MATH-332

Applied stochastic processes

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Cursus	Sem.	Type
Mathematics	BA6	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course introduces the theory of stochastic processes including Markov chains in discrete and continuous time, Poisson processes, and renewal processes. The use of these processes is illustrated in various areas of applications.

Content

Stochastic processes occur in finance as models for asset prices, in telecommunications as models for data traffic, in computational biology as hidden Markov models for gene structure, in chemistry as models for reactions, in manufacturing as models for assembly and inventory processes, in biology as models for the growth and dispersion of plant and animal populations, in speech pathology and speech recognition and many other areas.
This course introduces the theory of stochastic processes including Markov chains in discrete and continuous time, Poisson processes, and renewal processes. These processes are illustrated using examples from real-life situations. It then considers important applications in areas such as biology and genetics, queues and queueing networks (the foundation of telecommunication models), as well as in Bayesian statistics through the Markov chain Monte Carlo method.

Keywords

discrete-time Markov chain, continuous-time Markov chain, stationary distribution, Poisson process, renewal process, branching process, epidemic process, queueing models, Markov chain Monte Carlo.

Learning Outcomes

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

- understand the basic concepts of random processes in discrete and continuous time
- acquire an appreciation of how randomness and variability in time can be mathematically described using probability theory
- be able to build, analyze and simulate basic stochastic models for simple real-life random phenomena evolving in time

Assessment methods

Written exam
Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés

Resources

Bibliography

• Norris, J. R. (1998), *Markov chains*, Cambridge University Press, Cambridge.
• Guttorp, P. (1995), *Stochastic modeling of scientific data*, Stochastic Modeling Series. Chapman & Hall, London.
• Cinlar, E. (2013), *Introduction to Stochastic Processes*. Courier Corporation.
• Chung, K. L. (2001). *A course in probability theory.* Academic press.
• Sericola, B. (2013). *Markov Chains: theory, algorithms and applications.* John Wiley & Sons.
• Graham, C. (2008). *Chaînes de Markov: cours, exercices et corrigés détaillés*. Dunod.