MATH 5010/6805-02: Introduction to Probability

Fall 2021 Syllabus

Time and Location: Monday, Wednesday 6:00-7:30 pm in LCB 225

Instructor: Sean Groathouse
he/him/his pronouns
preferred name/address: Sean

Email: sean@math.utah.edu

Office Hours: Mondays 7:30-8:00 pm, on campus after class
Tuesdays 6:00-7:00 pm, online on Zoom (link will be on Canvas)
Wednesdays 7:30-8:00 pm, on campus after class
before class most days
or by appointment

Course Web Page: I will post all course information and announcements on Canvas:
https://utah.instructure.com/courses/713423

Prerequisites: C or better in MATH 2210 or MATH 1260 or MATH 1280 or MATH 1321 or MATH 3140.

Textbook: *Introduction to Probability*, by Anderson, Seppäläinen, Valkó; ISBN: 978-1108415859

Course Description: Introduction to probability theory including combinatorial analysis, conditional probability, independence, discrete and continuous random variables, jointly distributed random variables, expected value and moments, the Law of Large Numbers, and the Central Limit Theorem.

Expected Learning Outcomes: At the end of the course, students will be able to:

- Define probability in terms of a sample space and construct a sample space to model a situation.
- Use the rules of probability and combinatorics to reason probabilistically.
- Calculate conditional probabilities, apply Bayes' Rule, and understand independence of events and random variables.
- Work with discrete and continuous random variables from standard distributions or from a given pmf/pdf/CDF. Work with jointly distributed random variables.
- Compute MGFs and utilize them to understand a sum of independent random variables.
- Calculate expected values and moments of random variables. Utilize the linearity of expectation and independence properties.
- Compute and interpret variance, covariance, and correlation of random variables.
- Understand the Law of Large Numbers and Central Limit Theorem and apply them.
- Calculate conditional distributions and understand conditional expectation as a random variable.
- Continue using probability in further classes such as Stochastic Processes (5040), Statistical Inference (5080), Math Finance (5760), and Actuarial Math (5030).

Grading: Grades will have the following weights and scale:

Homework	10%
Mini-Projects	10%
Final Project	15%
Midterm 1	20%
Midterm 2	20%
Final Exam	25%

$[93, 100]$ A	$[80, 83)$ B-	$[67, 70)$ D+
$[90, 93)$ A-	$[77, 80)$ C+	$[63, 67)$ D
$[87, 90)$ B+	$[73, 77)$ C	$[60, 63)$ D-
$[83, 87)$ B	$[70, 73)$ C-	$[0, 60)$ E

Although I'm not philosophically opposed to curving grades, I find it's usually not necessary. If I do need to curve the grades, I will explain any modifications to this scale on Canvas.

Homework: Homework will be assigned weekly, due on Mondays. It will be graded for completion, so everyone who submits the homework will receive full credit. Although the homework will not be graded for correctness, I believe working on these problems is one of the best ways to learn the material. The final answers are posted so you can check your work, and I am always happy to discuss homework problems.

Mini-Projects: We will have three mini-projects during the first half of the semester. They will be due on Wednesdays, roughly two weeks apart. They will provide an opportunity to apply some of the topics we are studying to different problems, and I hope they will cover a variety of interests related to our class. If you like, you may work with other students in our class in groups of 2 or 3 and submit one write-up for the group.

Final Project: During the second half of the semester, instead of the mini-projects, we will have one final project due on Monday, December 6. This project will involve researching a topic that uses some of the ideas we worked with in class. I will provide several suggested topics for you to pick from, or you are welcome to choose your own topic. If you select your own topic, it would be helpful for us to have a quick conversation to make sure the topic is feasible and will fit the grading criteria. Like with the mini-projects, you are welcome to work in a group of 2 or 3 if you like. For this project, the expectations for how much the project covers will increase the more people are in the group. But I still think working in groups is helpful, and the work per person should not be any more than doing the project individually. I'll provide more information about this project during the semester.

Submitting your work: Homework, Mini-Projects, and the Final Project will be turned in online through Canvas. Please submit your work as one of these file types (these work the best with Canvas): pdf, jpg, jpeg, png, bmp, tif, tiff, doc, docx, odf, or odt. Certain phones may take pictures in a proprietary format that doesn't work well with Canvas. This can usually be changed in the settings, or you could use an app to convert the pictures to a pdf file. You can also email your work or turn it in during class if you encounter any issues with Canvas or other technical issues.

Late Work: I generally will not accept late mini-projects, since solutions will be available after the due date. In cases of illness or emergency, please let me know as soon as possible so that we can work something out.

For the final project, I will accept these late through the day of the final exam, but there will be a point deduction for each week that it is late. The reason for this is to try to keep consistency in the grading so that the extra time doesn't provide an unfair advantage. As always, in cases of illness or emergency please let me know as soon as possible so we can work something out for your particular situation.

Because the homework is graded for completion, I will accept late homework for full credit through the day of the final exam. I encourage you to try to stick to the posted homework dates whenever possible so it doesn't pile up, but you are welcome to take more time on the homework when you need to.

Midterm Exams: We will have two midterm exams during class time on Wednesday, October 6, and Wednesday, November 17. Each midterm will include material covered in class through the previous week. I will post review materials to Canvas at least one week before the exam, and we will have some review sessions available during the week of the exam.

Final Exam: We will have a comprehensive final exam on Monday, December 13 from 6:00-8:00pm in our usual classroom LCB 225. Review materials will be posted at least a week before, and we will have review sessions the week leading up to the final.

Class Policies

- I will post announcements, messages, and grades on Canvas, so it is essential that you either check Canvas regularly or have Canvas notifications forwarded to an email that you do check.
- Please make sure you do your best throughout the semester, knowing the grading scheme and what's expected of you, and talk to me if you need further study strategies. I am happy to brainstorm ideas to help you maximize your study strategies and improve your mathematical understanding. No extra credit will be provided at the end of the course, so please talk with me early on about any concerns with your grade, so we have time to address them.
- If you have crisis-level extenuating circumstances which affect your class performance, and you need guidance/advice/flexibility, please communicate with me as soon as possible so I can help you in some manner, which I'm truly happy to do. The longer you wait to communicate with me, the less I can do to help.
- If you want to appeal the grading of a mini-project, exam, or the final project, I ask that you please bring it to me within one week of it being returned. This policy helps me maintain consistency in grading and helps make sure I can address any grading issues before the final grades are submitted. I'm always happy to look over any classwork with you, answer any questions you have, and fix any grading issues when appropriate.
- It is possible during the semester that I may need to modify this syllabus to help meet the learning goals of our class. If I do need to make any changes, I will announce them in class and on Canvas.

Covid-19 Specific Information

Our class is scheduled to meet in-person throughout the semester. It is possible that we will be put under quarantine at some point in the semester. If this happens we will switch to meeting on Zoom during class time until our quarantine is lifted.

I know that this semester may be more challenging than other semesters due to the pandemic, and there may be certain weeks where you cannot come to campus. I will post on Canvas blank and completed versions of my notes that go along with what we covered each day in class. Also our Tuesday office hour will always be online through Zoom so that we have a specific time set for questions if you cannot come to campus. I can also help with finding additional resources or meeting at other times by Zoom.

Additionally here is some information from our university leadership which applies to all classes: University leadership urges all faculty, students, and staff to model the vaccination, testing, and masking behaviors

we want to see in our campus community. These include:

Vaccination: Get a COVID-19 vaccination if you have not already done so. Vaccination is proving highly effective in preventing severe COVID-19 symptoms, hospitalization and death from coronavirus. Vaccination is the single best way to stop this COVID resurgence in its tracks. Visit http://mychart.med.utah.edu/, http://alert.utah.edu/covid/vaccine, or http://vaccines.gov/ to schedule your vaccination.

Masking: While masks are no longer required outside of Health Sciences facilities, UTA buses and campus shuttles, CDC guidelines now call for everyone to wear face masks indoors.

Testing: If you are not yet vaccinated, get weekly asymptomatic coronavirus tests. This is a helpful way to protect yourself and those around you because asymptomatic individuals can unknowingly spread the coronavirus to others. Saliva based testing is available at alert.utah.edu/covid/testing

Self-Reporting: All of us, including faculty, students, and staff, must self-report if we test positive for COVID-19 via this website: https://coronavirus.utah.edu/.

Other Policies and Resources

Math Tutoring Center: Please do not hesitate to come to office hours or contact me with any questions you have or to discuss anything about the course. Additionally, the T. Benny Rushing Mathematics Tutoring Center offers free online tutoring. The website can be found here:
https://www.math.utah.edu/undergrad/mathcenter.php

Private Tutoring: The Learning Center has additional tutoring available for our class. Their website can be found here: https://learningcenter.utah.edu/
The math department also maintains a list of private tutors.

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the students' legal name as well as preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS), so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your U-ID card, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

Veterans Center: If you are a student veteran, the University of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8:00am – 5:00pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

Center for Student Wellness: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., may interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources, contact the Center for Student Wellness: https://wellness.utah.edu/

The Americans with Disabilities Act: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building,

801-581-5020, https://disability.utah.edu/. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, office for equal opportunity and affirmative action including sexual orientation or gender identity/expression, you are encouraged to report it to the University's Title IX Coordinator; Director, Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, https://oeo.utah.edu/contact-us/index.php or to the Office of the Dean of Students, 270 Union Building, 801-581-7066, https://deanofstudents.utah.edu/. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to police, contact the Department of Public Safety, 801-585-2677(COPS), https://police.utah.edu/.

Faculty and Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know that they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty's responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. See http://regulations.utah.edu/academics/6-400.php

Campus Safety: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu

University Counseling Center: The UCC staff is committed to supporting the mental health needs of our campus community. Their phone number is 801-581-6826. Their hours are Monday-Friday, 8:00am-5:00pm. For after-hours emergencies, contact the 24/7 Crisis Line: 801-587-3000 . More information is at https://counselingcenter.utah.edu/ .

Office of the Dean of Students: The Office of the Dean of Students is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. To contact the Office of the Dean of Students, please email deanofstudents@utah.edu or call 801-581-7066. There is more information at https://deanofstudents.utah.edu/ .

Important Dates:

We will meet for class every Monday and Wednesday except for these days:

Monday, September 6 (Labor Day holiday)
Monday, October 11 (Fall Break)
Wednesday, October 13 (Fall Break)

Last day to add, drop, elect CR/NC, or audit ..... Friday, September 3
Midterm 1 ..... Wednesday, October 6
Last day to withdraw ..... Friday, October 22
Midterm 2 ..... Wednesday, November 17
Last day to reverse Credit/No Credit ..... Friday, December 3
Final Project due ..... Monday, December 6
Final Exam ..... Monday, December 13

Tentative Schedule:

Aug. 23, 25: 1.1 Sample Spaces and Probabilities; Appendix C Combinatorics; 1.2 Random Sampling

Aug. 30, Sept. 1: 1.3 Infinitely Many Outcomes; 1.4 Consequences of the Rules of Probability; 1.5 First Look at Random Variables;

Sept. 8: 2.1 Conditional Probability

Sept. 13, 15: 2.2 Bayes' Formula; 2.3 Independence; 2.4 Independent Trials

Sept. 20, 22: 2.5 Further Topics on Sampling and Independence; 3.1 Probability Distributions of Random Variables; 3.2 Cumulative Distribution Function

Sept. 27, 29: 3.3 Expectation; 3.4 Variance; 3.5 Gaussian Distribution

Oct. 4, 6: 4.1 Normal Approximation; Midterm 1

Oct. 11, 13: Fall Break

Oct. 18, 20: 4.2 Law of Large Numbers; 4.3 Applications of the Normal Approximation; 4.4 Poisson Approximation; 4.5 Exponential Distribution

Oct. 25, 27: 5.1 Moment Generating Function; 5.2 Distribution of a Function of a Random Variable; Start 6.1 Joint Distribution of Discrete Random Variables

Nov. 1, 3: Finish 6.1; 6.2 Jointly Continuous Random Variables; 6.3 Joint Distributions and Independence

Nov. 8, 10: 7.1 Sums of Independent Random Variables; 7.2 Exchangeable Random Variables; 8.1 Linearity of Expectation 8.2 Expectation and Independence;

Nov. 15, 17: 8.3 Sums and Moment Generating Functions; Midterm 2

Nov. 22, 24: 8.4 Covariance and Correlation; 9.1 Estimating Tail Probabilities; 9.2 Law of Large Numbers; 9.3 Central Limit Theorem

Nov. 29, Dec. 1: 10.1 Conditional Distributions of a Discrete Random Variable; 10.2 Conditional Distribution for Jointly Continuous Random Variables 10.3 Conditional Expectation;

Dec. 6, 8: Catch-up, Review

Dec. 13: Final exam, 6:00-8:00pm in LCB 225

Note: This is an approximate schedule, and I may need to adjust the pace for the learning needs of our class.