedback is important. UW-Madison strongly encourages student participation in course evaluations.

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### **Privacy of Student Records & the Use of Audio Recorded Lectures Statement**

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without the instructor's permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1]

Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct. View more information about FERPA [here](#).

### **Teaching & Learning Data Transparency Statement**

The privacy and security of faculty, staff and students' personal information is a top priority for UW-Madison. The university carefully evaluates and vets all campus-supported digital tools used to support teaching and learning, to help support success through learning analytics (<https://teachlearn.provost.wisc.edu/learning-analytics/>), and to enable proctoring capabilities. View the university's full teaching and learning data transparency statement here:

<https://teachlearn.provost.wisc.edu/teaching-and-learning-data-transparency-statement/>.

### **Students' Rules, Rights & Responsibilities**

See [here](#) for a guide on students' privacy rights (FERPA), responsibilities, and other information.

### **Diversity and Inclusion Statement**

**Diversity** is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

### **Mental Health and Wellbeing Statement**

Students often experience stressors that can impact both their academic experience and personal well-being. These may include mental health concerns, substance misuse, sexual or relationship violence, family circumstances, campus climate, financial matters, among others.

### **Statement on the use of ChatGPT and other AI language models**

While the Statistics Department recognizes the potential benefits of AI language models, their use in academic work can be problematic. In this course, two rules regarding the use of ChatGPT and other AI language models will be enforced: (1) Passing off AI-generated responses as original student work constitutes plagiarism and is strictly prohibited. Any students found to be engaging in this practice will be cited for academic misconduct. (2) Unless explicitly authorized by the instructor to do so, any form of attribution or citation to AI-generated responses as sources is prohibited.

### **Academic Integrity**

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison; academic misconduct is behavior that negatively impacts the integrity of the institution. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of misconduct which may result in disciplinary action. Examples of disciplinary sanctions include, but are not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion.

### **Standards of Ethical Conduct in Data Analysis and Data Privacy**

The members of the faculty of the Department of Statistics at UW-Madison uphold the highest ethical standards of teaching, data, and research. They expect their students to uphold the same standards of ethical conduct. Standards of ethical conduct in data analysis and data privacy are detailed on the ASA website (<https://www.amstat.org/ASA/Your-Career/Ethical-Guidelines-for-Statistical-Practice.aspx>), and include:

- Use methodology and data that are relevant and appropriate; without favoritism or prejudice; and in a manner intended to produce valid, interpretable, and reproducible results.
- Be candid about any known or suspected limitations, defects, or biases in the data that may affect the integrity or reliability of the analysis. Obviously, never modify or falsify data.
- Protect the privacy and confidentiality of research subjects and data concerning them, whether obtained from the subjects directly, other persons, or existing records.

By registering for this course, you are implicitly agreeing to conduct yourself with the utmost integrity throughout the semester.

### **Netiquette**

See [KnowledgeBase](#) for general netiquette guidelines. Specifically:

- Any comment or answers must be on topic, concise, polite, and respectful of others.
- Assume the best intentions of others in the class and be forgiving when you think that the tone of someone's post is offensive. It is easy to misread the tone of someone's written communication. If in doubt, ask an open, honest question about what the person meant so that you can clarify before making assumptions that damage your perception of your colleague.
- Students must not post answers to homework problems.
- Questions about course material should be sent via Piazza. Students should not expect an immediate answer to a question posted late at night before an assignment due date.

## Complaints

If you have a complaint about a TA or course instructor, you should feel free to discuss the matter directly with the TA or instructor. If the complaint is about the TA and you do not feel comfortable discussing it with him or her, you should discuss it with the course instructor. Complaints about mistakes in grading should be resolved with the instructor in the great majority of cases. If the complaint is about the instructor (other than ordinary grading questions) and you do not feel comfortable discussing it with him or her, contact the Director of Undergraduate Studies, Professor Cecile Ane ([cecile.ane@wisc.edu](mailto:cecile.ane@wisc.edu)).

If your complaint concerns sexual harassment, please see campus resources listed at: <https://compliance.wisc.edu/titleix/resources/>. In particular, there are a number of options to speak to someone confidentially.

If you have concerns about climate or bias in this class, or if you wish to report an incident of bias or hate that has occurred in class, you may contact the Chair of the Statistics Department Climate and Diversity Committee, Professor Jessi Cisewski-Kehe ([jjkehe@wisc.edu](mailto:jjkehe@wisc.edu)). You may also use the University's bias incident reporting system, which you can reach at: <https://doso.students.wisc.edu/report-an-issue/bias-or-hate-reporting/>.

## Overlapping Course Time Statement

The Department of Statistics strongly discourages students from enrolling in any courses whose regular class meeting dates and times overlap with each other. This policy is in alignment with the College of Letters and Sciences Course Attendance Policy. It is also consistent with the Class Attendance Policy for Students at UW-Madison (<https://kb.wisc.edu/lis/24628>), whose first sentence reads, "It is expected that every student will be present at all classes."

Statistics instructors may opt not to make any alternative arrangements in the event any conflict arises due to a student taking a course with class meetings that overlap with a Statistics course, including a conflict between two Statistics courses. Note that final exams occasionally are scheduled simultaneously for courses which meet at different times; in this situation, please contact your instructor well before the exam date about potential accommodations.

## Accommodations for Students with Disabilities Statement

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (UW-855) require the university to provide reasonable accommodations to students with disabilities to access and participate in its academic programs and educational services.

Faculty and students share responsibility in the accommodation process. Students are expected to inform me of their need for instructional accommodations during the beginning of the semester, or as soon as possible after being approved for accommodations. I will work either directly with the you or in coordination with the McBurney Center to provide reasonable instructional and course-related accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: [McBurney Disability Resource Center](#))

### **Academic Calendar & Religious Observances**

Establishment of the academic calendar for the University of Wisconsin-Madison falls within the authority of the faculty as set forth in Faculty Policies and Procedures ([https://policy.wisc.edu/library/UW-801#Pol801\\_1\\_20](https://policy.wisc.edu/library/UW-801#Pol801_1_20)). Construction of the academic calendar is subject to various rules and laws prescribed by the Board of Regents, the Faculty Senate, State of Wisconsin and the federal government. For additional dates and deadlines for students, see the Office of the Registrar's pages (<https://registrar.wisc.edu/dates/>). Students are responsible for notifying instructors within the first two weeks of classes about any need for flexibility due to religious observances (<https://policy.wisc.edu/library/UW-880>).

### **COVID-19**

Information on COVID-19 is constantly changing. Students should be attentive to University communications regarding COVID-19 that may alter instruction and supersede parts of this syllabus.