UNIVERSITY OF GOTHENBURG

DEPARTMENT OF MATHEMATICAL SCIENCES

MSA350 Stochastic Calculus, 7.5 higher education credits

Stokastisk analys, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Mathematical Sciences on 2017-06-14 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 programmes: 1) Mathematical Sciences, Master's Programme (N2MAT) and 2) Complex Adaptive Systems, Master's Programme (N2CAS)

Main field of studies	*Specialization*
Mathematical Statistics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Entry requirements

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

Learning outcomes

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

- Describe defining properties for stochastic differential equations and their solutions together with ability to use basic methods solution methods thereof including quadratic variation, martingale techniques and Ito's formula.
- Describe the relation between solutions to stochastic differential equations and solutions to certain (deterministic) partial differential equations from a principal theoretical point of view as well as performing corresponding computational

examples.
- Describe change of measure and change of drift coefficient for solutions to stochastic differential equations from a principal theoretical point of view as well as by application to statistical inference.
- Describe basic principles for numerical solution of stochastic differential equations according to the course literature from a principal theoretical point of view as well as performing corresponding computational examples.

Course content
- Variation and quadratic variation of functions.
- Review of Riemann integral, Riemann-Stieltjes integral and Lebesgue integral.
- Introduction to axiomatic probability theory and to abstract conditional expectation with respect to sigma fields.
- Brownian motion (Wiener process) together with its most important properties.
- Defining properties of martingales and Markov processes with continuous time and continuous values.
- Ito integrals, Ito integral processes and Ito's formula.
- Stochastic differential equations together with existence, uniqueness and Markov property of weak solutions and strong solutions thereof.
- Stochastic exponential, stochastic logarithm and linear stochastic differential equations.
- Stratonovich stochastic calculus.
- Kolmogorov's equations together with Dynkin's formula and the Feynman-Kac formula.
- Time homogeneous diffusion processes together with explosion, recurrence, transience and stationary distributions thereof.
- Change of probability measure for stochastic variables.
- Change of probability measure and drift coefficient for solutions of stochastic differential equations with applications to likelihood principles and statistical inference.

Form of teaching
Lectures and exercise sessions.

Language of instruction: English

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

At the end of the course the students will be asked to answer a questionnaire. The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.

Additional information

The syllabus replaces the earlier syllabus valid from July 1, 2007.