

*Math 489/889: Stochastic Processes
and Advanced Mathematical Finance*

Section 001
11:30 - 12:20 MWF
3 credit hours
Steve Dunbar

Fall Semester, 2010

The course goals are:

1. Understand the properties of stochastic processes such as sequences of random variables, coin-flipping games, Brownian motion and the solutions of stochastic differential equations as a means for modeling modern financial instruments for the management of risk.
2. Use sophisticated financial instruments for the management of risk as motivations for the detailed study of stochastic processes and solutions of stochastic differential equations.
3. One emphasis will be on understanding standard stochastic processes at the level of the classic references by Karlin and Taylor, and Feller. The course will not hesitate to prove mathematical statements at the level of proof employed in Math 325.
4. The course emphasizes the mathematical modeling process applied to a modern area which is not based on physical science yet still leads to classical partial differential equations and numerical methods. The field of mathematical finance is only 35 years old, uses leading-edge mathematical and economic ideas, and has some controversial foundational hypotheses. Mathematical finance is also data-rich and even advanced results are testable in the market. Using mathematics illustrated daily on newspaper financial pages, the course applies the full cycle of mathematical modeling and analysis in a non-trivial, but still accessible, way that has economic implications.
5. The goal of the course will be to reach a point where the students thoroughly understand the derivation and modeling of financial instruments, advanced financial models, advanced stochastic processes, partial differential equations, and numerical methods at a level sufficient for beginning

graduate study in mathematics, finance, economics, actuarial science, and for entry-level positions in the sophisticated financial services industry.

ACE Outcome 10: This course satisfies ACE Outcome 10. The entire set of your homework, projects and exams will be a scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.

The course provides a capstone mathematical experience in that it combines the mathematical areas of probability and statistics, mathematical modeling, calculus, difference and differential equations, numerical solution and simulation and mathematical analysis in a single course. In addition, the course uses all of these topics to investigate modern financial instruments that have enormous economic influence, but are hidden from popular view because they are wrongly believed to be esoteric and difficult. The course is based on material that is extremely data-rich. The financial news has daily coverage of price fluctuations, not to mention Internet resources which can provide nearly real-time as well as historical coverage of financial information. This provides the opportunity for students to compare the theoretical understanding to the reality of financial markets. The combination of these topics gives the course a unified view of mathematics in the context of an important modern application.

Keep a file of your graded projects and exams. To satisfy Outcome 10, some of these files will be collected, copied and returned at the end of the course.

The technical prerequisites of the seminar are understanding of

1. the meaning and calculation of mean, variance, and standard deviation
2. calculating joint probabilities of independent events,
3. the meaning and use of binomial random variables,
4. the meaning and calculation of probabilities for a normal random variable.

Math/Stat 380 and the mathematical maturity to follow mathematical proofs are the general prerequisites. Some familiarity with differential equations and mathematical analysis will be helpful.

The class will meet Fall Semester 2010, 11:30 – 12:20, Mondays, Wednesdays, and Fridays.

The text for the course will be published on the web at

<http://www.math.unl.edu/~sdunbar1/Teaching/MathematicalFinance/mathfinance.shtml>

and also on the UNL Blackboard site: my.unl.edu in the course **STOCHASTIC PROCESSES MATH489 SEC001 FALL 2010**. Students will need access to a web-browser capable of rendering MathML. I recommend the freely available Firefox 3.5 or later, available for all platforms. Students may also need to occasionally use specialized mathematical software in the Mathematics Computer Lab, Avery 18. Students registered for a math class automatically a valid log-in for the Mathematics Computer Lab.

Office and Availability:

Office Hours: Mon-Wed-Fri, 10:30 am – 11:20 am, 308 Avery

Phone: 472-7236 (24 hour University Voice Mail)

Math Department: 472-3731 (8:00 AM – 5:00 PM)

Email: sdunbar1@unl.edu , URL: <http://www.math.unl.edu/~sdunbar1>

Class Policies:

1. Collaboration on homework is allowed, but each student must turn in the assigned homework.
2. Grading will be based on approximately 10 homework assignments worth approximately 47%, quizzes worth approximately 15%, an extended project worth 13%, one mid-term exam worth approximately 15%, and one comprehensive final exam worth approximately 15% of the course grade.
3. The mid-term is tentatively scheduled for class time Friday, October 29, 2010 and the Final Exam is scheduled for 10:00 AM - 12:00 NOON, Tuesday, Dec 14, 2010.