



VALUATION OF REAL OPTIONS

MIS 383N, Spring 2007

COURSE INFORMATION

Instructor: James S. Dyer

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Of. hours: T TH 3:30-5:00 PM

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Of. hours : By appointment

REQUIRED MATERIALS

- ♦ T. Copeland and V. Antikarov, Real Options, Texere, Revised 2003.
- ♦ R. Clemen and T. Reilly, Making Hard Decisions with Decision Tools Suite, 2nd Edition (2004 update), Duxbury Press, 2001.
- ♦ Software: Student versions of DPL 5.0 and @Risk. (@Risk available on the Business School server and also in CD in the Clemen and Reilly book)

SUPPLEMENTAL REFERENCES

- ♦ M. Grinblatt and S. Titman, Financial Markets and Corporate Strategy, Irwin/McGraw-Hill, 2nd Edition, 2001.
- ♦ J. Hull, Options, Futures, and Other Derivatives, Prentice-Hall, 2003, 5th Edition

COURSE DESCRIPTION

Real Option Valuation is the state of the art method for valuation and management of strategic investments. In many project settings where the firm is subject to an irreversible investment with widespread uncertainty, there may be a degree of flexibility that allows managers to make changes to the project during its life. This project flexibility, or real options, is ignored in DCF analysis and can significantly increase the value of the project by taking into account the value of being able to alter a project in response to unexpected developments. Real Option Valuation complements traditional valuation methods by applying financial option theory to capital budgeting.

In this course we will present the Real Options method and use Decision Analysis tools such as binomial decision trees to model the project uncertainties and flexibilities. The real options approach to valuing managerial flexibility and real options requires an understanding of both traditional DCF methods of valuation and option pricing techniques. We will begin with a brief review of the fundamental ideas associated with these areas before proceeding into decision analysis and real options. We will also provide some hands on experience with some of the software tools that support the analysis of problems using these ideas and will see models of real options implementation using decision tree software. It will be assumed that students have taken at least one course in corporate finance and valuation.

GRADING

This will be as much as a “hand on” course as possible, with a focus on the practical side of applying real option valuation in the real world. There will a number of homework assignments and case studies to be turned in and class participation will also count towards the final grade. Students should be prepared to be called upon to discuss any assigned work. A final assignment will be handed out in the last day of class, which must be prepared and submitted in one week. For this assignment, students may work in groups of three.

Class participation:	10%
Homework Assignments:	30%
Cases:	30%
Final Assignment:	30%

CLASS SCHEDULE

1 Jan 16 Introduction

- Tues Reading:
- ◆ Copeland & Antikarov Chapter 1
 - ◆ A. Triantis, "Realizing the Value of Real Options: Does Theory Meet Practice", *Journal of Applied Corporate Finance*, Vol. 14, No. 1, Spring 2005.

2 Jan 18 Financial Options and Real Options

- Thur Reading:
- ◆ Clemen & Reilly Chapter 1,2,3 (Skip Precision Tree)
 - ◆ DPL tutorial Version 6.
 - ◆ DPL User Guide, to be assigned
 - ◆ Copeland & Antikarov Chapter 2

3 Jan 23 Structuring Decisions

- Tues Reading:
Practice Problems:
- ◆ Early Bird, Inc.(pg 39), 3.24, 3.25
- Assignment due:
- ◆ Case Study: The Nanotech Project.
Nanotech Inc. has a unique opportunity to invest in a project to develop and market a new product, but there are significant uncertainties over the future sales levels. On the other hand, if sales are good, there is the potential to expand this project in five years time. How should the firm analyze and value this project?

4 Jan 25 Modeling Flexibility

- Thur Reading:
- ◆ Clemen & Reilly Chapter 4 pages 111-119, 128-133.
- Practice Problems:
- ◆ 4.14, 4.15, GPC's New Product Decision

5 Jan 30 Making Choices under Uncertainty

- Tues Reading:
- ◆ Clemen & Reilly Chapter 5 (sensitivity analysis) and skim Ch. 6
- Assignment due:
- ◆ Strenlar (Clemen & Reilly pg 167)
Fred Wallace came up with a concept for a new product and quit his job to develop his idea. Now, his former employer made an offer to bring him back to the firm and threatens to sue if he does not accept. What is the best decision for Mr. Wallace?

6 Feb 01 Value of Perfect Information

- Thur Reading:
- ◆ Clemen & Reilly Chapter 12, Chapter 7, pp. 272-278
- Practice Problems:
- ◆ 12.6

7 Feb 06 Value of Imperfect Information

Tues	Reading: <ul style="list-style-type: none"> ◆ Clemen & Reilly Chapter 12 Practice Problems: <ul style="list-style-type: none"> ◆ 12.7, 12.11
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8 Feb 8	Assessing “Private” Risk Attitudes
Thur	Assignment Due: <ul style="list-style-type: none"> ◆ Hawthorne Plastics, Inc. Prepare an analysis of the alternative production processes that are available to Hawthorne Plastics, Inc., and make a recommendation. Be careful to separate the “fixed costs” from the “variable costs” in developing your analysis. What is the value of the information that is provided by the test that is available? You might consider performing some sensitivity analysis on some of the key problem parameters. Reading: <ul style="list-style-type: none"> ◆ Clemen & Reilly Chapter 13 Practice Problems: <ul style="list-style-type: none"> ◆ 13.14, 13.15, 13.16, 13.20
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9 Feb 13	Assessing “Private” Risk Attitudes (continued)
Tues	Reading: <ul style="list-style-type: none"> ◆ Clemen & Reilly Chapter 13 Practice Problems: <ul style="list-style-type: none"> ◆ Strenlar, Part III at end of Chapter 13
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10 Feb 15	Valuing Flexibility through Decision Analysis
Thur	Assignment Due: <ul style="list-style-type: none"> ◆ Orion Controls KL-798 case Nathan Armstrong, head of Marketing at Orion Controls, faced an interesting opportunity that had recently emerged from discussions with Avion Chemicals. Avion Chemicals, a global chemicals manufacturer, was addressing, in this year’s Safety Program, an improved phenol-handling safety plan that relied on the rapid shutdown and diversion of phenol should there be an interruption in the production process. The improved value would require the development of flow-sensing-and-control software as well as a significant improvement in valve design to accommodate the exacting value-gate positioning demanded by Avion’s specifications. Armstrong needed to prepare a response to the Avion offer that would also satisfy the financial objectives of an internal review board.
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11 Feb 20	Valuing Flexibility with Real Options
Tues	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 3 Practice Problems: <ul style="list-style-type: none"> ◆ Ex. 3.5, 3.6, 3.7.
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12 Feb 22	Modeling Uncertainty: Stochastic Processes

Thur	Assignment due: <ul style="list-style-type: none"> ◆ Case Study: The Bailey Prospect A natural-resource exploration company has to decide whether to invest in a new drilling opportunity. A spreadsheet that projects the most likely scenario for the well and calculates the net present value and internal rate of return has already been prepared; however, additional uncertainties must also be addressed.
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13 Feb 27	Real Options and Decision Trees
Tues	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 4 Practice Problems: <ul style="list-style-type: none"> ◆ Ex. 4.1, 4.2, 4.5
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14 Mar 1	Binomial Lattice Approximation and Risk Neutral Valuation
Thur	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 4 Assignment due: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter Ch. 4, Ex. 4.6, 4.8 and 4.9
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15 Mar 6	Numerical Methods for Simple Options
Tues	Reading: <ul style="list-style-type: none"> ◆ Review of Chapter 4 ◆ Copeland & Antikarov Chapter 5
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16 Mar 8	Numerical Methods for Simple Options
Thur	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 5 Practice Problems: <ul style="list-style-type: none"> ◆ Ex. 5.3, 5.5, 5.9
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17 Mar 20	Monte Carlo Methods for Simple Options
Tues	Reading: <ul style="list-style-type: none"> ◆ Longstaff, F. and Schwartz, E., "Valuing American Options by Simulation: A Simple Least-Squares Approach," <i>The Review of Financial Studies</i>, 14 (2001), 113-147.
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18 Mar 22	Monte Carlo Methods for Simple Options (Continued)
Thurs	Reading: <ul style="list-style-type: none"> ◆ Longstaff, F. and Schwartz, E., "Valuing American Options by Simulation: A Simple Least-Squares Approach," <i>The Review of Financial Studies</i>, 14 (2001), 113-147
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19 Mar 27	Simple Real Option Examples
Tues	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 5 Assignment due: <ul style="list-style-type: none"> ◆ Corporate Financial Management: Options Exercises. (Problem 3) ◆ You are a member of a team that must make a recommendation on a project the firm is considering. The project is risky and there is much discussion about what discount rate to use in this case. What is the best approach to value this project?
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20 Mar 29	Compound Options

Thur	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 6 Practice Problems: <ul style="list-style-type: none"> ◆ Ex. 6.4 and 6.5
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21 Apr 3	Model Assumptions
Tues	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 7 and 8
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22 Apr 5	Using Simulation to Determine Volatility
Thur	Reading: <ul style="list-style-type: none"> ◆ Copeland & Antikarov Chapter 9 ◆ Brandao, L, J. Dyer, and W. Hahn, "Using Decision Analysis to Solve Real Option Valuation Problems: Building a Generalized Approach", <i>Decision Analysis</i>, Vol. 2, No. 2, June 2005.
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23 Apr 10	Approximating Mean Reverting Commodity Forecasts
Tues	Reading: <ul style="list-style-type: none"> ◆ Hahn, W., and J. Dyer, "Incorporating Mean-Reverting Price Forecasts into Exploration and Production Project Valuation", SPE 94577, Proceedings of the 2005 SPE Hydrocarbon Economics and Evaluation Symposium, Dallas, TX, April 3-5, 2005.
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24 Apr 12	Approximating Mean Reverting Commodity Forecasts (Continued)
Thur	Assignment due: <ul style="list-style-type: none"> ◆ Bidding for Antamina In June 1996, executives of the multinational mining company RTZ-CRA are contemplating bidding to acquire the Antamina copper and zinc mine in Peru. The Antamina project is being offered for sale by auction as part of the privatization of Peru's state mining company. RTZ-CRA has to determine what the mine is worth, and to recommend whether and how RTZ-CRA should bid in the upcoming auction. The bidding rules put in place by the Peruvian government dictate that each company's bid contain two components: an up-front cash amount and the amount the bidder will invest to develop the property, if development is warranted after further exploration is completed.
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25 Apr 17	Market Uncertainty and Private Risks
Tues	Practice Problems: <ul style="list-style-type: none"> ◆ Ex. 9.3, 9.4
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26 Apr 19	Market Uncertainty and Private Risks (Continued)
Thur	Reading: <ul style="list-style-type: none"> ◆ J. Smith and R. Nau, "Valuing Risky Projects: Option Pricing and Decision Analysis", <i>Management Science</i>, 41 (1995), 795-816 ◆ Smith, J. E., "Alternative Approaches to Solving Real Options Problems: A Comment on Brandao, Dyer and Hahn", <i>Decision Analysis</i>, Vol. 2, No. 2, June 2005. ◆ Brandao, L., Dyer, J., and Hahn, W., "Response to: Alternative Approaches for Solving Real Options Problems: A Comment on Brandão, Dyer and Hahn (2005)", <i>Decision Analysis</i>, Vol. 2, No. 2, June 2005.

27 Apr 24 Simultaneous Correlated Uncertainties

- Tues Reading:
- ◆ Copeland & Antikarov Chapter 10
 - ◆ Hahn, W., and J. Dyer, "Discrete Time Modeling of Mean-Reverting Stochastic Processes for Real Option Valuation", *European Journal of Operations Research*, in press.
- Practice Problem:
- ◆ Redo problem of page 281 using DPL
- Assignment due:
- ◆ Copeland & Antikarov Chapter Ch.9, Ex. 9.5

28 Apr 26 Real Option Applications

- Thur Reading:
- ◆ Copeland & Antikarov Chapter 11
- Assignment due:
- ◆ The ACME Software Company

29 May 1 Model Extensions

- Tues Reading:
- ◆ Copeland & Antikarov Chapter 12
 - ◆ "Options in the Real World: Lessons Learned in Evaluating Oil and Gas Investments", Smith and McCardle, *Operations Research*, 47 (1999), 1-15.

30 May 3 Lesson Learned

- Thur Reading:
- ◆ "Much Ado about Options?" Smith, *Newsletter of the Decision Analysis Section of INFORMS*, Fall 1999.
 - ◆ A. Borison, "Real Options Analysis: Where are the Emporor's Clothes?", *Journal of Applied Corporate Finance*, Vol. 14, No. 1, Spring 2005.
- Final Assignment:
- ◆ The Via Dutra Concession Project
In 1996 the NovaDutra consortium must determine the price they will bid for the concession of one of the most important highways in Brazil, the Via Dutra, which links two of its largest cities. The project presents not only market uncertainties such as traffic volume and exchange rate risks, but also private, non diversifiable uncertainties, such as political risk. You are asked to structure a valuation model that takes all these risks into account, as well as any real options the project may have.