

## **Multivariate Statistical Methods**

Multivariata statistiska metoder  
6 credits

Programme course

732A88

Valid from: 2025 Autumn semester

<b>Determined by</b> Chairman of the Course and Programme Syllabus Board at the Faculty of Arts and Sciences	<b>Main field of study</b> Statistics	
<b>Date determined</b> 2024-05-29	<b>Course level</b> Second cycle	<b>Progressive specialisation</b> A1F
<b>Revised by</b> Chairman of the Course and Programme Syllabus Board at the Faculty of Arts and Sciences	<b>Disciplinary domain</b> Technology	
<b>Revision date</b> 2024-09-30	<b>Subject group</b> Statistics	
<b>Offered first time</b> Autumn semester 2025	<b>Offered for the last time</b>	
<b>Department</b> Institutionen för datavetenskap	<b>Replaced by</b>	

## Course offered for

- Master's Programme in Statistics and Machine Learning

## Entry requirements

- 180 ECTS credits passed including 90 ECTS credits in one of the following subjects:
  - statistics
  - mathematics
  - applied mathematics
  - computer science
  - engineering
- Passed courses in:
  - calculus
  - linear algebra
  - statistics
  - programming
- English corresponding to the level of English in Swedish upper secondary education (Engelska 6)  
Exemption from Swedish
- At least 24 ECTS credits passed in the main field of Statistics at second cycle and at least 5 ECTS credits passed in the main field of Computer Science at second cycle

## Intended learning outcomes

After completion of the course, the student should be able to:

- analyze multivariate data by using appropriate multivariate models,
- account for mathematical models related to various multivariate methods and derive theoretical results from these models,
- apply hypothesis testing and large sample theory to assess the credibility of the results obtained by multivariate models,
- use computer simulations to solve multivariate statistical problems,
- account for different types of covariance structures and their impact on interpretation,
- apply multivariate methods for dimension reduction.

## Course content

The course comprises the mathematical theory for the multivariate normal distribution and its related distributions, as well as the practical application of this theory to a range of multivariate statistical models and inference problems in statistics, machine learning and engineering.

The course includes:

- matrix algebra, random vectors and matrices
- multivariate normal distribution, mathematical properties of sampling distributions and large sample theory.
- inference of mean vectors, related hypothesis testing models and confidence regions
- principal component analysis and large sample inference
- factor analysis,
- canonical correlation analysis and large sample inference,
- MANOVA models.

## Teaching and working methods

The teaching comprises lectures, computer exercises and seminars. Homework and independent study are a necessary complement to the course.

Language of instruction: English.

## Examination

The course is examined by:

- written reports in groups on the lab assignments, grade scale: EC, P/F
- active participation at the seminars: EC, P/F
- individual written examination, grade scale: EC

For Pass (E) as the final grade, at least E is required on all examination parts. Higher grades are based on the individual written examination.

Detailed information can be found in the study instructions.

If special circumstances prevail, and if it is possible with consideration of the nature of the compulsory component, the examiner may decide to replace the compulsory component with another equivalent component.

If the LiU coordinator for students with disabilities has granted a student the right to an adapted examination for a written examination in an examination hall, the student has the right to it.

If the coordinator has recommended for the student an adapted examination or alternative form of examination, the examiner may grant this if the examiner assesses that it is possible, based on consideration of the course objectives.

An examiner may also decide that an adapted examination or alternative form of examination if the examiner assessed that special circumstances prevail, and the examiner assesses that it is possible while maintaining the objectives of the course.

Students failing an exam covering either the entire course or part of the course twice are entitled to have a new examiner appointed for the reexamination.

Students who have passed an examination may not retake it in order to improve their grades.

## Grades

ECTS, EC

## Other information

Planning and implementation of a course must take its starting point in the wording of the syllabus. The course evaluation included in each course must therefore take up the question how well the course agrees with the syllabus.

The course is conducted in such a way that there are equal opportunities with regard to sex, transgender identity or expression, ethnicity, religion or other belief, disability, sexual orientation and age.

If special circumstances prevail, the vice-chancellor may in a special decision specify the preconditions for temporary deviations from this course syllabus, and delegate the right to take such decisions.

### **About teaching and examination language**

The teaching language is presented in the Overview tab for each course. The examination language relates to the teaching language as follows:

- If teaching language is “Swedish”, the course as a whole could be given in Swedish, or partly, or as a whole, in English. Examination language is Swedish, but parts of the examination can be in English.
- If teaching language is “English”, the course as a whole is taught in English. Examination language is English.
- If teaching language is “Swedish/English”, the course as a whole will be taught in English if students without prior knowledge of the Swedish language participate. Examination language is Swedish or English depending on teaching language.