SF3953 Markov Chains and Processes, 7.5 hp

General information

Markov processes form a fundamental class of stochastic processes with applications in a wide range of scientific and engineering disciplines. The purpose of this PhD course is to provide a theoretical basis for the structure and stability of Markov processes from a general perspective.

Learning outcomes

After having passed the course, the participant is supposed to be able to

- classify Markov chains as irreducible, recurrent or transient, positive or null.
- explain the classical recurrence-transience dichotomy for Markov chains.
- establish that a given Markov chain has a unique invariant distribution.
- explain the central limit theorem for ergodic Markov chains.
- judge whether a given Markov chain is geometrically ergodic using coupling sets and Foster-Lyapunov drift conditions.
- illustrate the theory by examples from time series analysis and Markov chain Monte Carlo methods.

Course disposition and main content

The course consists of four two-week cycles, each comprising two theory lectures (90 min) and one exercise class (90 min). The lectures will cover the following topics.

1. Markov chains: basic definitions
2. Stopping times and the strong Markov property
3. Atomic chains
4. General irreducible chains
5. Feller kernels
6. Ergodic theory and the law of large numbers
7. Central limit theorems and the Poisson equation
8. Geometric ergodicity and Foster-Lyapunov conditions

Eligibility

An advanced level course in stochastic processes and knowledge of basic measure theory.

Examination

The examination consists in a combination of home assignments and an oral exam.

Course literature

The course is based on lecture notes. Relevant references are, e.g.,

Meyn, S. P. and Tweedie, R. L. (2009). *Markov Chains and Stochastic Stability*. Cambridge University Press, London.

Assmussen, S. (2003). *Applied Probability and Queues*. Springer, New York.

Contact person

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Examiner

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