Faculty of Science

MASM17, Mathematical Statistics: Time Series Analysis, 7.5 credits

Matematisk statistik: Tidsserieanalys, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-06-14 (N2007148) and was last revised on 2025-12-04 by The Education Board of Faculty of Science. The revised syllabus comes into effect 2025-12-04 and is valid from the autumn semester 2026.

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 study	*Specialisation*
Mathematics	A1N, Second cycle, has only first-cycle course/s as entry requirements
Mathematical Statistics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The overall pupose of the course is to give the students practical and theoretical knowledge in modelling, estimation, validation, prediction, and interpolation of time discrete dynamical stochastic systems, mainly linear systems. The course also gives a basis for further studies of time series systems, e.g. Financial statistics and Non-linear systems.

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 able to:

- construct a model based on data for a concrete practical time series problem,
- perform simple transformations of a non-stationary time series into a stationary time series,
- predict and interpolate in linear time series models,
- estimate parameters in linear time series models and validate a resulting model,
- construct a Kalman-filter based on a linear state model,
- estimate in time varying stochastic systems using recursive and adaptive techniques.

Competence and skills

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

- present the analysis of a practical problem in a written report and present it orally.

Judgement and approach

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

- reflect over the limitations of the chosen model and method, as well as alternative solutions.

Course content

Time series analysis concerns the mathematical modelling of time varying phenomena, e.g., ocean waves, water levels in lakes and rivers, demand for electrical power, radar signals, muscular reactions, ECG-signals, or option prices at the stock market. The structure of the model is chosen both with regard to the physical knowledge of the process, as well as using observed data. Central problems are the properties of different models and their prediction ability, estimation of the model parameters, and the model's ability to accurately describe the data. Consideration must be given to both the need for fast calculations and to the presence of measurement errors. The course gives a comprehensive presentation of stochastic models and methods in time series analysis. Time series problems appear in many subjects and knowledge from the course is used in, i.a., automatic control, signal processing, and econometrics.

The course treats:

- Further studies of ARMA-processes,
- Non-stationary models, slowly decreasing dependence,
- Transformations,
- Optimal prediction and reconstruction of processe,.
- State representation, principle of orthogonality, and Kalman filtering,
- Parameter estimation: Least squares and Maximum likelihood methods as well as recursive and adaptive variants,
- Non-parametric methods,covariance estimation, spectral estimation,
- An orientation on robust methods and detection of outliers.

Course design

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

Assessment

Assessment takes the form of laborations (1 hp) during the course and by written and oral presentation of the project (6,5 hp) 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.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
For a passing grade on the entire course a passing grade on the project presentation, laboratory work and participation in compulsory parts are required.

The grading scale for laboratory work is Fail, Pass, whereas project presentations is graded according to the scale Fail, Pass, Pass with Distinction

The final grade is given by the grade on the project.

Entry requirements

For admission to the course knowledge equivalent to the course MASC14, Stationary Stochastic processes, 7.5 credits is required together with English B.

Further information

The course is given by Centre for Mathematical Sciences, Lund University.

The course is read together with FMSN45 Time Series Analysis 7.5 credits which is a course given by Lund's engineering school LTH.

The examination of the course is scheduled according to LTH:s exam schedule.