Math 505B, Graduate Applied Probability Theory II, Spring 2021

Exterior Course Website: http://www.stevenheilman.org/~heilman/505bs21.html
Prerequisite: MATH 505A.
Course Content: Markov processes in discrete or continuous time; renewal processes; martingales; brownian motion and diffusion theory; random walks, inventory models, population growth, queuing models, shot noise.

Lecture Meeting Time/Location: Mondays, Wednesdays, and Fridays, 1PM-150PM, on zoom [link posted on blackboard]
Instructor: Steven Heilman, stevenmheilman@gmail.com
Office Hours: Mondays, 930AM-1130AM, on zoom [link posted on blackboard]
TA: ...
TA Office Hours: ..., (online in the Math Center).

Recommended Textbook Grimmett and Stirzaker, Probability and Random Processes, Third Edition, Oxford.(A draft of the book is available online here). I think this is a good book to own if you will study probability and its related fields in the future.
Other Textbooks (not required): I will be drawing on various sources in the course such as: Durrett, Probability: Theory and Examples, 4th Edition. (A draft of the book is available online here).
Dembo's notes available here.
Feller, An Introduction to Probability Theory and its Applications, Volumes 1 and 2. This set of two books is encyclopedic and very detailed.
Ledoux, The Concentration of Measure Phenomenon. I will perhaps include a few results from this book near the end of the course.

First Midterm: Friday, February 19, 1PM-150PM
Second Midterm: Monday, March 29, 1PM-150PM
Final Exam: Wednesday, May 5, 2PM-4PM
Other Resources: An introduction to mathematical arguments, Michael Hutchings, An Introduction to Proofs, How to Write Mathematical Arguments

Zoom Classroom Conduct: Students should attend zoom lectures in a considerate way and abide by the following rules of decorum. Failure to do so could result in a diminished participation grade. It is preferable (though not required, for equity reasons) that all students have a webcam on during the lecture.

Zoom Security: The zoom links posted on blackboard should not be shared with anyone. You must log into zoom with your USC email address. No one will be admitted to the lecture from the "waiting room" (if you are in the waiting room, you did not log in with your USC email address).

Zoom Technical Support: Technical support for undergraduate students is provided through USC's ITS. Below is the contact information.

Undergraduate Student Technology Support
Portal: https://itsusc.service-now.com/its sp

Phone: 213-740-5555
Email: consult@usc.edu

Lecture Recording: Zoom lectures will be recorded and posted on the blackboard site. It is USC policy to prohibit the sharing of any recording of course lectures with others. Similarly, you should not create your own recording of the lectures.

Time Zone Issues: If the course lectures, office hours, or exam schedules occur outside the range of 7AM-10PM in your current time zone, please alert me to this fact as soon as possible. Late notification of such an issue (e.g. the day before an exam) may result in a denied rescheduling request.

Email Policy:

- My email address for this course is stevenmheilman@gmail.com.
- It is your responsibility to make sure you are receiving emails from stevenmheilman@gmail.com, and they are not being sent to your spam folder.
- Do NOT email me with questions that can be answered from this document.

Exam Procedures: If enrollment is ten or lower, midterm exams will be oral exams, where I ask each person questions individually, over zoom (probably for 10-20 minutes). If enrollment goes higher than ten, the midterms will be 24-hour take-home exams, to be submitted on blackboard. In the midterm exams, you are allowed to consult your homeworks, your notes, and your textbook, but these are the only resources you are allowed to use during the exams. So, you are not allowed to use the internet, internet searches, a friend or assistant, etc. Phones must be turned off. If you have anticipate issues with a stable internet connection (for obtaining the exam), issues with obtaining a suitable exam environment, etc., please let me know as soon as possible and we can try to come up with a solution to these issues. Cheating on an exam results in a score of zero on that exam. Exams can be regraded at most 15 days after the date of the exam. This policy extends to homeworks as well. All students are expected to be familiar with the USC Student Conduct Code. (See also here.)

Disability Services: If you are registered with disability services, I would be happy to discuss this at the beginning of the course. Any student requesting accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in 301 STU and is open 8:30am-5:00pm, Monday through Friday.
https://dsp.usc.edu
213-740-0776 (phone)
213-740-6948 (TDD only)
213-740-8216 (fax)
ability@usc.edu

Student Conduct: Discrimination, sexual assault, and harassment are not tolerated by the

university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community - such as a friend, classmate, advisor, or faculty member - can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Homework Policy:

- Homeworks are due at **12PM noon Fridays**.
- Homeworks are submitted in blackboard, under the "Assignments" tab. You are allowed unlimited submission "attempts" for an assignment, but only the last submission will be graded. To avoid internet issues, I recommend making your first submission of an assignment well in advance of the deadline. (Note that phone tethering can also give you an internet connection to a computer.)
- Homeworks should be submitted as single PDF documents. One way to create a PDF document from paper homework assignments is the freely available Adode Scan App.
- Late homework is not accepted.
- If you still want to turn in late homework, then the number of minutes late, divided by ten, will be deducted from the score. (The time estimate is not guaranteed to be accurate.)
- Do not submit homework via email.
- The **lowest two** homework scores will be dropped. This policy is meant to account for illnesses, emergencies, dropped internet connections, etc.
- You may not use the internet to try to find answers to homework problems.
- A random subset of the homework problems will be graded each week. However, it is strongly recommended that you try to complete the entire homework assignment.
- All homework assignments must be **written by you**, i.e. you cannot copy someone else's solution verbatim. However, collaboration on homeworks is allowed and encouraged.
- Homework solutions will be posted on Friday after the homework is turned in.

Grading Policy:

- The final course grade is weighted as the larger of the following two schemes: Scheme 1: class participation (5%), homework (35%), the first midterm (15%), the second midterm (20%), and the final (25%). Scheme 2: class participation (5%), homework (35%), the largest midterm grade (25%), and the final (35%).
- The grade for the semester will be curved. However, I do not "curve down" since anyone who exceeds my expectations in the class by showing A-level performance on the exams and homeworks will receive an A for the class.

- If you cannot attend one of the exams, you must notify me within the first two weeks of the start of the quarter. Later requests for rescheduling will most likely be denied.
- Class participation is not the same as attendance. I will never explicitly take attendance, but I will notice if someone is frequently absent. Things that increase your class participation grade include: asking good questions, paying attention in class, showing up on time or early to class, etc. Things that decrease your class participation grade include: excessive talking or disruptions during class, frequent absences, excessive texting/smartphone usage in class, frequent tardiness, etc.
- You must take the final exam to pass the course.

Tentative Schedule: (This schedule may change slightly during the course.)

Week	Monday	Tu	Wednesday	Th	Friday
0					Jan 15: Review
1	Jan 18: No class		Jan 20: Review		Jan 22: Review
2	Jan 25: 6.1, Markov chains		Jan 27: 6.2, Classification of States		Jan 29: Homework 1 due. 6.2, Classification of States
3	Feb 1: 6.4, Stationary Distribution		Feb 3: 6.4, Stationary Distribution		Feb 5: 6.4, Limiting Behavior
4	Feb 8: 6.5, Reversibility		Feb 10: 6.9 Continuous-time Markov chains		Feb 12: Homework 2 due. 6.10, Uniform semigroups
5	Feb 15: No class		Feb 17: 5.3, Random Walks		Feb 19: Midterm # 1
6	Feb 22: 5.3, Random Walks		Feb 24: 5.3, Random Walks		Feb 26: Homework 3 due, 5.3, Random Walks
7	Mar 1: 7.7, Martingales		Mar 3: 7.7, Martingales		Oct 2: 12.1, Martingales
8	Mar 8: 12.2, Concentration		Mar 10: 12.4, Stopping Times		Mar 12: Homework 4 due. No class
9	Mar 15: 12.5, Optional Stopping		Mar 17: 6.8, Poisson Process		Mar 19: 6.8, Poisson Process
10	Mar 22: 6.8, Poisson Process		Mar 24: 10.1, Renewal Theory		Mar 26: Homework 5 due, 10.2, Renewal Theory
11	Mar 29: Midterm #2		Mar 31: 13.1, Brownian Motion		Apr 2: 13.2, Brownian Motion
12	Apr 5: 13.3, Diffusion Processes		Apr 7: No class		Apr 9: Homework 6 due, 13.4, Passage Times
13	Apr 12: 13.5, Barriers		Apr 14: 13.6, Brownian Bridge		Apr 16: Stochastic Calculus
14	Apr 19: 13.8, Itô Integral		Apr 14: 13.8, Itô Integral		Homework 7 due, 13.9, Itô Formula
15	Apr 26: 13.10, Option Procing		Apr 28: Review of course		Apr 30: No class

Advice on succeeding in a math class:

- Review the relevant course material **before** you come to lecture. Consider reviewing course material a week or two before the semester starts.

- When reading mathematics, use a pencil and paper to sketch the calculations that are performed by the author.
- Come to class with questions, so you can get more out of the lecture. Also, finish your homework at least **two days** before it is due, to alleviate deadline stress.
- Write a rough draft and a separate final draft for your homework. This procedure will help you catch mistakes. Also, it might be beneficial to typeset your homework. Learning LaTeX is a good skill to have for doing mathematics. Here is a template .tex file if you want to get started typesetting.
- If you are having difficulty with the material or a particular homework problem, review Polya's Problem Solving Strategies, and come to office hours.