Derivative Securities
G63.2791, Fall 2000
Tuesdays 7:10–9:00pm
401 Main

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Content: An introduction to arbitrage-based pricing of derivative securities. Topics include: arbitrage; risk-neutral valuation; the log-normal hypothesis; binomial trees; the Black-Scholes formula and applications; the Black-Scholes partial differential equation; American options; barrier options; one-factor interest rate models; swaps, caps, floors, swaptions, and other interest-based derivatives.

Changes since last year: Derivative Securities replaces Mathematical Finance I, with two main differences: (1) We will not discuss portfolio theory (CAPM, APT, utility maximization) – these topics are now covered in the course Capital Markets and Portfolio Theory. (2) We will spend about 1/3 of the semester on interest-based derivatives – these were previously covered only in the spring semester. The natural sequel to this course is Continuous Time Finance, taught in the spring (formerly Mathematical Finance II).

Lecture notes: Lecture notes, homework assignments, etc. will be posted on my web page in postscript and pdf format – normally within a day of when they are distributed. The first 2/3 of the semester will be roughly similar to the old Math Finance I; therefore the notes I wrote for Math Finance I in 1997, which still appear on my web page, may be of use for reading ahead – and to judge whether you have the necessary prerequisites.

Prerequisites: Calculus, linear algebra, and discrete probability. Concerning probability: students should be familiar with concepts such as expected value, variance, independence, conditional probability, the distribution of a random variable, the Gaussian distribution, the law of large numbers, and the central limit theorem. These topics are addressed early in most undergraduate texts on probability. Simultaneous registration in the course Basic Probability and Stochastic Processes is sufficient.

Course requirements: There will be approx 7 homework sets, one every couple of weeks. Collaboration on homework is encouraged (homeworks are not exams) but registered students must write up and turn in their solutions individually. There will be an in-class final exam.

Books: We will not follow any single book linearly. However to master the material of this course you should expect to do plenty of reading. I recommend purchasing at least these two books:

- R. Jarrow and S. Turnbull, *Derivative securities*, Southwestern Publishing, 2nd edition (2000), approx. $95. [If you have access to the first edition that's good enough.]

- M. Baxter and A. Rennie, *Financial calculus: an intoduction to derivative pricing*, Cambridge University Press, 1996, approx $48.

The NYU bookstore (18 Washington Place) ordered at least 40 copies of each. They complement each another nicely: Jarrow and Turnbull is aimed mainly at MBA students, has lots of practical information, stays relatively elementary, and has very good exercises (my homework sets will draw heavily from its exercises). Baxter and Rennie is aimed mainly at mathematicians, and though it has little practical information it presents the modern, arbitrage-based theory of option pricing in a very concise, elegant, and lucid manner. Both books go considerably beyond the scope of this course, covering also material associated with the spring semester sequel Continuous Time Finance.

Here are some other books you may wish to buy or at least consult:

- J.C. Hull, *Options, futures, and other derivatives*, 4th Edition, 2000, Prentice-Hall, approx. $89.

- M. Avellaneda and P. Laurence, *Quantitative Modeling of Derivative Securities*, CRC Press, 1999, approx. $60.

- P. Wilmott, S. Howison, and J. Dewynne, *The mathematics of financial derivatives - a student introduction*, Cambridge University Press, 1995, approx. $30

- L. Clewlow and C. Strickland, *Implementing derivatives models*, Wiley, 1998, approx. $70

- N. Chriss, *Black-Scholes and beyond: option pricing models*, McGraw-Hill, 1996, approx. $60

- P. Wilmott, *Derivatives; the theory and practice of financial engineering*, Wiley, 1998, approx. $65

- S. Neftci, *An introduction to the mathematics of financial derivatives*, Academic Press, 1996.

The NYU bookstore has a few copies of Hull and Avellaneda-Laurence on order as "recommended texts." All the books listed above are on reserve in the CIMS library. Our treatment of interest-based derivatives will probably draw more on Hull and Clewlow-Strickland than on Jarrow-Turnbull or Baxter-Rennie.