

ISYE 4311 CAPITAL INVESTMENT ANALYSIS

Elective

Credit: 3-0-3

Prepared Prof Steve Hackman, 2011

Prerequisite(s): ISyE 3025, ISyE 3133 and ISyE3232

Catalog Description

Students learn core concepts and techniques for economic decision analysis of complex capital investment problems that involve dimensions of time, uncertainty and strategy.

Course Description and Objectives

Students learn core concepts and techniques for economic decision analysis of complex capital investment problems that involve dimensions of time, uncertainty and strategy. Students are also introduced to basic terminology, concepts and issues relevant to financial engineering, financial management and corporate finance.

Text

There is no textbook. Course handouts will be provided on my website. [Download the Hava program from my website](#). Portions of the course content have been adapted from the following texts:

- *Investment Science* by D. Luenberger. Prentice-Hall. 1998.
- *Real Options* by T. Copeland and V. Antikarov. Texere. 2003.
- *Engineering Economy and the Decision-Making Process* by J. Hartman. 2007.
- *Capital Investment Analysis, 3rd ed*, by J. Canada et. al. Prentice-Hall. 2005.
- *Stochastic Calculus for Finance I* by S. Shreve. Springer. 2004.

Topical Outline

I. *Discounted Cash Flow Analysis.*

Interest rates, time value of money, present value calculations.
Pro forma project cash flow projections.
After-tax analysis. Sensitivity analysis.
Rate of return analysis for capital investment selection.
Project cash flow optimization via dynamic programming.

II. *Risk-Return Analysis.*

Utility theory and stochastic dominance.
Expected utility criterion and certainty equivalence.
Mean-variance portfolio optimization. Security market line.
Debt, equity and cost of capital.
Maximizing value of risky project cash flow alternatives.

III. *Financial Options Analysis.*

Financial option basics.
No-arbitrage, replication, risk-neutral valuation.
Lattice models for valuation of vanilla and exotic options.
Stochastic models of asset price dynamics.

IV. *Decision Analysis.*

Classification of embedded project options.
Real options analysis via stochastic dynamic programming and risk-neutral valuation.
Decision-tree analysis.
Value of information via Bayesian updating and contingent decision-making.

Course Organization

Class time will be used to motivate, explain, and illustrate concepts and techniques. Participation is expected. On occasion you will be asked to solve problems in class in a group setting. Bring a calculator. It is your responsibility for bringing materials to class posted on my website. It is also your responsibility to catch up if you must miss class. Some material in the handouts may not be covered in class.

Grading

Your grade will be based on two midterms and a final. Dates will be posted in advance. In case of an emergency, you must receive my prior permission to miss an exam. In such a case, at my discretion either: (i) the exam will be rescheduled, (ii) an alternative exam will be scheduled, or (iii) your grade will be based on the remaining exams with weights determined by me.

Homework

You are encouraged to work together and consult with me. Use the Hava files provided to you to create and solve example problems to learn the material. Handouts include problems with complete solutions. Always best to work problems first!

Course Outcomes and their relationships to ISyE Program Outcomes

At the end of this course, students will be able to:

- Prepare and value a capital investment cash flow stream.
- Select among risky alternatives.
- Optimize capital investment value.
- Value financial options.
- Analyze and value embedded capital investment options.
- Value information.

Course outcome \ Program Outcomes	a. apply math	b. data	c. IE method	d. team	e. problem solving	f. prof/ and ethical responsibilities	g. communication	h. global, eco, envi and soc context	i. continue to improve	j. current issues	k. participate in an organization
Prepare and value cash flow a capital investment cash flow stream.		M	H				H				
Select among risky alternatives.	H		H		M		L				
Optimize capital investment value.	H	M	H		M		H				
Value financial options.	M	M	H		H						
Analyze and value embedded capital investment options.	M	M	H		H		H				
Value information.	M	M	H	M	H		M				

- H, M and L denote high, moderate and low relationships.
- Team projects are sometimes conducted

Evaluation of the important course outcomes

Three or more important outcomes will be evaluated from direct questions on exams:

1. Prepare a pro forma analysis of a capital investment project.
2. Use utility theory to select among risky alternatives.
3. Optimize capital investment value via optimization and dynamic programming.
4. Value both standard and non-standard options using a binomial lattice model.
5. Analyze and value a risky investment project using risk-neutral valuation.
6. Assess value of information via Bayesian updating.