MTH/SDS 246: Probability

Class Location: Bass 204
Class Time: Wednesday/Friday, 2:45 PM - 4:00 PM
Instructor: Rebecca Kurtz-Garcia
Email: rkurtzgarcia@smith.edu
Office location: Burton 315
Office Hours: Monday 3:00 pm - 4:30 pm; Wednesday, 10:30 am - Noon; By Appointment

Course Description: An introduction to probability, including combinatorial probability, random variables, discrete and continuous distributions. Prerequisites: MTH 153 and MTH 212 (may be taken concurrently), or equivalent.

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Textbooks: The first textbook will be our main text. The other textbooks are supplementary.

- [BH] *Introduction to Probability*, Second Edition by Joseph K. Blitzstein and Jessica Hwang, 2019. Available free online at: http://probabilitybook.net
- [DS] *Probability and Statistics*, Fourth Edition Morris H. DeGroot and Mark J. Schervish. Pearson, 2011.
- [CB] *Statistical inference*. CRC Press, 2024. By George Casella, and Roger Berger.
- [HMC] *Introduction to Mathematical Statistics 8th Edition* by Robert Hogg, Joseph McKean, Allen Craig
- [FS] *Stochastic Modeling and Mathematical Statistics: A Text for Statisticians and Quantitative Scientists (2014)*, New York: Chapman and Hall by Francisco J. Samaniego

Supplementary References: This course and the materials used are based on Harvard University's STAT 110 taught by Joe Blitzstein. The corresponding course website and YouTube playlist (which includes a complete set of STAT 110 lecture recordings) will be a helpful companion to what we do in MTH 246. I have also used materials from Grinnell College's MAT 335 taught by Jonathan Wells, and Smith College's MTH 246 taught by Kaitlyn Cook. Each of these instructors have used our main textbook and have graciously shared their materials with us.

Evaluation: Final grades will be weighted as follows:

- 15% - Pre-Class Notes
- 10% - Engagement
- 30% - Homework
- 20% - Midterm
- 25% - Final

I may curve final grades up at the end of the semester, but I will never curve grades down.

Homework: Homeworks will be assigned approximately weekly and typically be due at 11:55 pm on Tuesdays. You will turn all of your assignments electronically on Gradescope. You may

either typeset your problem sets using LATEX or complete them by hand and then scan them. Your lowest homework grade will be dropped.

Homeworks will be graded out of 10 points:

- 3 points for completing all the problems
- 1 point for being well formatted and clear. All pages are oriented in the correct way, problems are in order, and writing is overall legible.
- 6 points will be allotted for a subset of problems selected for grading.

Homework Extensions: There are a lot of homework assignments, and it is important to turn them in on time because they are a pivotal part of the course. However, if for some reason you need more time you can submit due date extension requests on homework by using this form: https://forms.gle/RJZYU6Qevr3RmTrg8. A late work request must be submitted before the assignment due date. Below are the requirements based on the different extension requests:

- *24 hrs or less*: Almost always be approved. You can assume it has been approved even if you do not get an email from me.
- *Between 24-48 hrs*: Requests should be due to a more serious reason. If there have been a lot of extension requests in this bracket I may ask for documentation. These requests are not automatically approved, you will get a follow up email regarding your request.
- *Above 48 hrs*: Should be a college approved excuse. Documentation is often asked for. You will get a follow up email regarding your request.

You do not need to provide extensive details for the reason for your request, just a general idea. Late assignments will be penalized at the rate of 2 points per day.

Pre-Class Notes: Probability intuition takes time to develop. 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.

There will be assigned readings/videos posted on the schedule in Moodle. You will need to upload your notes on these readings or videos before the start of class each day on to Gradescope. You do not need to take notes on both, you can just pick one. Your pre-class notes are assessed primarily on the basis of completion. No extensions on pre-class notes will be given, but up to five assignments may be missed without penalty.

In addition, you have the option to submit a reflection corresponding to the notes. The primary goal of the reflection is to help me make sure you get your questions answered. It is not explicitly part of your grade but can be used to get engagement points.

Exams: There will be one self-scheduled midterm exam, and one final exam.

Engagement: Throughout the semester there will be 26 class meetings. Your engagement grade should largely be a reflection of active participation and interaction with material of the course. You can earn up to 10 points in the following way:

- 4 points: You can earn 1 point each time you present a solution in class, up to a maximum of 4 points. You will be graded on sharing your thought process, not on having the correct final answer.
- 4 points: Attend at least 20 of the 26 class sessions. If you attend less, I will take the proportion of how many classes you attend out of 20.
- 4 points: You can earn 1 point each time you submit a reflection on the pre-class reading before class, up to a maximum of 4 points.

Course Communication: All course materials—including lecture slides and handouts, assignments, and other course resources—will be posted on the class Moodle, and all grades will be recorded there. During the week, I will try my best to answer all messages and emails within 24 hours of receiving them. If you contact me over the weekend, however, I may not respond to your message until Monday in an effort to maintain my own work-life balance. Please plan accordingly.

Computing: We will be using R and RStudio throughout this course.

- You may access both of these resources on the Smith College server: https://rstudio.smith.edu. Please contact me if you have any issues logging in.
- Alternatively, R is available for free desktop download at https://www.r-project.org and RStudio is available for free download at https://www.rstudio.com.

Class Policies and Expectations: This is a 4 credit course, meaning that by federal guidelines, it should consume about 12 hours per week of your time. We meet for 2.5 hours per week. That means you should be spending about 9.5 hours per week on this course outside of class, or roughly 4.75 hours per each class period outside of the regular class meeting time.

We are implementing a modified flipped-classroom approach, requiring you to review the material and grasp its content before attending class. Our class meetings will have minimal lecturing, with a significant portion of the time dedicated to collaborative completion of problems in small groups and addressing your queries. It is advised to invest several hours before class in reading upcoming material, completing the pre-course materials, and starting on problems.

Collaboration/External Resources: I strongly encourage you to form study groups and to work together to complete your homework assignments and prepare for exams. You can also use external resources! When collaborating or using external resources, here are a few general principles to keep in mind.

- *Reliable Information Sourcing*: Rely on credible sources for information. If consulting unverified sources like ChatGPT, Wikipedia, or StackOverflow, a good rule of thumb is to cross-check the information with at least two credible sources to mitigate confirmation bias.
- *Aim for genuine comprehension*: Avoid directly copying and pasting prompts into search engines or seeking specific answers from peers like, "How did you solve question 7.2.2?". Instead, concentrate on grasping the underlying concepts, such as “What is a likelihood function?”.

- *Maintain Academic Integrity*: While collaboration and external resources are permitted, your submissions must reflect your understanding and be expressed in your own words. Do not directly copy others' work. If uncertain, acknowledge your sources through citations.

Academic Honesty: Every student in this class is expected to abide by the Academic Honor Code:

> *Students and faculty at Smith are part of an academic community defined by its commitment to scholarship, which depends on scrupulous and attentive acknowledgement of all sources of information and honest and respectful use of college resources.*
> *Smith College expects all students to be honest and committed to the principles of academic and intellectual integrity in their preparation and submission of course work and examinations. All submitted work of any kind must be the original work of the student who must cite all the sources used in its preparation.*

All violations of the Academic Honor Code will be reported to the Academic Honor Board.

Accessibility: This course is for all Smith and Five Colleges students, no matter your background, identity, disability, or life/financial circumstances. If you have personal circumstances that may impact your experience in this class, I encourage you to contact the Office of Disability Services in College Hall 104 or at ods@smith.edu to obtain an accommodation letter. Once you have this letter, you are welcome to set up an appointment with me to discuss how we can tailor this course accordingly. Whether or not you have a letter from ODS, please feel free to contact me if you would like to discuss how we can maximize your learning potential in the course.

Student Well-being: College life is stressful and life outside of college can be overwhelming. I firmly believe that your physical and mental health should be a top priority and that they are far more important than any particular class. Please let me know if you are struggling with this course or having trouble meeting course expectations (for any reason), or if there is anything else that I can do to make this course work better with your needs this semester. If you or someone you know is experiencing distress, there are numerous campus resources that can provide support via the Schacht Center. In particular, the Smith College Counseling Services provide free, confidential mental health services on campus. They are reachable at 413-585-2840 or on their website. Help is always available.

Discrimination and Harassment: Discrimination and harassment will not be tolerated. If you feel uncomfortable or unwelcome in this course because of the actions of anyone else (in this class or otherwise), please consult with me, your class dean, the associate provost, or the vice president for inclusion, diversity, and equity. You may also report violations of Smith's Code of Conduct as well as Title IX violations (such as sexual assault, sexual harassment, relationship abuse, gender-based violence, and stalking) using the confidential reporting system EthicsPoint.

Please note that I am a responsible reporter, meaning that I must notify the Title IX Coordinator of all disclosures of sexual or gender-based misconduct and domestic violence. If you would like to speak to someone confidentially, you may contact:

- Smith College Counseling Services, for free-of-charge counseling services: 413-585-2840
- Campus health service providers, for medical assistance and referrals: 413-585-2811
- The Director of Religious Life: 413-585-2750
- The Assistant Director of Student Affairs: 413-585-4908

Approximate Schedule: More details will be posted on Moodle.

Class #	Topic	Reading
1	Sample Spaces and Events	A.1, 1.1, 1.2
2	Counting Principles	1.3, 1.4
3	Axioms of Probability	1.6
4	Conditional probability (Part 1)	2.1, 2.2
5	Conditional probability (Part 2)	2.3, 2.4
6	Independence and Conditional Probability	2.5, 2.6
7	Problems and Paradoxes	2.7.1, 2.8
8	Random Variables	3.1, 3.2, 3.6
9	Common Discrete RVs	3.3, 3.4, 3.5
10	Functions and Relationships of RVs	3.7, 3.8 (3.9)
11	Expected Value	4.1, 4.2
12	More Discrete Random Variables	4.3, (4.7)
13	LOTUS	4.4, 4.5, 4.6
14	Flex Day (Midterm this weekend).	
15	Introduction to Continuous Random Variables	5.1
16	Continuous Uniform	5.2, 5.3
17	Normal and Exponential Distribution	5.4, 5.5
18	Measures of Center and Moments	6.1 - 6.3
19	Moment Generating Functions	6.4 - 6.6
20	Jointly Distributed Random Variables (Discrete)	7.1.1
21	Jointly Distributed Random Variables (Continuous, Hybrid)	7.1.2, 7.1.3
22	Covariance and Correlation	7.2, 7.3
23	Transformations	8.1

24	Order Statistics	8.2, 8.6
25	Conditional Expectation	9.1 - 9.3
26	Conditional Variance	9.4 - 9.6