NYU | LEONARD N. STERN SCHOOL OF BUSINESS

Decision Making Under Uncertainty • Professor Juran

MEETINGS	6:00-9:00 PM, Wednesdays starting Feb. 7
INSTRUCTOR	David Juran <djuran@stern.nyu.edu> <http://people.stern.nyu.edu/djuran/>
TEACHING ASSISTANT	Trenton Gaucher <trg281@stern.nyu.edu>

COURSE DESCRIPTION

This course introduces the basic concepts, principles, and techniques of decision making under uncertainty. You will learn how to model complex business problems that involve risk and uncertainty with the help of spreadsheet models. The course covers analytical models such as **Decision Trees**, **Stochastic Optimization**, **Simulation & Optimization**, and **Dynamic Optimization**. The course is **hands-on**. The emphasis will be on model formulation and interpretation of results, not on mathematical theory.

This course does **NOT** require the course "Decision Models and Analytics" (DMA) as a prerequisite. This course emphasizes optimization models with uncertain parameter values. In contrast, the DMA course focuses on various deterministic optimization models and Monte Carlo simulation. You are encouraged to take both courses.

Examples covered in this course come from a wide range of business applications, including:

- Financial and operational hedging strategies for risk management (currency exchange rate, stock price, etc.)
- Option pricing (European options, American options)
- Real option approach to the valuation of investment opportunities
- Capacity planning for new product development (drugs, cell phones, etc.)
- Optimal timing for market entry
- Choosing a portfolio of supply contracts that balance risk and cost
- Inventory management with random demand

LEARNING OBJECTIVES

From this course, students will

- Become aware of the scope of management problems that can be addressed with stochastic optimization models; and learn to identify opportunities for creating value using these models;

- Develop models that can be used to improve decision making under uncertainty within an organization;
- Sharpen their ability to structure problems and to perform logical analyses;
- Know how to assess the significance of model outputs for managerial insights and action;

PREREQUISITES

- COR1-GB.1305 Statistics and Data Analysis
- Basic familiarity with Microsoft Excel: developing and copying formulas with relative and absolute cell addresses, and using the function and chart wizards.

RECOMMENDED TEXTBOOKS

The following books are very good references for this course. They are **recommended**, *not required*.

- *Decision Making Under Uncertainty with RISKOptimizer* (2nd edition), by Wayne Winston.
- *Financial Models Using Simulation and Optimization II* (3rd edition), by Wayne Winston

WEBSITE/COURSE MATERIALS

Material, including Excel solution models, software, optional readings and lecture slides, will be distributed electronically through the course web site. Hard copies of lecture slides will be distributed in class.

GRADING

Your course grade will be based on:

- *Group Assignments* (80% - four assignments: 20% each). There will be four graded group assignment studies, with the due dates indicated in the course schedule. You are asked to work in groups of two. One copy of the final report should be handed in, and all members of the group will get the same grade.
- *Class Participation* (20%). This fraction of the grade will be assigned on the basis of class participation and individual professional conduct. Class participation includes class discussions of assignments and cases, presentation and submission of an exercise solution, as well as active participation in lectures. I expect all class participants to arrive to class on-time and prepared, and to stay involved during class sessions. Every conceivable effort should be made to avoid absences, late arrivals or early departures. In cases when these are unavoidable, they need to be communicated to me in advance.

CLASS WORK

The process of modeling is the most important and difficult problem solving skill. It involves developing a structure to conceptualize, formalize and analyze a given problem. It seems deceptively simple to watch someone else do it, but the only way to learn this skill is by practicing it yourself. Therefore, this course involves a hand-on, in-class learning experience. **Attending each class and bringing a laptop computer to class are essential.** Preparation for each class involves reading and thinking about the problems to be covered in class. The problems will be posted on Blackboard one week in advance. Excel files of the problems modeled and analyzed in class should be downloaded from Blackboard before (not during) the class.

Laptops

You are expected to bring a laptop to each class, unless otherwise instructed. But we will not use it throughout each class. Please close your laptop until you are asked to use it.

Ethical Guidelines

All students are expected to follow the **Stern Code of Conduct** (http://www.stern.nyu.edu/uc/codeofconduct). A student's responsibilities include, but are not limited to, the following:

- A duty to acknowledge the work and efforts of others when submitting work as one's own. Ideas, data, direct quotations, paraphrasing, creative expression, or any other incorporation of the work of others must be clearly referenced.
- A duty to exercise the utmost integrity when preparing for and completing examinations, including an obligation to report any observed violations.

Students with Disabilities

If you have a qualified disability and will require academic accommodation during this course, please contact the Moses Center for Students with Disabilities (CSD, 998-4980) and provide me with a letter from them verifying your registration and outlining the accommodations they recommend.

Tentative Class Schedule
(subject to minor changes**)**

- **Session 1 2/7 : Introduction**
  - Flaw of average
  - Decision rules
  - Utility function
  - Retirement planning
  - Investment wheel
  - Volatility pumping

- **Session 2 2/14: Simulation and Static Stochastic Optimization**
  - Brief introduction to Monte Carlo simulation
  - Case study: Konys
  - Airline booking control

- **Session 3 2/21: Optimal financial hedging**
  - Log-normal distribution: modeling movement of stock price, currency exchange rate, commodity price:
  - Estimating volatility (implied or historical) of stock prices using data
  - Brief introduction of financial options
  - Option pricing: Black-Scholes and simulation
  - Optimal financial hedging

- **Session 4 2/28: Multistage Decision Making under Uncertainty and Real Options**
  - Project valuation: discounted-cash-flow approach vs. real option approach
  - Brief introduction to decision tree
  - R&D project valuation
  - Investment valuation
  - Pioneer option, postpone option, expand option,

- **Session 5 3/7: Dynamic Decision Making**
  - Deterministic dynamic programming
  - Stochastic dynamic programming

- **Spring Break: No Class March 14, 21**

- **Session 6 and 7 3/28 and 4/4: Application of Stochastic Dynamic Programming**
  - Binomial tree
  - American option pricing

- Real option valuation
- Personalized marketing
- Dynamic pricing
- Value a lease on goldmine

- **Session 8 4/11: Simple Policies in Dynamic Decision Making**
  - Inventory management at a retail pharmacy
  - Optimal timing for market entry
  - Cash management at a retail bank

- **Session 9 4/18: Deterministic Approximation**
  - Brief review of forecasting methods
  - Brief review of linear programming
  - Markdown Pricing and Re-optimization

- **Session 10 4/25: Chance-Constrained Stochastic Optimization**
  - Capital budgeting: when projects have uncertain NPVs and uncertain capital usage
  - Production strategy: managing quality risk of raw materials
  - Value-at-risk
  - Conditional value-at-risk
  - Case study: Applichem (Plant location for a multinational firm: hedging currency exchange risk)

- **Session 12? 5/2: Make-up Date**