MATHEMATICS 191, FALL 2003
MATHEMATICAL PROBABILITY

Last revised: September 16, 2003

Instructor: Paul Bamberg
Offices: SC 423, 495-1748 and Quincy House 102, 493-3100. Quincy 102 opens off the Quincy House courtyard, near the raised cubical library.
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Course Website: http://www.courses.fas.harvard.edu/~math191 (That's a tilde before math191)

Goals and Prerequisites: This is a moderately rigorous course in probability theory and its applications. A nice feature of probability is that it presents subtle issues involving the infinite in contexts that appear realistic in the sense that you could imagine betting on the outcome of the questions that was posed. So while the course will require only infinite series (Math 1b), multivariable calculus (Math 21a) and a bit of linear algebra (Math 21b) it will lead naturally into areas such as set theory and elementary measure theory.

Application areas will depend on the interests of the class. Here are some possibilities:

- Entropy and Statistical Mechanics
- Brownian Motion and Diffusion
- Signal Processing for Computer Speech Recognition
- Language Modeling for Computer Speech Recognition
- Martingales and Gambling Systems
- Theory of Option Pricing

One application area that will not be included is statistics, since there are plenty of other courses in that area.

Course Meetings: The course meets TTh from 10-11:30 A. M. in Science Center 116. There will also be additional weekly problem sessions led by the course assistant. These will not be the usual optional "help sessions." Instead, members of the class will be assigned problems to present at the blackboard, drawn from the collection of 1000 solved problems that accompanies the textbook. Participation in these sessions will count for one-third of your homework grade, and graded written problem sets will be shorter than usual.

Grades: Your course grade will be determined as follows:

- required homework, 40 points
- problem session presentations, 20 points
- two best quizzes, 20 points each
- third quiz, 10 points
- final exam, 100 points

The total points available are thus 210, and the grading scheme is as follows:

Points	Minimum Grade
192	A
180	A-
168	B+
154	B
142	B-
130	C+
118	C

Since this is the first time I am teaching this course, I reserve the right to be more generous if exams prove unexpectedly long or difficult.

Exams: There will be three in-class quizzes and one final exam. The quizzes will be roughly one-half hour each, and the final is scheduled for three hours.

Three Quizzes:	Tuesday, October 5
	Tuesday, November 4
	Tuesday, December 2
Final Exam:	comprehensive, with fairly uniform coverage

Texts:

"Probability and Random Processes," Grimmett and Stirzaker, third edition, Oxford University Press, 2002, ISBN# 0-19-857222-0 (at the Coop)

"One Thousand Exercises in Probability," Grimmett and Stirzaker, Oxford University Press, 2002, ISBN# 0-19-857221-2 (at the Coop)

"Calculus, Volume II, 2nd Ed." Tom M. Apostol, Wiley, 1969, ISBN# 0-536-00008-5 (Ch. 13 only – will be available as a course pack)

"50 Challenging Problems in Probability, " Mosteller, Dover, 1965, ISBN# 0-486-65355-2 (at the Coop)

Office Hours:

- Tu 2:30-3:30 in Science Center 423
- W mornings in Quincy 102 (most any time, but phone 3-3100 first)
- M and W evenings in Quincy 102, but phone 3-3100 first)

Homework and Programming Assignments: Homework will be assigned weekly and will be due at the start of Thursday's class. Your CA will return your corrected homework to you at the following class.

You are encouraged to discuss the course with other students, your CA and the instructors, *but you should always write your homework solutions out yourself in your own words.*

Very Approximate Day-by-Day Syllabus:

Date		Chapter	Topics
September	16	Apostol	Countability and Uncountability
	18	1	Sets and Probability
	23	1	Combinatorics, Bridge, Poker, and Dice
	25	1	Conditional Probability and Independence
	30	2	Random Variables
October	2	3	Discrete Distributions and Random Variables
	7	3	QUIZ #1 and Conditional Expectation
	9	3	Simple Random Walk
	14	4	Continuous Distributions and Random Variables
	16	4	Functions and Sums of Random Variables
	21	4	Multivariate Normal Distribution
	23	4	Geometric Probability
	28	5	Generating Functions
	30	5	Random Walk and Branching Processes
November	4	5	QUIZ #2 and Characteristic Functions
	6	5	Weak Law of Large Numbers, Central Limit Theorem
	13	6	Markov Processes
	18	6	Stationary Distributions and Markov Processes
	20	6	Poisson Processes and Radioactive Decay
	25	7	Convergence of Random Variables
December	2	7	QUIZ #3 and Strong Law of Large Numbers
	4	?	Applications 1
	9	?	Applications 2
	11	?	Applications 3
	16	?	Applications 4

Chapters 1-5 of Grimmett and Stirzaker will be covered quite thoroughly. Coverage of chapters 6 and 7 will be limited to the easier topics. Coverage of chapters 8-13 will be limited to special topics for applications.