

# Research & Development Planning

Fall 2007  
Dr. Smith

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## Contact Info: Research and Development Planning

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## Office Hours

3:30-4:30, after class, or by appointment.  
Location: GER 235

## Importance of this course:

As the rate of technology evolution continues to accelerate across an expanding variety of markets and countries, organizations seek to obtain or maintain competitive position through their research and development investment decisions. Examples include decisions about new information technologies (e.g., information technology), business infrastructure (e.g., communication and control), new product decisions (e.g., advanced product designs), and production technologies (e.g., how to fabricate and distribute new products). Resolving these decisions in the face of conflicting organizational goals, competing projects with different development costs and risks, an array of technologies needed for each project with their own costs and development risks, coupled with uncertain budgets and dependencies among developments presents a formidable problem.

This course provides a framework and approach for addressing such problems and is designed to enable the student to formulate, collect, analyze, frame, and interpret decision making information for selecting an optimal research and development portfolio.

## Course Description

The course is designed to provide the student with the skills necessary to define, analyze, and solve R&D technology investment decision problems. This is an integrative course presented in three phases that combines a variety of techniques from decision analysis, probability and statistics, simulation, and engineering economics. The first phase of the course consists of a review of

background topics in probability and study of investment problem concepts with tools and techniques for solving research and development investment problems (decision analysis, integer and dynamic programming). The second phase of the course covers mean-variance portfolio theory and the estimation of technology value. The third phase of the course examines advanced R&D portfolio selection topics such as data estimation, technology investment dependencies, linkage to project requirements, and real options methods. The student will gain practical experience through a series of examples, homework assignments, and case studies. The topics are summarized below.

Ch 1, Appendix A,B, Review	Introduction, Basic concepts, probability, optimization
Ch 2-3, Investment concepts	Definitions
Ch 5, Technology investment methods	Multiattribute utility; Integer and dynamic programming
Ch 6, Markowitz mean-variance portfolio theory	Modeling risk versus return
Ch 7, Valuing investments	Estimating the value of technology investments
Ch 8, Models of technology return	Ranking technology options with budget constraints
Ch 9, Utility theory	Investment risks
Ch 11-12, Advanced topics	Technology dependencies; Real options

The course will follow a dual track approach using financial investment concepts contrasted with R&D portfolio investment concepts.

#### Suggestions (for success)

You should read over the reading assignments before the corresponding lecture.  
 You should attempt the homework on your own before asking for help.  
 Make an honest attempt to understand the material before uttering the words, "I don't get this."

#### Course Prerequisite Knowledge

ISE 220, algebra, familiarity with spreadsheet program (e.g., Excel); working knowledge of Calculus;  
 Optional (but helpful): introductory course in decision analysis

#### Course Goals

Students will learn:

- tools and techniques for defining and solving R&D portfolio problems
- when and how to apply the tools
- practice application of the tools with homework exercises

#### Text

*Investment Science*, David Luenberger, Oxford University Press, New York, NY, 1998.

### Course Requirements and Grades

The course requirements are as follows:

Requirement	Point Total
3 Homework assignments @ 10 points	30
Midterm Exam	25
Project	20
Final Exam	25
Course Total	100

The project will be announced after submission of homework assignment 3; grading based on creativity, relevance, content, organization, and timeliness (4 pts each). All grading issues are closed after 2 weeks from the original due date. Late homeworks—30% off per day.

### Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

### Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus*, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

Schedule Note: homework due in class on date shown.

Date	Topic	Readings	Notes
Monday August 27	Introduction	Ch 1	
Wednesday Aug. 29	Review	App. B	
Monday Sept. 3	Labor Day—No class	App. A, notes	
Wednesday Sept. 5	Review		
Monday Sept. 10	Investment concepts	Ch 2	
Wednesday Sept. 12	Technology investment concepts	Ch 2, notes	
Monday Sept. 17	Investment evaluation	Ch 3	
Wednesday Sept. 19	Investment evaluation	Ch 3, notes	
Monday Sept. 24	Optimal portfolio selection	Ch 5, notes	
Wednesday Sept. 26	Optimal portfolio selection	Ch 5, notes	
Monday Oct. 1	Optimal portfolio selection	Ch 5, notes	HW1 due
Wednesday Oct. 3	Optimal portfolio selection	Ch 5, notes	
Monday Oct. 8	Optimal portfolio selection	Ch 5, notes	
Wednesday Oct. 10	Mean-variance portfolio analysis	Ch 6	
Monday Oct. 15	Mean-variance portfolio analysis	Ch 6	
Wednesday Oct. 17	Midterm review		
Monday Oct. 22	Midterm		
Wednesday Oct. 24	Mean-variance portfolio analysis	Ch 6	
Monday Oct. 29	Mean-variance portfolio analysis	Ch 6	
Wednesday Oct. 31	Mean-variance portfolio analysis	Ch 6, notes	
Monday Nov. 5	Estimating investment value	Ch 7	HW2 due
Wednesday Nov. 7	Estimating investment value	Ch 7, notes	
Monday Nov. 12	Models of investment return	Ch 8	
Wednesday Nov. 14	Models of investment return	Ch 8, notes	
Monday Nov. 19	Utility theory	Ch 9	
Wednesday Nov. 21	Utility theory	Ch 9	
Monday Nov. 26	Utility theory	Ch 9, notes	
Wednesday Nov. 28	Technology data inputs	notes	
Monday Dec. 3	Advanced topics: real options; technology dependencies	Ch 12, notes	
Wednesday Dec. 5	Advanced topics: real options; technology dependencies; Review	Ch 12, notes	HW 3 due
Friday Dec. 14	Final Exam, 2-4 pm.		