University of California, Berkeley
Haas School of Business

Business Administration 239b
Doctoral Seminar in Continuous-Time Finance
Spring 2003

Instructor

Bob Anderson
501 Evans
anderson@econ.berkeley.edu
642-5248
office hours: drop-in hours Wednesday 4:00-6:00 (exception: W 1/22 2:00-3:00); other times by appointment
The best way to reach me outside of class is via e-mail. All E-mail from students in the class will be answered.

Course Material

There will be two texts:

- Lars Tyge Nielsen, *Pricing and Hedging of Derivative Securities.*
- Salih N. Neftci, *An Introduction to the Mathematics of Financial Derivatives*

Course Requirements

Lectures: Tuesday, Thursday 12:30-2:00, C325 Haas

Most weeks, a problem set will be handed out in the Thursday lecture which will be due by the end of class the following Thursday. There will be N (approximately equal to twelve) problem sets. Students are urged to work in groups to complete the problem sets, but you should write up your solutions on your own. Your problem set grade will be based on the N-3 highest grades of the problem sets you hand in; this will allow you to miss three problem sets with no penalty.

The final grade will be based 25% on the problem sets and 75% on a take-home exam. You may do the take-home exam during any 72-hour period of your choosing in the period May 13-May 27. There will be no formal final exam.

Course materials will be posted at the following course website: http://emlab.berkeley.edu/users/anderson/BusAd238b/238bindex.html.

Course Outline

I have looked at lecture notes that have been used recently in the continuous-time finance class at Berkeley and several other top finance programs. I also looked at seven different texts. I found considerable variation in the topics covered, and in the level of the mathematics used.

This lack of consensus reflects a fundamental problem in this course. We are supposed to cram the material of two graduate classes in math and statistics, plus a large number of finance applications, into a single semester class. It simply can't be done. Hence, different courses and texts have taken the following very different approaches:

1. *Tell old war stories*. A distinguished contributor to the development of the literature explains how he thought of various important ideas. This fits neatly into the time available, but doesn't help the students much.
2. *Do a truly elegant treatment of the mathematics, with no connection to finance*. A couple of texts provide truly beautiful presentations of the math, but they are so slick that they are hard for the first time reader to understand. I believe that to understand the math, you have to get your hands dirty. Only then you can appreciate the beauty of something slicker. And the best way to get your hands dirty is to use finance to motivate the mathematics.
3. *Relegate all the mathematics to a brief appendix, and pursue a large number of finance applications*. A variant of this is to devote one or two lectures to stating the main math results, then move quickly on to the finance applications. The problem is that the students cannot get even a basic understanding of stochastic processes, and it is very hard for me to see how they can do research in continuous-time finance without it.

You've probably guessed that I am not going to use one of the above approaches. I believe that one needs to develop a solid, hand-on, intuitive understanding of Brownian motion and stochastic integration before one can make sense of this material. But finance is the best motivation for stochastic integration, so it will be used for motivation early on. The goal is to give you a solid mathematical and

finance grounding in option pricing in continuous time, including recent work with non-Brownian price processes.

The text that comes closest to my view of how this material should be taught is Nielsen. Nielsen's first three chapters develop the necessary material on stochastic processes. I will also be drawing on my understanding of the material, which came in large part from a really intuitive course taught by Kakutani in the Yale Math department in 1975. I will stress the close relationship between Brownian motion and random walk. Random walk is more intuitive and simpler theoretically, but Brownian motion makes many calculations much easier. I will use only occasional bits and pieces from Neftci, but I think you will find it a very accessible reference if you are having trouble reading Nielsen.

Nielsen's chapters 4, 5 and 6 cover martingale valuation and option pricing when price processes are given by Brownian motion.

The following chapter references are to Nielsen's text.

Chapter 1: Weeks 1-3
Chapter 2: Weeks 4-6
Chapter 3: Read on your own
Chapter 4: Weeks 7-9
Chapter 5: Weeks 9-10
Chapter 6: Weeks 10-12
Non-Brownian Processes: Weeks 13-16

Take-home exam may be done in any 72-hour period of your choosing, starting no earlier than May 13 and ending no later than May 27.