STOCHASTIC MODELS AND OPTIMIZATION, 2018-19

1. Overview and Objectives

The main objective of the course is to introduce students to quantitative decision making under uncertainty through Dynamic Programming. Along the way, it presents mathematical formulations and solution concepts for important managerial problems such as inventory management, asset selling, portfolio selection and dynamic pricing. The course also highlights extensions of the standard methodology to problems with imperfect state information (i.e., learning) or infinite horizon.

2. Course Outline

Introduction to Dynamic Programming
Stochastic Optimization Problems
Dynamic Programming Algorithm

Shortest Path Problems
Label Correcting Methods
Hidden Markov Models and Viterbi Algorithm

Inventory Management
Newsvendor Model
(s, S) Inventory Replenishment Policy
Inventory Pooling

Asset Selling
Optimal Stopping Problems
One-Step Lookahead Policy

Portfolio Selection
Mean-Variance Formulations
Portfolio Diversification
Dynamic Portfolio Analysis

Dynamic Pricing
Optimality Conditions and Interpretation
Asymptotic Optimality of Static Pricing

Sequential Hypothesis Testing
Sufficient Statistics
Sequential Probability Ratio Test

Infinite-Horizon Discounted Problems
Monotonicity and Contraction
Computational Methods

3. Schedule of Classes

Sessions 1-2: January 7, 2:30-5:15pm

Sessions 3-4: January 8, 2:30-5:15pm

Sessions 5-6: January 10, 2:30-5:15pm

Sessions 7-8: January 21, 2:30-5:15pm

Sessions 9-10: February 4, 2:30-5:15pm

Sessions 11-12: February 14, 2:30-5:15pm

Sessions 13-14: February 22, 2:30-5:15pm

Sessions 15-16: February 28, 2:30-5:15pm

4. Instructor

Mihalis Markakis, Production, Technology and Operations Management

Email: MMarkakis@iese.edu

Website: https://www.iese.edu/faculty-research/faculty/mihalis-markakis/

5. Evaluation

Four problem sets account for 60% of the final grade, while the remaining 40% comes from a final project. Both the problem sets and the final project are individual, and are submitted to the instructor via email.

Typically, final projects are applied and computational in nature, and each team is free to choose any application domain for their project as long as it uses knowledge acquired during the course in a meaningful way. The deliverables for the final project are: (i) a 15-20 min high-level presentation; and (ii) a technical report elaborating on the methodological and implementation details of the project. The grade of the final project is broken down as follows: 5% motivation, 15% innovation/sophistication of methodological approach, 15% implementation, 5% presentation style.

6. Textbook

Although class notes are reasonably self-contained, the course relies heavily on the first volume of the textbook by D.P. Bertsekas, "Dynamic Programming and Optimal Control," 3^{rd} Ed., *Athena Scientific*.