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

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