MATH 36a: Probability
Summer 2019 (Session II)

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Office Hours: TBA

“The greatest advantage in gambling lies in not playing at all.”
- Gerolamo Cardano, ca.1560

Course Description:
Philosophers such as Aristotle, Cicero, and Boethius first wrote about probability over two thousand years ago\(^1\). Even the mathematical approach to probability is not new - having started with the gambler Gerolamo Cardano studying games of chance in the 16th century\(^2\). This has led to a rich mathematical theory which allows us to assign precise numerical values to the uncertainty of events.

In this course, students will learn the language and techniques behind both discrete and continuous probability. Some examples of the questions this will let us answer are:

- Should a flush beat a straight in poker?
- Should I expect a run of 4 consecutive heads or tails if I flip a coin 10 times?
- How long should I expect my laptop to work before it crashes?
- Can appearing in an anonymized dataset violate my privacy?

Learning Goals for Math 36a: Students will

- Become familiar with the language of probability and its key theorems.
- Hone computational skills applicable to future courses in mathematics and related fields.
- Practice communicating their understanding of solutions through written and oral presentation.
- Learn to look critically at how probability is presented in the media.

Text: *A First Course in Probability*, Sheldon Ross, 10th edition (Pearson) - Available as an ebook (recommended) or physical textbook.

Prerequisites: Math 20a or 22b, or equivalent (multivariable calculus). This class will use quite a bit of single-variable integration (including improper integration) and some multiple integration.

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Course Layout:
The best way to learn mathematics is by doing mathematics. Listening to me lecture for 2.5 hours every day is not the best way to learn new material. As such, this course will (in addition to a lecture) include time for students to work together on problems and present solutions to each other. The general layout will be as follows.

1. Before Class: Students read the assigned sections of the book and complete the online reading quiz.

2. Beginning of Class (~5-10 mins): Students take turns presenting solutions to problems. These presentations are meant to be informal but give students the opportunity to practice putting words to their ideas.

3. After the day’s presentations, I will lecture on new material. The expectation is that students have completed the reading beforehand, so the lectures will be fast-paced. This is also when students can ask questions about the reading.

4. Throughout the lecture, there will be time for students to work together on solving problems. Problems which are not completed during class can be finished as homework. We will also take a break about halfway through.

5. After Class: Students finish problem sets as homework to be presented/turned in within a day or two and complete the next reading assignment.

Assessment:
Final grades will be based on in-class participation, short writing assignments, reading quizzes, problem sets, a midterm, and a final.

<table>
<thead>
<tr>
<th>Grade Item</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Participation</td>
<td>5%</td>
</tr>
<tr>
<td>Writing Assignments</td>
<td>5%</td>
</tr>
<tr>
<td>Reading Quizzes</td>
<td>10%</td>
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<tr>
<td>Problem Sets</td>
<td>20%</td>
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<tr>
<td>Midterm</td>
<td>30%</td>
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<tr>
<td>Final</td>
<td>30%</td>
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1. **Participation:** This portion of your grade is mainly determined by your presentations at the beginning of class. You will know ahead of time when it is your turn to present and will have some choice in which problem(s) you would like to present for the class. This portion of your grade will also reflect the expectation that students are completing the readings ahead of time and are working together during in-class work time.

2. **Writing Assignments:** Once per week, you will be asked to find a presentation of probability in the media (for example in a newspaper article) and write (1-2 paragraphs) about whether or not the presentation is dishonest or misleading and how it could be improved.

3. **Reading Quizzes:** There will be a short quiz on LATTE for every reading assignment. These are due **ONE HOUR BEFORE** class begins. This allows me to look through the quizzes and tailor my lectures to topics the class found more difficult. **NO LATE READING QUIZZES ARE ACCEPTED**, but your 2 lowest scores will be dropped.
4. **Problem Sets:** Problem sets are due by the beginning of class. You are encouraged to work together on the problem sets, but all of your writing should be your own. In particular, make sure you understand each solution and can explain it in your own words. You may not consult solutions manuals. **NO LATE PROBLEM SETS ARE ACCEPTED**, but your 2 lowest scores will be dropped.

5. **Midterm:** The midterm will be held during class roughly halfway through the material. It will be closed-note, closed-book, closed-internet, etc. You will not be able to use a calculator, but you will also not be required to simplify numerical answers.

6. **Final:** The final will be cumulative, but will mostly focus on material from the second half of the course. It will be closed-note, closed-book, closed-internet, etc. You will not be able to use a calculator, but you will also not be required to simplify numerical answers.

**Topics Covered:**

We will cover parts of chapters 1-8 in the text along with one supplementary topic. The plan will be to move quickly at the start so that we have more time when we reach more difficult and technical material near the end of the semester. A more detailed (and tentative!) course plan is shown below.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Textbook Reference</th>
<th>Number of Class Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counting</td>
<td>Sections 1.2-1.5</td>
<td>1</td>
</tr>
<tr>
<td>Axioms of Probability</td>
<td>Sections 2.2-2.5</td>
<td>1</td>
</tr>
<tr>
<td>Conditional Probability</td>
<td>Sections 3.2-3.4</td>
<td>2</td>
</tr>
<tr>
<td>Discrete Random Variables</td>
<td>Chapter 4</td>
<td>5</td>
</tr>
<tr>
<td>Continuous Random Variables</td>
<td>Sections 5.2-5.5</td>
<td>2.5</td>
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<tr>
<td>Differential Privacy</td>
<td>Supplementary Material</td>
<td>1.5</td>
</tr>
<tr>
<td>Independence</td>
<td>Sections 6.1-6.2</td>
<td>1</td>
</tr>
<tr>
<td>Correlation and Conditioning</td>
<td>Sections 7.2, 7.4-7.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Limit Theorems</td>
<td>Sections 8.2-8.4</td>
<td>1.5</td>
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This leaves one day for the midterm and one ‘catch-up’ day.

**LATTE:**

All course materials for Math 36a will be available online on LATTE. Log in at [http://latte.brandeis.edu](http://latte.brandeis.edu) using your Unet username and password.

**Laptops/Tablets:**

You are welcome to bring a laptop or tablet with you to class in order to take notes or access the textbook during class; however, if these devices become a distraction, I reserve the right to change this rule.

**Calculators:**

Calculators **not** allowed during exams. You should have access to a calculator for homework (an online one is fine, for example [http://www.wolframalpha.com](http://www.wolframalpha.com)).

**Four-Credit Course (with ten hours of class-time per week):**

As per the Department of Education Standard, success in a five-week, four-credit course is based on the expectation that students will spend 26 hours of study time per week in preparation for class (readings, papers, discussion sections, preparation for exams, etc.).
Students with Disabilities:

Brandeis seeks to welcome and include all students. If you are a student who needs accommodations as outlined in an accommodations letter, please talk with me and present your letter of accommodation as soon as you can. I want to support you.

In order to provide test accommodations, I need the letter more than 48 hours in advance. I want to provide your accommodations, but cannot do so retroactively. If you have questions about documenting a disability or requesting accommodations, please contact Student Accessibility Support (SAS) at 781.736.3470 or access@brandeis.edu.

Academic Integrity:

You are expected to follow the University’s policy on academic integrity, which is distributed annually as section 4 of the Rights and Responsibilities Handbook (see https://www.brandeis.edu/studentlife/srsrcs/rightsresponsibilities/index.html). Instances of alleged dishonesty will be forwarded to the Department of Student Development and Conduct for possible referral to the Student Judicial System. Potential sanctions include failure in the course and suspension from the University. If you have any questions about how these policies apply to your conduct in this course, please ask.

Name/Pronouns:

If you have a preferred name and/or preferred pronouns you would like me to use, please send me an email to let me know.

Now email me with your favorite joke to show that you have read the syllabus!