

Syllabus IE 515 Dynamic programming Fall Semester 2021

1 Instructor

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Office hours	On Appointment

2 Class schedule Fall Semester 2021

1. Thursday 14.40-16.30 (most likely in-class FENS L035)
2. Friday 11.40-12.30 (most likely in class FENS L027)

2.1 Prerequisite.

Basic knowledge of probability theory at the level of MATH 302 (if needed a short overview will be given). No knowledge of stochastic processes is required.

3 Course Objective

The goal of this course is to develop an understanding of the theory of dynamic programming and discuss its application in different research areas such as revenue management, health care, revenue management, production planning, inventory control and maintenance. The focus of the course will be as much on the theory as on the applications of the technique of Dynamic Programming in different research areas of industrial engineering. This course is a basic introduction to the theory of Dynamic Programming together with some of its applications.

4 Learning outcomes of the course

After successful completion of this course the students should be able to:

1. Understand the main ideas of nonlinear and dynamic programming techniques in deterministic industrial engineering problems.
2. Model the inherent uncertainty in real-world dynamic problems by formulating finite and infinite horizon stochastic dynamic problems

3. Apply backward induction, value iteration and policy iteration to solve finite and infinite horizon problems and formulate dynamic programs as linear programs
4. Know the different applications of dynamic programming in different fields of application such as inventory control, pricing, production and revenue management.

4.1 Class Material and References.

1. Course notes will be made available on SUcourse
2. Papers: to be handed out.
3. Text books
 - Ross, Sheldon M. Applied Probability Models with Optimization Applications, Dover books, 1992.
 - Ross, Sheldon M. Introduction to Stochastic Dynamic programming, Academic Press, 1983.
 - Talluri, Kalyan and Van Ryzin, Garrett, The Theory and Practice of Revenue Management, Springer International Series in Operations Research and Management Science, 2004
 - Puterman, Martin L., Markov Decision Processes, Wiley, 2008.

5 Course Outline.

Sometimes reading assignments will be given to read certain papers and/or parts of the books listed above. The topics are:

1. Introduction to main ideas in nonlinear programming and the role of dynamic programming in nonlinear optimization. (syllabus)
2. Markov decision processes in finite and infinite horizon problems and applications of these processes in different areas like revenue management, production planning, pricing and inventory control
3. Markov policies and algorithms to solve Markov decision problems (backward induction, value iteration, policy iteration)
4. Overview of material at the end of the course.

6 Grading policy and course evaluation.

1. In-class assignments in the form of 4 to 5 exercise sets to be worked out at home. Frequency: once every 3 weeks after the completion of a part of the course. These exercises will be graded. Every student should do these assignments. If not they are not allowed to do the take home exam.
2. One take-home exam at the end of the semester.
3. At the end of the semester the teacher MIGHT decide to have an oral exam with a student in case there is big discrepancy between the take home exam and the performance on the exercises.
4. Course evaluation: (These percentages should be taken as guidelines and might be changed slightly!)
 - Exercises: 40 %
 - Take home exam: 50%
 - Participation in class: 10%

7 Covid

Since some students cannot attend physically the class the lectures will start to be online and recordings will be made. Depending on the situation I might decide to change the lectures for this class into hybrid. It all depends on the type of practical problems to be encountered . For the moment online seems to be the best option. Not desirable but at least feasible. Everybody is expected to join at least 75 percent of the online lectures. Hopefully this online environment can still create a two way communication between students and teacher. The links for the zoom meetings can be found in Sucourse+

8 Final Remark.

Since coding assignments in general take a lot of time there will be no coding assignments given in this course. The purpose of this course is to learn the technique of dynamic programming and not how to implement dynamic programming algorithms on a computer using a certain computer language. However if the student for his understanding likes to write a computer code to evaluate numerically a dynamic programming problem there is always a possibility to do this. In case of extensive time efforts on coding this might replace the obligation to hand in certain exercise sets.