Course syllabus

Matematisk statistik, allmän kurs
Mathematical Statistics, Basic Course

FMSF75, 7,5 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: W3
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 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 to their colleagues. They will also be expected to be able to read and assess the analyses of others.

The course shall also give a basis for further studies, particularly in design of experiments and risk evaluation.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to relate environmental statistical questions regarding random variation and observed data to the concepts of random variables, distributions, relationships between variables, and dependent data,
- be able to explain the concepts of independence, probability, distribution, expectation, and variance,
- be able to calculate the probability of an event and the expectation from a given distribution,
- be able to describe fundamental techniques for statistical inference and be able to use them on basic statistical models.

Competences and skills
For a passing grade the student must

- be able to construct a simple statistical model describing a problem based on a real life situation or on a collected data material,
- be able to examine a statistical model and its ability to describe reality,
- be able to use a computational program for simulation and interpretation of statistical models, as well as for data analysis,
- be able to choose, perform, and interpret a statistical procedure that answers a given statistical problem,
- be able to use statistical terms within the field both written and orally,
- be able to present a statistical analysis in a technical report,
- examine a statistical analysis of a data material and present the judgement orally.

Contents

The course contains fundamental concepts in probability theory, inference theory, regression analysis, and time series analysis.

In probability theory the concepts used are random variables and distributions for describing variation and random phenomena, often related to applications in environmental statistics. Different distributions, such as binomial, Poisson, normal, exponential, and log normal distributions, are studied and the concept of expectation and variance of a distribution is introduced. Special attention is paid to the normal distribution and its property as a limit distribution. Simulations from the distributions and studies of the models are performed in Matlab. This part constitutes approximately 2/7 of the course.

In inference theory we start with observed data and estimate parameters in simple probability models, and describe the uncertainty of the estimates. Emphasis is placed on the relationship between the model and the reality based problem, as well as the conclusions that can be drawn from observed data. In this analysis we use basic techniques, such as confidence intervals and hypothesis testing. This part constitutes approximately 2/7 of the course.

In regression analysis we study how the relationship between two or more variables can be described. Most often the relationship will be linear. Often in environmental applications one of the variables is a time variable which leads to trend analysis. We study different techniques for comparison and choice between different models for relationships. Environmental data if often dependent and therefore we introduce time series with concepts of trend, season, and noise. Techniques, such as auto-correlation function, are used to describe the dependence. A simple AR(1) model for dependent data is introduced. This part, resting heavily on the use of Matlab, constitutes approximately 3/7 of the course.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam, written project report and computational ability test.

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: 0117. **Name:** Computational Ability Test.
Credits: 0,5. **Grading scale:** UG. **Assessment:** Computer based test
Code: 0217. **Name:** Examination.
Credits: 5,5. **Grading scale:** TH. **Assessment:** Written exam.
Code: 0317. **Name:** Project Work.
Credits: 1,5. **Grading scale:** UG. **Assessment:** Written project report.

Admission

Admission requirements:

- FMAA01 Calculus in One Variable or FMAA05 Calculus in One Variable or FMAB30 Calculus in Several Variables or FMAB35 Calculus in Several Variables or FMAB45 Calculus in One Variable A1 or FMAB50 Calculus in One Variable A2 or FMAB65 Calculus in One Variable B1 or FMAB70 Calculus in One Variable B2
- FMAA01 Calculus in One Variable or FMAA05 Calculus in One Variable or FMAB30 Calculus in Several Variables or FMAB35 Calculus in Several Variables or FMAB45 Calculus in One Variable A1 or FMAB60 Calculus in One Variable A3 or FMAB65 Calculus in One Variable B1 or FMAB70 Calculus in One Variable B2
- FMAA01 Calculus in One Variable or FMAA05 Calculus in One Variable or FMAB30 Calculus in Several Variables or FMAB35 Calculus in Several Variables or FMAB50 Calculus in One Variable A2 or FMAB60 Calculus in One Variable A3 or FMAB65 Calculus in One Variable B1 or FMAB70 Calculus in One Variable B2

Assumed prior knowledge: Calculus in one variables and Linear algebra.
The number of participants is limited to: No
The course overlaps following course/s: FMSF20, FMSF25, FMSF30, FMSF35, FMSF40, FMSF45, MASB03, FMSF50, FMSF55, FMSF70, MASB02, MASA01, FMS140, MASA02, FMSF80

Reading list

- Vännman K, Jonsson A: Matematisk statistik, tredje upplagan. Studentlitteratur, 2020, ISBN: 9789144133249.
- Lena Zetterqvist och Johan Lindström: Räkna med variation - Ett arbetsmaterial i sannolikhetslära och statistisk inferens. Studentlitteratur, 2017, ISBN: 9789144113142.

Contact and other information

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Course homepage:
https://www.maths.lu.se/utbildning/civilingenjoersutbildning/matematisk-statistik-paa-civilingenjoersprogram/
Further information: Cooperative learning in fixed smaller groups under tutelage of teacher, discussion and solving of exercises, individual work with home assignments, project work in groups of two, lectures, and seminars.