



LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Spatial statistik med bildanalys Spatial Statistics with Image Analysis

FMSN20, 7,5 credits, A (Second Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED I

Date of Decision: 2023-04-14

General Information

Elective for: BME4, C4, D5-bg, E4-bg, F4, F4-bg, Pi4-ssr, Pi4-biek, Pi4-bam, MMSR2, R4

Language of instruction: The course will be given in English

Aim

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.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- 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.

Competences and skills

For a passing grade the student must

- independently suggest and analyse 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

For a passing grade the student must

- identify and problemise 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.

Contents

Bayesian methods for stochastic modelling, classification and reconstruction. Random fields, Gaussian random fields, Kriging, Markov fields, Gaussian Markov random fields, non-Gaussian observation. Covariance functions, multivariate techniques. Simulation methods for stochastic inference (Gibbs sampling). Applications in climate, environmental statistics, remote sensing, and spatial statistics.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: Written and oral project presentation. The final grade is determined by the result of the project parts.

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.

Parts

Code: 0115. **Name:** Project Part 1.

Credits: 2,5. **Grading scale:** UG. **Assessment:** Written project report

Code: 0215. **Name:** Project Part 2.

Credits: 5. **Grading scale:** UG. **Assessment:** Written and oral project presentation

Admission

Admission requirements:

- FMSF10 Stationary Stochastic Processes or FMSF15 Markov Processes or FMSF20 Mathematical Statistics, Basic Course or FMSF25 Mathematical Statistics - Complementary Project or FMSF32 Mathematical Statistics or FMSF45 Mathematical Statistics, Basic Course or FMSF50 Mathematical Statistics, Basic Course or FMSF55 Mathematical Statistics, Basic Course or FMSF70 Mathematical Statistics or FMSF75 Mathematical Statistics, Basic Course or FMSF80 Mathematical Statistics, Basic Course

Assumed prior knowledge: At least one course in Markov processes or Stationary stochastic processes. Matlab proficiency.

The number of participants is limited to: No

The course overlaps following course/s: FMS150, MASM13, MASM25

Reading list

- A. Gelfand, P. Diggle, P. Guttorp, M. Fuentes (Eds.): Handbook of Spatial Statistics. CRC Press Inc, 2010, ISBN: 9781420072877. Only parts of the book are used, available as e-book.

Contact and other information

Director of studies: Johan Lindström, studierektor@matstat.lu.se

Course administrator: Susann Nordqvist, expedition@matstat.lu.se

Course homepage:

<https://www.maths.lu.se/utbildning/civilingenjoersutbildning/matematisk-statistik-paa-civilingenjoersprogram/>

Further information: In addition to the Handbook of Spatial Statistics other literature, freely available from the Lund University Library, might be recommended. The course is also given at the faculty of science with the code MASM25.