SYLLABUS

Mathematics 335 will meet on Mondays, Wednesdays, and Fridays,
from 2:30 p.m. to 3:20 p.m., in King 237.

TAUGHT BY: Elizabeth Wilmer
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OFFICE HOURS: Monday, 3:30–4:30 p.m.
Tuesday,11:30 a.m.–12:30 p.m.
Tuesday, 3:00–4:00 p.m.
Thursday, 2:00–3:00 p.m.
IM HOURS: Monday, Tuesday evenings.

GOALS OF THE COURSE: An introduction to the tools and methods of modern probability theory for discrete and continuous distributions. We will discuss sample spaces, events, random variables, conditional probability, independence, expectation, and variance on our way to Weak Law of Large Numbers and the Central Limit Theorem. In order to compute parameters in examples, we will also study some counting techniques and exploit power series in several ways. Throughout the course we will explore applications, inter-pretations, and paradoxes. We will conclude with an examination of random walks.

TEXTS: Our main textbook will be *The Essentials of Probability* (R. Durrett, Duxbury, 1994), which is available at the Oberlin Bookstore. At the end of the semester, we will study Chapter 12 of *Introduction to Probability* (C.M. Grinstead and J.L. Snell, AMS, 1997), which is available online at

http://www.dartmouth.edu/~chance/teaching_aids/articles.html

There will also be occasional *handouts*: some reminding you of background material, some supplementing the textbook.

EVALUATION: Each of the two take-home exams will be worth 100 points. The final will be worth 100 points. The homework will be worth 100 points.

EXAMS: There will be two take-home exams during the semester:

the first between **Wednesday, October 8** and **Friday, October 10**,
the second between **Wednesday, November 19** and **Friday, November 21**.

These exams will be written to take two hours; however, you will be allowed to work on each exam for 24 hours after unsealing it. You will be allowed to use calculus books as references. Exact rules and procedures for the take-homes will be provided later.

Class will meet as usual during the take-homes. You should allot extra time for Math 335 during those weeks.

The final, which will focus on material from the last third of the semester, will also be take-home and will be run similarly to the semester exams. While exact rules will be announced later, the final

must be returned by 4:00 p.m. on **Tuesday, December 16**.

HOMEWORK: Implicit in each lecture and each problem set is a reading assignment. You should read each section of the book, and each handout supplementing the book, that we discuss.

There will be one problem set per week. They will generally be due at 4:30 p.m. on Friday. You should turn your homework in to the MATH 335 folder hanging on the wall outside the Mathematics Department office, King 205.

The homework will be graded on a √+, √, √- scale. An even mix of check-plusses and checks will be scaled to at least a B when final grades are prepared.

Late assignments will not be accepted (medical emergencies excepted), although your lowest problem set score will be dropped.

The majority of the problems assigned to turn in will be challenging. Some computations will be tricky; you will generally have to write proofs and to think beyond examples done in class or in the book.

Solution sets will be posted to Blackboard shortly after the assignments are due.

IF YOU HAVE QUESTIONS: Ask! Stop by at office hours (or make an appointment for a time that's better for you). Send e-mail, or IM. Call.

THE HONOR CODE AND MATHEMATICS 335: As your grade for Mathematics 335 will depend on both your exam scores and your homework scores, you must uphold the Honor Code while completing both types of work. You are expected to write and sign the Honor Pledge,

"I affirm that I have adhered to the Honor Code in this assignment,"

at the end of each problem set and each exam. The meaning of adhering to the Honor Code differs, however, for the two types of assignments.

THE HONOR CODE AND HOMEWORK: Talking about mathematics is one of the best ways to improve your understanding of the subject, both because other points of view can be illuminating and because conversation requires you to articulate your own ideas. I encourage you to discuss homework problems with other students. Unless otherwise specified, however, *you must write up the problems on your own*. Some quick examples:

> **OKAY:** "I wonder if we can use the law of total probability to turn this into a sum. Pat, do you think that will work, or is something different going on?"
>
> **NOT OKAY:** "Pat, I hate it when you write so small! Is that a *2* or an *a* in front of the *y*? I'm never going to get this copied by the time class starts!"
>
> **OKAY:** "I'm not sure I understand what's going on. Maybe we should try to find another example like this, except where X and Y are not independent."
>
> **NOT OKAY:** "Huh. You have this variable m in your write-up. Maybe I can call it k instead, to make it look different. "

You may also feel free, when working on problem sets, to consult other written resources (such as other books or web sites on probability)–as long as the sources you consult do not directly address assigned problems or close variants of assigned problems. Please credit any sources you consult.

THE HONOR CODE AND TAKE-HOME EXAMS: You will be expected to work *entirely on your own* during the take-home exams, using *only* the written resources specified at the time of the exam.

HOW TO SUCCEED IN MATHEMATICS 335

Probability is a challenging class for many students, due in large part to:

- **The inherent difficulty of the material.** Probability was not fully "mathematicized" until early in the 20th century. The formalisms capture our intuitive ideas of probability in surprising ways, and everyone needs practice to become comfortable with all the new definitions, computations, and theorems.

- **The reliance on material learned in earlier mathematics classes.** We will use calculus, both single and multi-variable, intensively. You will need to recall formulas (such as the power series for the exponential function) and algorithms (e.g., how to evaluate a multiple integral). You will also need, however, to understand the *concepts* of calculus to fully comprehend many ideas in this course. Most likely Mathematics 335 will deepen your understanding of the earlier material—but you should expect to refer to your books and/or notes from earlier classes.

- **As a 300-level class, Mathematics 335 demands greater mathematical maturity** than do intermediate courses. We will proceed from definition to properties to proof with fewer pauses. There will be bigger formulas, more definitions, and longer proofs. You will be expected to explore further on your own in the homework—and to include in your own write-ups those bigger formulas and more sustained reasoning.

What you can, and should, do:

- **Keep up with the class**. We will build ideas on top of each other; missing material early on will cause a great deal of trouble later. If you don't understand something, ask about it sooner rather than later—during class, or during office hours.

- **Read the book**. It will give you another perspective on the material and is available at all times of day or night. When you read, read actively. Have pencil and paper ready to work through any omitted details (and many details are omitted; Durrett is quite terse). If you suspect you've found an error in the book, you might well be right—there are many. There is a list of typos at

  `http://www.math.cornell.edu/~durrett/eoptypos.txt`

- **Work through as many examples as possible**.

  - Go over your class notes and make sure you understand what happened. Come in and talk with me if you still have questions.

  - Do practice problems. Durrett lists problems in increasing order of difficulty; I'll usually assign from the ends of the sections, but you can do problems from the beginnings as warm-ups. (The answers to the even-numbered problems are at the end of the book.)

  - You should make up your own examples, too. Ask "what if…?" and then try to answer your own question. Figuring out which questions a given method can answer is a terrific way to understand that method.

MATHEMATICS 335 COURSE OUTLINE

The section numbers are from Durrett.

SEPTEMBER 3–5

1.1 Sample spaces, events.
Review of set theory.
1.2 Probabilities. Basic properties.

SEPTEMBER 8–12

Asymptotics. Big O, little o, ~.
1.3 Permutations and combinations.
1.4 Sampling without replacement.
1.5 Repeated experiments, sampling with replacement.

SEPTEMBER 15–19

2.1 Independence. Binomial, geometric, and negative binomial distributions.
2.2 Conditional probability.

SEPTEMBER 22–26

2.3 Two-stage experiments.
Law of total probability.
2.4 Bayes formula for computing conditional probability.

SEPTEMBER 29–OCTOBER 3

3.1 Discrete distributions.
Poisson distribution.
3.2 Continuous random variables.
Densities. Cumulative distribution functions. Uniform, power law, exponential, and normal distributions.

OCTOBER 6–10

Exam I, Chapters 1 and 2.
3.3 Finding the density of a function of a random variable.
3.4 Joint distributions and joint densities.

OCTOBER 13–17

3.5 Marginal distributions.
Independence of random variables.
3.6 Sums of independent random variables.
Convolutions.

FALL BREAK

OCTOBER 27–31

4.1 Expected value.
Definition and examples.
4.2 Expected value of function of random variable.
Moments. Generating functions.

NOVEMBER 3–7

4.3 Properties of expectation.
4.4 Variance and covariance.

NOVEMBER 10–14

5.1 Markov, Chebyshev inequalities.
Laws of Large Numbers.
Chernoff bounds on large deviations.

NOVEMBER 17–25

Exam II, Chapters 3 and 4.
5.1 Central Limit Theorem.

THANKSGIVING

DECEMBER 1–12

Random walks.

Review sessions will be held during Reading Period. I will also hold office hours then for individual questions.

DECEMBER 16, 4:00 P.M.

Final exam, concentrating on Chapter 5 and random walks, due.