Faculty of Science

MASM25, Mathematical Statistics: Spatial Statistics with Image Analysis, 7.5 credits

Matematisk statistik: Spatial statistik med bildanalys, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-07-01 (N2007148) and was last revised on 2025-12-05 by The Education Board of Faculty of Science. The revised syllabus comes into effect 2025-12-05 and is valid from the autumn semester 2026.

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 study	*Specialisation*
Mathematical Statistics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Mathematics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is to provide the student with tools for handling high-dimensional statistical problems. The course contains models, and methods with practical applications, mainly for spatial statistics and image analysis. Of special importance are the Bayesian aspects, since they form the foundation for many modern spatial statistical and image analysis methods. The course emphasises methods with applications in climate, environmental statistics, and remote sensing.

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:

- explain and use the concept of a stochastic model, in particular from a Bayesian perspective,
- describe the principles of Bayesian modelling and inference,
- identify and describe stochastic models and analysis methods for high-dimensional problems, in particular regarding spatial statistics and image analysis.

Competence and skills

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

- independently suggest and analyze stochastic models for high-dimensional data, in particular in spatial statistics and image analysis,
- independently implement a computer program for the solution of a given statistical problem and relating analysis method,
- present motivations, course of action, and conclusions in the solution of a given statistical problem, both written and orally.

Judgement and approach

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

- identify and problematize possibilities and limitations of stochastic modelling and inference, in particular in high-dimensional problems,
- be able to assume a stochastic point of view on random variation in natural phenomena.

Course content

- Bayesian methods for stochastic modelling and reconstruction,
- Random fields, Gaussian random fields, Kriging, Gaussian process regression, Gaussian Markov random fields,
- Spatial fields defined through stochastic partial differential equations,
- Non-Gaussian observations,
- Covariance functions, multivariate techniques,
- Simulation methods for stochastic inference (Gibbs sampling),
- Applications in climate, environmental statistics, remote sensing, and spatial statistics.

Course design

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

Assessment

Assessment takes the form of written lab reports (2,5 credits) during the course as well as av final project with written and oral project presentation (5 credits) at the end of the course.

Students who fail the regular exam are offered a re-examination shortly afterwards.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
For passing grade on the entire course passing grade on the project presentation (written and oral), laboratory work as well as participation in compulsory parts are required.

The grading scale for laboratory work is Fail, Pass, whereas the project presentations is graded according to the scale Fail, Pass, Pass with Distinction.

The final grade is given by the grade on the project.

Entry requirements

For admission to the course knowledge equivalent to at least one of the courses MASC13, Markov processes, 7.5 credits or MASC14, Stationary Stochastic processes, 7.5 credits are required together with English B.

Further information

The course is studied together with FMSN20 Spatial Statistics 7.5 credits, which is a course at Lund University's Faculty of Engineering, LTH.

The course is assessed according to the LTH exam schedule.

The course is offered at the Centre for Mathematical Sciences, Lund University.