# 36-217
# Probability Theory and Random Processes

# Summer 2018

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| **Instructor:** | Robert Lunde |
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| | Office Hours: TBA and by appointment |
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| **Teaching Assistant:** | Boyan Duan |
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| | Office Hours: TBA |
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| **Textbook:** | *Introduction to Probability* |
| | D. P. Bertsekas, J. N. Tsitsiklis |
| | Athena Scientific, 2008 ($2^{nd}$ edition) |
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| **Lectures** | MTWThF, 12:00pm – 1:20pm, Scaife Hall 214. |
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| **Course Materials:** | Canvas page. |
| **Homework:** | due on Tuesdays and Thursdays at the beginning of class, |
| | unless otherwise instructed |
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| **Midterm Exam:** | Friday, June 8th, 2018 |
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| **Final Exam:** | Friday, June 29th, 2018 |
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| **Prerequisites:** | 21-112 or 21-122 or 21-123 or 21-256 or 21-259 |
| | Not open to students who have received credit for 36-225, or 36-625 |
| | C or better is required in order to use this course |
| |  as a pre-requisite for 36-226 and 36-410. |

## Course Description

This course provides an introduction to probability theory. Topics include elementary probability theory, conditional probability and independence, random variables, distribution functions, joint and conditional distributions, limit theorems, and an introduction to random processes.

## Course Objectives

By the end of the course, you will be able to:

1. **Basic Probability.**

   - Use counting tools to enumerate the number of equally likely outcomes.
   - Use the law of total probability and Bayes' Rule to calculate probabilities.
   - Define and identify independence of events.

2. **Random Variables.**

   - Use PMFs, PDFs, and CDFs to derive probabilities and quantities of interest.
   - Calculate expectations for a random variable.
   - Calculate conditional distributions of random variables.
   - Describe and determine independence of random variables.
   - Derive the distributions of functions of random variables.

3. **Advanced Probability Topics.**

   - Describe the Central Limit Theorem, Weak Law of Large Numbers and Chebyshev's Inequality.
   - Describe a Markov chain.
   - Use a probability matrix to calculate the probability of an outcome from a Markov chain.

## Course Components

1. **Lectures.** This class moves rapidly, so it is important that you attend regularly to avoid falling behind. Lecture notes will be provided before class, but solutions to some of the exercises will only be given in class.

2. **Handouts.** Each class will typically have a lecture component and an in-class activity component. The in-class activity will generally consist of handouts with additional practice problems that supplement the lecture material. You are allowed to work in groups and discuss problems with your classmates. Please attempt the problems in class and ask me if you are stuck. I intend to grade problems for effort rather than correctness, but this policy is subject to change if people use this time for doodling, texting, etc. instead of attempting the problem.

3. **Readings.** For most lectures, there will be recommended readings from the textbook. These readings may contain additional material not covered in class. **I recommend obtaining a copy of the required textbook and reading the relevant sections when advised: you will understand the concepts and examples much better.**

4. **Homework.** Homework problems provide you with the opportunity of learning, practicing, and testing your knowledge and understanding of the material. The questions will be both theoretical and applied in nature, with the latter problems encouraging probabilistic/statistical modeling for real-world problems.

5. **Exams.** There will be one midterm exam and one final exam.

   The university calendar for the academic year 2017/2018 is available here:

   http://www.cmu.edu/hub/calendar.html

## Grading Breakdown

- Midterm grades will be computed with the following weights:

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  | Midterm Exam | 40% |
  | Homework | 60% |

- Final grades will be computed according to the following weights:

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  |---|---|
  | Final Exam | 30% |
  | Midterm Exam | 30% |
  | Homework | 30% |
  | Attendance/Participation | 10% |

- Letter grades will be determined according to the following scale:

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  |---|---|
  | A | $> 90$ |
  | B | 80–89 |
  | C | 70–79 |
  | D | 60–69 |
  | R | $< 60$ |

  **Depending on the performance of the class, the scale used to determine the final letter score may be curved.**

## Administrative Procedures and Logistics

- **Prerequisites.** If you don't satisfy the prerequisites for taking this class, you cannot enroll and take the class.

- **Conflicts with Other Classes.** If the lecture times of this class conflict with the lecture times of another class that you are taking, you must decide which of the two classes you want to take and drop the other class.

- **Lectures.** Use common courtesy: arrive on time; do not leave early; no cell-phone, etc. The use of laptops is allowed only for the purposes of note-taking and downloading of course material.

- **Communication.** If you have any questions related to the class material, homework problems and exams, feel free to ask the instructor during class or ask the instructor and the TA during office hours. Please try to use the email only to address administrative and logistic issues. You should not expect a reply within 24 hours. Email communications between you and the instructor/TA must be polite and respectful.

- **Homework.** Homework assignments are due on **Tuesdays and Thursdays in class**, unless otherwise communicated. During exam weeks, there will be one homework due on Wednesday. Assignments must be completed and submitted on paper. **Electronic versions will not be accepted,** unless previous arrangements are made.

  You are encouraged to discuss homework problems and collaborate with classmates, however the work you submit must be your own. Instances of identical or nearly identical or copied homework will be considered cheating and plagiarism.

  **The use of material from previous semesters of this course or from any other source to solve homework and exam problems is regarded as unauthorized assistance and therefore as a violation of the Carnegie Mellon University code of academic integrity.**

  **You are required to write your name and `andrew` ID on the first page of your homework.**

  You can retrieve your graded homework from the instructor at the end of the class (upon signing a privacy waiver) or from the instructor/TA during office hours.

- **Homework Extensions.** There will not be individual homework extensions. The only type of homework extension that may be granted is when the homework deadline is extended for the entire class. However, once during the semester, you may use a grace day to submit homework one day late with no penalty.

- **Missed Exams.**

  1. **Midterm Exam.** A missed midterm will receive a zero score. **This rule admits no exceptions other than documented medical emergencies.** A makeup midterm exam will be arranged only in case of a documented medical emergency which prevents the student to take the midterm exam on the scheduled day.

  2. **Final Exam.** Do not miss the final exam or you will get a null grade to it. **Once again, this rule admits no exceptions other than documented medical emergencies.** A makeup final exam will be arranged only in case of a documented medical emergency which prevents the student to take the final exam on the scheduled day.

- **Integrity.** Cheating, plagiarism and unauthorized assistance on homework or exams will be dealt with in accordance with the academic integrity policy in place at Carnegie Mellon University, as described here:

  http://www.cmu.edu/academic-integrity/index.html

- **Disability Services.** If you have a disability and need special accommodations in this class, please contact the instructor **immediately.** Special accommodations for exams must be requested **no later than one week prior to the exam.** You should also contact the Disability Resources office and request the appropriate documentation. For more information,

see the Carnegie Mellon Equal Opportunity Services and Disability Resources webpage

<http://www.cmu.edu/hr/eos/index.html>

- **Take care of yourself:** Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

CaPS: 412-268-2922

Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police:

On campus: CMU Police: 412-268-2323

Off campus: 911