CE 484 RISK ASSESSMENT & MANAGEMENT

Elective Course

Fall 2008

Instructor(s): Ali Rana Atılgan
Course Data: Hours: WWW 678, Room: M2170

Course Description (Proposed)
CE 484 Special Studies in Civil Engineering: Risk Assessment and Management (3+0+0)3
Assessment, analysis and management. Mean-variance portfolio theory. Efficient market hypothesis. Single- and multi-factor models. Certainty equivalent analysis. An introduction to stochastic calculus. Options and real options and applications in project management. Risk analysis in capital investments. Random sampling from input distributions and simulations. Utility and measures of risk aversion. Integrated risk management.
Course Objectives:
This course is designed for senior students to make them conversant in the fundamentals of risk assessment and risk-based decision criteria, elementary approaches to financial risk, analysis of risk and uncertainty in engineering projects, and dynamic strategies to manage risks.
Textbooks:
Luenberger, D.G., ***Investment Science***, Oxford University Press, 1988. *HG4515.2 .L84 1998*
Eeckhoudt, L. and C. Gollier, ***Risk: Evaluation, Management and Sharing***, Harvester Wheatsheaf, 1995. *HB615 .E4513 1995*
Ref. Books:
Evans, J.R. and D.L. Olson, ***Introduction to Simulation and Risk Analysis***, Prentice Hall, 1998.
Flanagan, R. and G. Norman, ***Risk Management and Construction***, Blackwell, 1997.
Curricular Context
This elective course provides the students an opportunity to learn and tackle interdisciplinary issues, and it introduces modern concepts such as risk analysis and management.
Computer Usage: Students are encouraged through homework and projects, which are counted as extra credits when turned in, to use software (Crystal Ball, @Risk, Excel, MATLAB) and to create their own codes (in Fortran, C, C++, or in Java) for simulations.
Laboratory Sessions: N/A
Class Policies: Midterm: Two (2) midterms, 30% each of the final grade, Final exam: 40% of the final grade, Homework & Project: Not mandatory, will count as extra credit
Contribution of the Course to Program Outcomes:
This course is intended to contribute to the following program outcomes:

✓	(a)	An ability to apply knowledge of mathematics, science and engineering
✓	(b)	An ability to design and conduct experiments, as well as to analyze and interpret data
✓	(e)	An ability to identify, formulate and solve engineering problems
✓	(h)	The broad education necessary to understand the impact of engineering solutions in a global and societal context
	(i)	A recognition of the need for, and ability to engage in life-long learning
✓	(j)	A knowledge of contemporary issues
✓	(k)	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Course Assessment: Course will be assessed on the basis of the accomplishments regarding the course objectives and the contributions to the program outcomes. The evaluation will consist mainly of the responses from the students, who will provide their comments to various course related questions in the final week of the semester.

Week	Topics	Reading Assignments	Homework Assignment	Objectives
1	Concept of assessment, monitoring, and management; events, patterns, and structure; types and nature of systems; a brief history of risk	Haimes Ch 1,2; #1		To put forward that the identification of key variables and establishing the links among them is called assessment and construction of the structure from events is a bottleneck
2	Unification of data, information, knowledge, understanding, and wisdom; management as attitude towards change; 3 P's of risk management	Flanagan & Norman Ch 2,3; #2		To conceptualize that the risk-based decision making requires forecasting which is a synthesis of the past and present formed by statistical signatures and preferences
3	Random variables, probability distributions (review); rate of return, variance; mean-variance portfolio theory; efficient frontier	Luenberger Ch 6; #3,4		How to optimize a specified property of a mixture for given constituents and a desired performance criterion? To reiterate entropy-energy interplay in mean-variance form
4	Quadratic programming; short sales; diversification; risk-free asset and one-fund theorem; efficient market hypothesis	Luenberger Ch 6; #5,6	HOMEWORK 1	To play with numbers, utilization of simple spreadsheet or symbolic computations; to introduce equilibrium in social sciences, esp. in markets; naïve explanation of futures
5	Capital asset pricing model, concept of beta, company cost of capital; certainty equivalent; project's beta and NPV	Luenberger Ch 7; #7,8,9		To define risk in convoluted form, relative to market in which the asset is monitored; how to take into account of haircut for risk in simple investment projects
6	Interpreting data; factor models and generalization of factor idea; relationship correlated risks; single and multi-factor models. MIDTERM 1.	Luenberger Ch 8; #10,11		Is it possible to calculate mean and variance as accurate as we like for a given period of time? How do you identify and categorize the regression parameters/factors?
7	Introducing derivatives; binomial lattice; single-period analysis; risk-neutral probability and arbitrage free option premium.	Luenberger Ch 12; #12,13	HOMEWORK 2	To accentuate the difference between expectations and derivatives; to examine the relationship between the risk-neutral probability and arbitrage
8	Random walk, Wiener and Ito processes; calculation of binomial lattice parameters; multi-period option pricing and a leasing application	Luenberger Ch 11; #14		To introduce stochastic differential equations using simple discrete (random walk) and continuous (Brownian motion); to calculate option premium on the binomial lattice
9	Decision tree and Bayesian analysis (review); real options analysis and hybrid real options; continuous processes and Black & Scholes table	Flanagan & Norman Ch 4; #15,16,17		To establish a one-to-one mapping between the project's NPV and option pricing; to pronounce what is real option what is not in risky development projects
10	Monte Carlo methodology, examples; fundamentals of project risk management; concept of value-at-risk and its applications. MIDTERM 2.	Hertz & Thomas'83-84; Dowd Ch 2,4; #20,21,22,23		To demonstrate the efficacy of MC simulations in project management cases; to initiate discussions on expected losses over a time period at a given confidence level
11	Expected utility; asking and bid price, Arrow-Pratt theory, measures of risk aversion; notion of changing risk; stochastic dominance	Gollier Ch 3,4,5; Flanagan & Norman Ch 5; #24,25,26	HOMEWORK 3	How to classify the human preferences? What is the rational pricing methodology for buying/selling a lottery ticket?
12	Insurance as a put option, types of contracts; integrated risk management; asymmetric information and consequences	Gollier Ch 9,10; #27,28,29,30		Why might an option on a portfolio be worth less than a portfolio of options? What type of insurance contract is superior to others? Why second-hand (used) assets are much cheaper than the new ones (not used)?