

36-752 – Advanced Probability Overview

Spring 2014

Instructor: Jing Lei, jinglei@andrew.cmu.edu, Baker Hall 132C. Office Hours: Monday 10:30-11:30 or by appointment.

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Lecture: 9:30-10:30 Mon/Wed/Fri, PH A22.

Texts: 1. *Probability Theory & Measure Theory*, 2nd Ed., by R. Ash and C. Doléans-Dale.
2. *Probability, Theory and Examples*, 4th Ed., by Rick Durrett.

<http://www.stat.cmu.edu/~jinglei/spring14.shtml>

Overview: This is a one-semester course designed to cover two semesters of measure theory and probability. Something will have to give way. Mostly, the proofs will give way. But we will try to prove some of the most important theorems when those proofs illustrate important techniques and concepts. All of the challenging new material in this course will involve limiting operations (epsilon-delta, subsequences, etc). If you are uncomfortable with limits or lack intuition about them, this course will be very unpleasant.

Topics

1. σ -fields, measures, probabilities, extension and uniqueness of probabilities.
2. Measurable functions, random variables, distributions, and integration.
3. Integration and limits, convergence theorems.
4. Densities, Radon-Nikodym derivatives.
5. Product spaces and product measures, Fubini's Theorem. Independence.
6. Weak law of large numbers. Convergence of random variables.
7. Borel-Cantalli Lemma, almost sure convergence.
8. L^p space and L^p convergence, Kolmogorov's theorems.
9. Strong law of large numbers.
10. Convergence in distribution and the Central Limit Theorem.
11. Characteristic functions.
12. Conditional probability and expectation.
13. Martingales.

Homework: Homework assignments will be posted weekly on Wednesdays and due on the following Wednesday at the beginning of class.

- No late homework submissions will be accepted, unless you notify the instructor at least one week before the due time with acceptable reason.
- You are encourage to solve the homework problems by yourself. But you can collaborate with classmates. You need to clearly indicate on your submission with whom and to which extent you have collaborated on the homework assignment.
- You can also use materials in other books or papers. If you do so, you still need to write the solution by yourself based on your own understanding and give clear reference to the external sources.
- Please read the university policy on academic integrity at the following url.

<http://www.cmu.edu/policies/documents/AcademicIntegrity.htm>

Grade: homework 30%, midterm test 30%, final exam 40%.

Bonus Points: Extra credits will be given for the following two items (see course website for further information).

- (a) Three bonus points will be given if all homework assignments and take-home exams (if any) are submitted in pdf format written by L^AT_EX. Templates will be provided on the course website shortly after the first homework assignment is posted there.
- (b) Up to three bonus points will be given for a short (10 min) presentation on a homework problem or any problem relevant to the course material. To proceed, please email the instructor with your choice of problem and a date on which you would like to present.

It is important that you write your name exactly the same way as it appears in Blackboard.

Important Dates

Week	Date	What's Happening
7	28 Feb (Fri)	Mid-Term Exam
8	7 Mar (Fri)	No Class: Mid-Sem Break
9	10-14 Mar (Mon-Fri)	No Class: Spring Break
13	11 Apr (Fri)	No Class: Spring Carnival
16	2 May (Fri)	Last Day of Class