Multivariate Statistical Methods

Programme course

6 credits

Multivariat statistik

TAMS39

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Mathematics, Applied Mathematics

Course level
Second cycle

Advancement level
A1X

Course offered for
- Computer Science and Engineering, M Sc in Engineering
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- Applied Physics and Electrical Engineering, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Biomedical Engineering, Master's programme
- Mathematics, Master's programme
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Information Technology, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Linear Algebra, Calculus of Several Variables, a course in probability, a course in statistics

Intended learning outcomes

This course provides an introduction to multivariate statistical analysis, both theory and methods. The theory discusses multivariate sampling distributions and their characteristic functions, quadratic forms, elliptical distributions, exterior forms, the Wishart distribution and its applications in sampling. The practical side of the course discusses multivariate significance tests, principal component analysis, factor analysis, multivariate distance measures, discriminant analysis, cluster analysis and canonical correlation analysis. These are implemented using appropriate statistical software to analyse data, interpret the results and draw appropriate conclusions. After completing the course the student should be able to:

- Compute the characteristic functions of some well known distributions and use multivariate characteristic functions to investigate properties of various distributions.
- Derive various multivariate sampling distributions and use exterior forms where appropriate to make the necessary changes of variables.
- Understand and be able to use Kronecker products in problems related to the multivariate normal distribution.
- Understand how the Wishart distribution arises in multivariate sampling and how to use it.
- Understand how to use various multivariate statistical methods (for example: test for significant differences between populations, use principal component analysis and factor analysis, discriminant analysis, cluster analysis and canonical correlation analysis)
- Understand the limitations of these multivariate analysis methods.
- Implement these methods using an appropriate statistical software package and draw appropriate conclusions.

Course content

Results from Linear Algebra. The characteristic function, the multivariate normal distribution and some properties. Generalised inverses. The Euler Gamma function, the chi squared, F and t distributions. Quadratic forms. Spherical and Elliptical Distributions, multivariate cumulants, skewness, kurtosis. Kronecker products, the Multivariate Gamma function, exterior products. Sampling from a multivariate normal distribution, the Wishart distribution and applications. Inferences about mean vectors. Principal components analysis, factor analysis, discriminant analysis and cluster analysis. Canonical correlation. Other multivariate methods. Use of statistical software.

Teaching and working methods

The teaching consists of 12 2 hour lectures, 9 2 hour tutorial sessions and 3 2 hour computer lessons.

Examination

UPG1	Laboratory work and hand in assignments/project	2 credits	U, G
MUN1	Oral examination	4 credits	U, 3, 4, 5

Grades

Four-grade scale, LiU, U, 3, 4, 5

Department

Matematiska institutionen

Director of Studies or equivalent

Ingegerd Skoglund

Examiner

Martin Singull

Course website and other links

http://courses.mai.liu.se/GU/TAMS39

Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Additional literature

Books

Muni S. Srivastava, *Methods of Multivariate Statistics* Wiley
Wiley Series in Probability and Statistics
Richard A. Johnson och Dean W. Wichern, *Applied Multivariate Statistical Analysis* Pearson International

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.