ECONOMICS 873

FINANCIAL DERIVATIVES

Frank Milne **Winter 2008 (revised December 2007)**

Room: MC A516

Ph. 36494

Texts:
S. Neftci, **An Introduction to the Mathematics of Financial Derivatives, (second edition),** Academic Press,2000.
R.Jarrow and S.Turnbull, **Derivative Securities**, (second edition) South-Western, 2000

Background Reading:
J.Hull, **Options, Futures and other Derivatives** (sixth edition) **,** Prentice Hall, 2006.

This course will consist of two sections:

Section 1 deals with the elementary Binomial/Multinomial pricing model and explores variations on this basic theme. The text for this part of the course is **J&T** and **Milne**. These texts will be supplemented by appropriate readings. It is assumed that the student has a thorough grounding in the Binomial/Multinomial model from Econ 870. Therefore we will quickly revise the material on equity options and explore models of the term structure of interest rates, and fixed income options.

Section two deals with the continuous time formulation that complements the Binomial/Multinomial model. The text for this section is S. Neftci, **An Introduction to the Mathematics of Financial Derivatives,** (second edition)**,** Academic Press, 2000. We will use Jarrow and Turnbull, **Derivative Securities** as a reference that integrates the binomial models and continuous time models.

A standard, "industry reference" is, J.Hull, **Options, Futures and other Derivatives,** Prentice Hall, 4th Edition, 2000. It will provide background on most topics. This course will be more rigorous then Hull, but it compliments Jarrow and Turnbull.

Additional Reading:
F. Milne **Finance Theory and Asset Pricing,** second edition, 2003.
N.Bingham and R.Kiesel, **Risk Neutral Valuation,** Springer, 1998.
S.Shreve, **Stochatic Calculus for Finance II, Continuous Time Models**, 2004.
L.Clewlow and C.Strickland ,**Implementing Derivative Models,** Wiley, 1999.
D.Tavella and C.Randall, **Pricing Financial Instruments: the finite difference approach,** Wiley, 2000.
Meissner, **Credit Derivatives,** Blackwell, 2005.

Hull is often referred to as an industry standard. It omits many proofs, but provides a useful summary at a non-technical level: it should be easy reading for students in this class. **B&K** is mathematically more advanced and forms a useful bridge between **Neftci** and more advanced mathematical treatments**. B&K** and **S** are recommended for mathematically sophisticated students or the more ambitious student who wishes to study further on the completion of the course**. S** is more advanced than **B&K** and **N** and includes careful, but accessible proofs of results not proved in **B&K**. **C&S** and **T&R** are texts that discuss finite techniques for solving PDE's in asset pricing. Both are accessible references for this class. **M** is an economist's view of asset and derivative pricing that emphasizes GE and arbitrage as the general organizing structure for discussing many theoretical applications. There are a number of other texts that I can refer to the interested student.

Topics:

Section 1: Discrete models

1.1 Introduction:

J&T Ch.1-3
Hull Chs.1,2,3,6-9.

1.2 Review of Options, Futures and Derivatives.

J&T Chs. 4-7.
N. Ch.2
B&K.Ch.3,4
V. Naik, "Finite State Security Market Models and Arbitrage", Ch.2 in R.Jarrow et al, **Finance**, N-H, 1995.
P.Carr and R.Jarrow, "A Discrete time Synthesis of Derivative Security Valuation Using a Term Structure of Futures Prices", Ch.7 in Jarrow et al.

1.3 Bonds and Interest Rate Derivatives.

J&T Chs. 13-15
R.Jarrow, "Pricing Interest Rate Options", Ch.8 in Jarrow et al.
N. Ch.17
Hull, Chs.4,5.

1.4.Credit Risk

J&T Ch.18
Jarrow et al. "A Markov Model for the Term Structure of Credit Risk Spreads" Rev.Fin.Stud. Summer 1997

1.5. General Discrete Factor models that mimic Continuous time Models.

Milne Chs. 12,14.

Section 2: Continuous Time Models:

2.1 Tools in Probability Theory

N. Ch.5 (Also review Calculus in N.Ch.3.)
B&K Ch.2.

2.2 Martingales and Martingale Representations:

N Ch.6.
B&K Ch.5.

2.3 Differentiation in Stochastic Environments:

N Ch.7.
B&K Ch.5

2.4 The Smooth Weiner Process and Jump Processes:

N. Ch.8
B&K Ch 5.

2.5 Integration in Stochastic Environments:

N. Ch.9
B&K.Ch.5

2.6 Ito's Lemma

N. Ch.10
B&K.Ch.5

2.7 The Dynamics of Derivative Prices

N. Ch.11
B&K.Ch.5 (and in general for the topics below)

2.8 Pricing Derivative Products

N. Ch.12

2.9 The Black-Scholes PDE

N. Ch.13
J&T Chs. 8-10
H. Ch.11-13, 15-18.
C&S. Chs. 1-3. (And later chapters for more detail)
T&R (general discussion)

2.10 Pricing Derivative Products

N. Ch.14

2.**11 Equivalent Martingale Measures**

N. Ch.15

2.12 Modeling Term Structure and Related Concepts

N. Ch.18

C&S Chs. 6-9

2.13 Classical and HJM Approaches to Fixed Income

N. Ch 19

J&T Ch 16

C&S Ch 10

2.14 Classical PDE Analysis for Interest Rate Derivatives

N. Ch.20

C&S Chs. 7-9

2.15 Relating Conditional Expectations to PDE's

N. Ch.21

2.16 Stopping Times and American-Type Securities

N. Ch.22

J&T Ch.7

2.17 Discrete and Continuous Time Credit Risk Derivative Models

Meissner, Ch.5.

Jarrow et al. "A Markov Model for the Term Structure of Credit Risk Spreads" Rev.Fin.Stud. Summer 1997.

2.18 Exotic Options

J&T Chs.19,20

C&S Ch.5

You are now in a position to read derivative articles in the main journals – see especially The Journal of Derivatives for many applications.