

MGT-484

Applied probability & stochastic processes

Cristi Andrés

| Cursus | Sem. | Type |
|---|----------|------|
| Life Sciences Engineering | MA2, MA4 | Opt. |
| Management of technology | | Opt. |
| Management, Technology and Entrepreneurship minor | E | Opt. |
| Managmt, tech et entr. | MA2, MA4 | Obl. |
| Neuro-X minor | E | Opt. |
| Neuro-X | MA2, MA4 | Opt. |
| Physics of living systems minor | E | Opt. |
| Systems Engineering minor | E | Opt. |

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| Language of teaching | English |
| Credits | 4 |
| Session | Summer |
| Semester | Spring |
| 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**Keywords**

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

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.
- Structure real decision-making situations using these models.
- Compute relevant performance measures for Markov models.
- Develop an awareness of the manifold uses of probability theory in management science.
- Use and understand the concept of a discrete-time Markov chain and know how Markov chains are used to model random phenomena
- Compute several properties of a given Markov chain, such as hitting probabilities, expected hitting times, invariant distributions and the long-run proportion of time spent in a given state
- Formalize decision problems under uncertainty as optimal control models
- Solve optimal control models via dynamic programming
- Reason about the concept of a discrete-time Markov chain and understand how Markov chains are used to model random phenomena
- Analyze the technical literature in applied probability and to undertake independent self-study (or research) in the future

Transversal skills

- Communicate effectively, being understood, including across different languages and cultures.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Use a work methodology appropriate to the task.

- Demonstrate the capacity for critical thinking

Teaching methods

Classical formal teaching interlaced with practical exercises.

Expected student activities

Active participation in exercise sessions is essential.

Assessment methods

- 30% midterm exam
- 70% final exam

Supervision

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| Office hours | Yes |
| Assistants | Yes |
| Forum | No |

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

- [Find the references at the Library](#)

Moodle Link

- <https://go.epfl.ch/MGT-484>

Prerequisite for

Advanced MTE courses