Instructor:	Jonathan "Nate" Wells	**Email:**	wellsj@reed.edu
Classroom:	Library 389	**Office:**	Library 392
In-person Office Hours:	M 3-4pm, W 10-11am, F 10-11am		
Virtual Office Hours:	T 2-3pm		
Zoom Link:	https://zoom.us/my/wellsj392		

Course Description: This course is a comprehensive introduction to the abstract theory of probability, as a language for interpreting and analyzing problems in statistics, natural and social sciences, and philosophy. Emphasis will be placed on refinement of problem-solving and mathematical modeling skills, along with R coding proficiency.

Prerequisites: MATH113 and MATH202, or Instructor Consent.

Distribution Requirements: This course can be used towards your Group III, "Natural, Mathematical, and Psychological Science," requirement. It accomplishes the following learning goals for the group:

> Use and evaluate quantitative data or modeling, or use logical/mathematical reasoning to evaluate, test or prove statements; Given a problem or question, formulate a hypothesis or conjecture, and design an experiment, collect data or use mathematical reasoning to test or validate it; Collect, interpret and analyze data

This course does not satisfy the "primary data collection and analysis" requirement.

Textbook: *Introduction to Probability*, 2nd Edition by Blitzstein and Hwang. We will cover chapters 1 through 11. Reading assignments will be given on frequent basis, so daily access to the textbook is necessary. A free online copy of the textbook is available on the author's website: `http://probabilitybook.net/`

Course Resources: The following web-based resources will be used for communicating class information:

- Slack `reedmath391fall2021.slack.com` (*announcements, discussions, direct messaging*)
- Moodle `https://moodle.reed.edu` (*documents, a daily schedule, assignments, videos*).
- Gradescope `https://www.gradescope.com/` (*Homework & daily assignment submissions*)

Technology: You are encouraged to bring a personal computer to class each day for notetaking, textbook reference, and live coding. Access to a computer with webbrowser will be required for homework completion and submission. Computing & Information Services offers programs for long-term laptop loan: `https://www.reed.edu/cis/facilities/student-technology-equipment-program.html`

We will make frequent use of the R programming language to perform routine calculations and create probability models. R and RStudio are free to use, and can either be installed locally on your computer, or can be accessed using the Reed RStudio Server: `https://rstudio.reed.edu/`

Communication: If you would like to contact me, I can most easily be reached via Slack message weekdays between 8am and 6pm. While I try to answer messages as soon as possible, in some cases, I may not be able to respond until the following school day. If you'd prefer to talk live, send me a message and we can schedule a time to chat on zoom.

Course Outcomes: By the end of the course, a student should be able to:

1. Describe uncertainty and randomness using the axiomatic language of sets and functions.
2. Incorporate new observations into a probability model using conditional probability and independence.
3. Quantify, predict, and analyze the outcomes of random experiments using both discrete and continuous random variables.
4. Calculate the expected value, variance and quantiles of common discrete and continuous random variables.
5. Summarize and specify a random variable using its moments and moment generating function.
6. Compare and describe multiple random variables using joint, marginal, and conditional distributions, along with covariance and correlation.
7. Obtain and analyze new random variables by applying transformations to a class of elementary distributions.
8. Estimate outcomes of experiments based on existing evidence, and describe the result using conditional expectation and conditional variance.
9. Determine the limit of a sequence of random variables, and characterize the limit's mean and fluctuations using inequalities.
10. Create and sample from probability models using the R programming language.

Format: The course will be taught using in a group-based and problem-focused model. A typical class day will involve the following:

- *Reading/Video Assignment:* Every class will have an assigned reading and pre-recorded lecture video, and you are expected to engage with at least one of these media before each class. At least an hour before the class period covering the given material, you will complete a Gradescope Quiz on those topics. You are also encouraged to submit any questions you have on the readings/videos, or requests to review a particular topic.
- *Active Class Session:* Our 50-minute meetings will include mini-lectures by the instructor, along with collaborative group work with your peers. The mini-lectures will provide supplementary content to the assigned readings/videos, while the group work will allow you to delve deeper into key problems and exercises.
- *Homework*: After each class session, several homework problems will be assigned, due on the following Monday by 11:59pm.

Workload: A prepared student will attend class for 50 minutes per day, three days each week, and spend about two to four hours per day of class on work outside the classroom (reading, watching lecture videos, doing homework, discussing, studying, etc.). Together, this represents a 9 - 15 hour per week commitment.

Grading Criteria:

Your grade in the class will be determined by your proficiency in each of the *Course Outcomes*, as demonstrated in the following assessments:

1) Daily Assignments 2) Homework 3) Participation 4) Midterm Exams 5) Final Exam

Daily Assignment: Mathematical knowledge takes time to develop, and understanding deepens upon revisiting a concept a 2^{nd}, 3^{rd}, or n^{th} time. Studying basic terminology and elementary examples in the textbook before class means that class can be spent clarifying and expanding ideas, rather than introducing them. Daily assignments will be posted on the Moodle course page, and will list the specific section(s) to read for each day, along with a link to a pre-recorded lecture. A brief quiz on the readings/videos will be posted on Gradescope, to be completed by noon each day of class (to give me time to review them before class). The quiz questions are not intended to be overly difficult, but should help both you and I highlight topics that need further review. The quiz will be assessed primarily on the basis of completion. No extensions on daily reading will be given, but up to three assignments may be missed without penalty.

Homework: Homework will be due weekly on Mondays at 11:59pm, and should be submitted online to Gradescope. All homework assignments must be typed and submitted as a .pdf file, using either LaTeXor RStudio. Solutions must be in complete sentences, and should be thorough enough that another student in the class can follow your reasoning without any question. Twice throughout the term, you may request up to a 4-day extension on your homework. Except in extraordinary circumstances, requests must be made prior to an assignment's due date.

In-class Participation: Because of the collaborative nature of this course, it is essential that you strive to attend class every day. But if you aren't able to attend class for any reason, please notify me, as well as your group members, before the start of class so that we can make appropriate arrangements for you to make-up missed work. Frequent absences for which make-up work is not completed will be reflected in your final course grade. **Please do not come to class if you are ill, or if you've had close exposure to someone else who has been ill.**

Midterm Exams: Three exams will be given during the term. The first and second will be take-home exams made available on a Friday 9/24 (Week 4) and Friday 11/5 (Week 9), to be completed before class the following Monday. The third exam will be an oral exam scheduled for 11/22 - 11/24 (Week 12). The take-home exams are intended to take between 3 and 4 hours to complete, and allow reference to course notes and the textbook. The oral exam will take approximately 20 minutes, and will be conducted virtually via Zoom.

Final Exam: A cumulative take-home final exam will be given during Finals Week, as scheduled by the Registrar.

Accessibility: Reed College is committed to creating inclusive and accommodating learning environments. Please notify me as soon as possible if there are aspects of the instruction or design of this course that result in barriers to your participation. I also encourage you to contact Disability & Accessibility Resources (DAR) at `https://www.reed.edu/disability-resources/` for additional support, including official accommodations. If you have already been approved for accommodations, please have DAR provide a letter during the first week of classes, or as soon as possible after approval. I will then contact you to schedule a meeting during which we can discuss the particular implementation of your accommodations.

Academic Integrity: Students are allowed and encouraged to collaborate on most in-class and homework assignments. However, any work that you turn in for grading must be your own. You are welcome to use other paper or internet resources to supplement content we cover in this course, with the exception of solutions to homework problems. Copying solutions from the internet or other sources is an Honor Principle violation. Exams will explicitly mention what resources may be consulted. All written work that references material outside of the textbook or lecture should be accompanied by an appropriate citation.

Code of Conduct: I expect all members of Math 391 to make participation a harassment-free experience for everyone, regardless of age, body size, visible or invisible disability, ethnicity, sex characteristics, gender identity and expression, level of experience, education, socio-economic status, nationality, personal appearance, race, religion, or sexual identity and orientation.

I expect everyone to act and interact in ways that contribute to an open, welcoming diverse, inclusive, and healthy community of learners. Examples of unacceptable behavior include: using sexualized language or imagery, making insulting or derogatory comments, harassing someone publicly or privately, or other unprofessional conduct. Instead you can contribute to a positive learning environment by demonstrating empathy and kindness, being respectful of differing viewpoints and experiences, and giving and gracefully accepting constructive feedback.

Assignment Feedback: You will receive timely feedback on your homework via Gradescope, either from me or the course grader (another mathematics undergraduate). Each homework problem can earn up to five points for mathematical content, and two points for the quality of writing. You are strongly encouraged to review comments on your solutions and rework missed problems. You are welcome to post questions about past homework problems on our Slack channel and to talk to me about them during office hours.

Help: I strongly encourage to attend my office hours each week. You are welcome to come either with specific questions, or just with general uncertainties about content we've discussed. If you are unable to attend scheduled office hours, please message me on Slack to schedule an alternative appointment (either in-person or virtual).

Our course assistant (a mathematics undergraduate) will also be holding several help sessions each week to provide assistance with and facilitate collaboration on homework.

Finally, every Reed student is entitled to one hour of free individual tutoring per week. Use the tutoring app in IRIS to schedule meetings with a student tutor.

Tentative Schedule: (Section numbers from Bltizstein and Hwang's *Intro to Probability*)

Week	**Sections Covered**	**Week**	**Sections Covered**
1	1.6, 2.1 - 2.4	8	7.1 - 7.3
2	2.5 - 2.8	9	7.4, 7.5 (Exam 2)
3	3.1 - 3.9	10	8.1 - 8.3
4	4.1 - 4.4 (Exam 1)	11	8.4 - 8.6
5	4.5 - 4.8, 5.1	12	10.1 - 10.4 (Exam 3)
6	5.1 - 5.5	13	9.1 - 9.6
7	6.1 - 6.6	14	Review, Reading Period
	Fall Break	15	Final Exam