MS&E 20: Discrete Probability Concepts and Models

This is a fast-paced, fundamental course designed to develop an understanding of uncertain phenomena using the theory of probability. The course provides students with conceptual and intuitive insights into probabilistic reasoning and the ability to understand real world situations, including legal, social, medical, financial, engineering, physical, and gaming problems.

For students seeking an introduction to probability theory and applications without any prerequisites, this course is designed to develop their intuition and model building skills. Although it is intended for undergraduate students, it does not satisfy the degree requirements for Management Science and Engineering. It should be taken for four units.

Students in MS&E should enroll in MS&E 120 or 220.

Course Learning Objectives

By the end of the quarter, students should be able to . . .

- make reasonable assumptions about real uncertain situations to build simple models of their beliefs about what is true or what will happen;
- use engineering principles to analyze the behavior of those simple models;
- represent the relationships among uncertain quantities and events in multiple ways; and
- update their beliefs about what is true or what might happen based on new information.

We develop and assess each of these skills through weekly homework and two midterm exams.

Course Staff

Professor:	Ross D. Shachter, Huang 337, shachter@stanford.edu, 650-353-7456
Teaching Assistant:	Morgan Knowlton, morgank2@stanford.edu
Staff Support:	Rosalind Morf, Huang 339A, rozm@stanford.edu, 723-4173

Schedule

Lectures:	Mondays and Wednesdays, 10:30-12:30am, Shriram 108
Review Session and Office Hours:	Mondays and Wednesdays, before class, Shriram 108
	Additional office hours will be announced if needed

We expect you to attend lectures and problem sessions because students who are present and asking questions during class gain a deeper understanding of the course concepts and methods. We post lecture notes to enrich the experience for those attending class, but they are not intended as an alternative to attending class.

Course Website

The course web site is on **Canvas.stanford.edu**, where you can find handouts.

Required Textbook

The required textbook for the course is

Sheldon Ross, **A First Course in Probability**, Pearson, 2019 (Tenth Edition).

It is on reserve in the Engineering Library in Huang.

Prerequisites

High school math is sufficient as calculus is not required. Please come to office hours if you need help with the math.

Accommodations

We do our best to accommodate students who need special arrangements. Please submit any OAE letter as a *private* Accommodation request on Ed Discussion. Please give us as much notice as possible so we can make any arrangements, and we may ask you to work with appropriate University officials for assistance and support.

Honor Code

The Honor Code is taken seriously at Stanford University and we expect it to be respectfully observed by the course staff and students. Simply put, it places the responsibility for ensuring honest behavior on the students as well as the course staff, and violations should not be tolerated. **The midterm examinations are strictly individual work and you may not consult on them with others.** You can consult with others on the homework assignments but **you must acknowledge by name those with whom you have discussed the work you submit for grading**. Please check with Ross if you have any questions about what is permitted.

Ed Discussion Forum

Please use the **Ed Discussion tab in Canvas** to ask your class-related questions or to share an OAE letter. We encourage you to ask questions whenever you're struggling to understand a course concept. When the questions you ask are visible to your classmates, your classmates can also benefit from the teaching team's answers.

Gradescope Submissions

Please submit your homework solutions and reflections via the **Gradescope tab in Canvas**. Submissions should be PDF files, and you should take the time to ensure that all answers are legible and appropriately tagged. Submission instructions and recommendations for PDF scanning by smartphone are available by searching "submit" or "scan" at **help.gradescope.com**.

Grades

Course grades are based on the percentages of the best possible score for each of the following components:

- **25% homework (or homework reflections) for homeworks 1-7, each pass/fail,**
- **25% first midterm exam, and**
- **25% second midterm exam, and**
- **25% maximum of the midterm exams**,

yielding an overall percentage of the best possible score. Any student who gets more than 90% of the best possible score will receive at least an A grade; 80% at least a B; and 70% at least a C. Borderline decisions will be affected by class participation.

Midterm Examinations

There will be **Midterm Examinations on Wednesday, July 24 and August 14, in class**.

The exams will all be open-book and open-notes.

All students are responsible for ensuring that they can attend both midterm examinations. If you need special arrangements, please let us know as soon as possible.

Homework

It is important to stay current with the course material and not fall behind. Trying to solve the homework problems yourself first is the best way to learn the material and prepare for the midterm exams, but please bring your questions to review sessions, office hours, and Ed Discussion.

The homework problems are posted in *Homework 1-7 Problems* in Canvas Files/Homework, based on the eighth edition of your textbook. You are permitted to work with others to master the principles and approaches used to solve homework problems (but not on the midterm exams), although the work you turn in should be your own. In the spirit of academic integrity and the Honor Code, **you must acknowledge** all the people and sources you have consulted, including course staff and any non-course websites, in preparing the work you submit for grading. You will get full credit (pass/fail) if we believe you demonstrated sufficient effort, so please show your work, and submit it via the Gradescope tab in Canvas by **11:59pm on Mondays**, as described under Gradescope Submissions.

Your homework will be graded pass/fail, and students who do not submit passing work **can get full credit (pass/fail) by submitting a homework reflection**. There will be a limited time after grades are posted for the homework for you to submit a reflection. Those students showing sufficient effort on a homework reflection by the deadline will get full credit for the homework. The reflection should include a brief response, for each problem for which a student did not submit a correct answer, that does one or more of the following, based on the solution set:

- explain their mistake,
- describe which course concepts or results apply to the problem,
- point out any mistakes or confusions in the solution set*, or
- ask whatever questions they still have about the problem*.

*Students are also encouraged to bring questions to office hours or post them to Ed Discussion.

Because reflections are available for the homework, there will be no deadline extensions for completing the homework and all nine homework assignments or reflections on them will be considered in the final grading.

Note that the course schedule appears on the following page.

Tentative Course Schedule

The text section numbers cited refer to the course textbook.
Note that some sections in the readings include topics not covered in this course.
In particular, you can skip the "continuous variable" examples in sections marked with *.
If the schedule changes, an updated schedule will be posted on the course web site.

Week	Lecture Topics	Text Sections	Assignments Due next Monday night
June 24, 26	Combinatorics, Axioms	1.1-1.5 2.1-2.4	Homework 1
July 1, 3	Axioms Conditioning	2.5, 2.7 3.1-3.3	Homework 2
July 8, 10	Conditioning, Discrete RVs	3.4-4.5	Homework 3
July 15, 17	Discrete Distributions Dependent Random Variables	4.6-4.10 6.1-6.4	Homework 4
July 22 July 24	Belief Networks **Midterm Examination 1**, in class	handout 1.1-4.10	Homework 5
July 29, 31	Exchangeability, Expectation	6.8, 7.1*-7.3*	Homework 6
Aug 5, 7	Conditional Expectation Probability Bounds	7.4*-7.6* 8.1*, 8.2*, 8.5*	Homework 7
Aug 12 Aug 14	Additional Topics **Midterm Examination 2**, in class	9.2-9.4	