**Faculty of Science**

# MASM28, Mathematical Statistics: Survival Analysis, 7.5 credits

*Matematisk statistik: Analys av överlevnadsdata, 7,5 högskolepoäng*

**Second Cycle / Avancerad nivå**

## Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2020-06-01 to be valid from 2020-06-01, spring semester 2021.

## General Information

The course is an elective course for second-cycle studies for a Master of Science in Mathematical statistics.

*Language of instruction:* English

| *Main field of studies* | *Depth of study relative to the degree requirements* |
| --- | --- |
| Mathematical Statistics | A1N, Second cycle, has only first-cycle course/s as entry requirements |

## Learning outcomes

The purpose of the course is that the students after the course should have acquired knowledge of survival data and related questions that occur in medical, technical and econometric investigations containing survival data. Important applications are e.g. when a certain disease occurs or when a symptom stops. It can also be times for disasters or defaults of companies.

### Knowledge and understanding
On completion of the course, the students are expected to:

- describe the fundamental concepts that are used in survival analysis, such as hazard function and survival function.
- describe semi parametric regression models such as Cox regression model and Aalens regression model.
- use residual analysis for control of model assumptions for survival data.

- use counting processes as models for survival data, statistical functionals for obtaining distributions of estimates in survival analysis.

### Competence and skills

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

- know basic non parametric methods for estimation of the survival function and the  cumulative hazard function as well as using density estimates of the hazard function.
- be able to estimate  parameters and functions in Cox and Aalens models.
- be able to use a statistical computer program to perform fundamental investigations of survival data in medical statistics.
- be able to use residual analysis to check model assumptions for survival data.
- be able to analyze data with various kinds of  censuring and truncation.
- be able to handle model choices and quantitatively give account of a  model's pros and cons.

### Judgement and approach

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

- be able to evaluate if a model is good enough to answer the underlying statistical question.
- be able to qualitatively decide which model structure that answers the underlying statistical question in the best way.

## Course content

The course treats:

- Survival data; censured and truncated data, covariates.
- Distributions and models  for survival data. Counting processes and martingale theory. Estimation of survival function and cumulative hazard function (Kaplan-Meier and Nelson-Aalen estimators). Non parametric one and multiple sample tests. Kernel estimates of hazard function.
- Semi parametric regression models for data with covariates. Cox model. Aalens model. Likelihood-theory for estimation in the Cox model. Breslow estimator of cumulative hazard in the Cox model. Projection methods in counting processes for estimation in the Aalen model.
- Bootstrap methods for survival data.
- Statistical functionals for limiting distributions in survival analysis.

## Course design

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

## Assessment

The examination are done through written project reports during the course and an oral exam at the end of the course.

Students who fail the regular exam are offered a re-examination shortly afterwards.

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.

*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 the project reports, only the grades Fail or Pass are given. For a passing grade on the entire course, a passing grade on the oral exam and a passing grad on the project reports as well as participation in compulsory parts are required.

The final grade is formed by weighing together the parts that are included in the examination.

## Entry requirements

For admission to the course English 6/B and knowledge equivalent to the courses MASA02, Mathematical Statistics: Basic Course, 15 credits, MASC01 Probability Theory, 7.5 credits and MASC02 Inference theory, 7.5 credits as well as 60 credits mathematics is required.

## Further information

The course may not be included in a degree together with MASMM21 Survival Analysis 7,5 credits or FMSN10 Survival Analysis.

## Subcourses in MASM28, Mathematical Statistics: Survival Analysis

Applies from V21

2101   Oral Exam, 5,0 hp
      Grading scale: Fail, Pass, Pass with distinction
2102   Project, 2,5 hp
      Grading scale: Fail, Pass