Applied Probability Theory and Stochastic Modeling
Andrew Sommese (Instructor)

Fall 2005: Applied Probability: Math 60850 1:55–2:45 MWF DeBartolo 216

This first-year graduate course is a solid introduction to Applied Probability. Though the only strict requirements are a full sequence of calculus with some linear algebra, and a willingness to learn what is needed, having had an undergraduate probability course and the equivalent of a mathematical methods course (eigenfunction expansions, rudiments of one complex variable, separation of variables to solve classical partial differential equations, Fourier and Laplace transforms) will help a lot.

Topics covered will include:

1. Basic setup of probability theory (including sample spaces, conditional probability, independence). Random variables (including the elements of measure and integration theory).
2. Discrete random variables (including random walks).
3. Continuous random variables, the basic distributions, sums of random variables.
4. Generating functions, branching processes, basic theory of characteristic functions, central limit theorems.
5. Markov chains (embedding, birth and death processes, Poisson processes)
6. Monte Carlo simulations
7. More "laws of large numbers," including the law of the iterated logarithm, Martingales, filtered sigma algebras, and the simplest martingale convergence theorems.
8. Various stochastic processes, including Brownian motion, queues, and applications.
9. Martingales, including stopping times and optimal stopping.
10. The rudiments of stochastic integration (including Ito's formula and the Black-Scholes differential equation).

G. Grimmett and D. Strizaker, Probability and random processes, Oxford, 3rd edition (2001) will be used as a text.

Spring 2006: Stochastic Modeling: Math 60860

This course is a sequel to Math 60850 (Applied Probability). It gives an introduction to stochastic modeling and stochastic differential equations, with application to models from biology and finance.

1. Stochastic versus deterministic models
2. Diffusion processes
3. Discrete and continuous Markov chain models with applications
4. The long run behavior of Markov chains
5. Poisson processes with applications
6. Brownian motion and related Processes, e.g., the Ornstein-Uhlenbeck Process
7. Elements of stochastic dynamical systems
8. Numerical methods for stochastic processes

   [4] will be one of the texts used in the class.

References

[1] G. Grimmett and D. Strizaker, Probability and random processes, Oxford, 3rd edition, 2001.

[2] S. Karlin and H. M. Taylor, A first course in stochastic processes. Second edition. Academic Press, New York-London, 1975.

[3] S. Karlin and H. M. Taylor, A second course in stochastic processes. Academic Press, New York-London, 1981

[4] B. Oksendal, Stochastic Differential Equations : An Introduction with Applications, Sixth edition. Universitext. Springer-Verlag, Berlin, 2003.

[5] H. M. Taylor and S. Karlin, An introduction to stochastic modeling, 3rd ed., San Diego : Academic Press, 1998.

[6] L. Rogers and D. Williams, Diffusions, Markov processes, and Martigales, vol. 1, Wiley, 1987.

[7] D. Williams, Probability and Martingales, Cambridge, 1991.