



**LUND**  
UNIVERSITY

Faculty of Science

## MASM15, Mathematical Statistics: Statistical Modelling of Extreme Values, 7.5 credits

*Matematisk statistik: Statistisk modellering av extremvärden, 7,5 högskolepoäng*

Second Cycle / Avancerad nivå

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### Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-01-31 and was last revised on 2007-01-31. The revised syllabus applies from 2007-07-01, autumn semester 2007.

### 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 studies*

Mathematics

Mathematical Statistics

*Depth of study relative to the degree requirements*

A1N, Second cycle, has only first-cycle course/s as entry requirements

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### Learning outcomes

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:

- be familiar with the fundamental results in uni-variate 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 uni-variate and multivariate extreme value theory.

### **Competence and skills**

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

- 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 uni-variate 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.

### **Course content**

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.

### **Course design**

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

### **Assessment**

The examination consists of a written exam. Students who fail the regular exam are offered a re-examination shortly afterwards.

*Subcourses that are part of this course can be found in an appendix at the end of this document.*

## Grades

Marking scale: Fail, Pass, Pass with distinction.

For a passing grade on the entire course a passed written exam, passed computer exercise reports as well as participation in all compulsory course parts are required. The final grade is the grade on the written exam.

## Entry requirements

For admission to the course knowledge equivalent to the courses MASA01, Mathematical Statistics: Basic Course, 15 credits and MASC01, Mathematical Statistics: Probability Theory, 7.5 credits is required.

## Subcourses in MASM15, Mathematical Statistics: Statistical Modelling of Extreme Values

Applies from V16

- 0703 Exam, 6,0 hp  
Grading scale: Fail, Pass, Pass with distinction
- 0704 Laboratory Work, 1,5 hp  
Grading scale: Fail, Pass

Applies from H07

- 0701 Exam, 7,5 hp  
Grading scale: Fail, Pass, Pass with distinction
- 0702 Computer Exercises, 0,0 hp  
Grading scale: Fail, Pass