Faculty of Science

MASM11, Mathematical Statistics: Monte Carlo Methods for Statistical Inference, 7.5 credits

Matematisk statistik: Monte Carlo-baserade statistiska metoder, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-01-31 and was last revised on 2007-01-31. The revised syllabus applies from 2007-07-01, autumn semester 2007.

General Information

The course is an elective course for second-cycle studies for a Master of Science in Mathematical statistics.

Language of instruction: Swedish and English

Main field of studies	*Depth of study relative to the degree requirements*
Mathematics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Mathematical Statistics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is that students on completion of the course should have acquired the following knowledge and skills:

Knowledge and understanding

On completion of the course, the students are expected to:

- describe fundamental principles of Monte Carlo integration and random variable generation.
- explain and use the concept of statistical uncertainty from a frequentist perspective as well as from a Bayesian perspective,
- describe fundamental principles of parametric and non-parametric resampling.

Competence and skills

On completion of the course, the students are expected to:

- given a stochastic model and problem formulation, choose relevant quantities in a way that permits approximation using Monte Carlo methods,
- given a (possibly multivariate) probability distribution, suggest and implement in a computer program, a method for generation of random variables from this distribution,
- given a large number of generated random variables from a probability distribution, approximate relevant probabilities and expectations as well as estimate the uncertainty in the approximated quantities,
- given a model description and a statistical problem, suggest a simple permutation test and implement it in a computer program,
- given a model description and a statistical problem, suggest a resampling procedure and implement it in a computer program,
- present the course of action taken and conclusions drawn in the solution of a given statistical problem.

Judgement and approach

On completion of the course, the students are expected to:

- be able to identify and problematize the possibilities and limitations of statistical inference.

Course content

Simulation based methods of integration and statistical analysis. Monte Carlo methods for sequential problems. Markov chain methods, e.g. Gibbs sampling and the Metropolis-Hastings algorithm, for simulation and inference. Bayesian modelling and inference. The re-sampling principle, both non-parametric and parametric. Methods for constructing confidence intervals using re-sampling. Simulation based tests as an alternative to asymptotic parametric tests.

Course design

Teaching consists of lectures, computer exercises and projects. Participation in project work, computer exercises and thereby integrated teaching is compulsory.

Assessment

The examination are done through written project reports and an oral exam.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
For passing grade on the entire course passed project reports, oral exam and participation in compulsory parts are required. The grade is formed by weighing together the results on the part which are included the examination.

Entry requirements

For admission to the course knowledge equivalent to at least one of the courses MASC03, Markov processes, 7.5 credits or MASC04, Stationary Stochastic processes, 7.5 credits are required together with English B.

Subcourses in MASM11, Mathematical Statistics: Monte Carlo Methods for Statistical Inference

Applies from V16

0703 Project part 1, 2,5 hp
Grading scale: Fail, Pass
0704 Project part 2, 5,0 hp
Grading scale: Fail, Pass

Applies from H07

0701 Project, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction
0702 Computer Exercises, 0,0 hp
Grading scale: Fail, Pass