MGT-484

Applied probability & stochastic processes

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Cursus	Sem.	Type
Bioengineering	MA1, MA3	Opt.
Life Sciences Engineering	MA1	Opt.
Management, Technology and Entrepreneurship minor	H	Opt.
Managmt, tech et entr.	MA1, MA3	Obl.
Systems Engineering minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course focuses on dynamic models of random phenomena, and in particular, the most popular classes of such models: Markov chains and Markov decision processes. We will also study applications in queuing theory, finance, project management, etc.

Content

The following topics will tentatively be covered in the course:

1. Discrete-time Markov chains
- Basic definitions, transition probabilities
- Classification of states
- Stationary and limiting distributions, convergence to equilibrium
- Hitting times and absorption probabilities
- Strong Markov property, law of large numbers for Markov chains

2. Dynamic programming and optimal control
- Basic principles
- Linear systems and quadratic cost, Ricatti equation
- Utility functions, dynamic portfolio allocation
- Optimal stopping
- Correlated disturbances, state augmentation

Keywords

Markov chains, Markov decision processes, dynamic programming, optimal control

Learning Prerequisites

Required courses

A course in basic probability theory

Important concepts to start the course

Students should be familiar with basic concepts of probability theory, calculus and linear algebra.

Learning Outcomes

By the end of the course, the student must be able to:

- Formulate Markov chain models for dynamic uncertain phenomena.

- Formulate Markov decision process models for dynamic decision problems under uncertainty.
- Use these models to structure real decision-making situations.
- Compute relevant performance measures for Markov models.
- Develop an awareness of the manifold uses of probability theory in management science.

Teaching methods

Classical formal teaching interlaced with practical exercices.

Expected student activities

Active participation in exercise sessions is essential.

Assessment methods

30% midterm exam
70% final exam

Resources

Bibliography

Introduction to Probability Models, 10th edition, Sheldon M. Ross, Academic Press, 2009.
Dynamic Programming and Optimal Control, 3rd edition, Dimitri P. Bertsekas, Athena Scientific, 2005.
Introduction to Probability, Dimitri P. Bertsekas and John N. Tsitsiklis, Athena Scientific, 2002.

Ressources en bibliothèque

- Dynamic Programming and Optimal Control / Bertsekas
- Introduction to Probability / Bertsekas
- Introduction to Probability Models / Ross

Prerequisite for

Advanced MTE courses