Technische Universität München

Module Description

MA5439: Graphical Models in Statistics

Department of Mathematics

Module level:	Language:	Module duration:	Occurrence:
Master	English	one semester	irregularly

Credits*:	Total number of hours:	Self-study hours:	Contact hours:
9	270	180	90

* The number of credits can vary depending on the corresponding SPO version. The valid number is always indicated on the Transcript of Records or the Performance Record.

Description of achievement and assessment methods:
There will be a written 90 min final exam. The exam tests that students
- have understood the definition and main properties of graphical models,
- have gained deeper knowledge about specific models including models for Gaussian or discrete observations,
- know how to estimate parameters in graphical models and solve model selection problems.

Possibility of re-taking:
In the next semester: not specified
At the end of the semester: Yes

(Recommended) requirements:
required: MA0009 Introduction to Probability and Statistics (former: MA2402 Basic Statistics)
recommended: MA3403 (Generalized Linear Models), MA5441 (Fundamentals of Mathematical Statistics)

Contents:
In this course we study multivariate statistical models in which joint probability distributions have a dependence structure that can be characterized with the help of a graph. This graph reveals conditional independence relations, permits easier comparisons between different models, and facilitates tractable statistical analysis. The course will cover the following topics:
- conditional independence and Markov properties of undirected and directed acyclic graphs (DAGs),
- density factorizations,
- models for Gaussian and categorical data,
- structural equation models and causal interpretation of DAGs,
- estimation and model selection algorithms,
- related software tools in the R environment.

Study goals:
After the successful completion of the module students are able
- to construct graphical models for multivariate data,
- can characterize the dependence structure in data arising from undirected and directed graphical models (Markov and Bayesian networks),
- know the differences between graphical model classes,

- know the causal interpretation of directed graphical models,
- can suggest graphs useful for the analysis of specific data sets.

Teaching and learning methods:
This module is offered as a lecture course with exercise classes. The lectures develop statistical models and methods and their theoretical properties. The exercise classes will deepen understanding of these concepts through problem solving as well as analysis of data examples using the statistical software R.

Media formats:
blackboard, slides, moodle course

Literature:
Edwards, D. (2012). Introduction to graphical modelling. Springer Science & Business Media.
Whittaker, J. (2009). Graphical models in applied multivariate statistics. Wiley Publishing.
Højsgaard, S., Edwards, D., & Lauritzen, S. (2012). Graphical models with R. Springer Science & Business Media.
Lauritzen, S. L. (1996). Graphical models (Vol. 17). Clarendon Press.
Maathuis, M., Drton, M., Lauritzen, S., Wainwright, M. (2019). Handbook of Graphical Models. CRC Press.

Responsible for the module:
Drton, Mathias; Prof. Ph.D.: mathias.drton@tum.de

Courses (Type, SH) Lecturer:

For further information about this module and its allocation to the curriculum see:
https://campus.tum.de/tumonline/wbModHb.wbShowMHBReadOnly?pKnotenNr=2728278

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