

IE464 Stochastic Optimization with Applications

Department of Industrial Engineering

Middle East Technical University

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Instructor: Zeynep Müge Avşar
e-mail address: mavsar@metu.edu.tr
office hour (online session): Tuesday 15:40-16:30, or by appointment

Assistant(s): to be announced

Course Homepage: ODTU-Class

Lecture Hours: to be announced

Course Catalog Description

Framework for stochastic optimization. Application areas. Structural properties of the policies. Decision criteria. Computational methods: value iteration, policy improvement, linear programming. Real-life case studies.

Prerequisite: IE361

Course Material

The material that will be presented in class will be derived from different sources. The primary references include most of the topics that will be covered in class.

Primary References

- S.M. Ross, *Introduction to Stochastic Dynamic Programming*, Academic Press (T57.83 R67).
- S.E. Dreyfus and A.M. Law, *The Art and Theory of Dynamic Programming*, Academic Press (T57.83 D73).

Other References

- F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, McGraw-Hill (Q175.H47).
- S.M. Ross, *Applied Probability Models with Optimization Applications*, Dover Books (T57.3.R67).
- D.P. Bertsekas, *Dynamic Programming and Optimal Control*, Athena Scientific (T57.83 B48).
- H. Tijms, *Stochastic Models: An Algorithmic Approach*, John Wiley & Sons (QA274 T47).
- E.V. Denardo, *Dynamic Programming*, Prentice-Hall.
- J. Filar and K. Vrieze, *Competitive Markov Decision Processes*, Springer-Verlag (QA274.7 F52).
- M.L. Puterman, *Markov Decision Processes: Discrete Stochastic Dynamic Programming*, Wiley (QA274.7.P88).
- D.P. Heyman, M.J.Sobel, *Stochastic Models in Operations Research*, Vol. II, Elsevier (T57.6 .H49 2).
- R.A. Howard, *Dynamic Programming and Markov Processes*, MIT Press (QA264.H6).

Grading and Exams

- Midterm Examination (with a weight of 35%)
 - Homework Assignments and/or Quizzes (with a weight of 25%)
 - Comprehensive Final Examination (with a weight of 40%)
(exam date to be announced by the Registrar's Office)
- The examinations will be **open-book exams**.
You can bring your textbook and lecture notes and study set solutions to the exams, but you will not be allowed to exchange these with other students during the exams.
 - Comprehensive **makeup exam(s)** will be given at the end of the final examination period and only in an unanticipated or serious case.
Only students with official excuses will be allowed to take makeup exam.
 - Answering some examination questions, especially the mathematical modelling questions, might necessitate going beyond the basic concepts, principles studied in class and building on them as in the cases of extensions or variations of the main problems or models studied in class.
 - **Nobody will receive a higher letter grade if he/she collects a lower total grade.**
After the letter grades are announced, an extra work that might change the total grade will not be given.

Tentative Outline

- Sequential Decision Making: Dynamic Programming
- Stochastic Shortest Path Problems
- Analytical Investigation of the Optimal Policy Structure
(gambling model, stock-option model, inventory model)
- Monotonicity of the Optimal Policy
(modular functions, gambling model, allocation problem)
- Adaptive Control Processes
 Incorporating Learning: Using Bayes' Law for Updates
 Bandit Problems
- Markov Decision Processes (MDPs)
 Optimal Stopping Problems: One-Stage Lookahead Policy
 Theory and Formulations
 Solution Procedures
- Stochastic (Sequential) Games

*This syllabus is subject to change. Changes (revisions), if any, will be announced in the lectures and/or the updated syllabus will be uploaded to the course web page on ODTU-Class. Students will be held responsible for all the changes. Students are responsible for checking the course web site on ODTU-Class regularly.