Math 311 - Probability Theory - Fall 2011
Instructor: Jeff Hamrick
Course Syllabus

SUMMARY INFORMATION
Instructor: Jeff Hamrick, Ph.D., CFA, FRM
Office: Ohlendorf 318
Office Hours: 11:00-11:50 a.m. TTh, 2:00-2:50 p.m. T, 1:00-1:50 p.m. W
Office Phone: 901/843-3253
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Class Location: Kennedy Hall 208
Class Time: 2:00-2:50 p.m. MWF

ON PROBABILITY THEORY. As a field of mathematics, probability theory is fairly young. Some historians say that the study of probability began in 1654, when Antoine Gombaud and Chevalier de Mere discovered that their intuition about the results of a certain dice game conflicted with their mathematical analysis. They contacted Blaise Pascal and Pierre de Fermat, who began to exchange letters and who jointly formulated some of the fundamental principles of probability theory.

Probability theory was not a well-respected field at the time; it was considered a conglomeration of counting tricks, quirky results, and rough heuristics. Although mathematicians like Jakob Bernoulli, Christian Huygens, and Abraham de Moivre continued to develop the field, they generally focused on problems associated with gambling. Pierre de Laplace was the first mathematician to show that probabilistic results could be applied to many different scientific and practical problems, especially in statistics and actuarial mathematics.

Probability still remained a messy discipline from a modern mathematical perspective, however. Mathematicians couldn't seem to agree on a good definition of probability that was both rigorous yet still flexible enough to permit the discipline to have broad applications. This matter was finally resolved by the famous Russian mathematician Andrei Kolmogorov in his monograph of 1933, in which he axiomatized the field. Since that time his ideas have been refined, of course, but due to his efforts probability theory has now been embedded in a larger field of mathematics called measure theory. Today, probability theory is central to the study of nearly every applied science, including financial mathematics, neuroscience, climatology, and quantum mechanics. I hope you will enjoy learning it with me!

ON COURSE GOALS. Any student who successfully completes this course should be able to do the following:

- Define and distinguish between the basic objects of probability theory;
- Compute the probability of various events, given the appropriate probability distributions;
- Model and simulate the occurrence of events using appropriate probability distributions;
- Recall a number of counterintuitive results from probability theory;
- Understand the critical role of the notion of *independence*;

- Understand the significance of, and apply, the Central Limit Theorem; and
- Prove facts in probability theory using techniques from calculus (i.e., integration and series convergence).

In general, this course will prepare successful students for basic applications of probability theory, including mathematical statistics (the topic of the next course, Math 312). Also, a student who successfully completes this course should, with approximately an additional 100 hours of study, be able to take and pass the first actuarial science examination (Examination 1/P).

ABOUT ME. My name is Jeff Hamrick. I'm an assistant professor in the Department of Mathematics and Computer Science at Rhodes College. Please call me Jeff. My office is located in room 318 of Ohlendorf Hall. I will hold office hours from 11:00-11:50 a.m. on Tuesdays and Thursdays, 2:00-2:50 p.m. on Tuesdays, and 1:00-1:50 p.m. on Wednesdays. My office number is 901/843-3253 and my e.mail address is `hamrickj@rhodes.edu`. Additional information (old tests, *Mathematica* projects, etc.) will be available on my professional web page (to be created shortly, I hope). Please stop by my office anytime. If you're unable to make my office hours, let me know and we may be able to schedule an appointment at an alternate time.

ABOUT YOU. You should be hard-working and enthusiastic about learning! This course features a fairly traditional treatment of calculus-based probability theory, so you should already have taken Math 121 and Math 122 or the equivalent courses at other institutions. (Alternatively, you might possess the appropriate Advanced Placement or International Baccalaureate credit.) Additionally, Math 223 is a co-requisite for this course, though we will only intensively use the concepts of partial differentiation and iterated/multiple integration from multivariate calculus. Some students have told me that they find this course to be easier and more enriching if they have already taken Math 201.

ABOUT US. We will meet to talk about probability theory on Mondays, Wednesdays, and Fridays from 2:00 p.m. - 2:50 p.m. during the fall semester. We will meet in Kennedy 208. We will use *Fundamentals of Probability, with Stochastic Processes*, by Saeed Ghahramani (ISBN: 0-13-145340-8). We will more or less cover the entire book (with the unfortunate exception of Chapter 12), though we will not necessarily cover every section in every chapter.

ON PREREQUISITES. On the first day of class, I will give out a take-home examination covering topics from univariate and multivariate calculus. You may work on these examinations in small groups so that you have an opportunity to recall some pretty important calculus concepts, to practice using the language of calculus, and to get to know one another better. This examination will count towards your final grade in this course and **will be due in my office on August 26, 2009 at 3:00 p.m.** If you find yourself utterly lost or totally unaware of some of the critical calculus concepts considered on this examination, you may want to consider re-taking (or reviewing the necessary concepts from) calculus before attempting to master the material in this course. **In short, you are expected to recall basic results from calculus.**

An additional warning: this course is, in a sense, similar to a basic calculus course, a computer science course, and a point-set topology course. We will compute probabilities, write computer software to simulate random variables and stochastic processes, and think carefully about theorems and write proofs of those theorems. Probability theorists must do a little bit of everything and they must do it well!

ON ATTENDANCE. Attendance is expected in this course but is neither required nor rewarded. You may only miss a midterm examination or the final examination under the most dire of circumstances, and even then only with advance consent from me.

ON HOMEWORK. Problems from the textbook will be assigned during each class period. They are noted on the course outline. I expect you to work on these homework problems very frequently but for short periods of time. In general, I encourage you to work with your colleagues on any of the assigned problems—but make sure that you are learning the material rather than passively learning while somebody else does the work.

Please write up each homework problem on a separate sheet of paper. Every day, I will ask you to turn in one of the homework problems, which I will choose at random. I will grade this particular problem and return it to you with feedback at the end of the next class lecture.

Each day, I will allot a few minutes of class time for homework-related questions. We won't have enough time to discuss many questions, so please come to my office hours. **I will not accept late homework assignments under any circumstances.** Instead, at the end of the semester, I will drop your three lowest homework grades.

ON ACTUARIAL EXAMINATION QUESTIONS. Each day, I will assign two multiple-choice questions from old (or sample) actuarial examinations. (In particular, the questions will come from the first actuarial examination, which covers calculus and probability theory.) Typically, but not always, these questions will correspond to the day's lecture or to material from previous lectures. You may work on these multiple choice questions with colleagues. You will self-grade the questions at the beginning of class and hand them in with your daily homework assignment.

ON SIMULATION ASSIGNMENTS. Because the final chapter of the Ghahramani text (which I will only follow loosely) is not particularly amenable to in-class testing, we will complete three simulation assignments during the semester instead. We will use *Mathematica* 7.0/8.0, which can greatly facilitate the creation of probabilistic intuition. You must begin simulation assignments well in advance of their due date and be actively engaged with me regarding your *Mathematica*-related questions.

ON MIDTERM EXAMINATIONS. Four times during the semester, we will pause and take a brief, 50-minute midterm examination. Each examination will focus on material that we have recently (but not too recently) discussed in class.

ON THE FINAL EXAMINATION. A final, written, comprehensive 2.5-hour examination will be held Wednesday, December 14, 2011 in our usual classroom location (Kennedy 208).

ON GRADING. I've noticed that students are too focused on grades, to the great detriment of their own learning. If students put as much effort into actually learning material as they did worrying about their grades, their performance would be much better. Nevertheless, part of my job is to assign grades fairly and in a manner that reflects the high academic standards at Rhodes College. In this class, we will use the standard ten-point scale. "Plus" or "minus" grades will be assigned to students with grades close to the extremes of each ten-point bracket (plus or minus two points from the boundary of each bracket). **In general, I do not inflate grades. Specifically, I do not curve final grades in this course. The "curve" is the make-up examination policy. See the section below.**

Your grade in this course will be computed according to the following weights:

Component	**Weight**
Initial Take-Home Examination	5%
Actuarial Examination Questions	5%
Homework	15%
Midterm Examinations	40%
Final Examination	20%
Simulation Assignments	15%

ON RETAKING EXAMINATIONS. Grades will not be curved at the end of the semester. I subscribe to the somewhat radical and non-modern notion that students should receive grades that indicate how much they have actually learned. However, I also believe in making learning objectives clear and attainable for a reasonably bright, reasonably hard-working student.

More importantly, I believe that when students do poorly on an examination, they should have the opportunity to review their errors, learn from those errors, and then demonstrate that they have acquired an improved mastery of the material. Hence, there will be two opportunities to obtain "grade forgiveness" in this course.

The first opportunity for "grade forgiveness" will be during the third midterm examination. After taking the third midterm examination, you may replace your first and/or second midterm examination grades by taking an examination similar to, but materially different from, the first and/or second midterms. By re-attempting the first or second examination, you will be irrevocably committing to replacing the grade(s) you earned on your earlier attempt(s). Hence it is possible to do worse on the make-up(s) than on the original examination(s) and to further damage your final grade in the course. You will have to tell me if you want to re-attempt the first and/or second midterm examinations several days prior to the third midterm examination.

The second opportunity will be during the final examination. You may again attempt to replace any or all of your earlier midterm examination grades by retaking those examinations. By retaking an earlier examination, you are irrevocably committing to replacing the grade you earned on the earlier attempt. Again, it is possible to do worse on make-ups than on the original examinations and end up in a worse position! You will have to tell me if you want to re-attempt an examination several days prior to the final examination.

You may not re-take the initial review examination that covers topics from calculus. Because of time constraints, you will not have an opportunity to re-take the final examination.

You should plan on allocating 50 minutes of your time for each examination. So, for example, if you plan on re-taking the first midterm examination on the day that we take the third midterm examination, you will have to stay an hour after class to do so. With respect to the final examination: you may need to stay up to four hours (!) after class if you want to do all of the possible make-ups. (We will have to find a special location for the make-up examinations; details are forthcoming.)

ON MISSING EXAMINATIONS. I do not, under any circumstances, offer make-up examinations due to absence or sickness. You must plan on taking each examination. If you miss an examination, you may simply opt to do the corresponding make-up examination at the midpoint or end of the semester.

ON CHEATING. In this class, we will adhere to the provisions of the Rhodes College Honor Code. Obviously, you may not work with other students on examinations and you may not use crib notes, a calculator, or your textbook during an examination. In general, if the Rhodes College Honor Council concludes that a student in this course has violated the honor code, I will adhere to the recommendations of the Honor Council. However, I reserve the right to lower a student's grade in this course if I sincerely believe that an infraction has occurred.

ON LaTeX . LaTeX is the most prominent document preparation package used by mathematicians, economists, and other scientists. If you nicely type up your daily homework assignment in LaTeX, I will increase your grade on that particular daily homework assignment by 5%. The web is filled with information on how to download, install, and use LaTeX, and I am happy to answer your questions about LaTeX too. (This provision does not apply to the simulation assignments, which I prefer for you to type up in *Mathematica* itself.)

ON SAFE ZONES. Along with many other members of the Rhodes community, I am a participant in the Safe Zones program, which is described here:

`http://www.rhodes.edu/campuslife/11503.asp`

In an academic environment, we can have legitimate differences and disagreements with one another. However, in my classes, I expect an overarching mutual respect among all participants, regardless of sex, race, ethnicity, sexual orientation, gender identity or expression, national origin, and religion. As Carl Friedrich Gauss said, mathematics is **the** queen of all academic disciplines, and consequently—in my view—every human being has a right to experience its power, applicability, and beauty.