



LTH

FACULTY OF
ENGINEERING

Course syllabus

Matematisk statistik, allmän kurs Mathematical Statistics, Basic Course

FMSF80, 9 credits, G2 (First Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED I

Date of Decision: 2023-04-14

General Information

Main field: Technology.

Compulsory for: F2, I2, Pi2

Language of instruction: The course will be given in Swedish

Aim

The course is intended to give the student the basics in mathematical modelling of random variation and an understanding of the principles behind statistical analysis. It shall also give the students a toolbox containing the most commonly used models and methods, as well as the ability to use these in practical situations. The student shall also be able to handle dependence between observations.

The course fills two purposes, providing a fundamental knowledge of mathematical statistics, as well as giving a foundation for further studies.

The fundamental knowledge is essential for those who, in their professional lives, will not necessarily be involved in statistical analyses on a daily basis, but who, on occasion, will be expected to perform basic statistical tests and present the results for their colleagues. They will also be expected to be able to read and assess the analyses of others.

The main purpose of the course is to provide a basis for further studies. Both in stochastic modelling and analysis of random phenomena in time and/or space, and in the application areas, such as physics, environment, medicin, economics, signal processing, logistics, and process control. The focus therefore lies in probability theory and stochastic modelling of both independent and dependent data.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- be able to relate questions regarding random variation and observed data to the concepts of random variables, distributions, and relationships between variables,
- be able to explain the concepts of independence, probability, conditional probability, distribution, expectation, variance, covariance, and correlation,
- be able to describe fundamental techniques for statistical inference
- understand that statistical dependence does not imply cause-effect.

Competences and skills

For a passing grade the student must

- be able to calculate the probability of an event, and the expectation and variance from a given distribution,
- be able to choose and modify a statistical model describing a problem based on a real life situation,
- be able to choose, modify, perform, and interpret a statistical procedure that answers a given statistical problem,
- be able to apply fundamental techniques for statistical inference to basic statistical models,
- be able to use a computational program for simulation and interpretation of probabilistic and statistical models, as well as for data analysis,
- be able to use statistical terms and communicate statistical conclusions in writing.

Judgement and approach

For a passing grade the student must

- be able to assume a stochastic point of view on random variation in data,
- be able to examine a statistical model and its ability to describe reality.
- be able to examine a basic measurement situation and judge if data has been collected in a manner that makes further analysis possible.

Contents

Data analysis. Descriptive statistics. Axioms of probability. Conditional probability, independent events. Stochastic variables. Transformations, linear combinations, sums, max and min of stochastic variables. Expectation, variance, covariance, and correlation. Discrete and continuous standard distributions, such as Normal, exponential, binomial and Poisson. Law of large numbers and central limit theorem. Conditional distributions and conditional expectations. Point estimates and their properties. Maximum likelihood and Least squares. Principles of interval estimates and hypothesis testing. Methods for interval estimation and hypothesis testing based on normally and approximately normally distributed estimates. Simulation based statistical methods. Multiple linear regression. Basic principles for model selection in regression. Examples are chosen with respect to the different programs and expected future career.

Examination details

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

Assessment: Written exam, compulsory computer based ability tests, computer exercises and written project report.

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: 0120. **Name:** Examination.

Credits: 4,5. **Grading scale:** TH. **Assessment:** Written exam.

Code: 0220. **Name:** Laboratory Work.

Credits: 1. **Grading scale:** UG. **Assessment:** Computer exercises.

Code: 0320. **Name:** Computational Ability Test 1.

Credits: 0,5. **Grading scale:** UG. **Assessment:** Computer based test covering probability theory

Code: 0420. **Name:** Computational Ability Test 2.

Credits: 1. **Grading scale:** UG. **Assessment:** Computer based test covering statistics

Code: 0520. **Name:** Project Work.

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

Admission

Admission requirements:

- FMAA01 Calculus in One Variable or FMAA05 Calculus in One Variable or FMAA50 Calculus or FMAB30 Calculus in Several Variables or FMAB35 Calculus in Several Variables or FMAB50 Calculus in One Variable A2 or FMAB70 Calculus in One Variable B2
- FMAA01 Calculus in One Variable or FMAA05 Calculus in One Variable or FMAA50 Calculus or FMAB30 Calculus in Several Variables or FMAB35 Calculus in Several Variables or FMAB60 Calculus in One Variable A3 or FMAB70 Calculus in One Variable B2

Assumed prior knowledge: Calculus in one and several variables and Linear algebra.

The number of participants is limited to: No

The course overlaps following course/s: FMSF20, FMSF30, FMSF35, FMSF40, MASB03, FMSF50, FMSF55, FMSF70, FMSF75, MASA01, FMS012, FMS121, FMSF45, MASA02

Reading list

- Blom, G, Enger, J, Englund, G, Grandell, J, Holst, L: Sannolikhetsteori och statistikteori med tillämpningar. Studentlitteratur, 2017, ISBN: 9789144123561.
- Matematisk Statistik, Matematikcentrum: Matematisk Statistik kompletterande övningar. KFS, 2006.

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: Course replaces FMSF45.