

# **Financial Modeling and Optimization-Course Syllabus**

MIS 383N.8 - unique # 03735  
Spring 2007 MW 12:30-2:00, CBA 3.106

## **Instructor**

Leon S. Lasdon

Office Phone: 471-9433

E-Mail: [lasdon@mail.utexas.edu](mailto:lasdon@mail.utexas.edu)

Office: CBA North 5.244

Office hours: MW 11-12, 2-3, or by appointment

Teaching Assistant: Wei Chen

TA e-mail: [wei.chen@phd.bus.utexas.edu](mailto:wei.chen@phd.bus.utexas.edu)

Course web page: [www.utexas.edu/courses/lasdon](http://www.utexas.edu/courses/lasdon), and our web page on UT's "Blackboard" system.

## **Course Topics**

1. The Process of Modeling
  - 1.1 A six-stage framework
  - 1.2 The craft of modeling
  - 1.3 Visual modeling tools
  - 1.4 Spreadsheet engineering
  - 1.5 Analysis Using Spreadsheets
2. Deterministic Cash Flow Streams
  - 2.1.1 Fixed Income Securities: duration and convexity, bond portfolios, immunization
  - 2.1.2 Term structure of interest rates
  - 2.1.3 Applications: capital budgeting, dynamic cash flows, valuation of a firm
3. Basic ideas of risk analysis
4. Single period Random Cash Flows
  - 4.1.1 Mean-Variance Portfolio Theory
  - 4.1.2 Capital Asset Pricing Model
  - 4.1.3 Variants of Mean-Variance models: factor models, arbitrage pricing theory, model parameter estimation
  - 4.1.4 Utility Theory
5. Derivative Securities
  - 5.1.1 Forwards, futures, and swaps
  - 5.1.2 Models of asset dynamics
  - 5.1.3 Basic options theory
  - 5.1.4 Additional options topics
  - 5.1.5 Interest rate derivatives
6. Multiperiod models

- 6.1.1 Optimal portfolio growth
- 6.1.2 General investment evaluation
- 7. Personal Investing

## **Software Used**

Learn to use state of the art optimization and simulation software including the following:

1. Excel and the Excel Solver for optimization
2. @RISK for Monte Carlo Simulation
3. Precision Tree for Decision Tree analysis
4. The GAMS algebraic modeling language

This software, and the concepts underlying it, has applications in all areas of business.

This course is designed for MBA students, engineers, operations research students, computer scientists, and others who are interested in quantitative methods and their application to finance and investing. The level of mathematics used in the course is fairly basic- algebra, elementary calculus, and basic probability and statistics. You also need the ability to think logically and systematically, but improving this ability is a course goal.

## **Instructional Methods**

The basic approach is to learn by doing. We will organize small learning groups, who work together to solve problems in class. These problems are stated on the plan for each class. Last years plans are on the course website, and are a reasonable guide to those used in the current year. We then discuss the problem solutions. This is interspersed with lecture segments when needed. There will also be occasional outside speakers, who will explain how they use course topics in their work.

## **Course Materials**

The text is “Investment Science” by David Luenberger, Oxford University Press, 1998. It is available at the Co-op or online and should be purchased by each student or group of students. This author is a renowned scholar, and the book has received excellent reviews.

A second book, “Financial Models Using Simulation and Optimization II” by Wayne Winston, Palisade Corp (pub), 2nd edition, 2002, will provide many problems and cases, all framed as Excel spreadsheet models, provided on a CD-ROM which accompanies the book. This second edition has substantial new material compared to the first edition, so don't buy the first edition. The CD-ROM also includes full trial versions of the PALISADES Excel add-in software @RISK (for Monte Carlo simulation), PRECISION TREE (for decision tree analysis), and EVOLVER, a genetic algorithm for optimization that can solve non-smooth and discrete problems. This book and its 68 excellent examples provide problem templates and solution software which many students will be able to apply in their future careers. Although individual purchase is encouraged, one

copy may be purchased and shared by each learning group. It is available at the Co-op or online

The third book is “Seeing Tomorrow” by Dembo and Freeman. It discusses models and tools for risk management in a highly readable way. It’s available at the Co-op or online and is inexpensive (from about \$2 used on Amazon to \$27.95 new at Amazon).

### **Grading**

There will be an in-class midterm exam counting 30%, and a term project selected by the students and approved by the instructor counting 30%. Cases and homework count 40%.

### **Tentative Schedule of Topics**

<b>Class number</b>	<b>Date</b>	<b>Topic</b>	<b>Text chapters and pages</b>	<b>Other book chapters and pages</b>	<b>Readings</b>
1	Jan 17	Introduction, modeling framework			Art of modeling ch 1
2	Jan 22	Craft of modeling			Art of modeling ch 3
3	Jan 24	Visual modeling tools			Art of modeling ch 4
4	Jan 29	Spreadsheet engineering, begin case 1			Art of modeling ch 5
5	Jan 31	Spreadsheet analysis			Art of modeling ch 6
6	Feb 5	Mortgages, annuities, bonds	ch3,40-61		
7	Feb 7	Bond portfolios, duration, immunization, convexity	Ch3,62-71,ch4	Winston ch25 duration and immunization	Bondyield.xls, duration derivation.doc
8	Feb 12	Term structure of interest rates, Begin case 2	ch 4	Winston ch 14	
9	Feb 14	Project selection	Ch 5	Winston ch15	
10	Feb19	Decision trees and multistage project models			Decision making under uncertainty
11	Feb 21	Decision trees and multistage			Decision making under uncertainty

		project models			
12	Feb 26	Risk management		Dembo and Freeman	
13	Feb 28	Midterm exam			
	Mar 5	Plus trips: informal classes	T:ch 5, pp.102-111		
	Mar 7	Plus trips: informal classes	T: ch 5, pp 111-134		
14	Feb 19	Risk management		Dembo and Freeman	
15	Feb 21	Risk management		Dembo and Freeman	
16	Mar 19	Mean-variance portfolios	ch 6, pp 137-162	Winston ch 16	
17	Mar 21	Mean-variance portfolios, begin case 3	ch 6, pp 162-172		
18	Mar 26	Scenario approach and other risk measures	Ch 9		3scen.xls
19	Mar 28	Modeling oil and gas E&P projects and selecting project portfolios		Winston ch 19	E&PPortfolioPaper103.doc, dcf tx expl onshore.xls, portfolioslidessponsors6.pdf,
20	Apr 2	Models and data	ch 8		
21`	Apr 9	Forwards, futures, and swaps	ch 10		
22	Apr 11	Stock Price models	ch 11		
23	Apr 16	Basic Options Theory	ch 12		
24	Apr 23	Black-Scholes option model, interest rate derivatives	ch 13,14		
25	Apr 25	Multi-period asset allocation models			Multiperiod asset allocation
26	Apr 30	Multi-period asset allocation models			Multiperiod asset allocation
27	May 2	Multi-period asset allocation			Multiperiod asset allocation

		models			
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