

# Advanced Probability Theory 1

MATH 587 – Fall 2019

<http://problab.ca/louigi/courses/2019/math587/>

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Course schedule: Tuesday, Thursday, 14:30-16:00, Burnside Hall 1104.

Office hours: Monday 13:30-15:00, Wednesday 8:30-10:00, or by appointment.

## TEXTBOOK

*Richard Durrett*, Probability: Theory and Examples (free PDF linked from website).

Supplemental text: *Patrick Billingsley*, Probability and Measure.

Further supplemental material is linked from the course website.

## PLANNED TOPICS

Basic set theory and measure theory, and their interpretations in probability: Dynkin's lemma; uniqueness of extension; Caratheodory's extension theorem; Lebesgue measure. Probability spaces; independence; Borel-Cantelli lemmas, Kolmogorov's zero-one law. Random variables and expectations; inequalities and  $L^p$ -spaces; Radon-Nikodym theorem. Sums of independent random variables: types of convergence; laws of large numbers; possibly Levy's equivalence theory. Conditional expectation: definitions; basic properties; martingales; stopping times; martingale convergence; uniform integrability. Further topics should time permit.

## GRADING SCHEME

Your grade will be calculated according to the more favourable of the following two options:

(A) Assignments 20%, midterm 20%, final 60%

(B) Assignments 25%, final 75%

Submitting an assignment written in LaTeX gives a 10% bonus to that assignment's grade. A LaTeX assignment solution template is available from the course website.

The penalty for late assignments is 10% per day.

**Five** total days of non-penalized lateness are allocated to each student. Additionally, assignments written in LaTeX and submitted by email may be 24 hours late without penalty; this won't count against the aforementioned five days.

Assignments will be judged on mathematical correctness and completeness and also on clarity of exposition. Clarity of explanation will be judged according to the standards of the book [Mathematical writing for undergraduate students](#). Writing that is similar to that in the "bad" examples from that book, and writing of a style that the book specifically suggests avoiding, may cause loss of marks. (Outline continues on next page.)

Missing an assignment without a medical note will result in a grade of zero for the assignment.

The midterm will be held in class on October 22. There will be no supplemental midterm; any student missing the midterm will be graded according to option (B).

#### PREREQUISITES.

1. McGill MATH 356.
2. McGill Math 243 or 255. (Two versions of analysis 2.)

On the analysis side, there are a couple of topics I will assume some familiarity with which are covered in Math 255 but not Math 243. In particular, you will be at a disadvantage if you don't already know the basics about metric spaces, completeness and compactness (e.g. the Heine Borel theorem). If you want to brush up on this material, Sam Drury's MATH 354 notes are a good place to look (roughly, chapters 1, 2, and 4.1,4.2,4.5). These notes are available at <http://www.math.mcgill.ca/drury/notes354.pdf>

#### ADDITIONAL INFORMATION.

1. In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.
2. McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures. See [www.mcgill.ca/students/srr/honest/](http://www.mcgill.ca/students/srr/honest/) for more information.
3. If I have concerns about plagiarism I may subject assignments to (what is these days shockingly sophisticated) text-matching software. McGill used to have a [policy on text-matching software](#), which has recently been [repealed](#), so my use of text-matching software has to be in accordance with a repealed policy. I don't know what that means, but it sounds to me like I can do whatever I want.
4. In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.