UNIVERSITY OF GOTHENBURG

DEPARTMENT OF MATHEMATICAL SCIENCES

MSG800 Basic Stochastic Processes, 7.5 higher education credits

Grundläggande stokastiska processer, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Mathematical Sciences on 2017-05-12 to be valid from 2017-07-01, autumn semester of 2017.

Field of education: Science 100%
Department: Department of Mathematical Sciences

Position in the educational system

The course can be part of the following programme: 1) Bachelor's Programme in Mathematics (N1MAT)

Main field of studies	*Specialization*
Mathematical Statistics	G1F, First Cycle, has less than 60 credits in first-cycle course/s as entry requirements

Entry requirements

Knowledge corresponding to the courses *MMG200 Mathematics 1*, *MMG300 Multivariable Analysis*, and *MSG110 Probability theory*.

Some experience of computer programming such as, for example, basic knowledge of Matlab programming is recommended.

Learning outcomes

On successful completion of the course the student will be able to

- Perform basic calculations of continuous time and discrete time Fourier transforms and inverse transforms as well as basic understanding of their usage in probability

theory (that is, characteristic functions) as well as in the context of stationary random processes and linear time invariant systems (that is, spectral analysis).
- Describe how continuous time and discrete time Markov chains (including queueing systems) work from a principal theoretical point of view and by means of implementation of corresponding computer code (or so called pseudo code) as well as performing computational examples on these objects.
- Describe the importance of dependence and independence between different stochastic process values (random variables) from a principal theoretical point of view as well as performing corresponding computational examples.
- Describe the basic defining properties of stationary processes, wide (weak) sense stationary processes, Gaussian processes and martingales from a principal theoretical point of view as well as performing corresponding computational examples.

Course content

The content of the course includes:

- Introduction to Fourier transforms (characteristic functions), convolutions and Dirac's delta-function together with a review of some important concepts from multivariate probability theory.
- Definition of discrete time and continuous time stochastic processes together with their finite dimensional distributions, mean functions, correlation functions and covariance functions.
- Processes with independent stationary increments (Levy processes) and Gaussian processes (normal processes).
- A quite substantial treatment of discrete time and continuous time Markov chains including applications to queueing systems (that adds up to upwards half of the total course material).
- Discrete time and continuous time martingales.
- Continuity and differentiability of stochastic processes together with integration and summation of them.
- Spectral densities together with white noise in continuous and discrete time.
- Stochastic processes as inputs to and outputs from linear time invariant systems.
- Computer implementation of the majority of the above mentioned classes of stochastic processes.

Form of teaching

Lectures and tutorials.

Language of instruction: Swedish
The language of instruction is English unless all involved are Swedish speakers.

Assessment
Written exam.

If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

Grades
The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation
Oral and/or written course evaluation will be performed. The results of the evaluation will be communicated to the students and will serve as a guide for the development of the course.