Course syllabus

Statistisk modellering av extremvärden
Statistical Modelling of Extreme Values

FMSN55, 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: D4, F4, F4-fm, I4-fir, Pi4-fm, Pi4-biek, R4
Language of instruction: The course will be given in English

Aim

The course aims to give theoretical knowledge in mathematical modelling of extreme events and discusses in detail how the theory can be applied in practice. Different courses of action for modelling of extreme values are discussed and guidance is given as to how the models can be modified to fit different practical situations. The students should also learn about more advanced models for extreme value analysis, including extreme values for non-stationary processes.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be familiar with the fundamental results in univariate extreme value analysis,
- be able to describe the fundamental statistical methods of extreme value theory,
- understand the mathematical theory behind the methods and implications of the assumptions made in order to develop the theory, as well as understand the impact of these assumptions on application of theory,

- be able to describe the differences between the univariate and multivariate extreme value theory.

Competences and skills
For a passing grade the student must

- identify those situations where extreme value theory can be used,
- know which computer packages are available for application of theory and also know how to use those discussed in the course,
- be able to estimate and predict extreme events in the univariate case,
- be able to explain the mathematical models and statistical methods for extreme value analysis,
- be able to explain what type of data is needed in order to apply the theory,
- assess whether the theory can be used on a specific problem,
- give some examples of application of the theory,
- explain, step by step, how the theory can be applied,
- know where to find more information about those models which have been discussed in detail in the course.

Contents

Extreme value theory concerns mathematical modelling of random extreme events. Recent development has introduced mathematical models for extreme values and statistical methods for them. Extreme values are of interest in, e.g., economics, safety and reliability, insurance mathematics, hydrology, meteorology, environmental sciences, and oceanography, as well as branches in statistics such as sequential analysis and robust statistics. The theory is used, e.g., for flood monitoring, construction of oil rigs, and calculation of insurance premiums for re-insurance of storm damage. Often extreme values can lead to very large consequences, both financial and in the loss of life and property. At the same time the experience of really extreme events is always very limited. Extreme value statistics is therefore forced to difficult and uncertain extrapolations, but is, none the less, necessary in order to use available experience in order to solve important problems.

The course will

- present the fundamental statistical methods for extreme value analysis,
- discuss examples of applications, i.a., regarding floods, storm damage, human life expectancy, and corrosion,
- provide practical use of the models, and
- point to some open problems and possible developments.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam and compulsory computer exercises.

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:** Examination.
Credits: 6. **Grading scale:** TH. **Assessment:** Written examination
Code: 0217. **Name:** Laboratory Work.
Credits: 1,5. **Grading scale:** UG. **Assessment:** Computer exercises

Admission

Admission requirements:

- 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: Probability theory corresponding to FMSF05 helps.
The number of participants is limited to: No
The course overlaps following course/s: MASM15, FMS155

Reading list

- Stuart Cole: An Introduction to Statistical Modeling of Extreme Values. Springer, 2001, ISBN: 978-1-85233-459-8.

Contact and other information

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Course homepage:
https://www.maths.lu.se/utbildning/civilingenjoersutbildning/matematisk-statistik-paa-civilingenjoersprogram/
Further information: The course is also given at the faculty of science with the code MASM15.