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Module MAT-62-21-M-7

Statistical Learning and Selected Applications (M, 4.5 LP)

Module Identification

Module Number	Module Name	CP (Effort)
MAT-62-21-M-7	Statistical Learning and Selected Applications	4.5 CP (135 h)

Basedata

CP, Effort	4.5 CP = 135 h
Position of the semester	1 Sem. irreg.
Level	[7] Master (Advanced)
Language	[EN] English
Module Manager	Sass, Jörn, Prof. Dr. (PROF DEPT: MAT) (/staff/31/)
Lecturers	Burger, Michael, Dr. (EXT DEPT: MAT, MV) (/staff/240/)
Area of study	[MAT-STO] Stochastics/Statistics/Financial Mathematics
Reference course of study	[MAT-88.105-SG] M.Sc. Mathematics (/mhb/FB-MAT/cos-538/)
Lifecycle-State	[NORM] Active

Courses

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V	MAT-62-21-K-7 (/mhb/courses/MAT-62-21-K-7/)	P	-	PL1	4.5	irreg.

- About [MAT-62-21-K-7]: Title: "Statistical Learning and Selected Applications"; Presence-Time: 28 h; Self-Study: 107 h

Examination achievement PL1

- Form of examination: **oral examination (20-30 Min.)**
- Examination Frequency: irregular (at least in semesters, if the course is offered and the subsequent semesters)
- Examination number: 86435 ("Statistical Learning and Selected Applications")

Evaluation of grades

The grade of the module examination is also the module grade.

Contents

From [MAT-62-21-K-7] **Statistical Learning and Selected Applications** (/mhb/courses/MAT-62-21-K-7/):

- Basic concepts of machine/statistical learning,
- Bayesian model choice,
- Local models,
- Random Forests, increased efficiency through combination of several experts, boosting,
- Support Vector Machines,
- Gaussian processes for regression and classification,
- Neural Networks,
- Identification of dynamic systems,
- Selected application examples:
 - Identification of vehicle systems for (load) prediction (e.g. predictive maintenance) and control (e.g. for control units or driver assistance systems)
 - Classification of working conditions based on easy to measure machine data,
 - Data-driven driver and operator modeling, machine learning for autonomous driving,
 - Reinforcement Learning for the control of traffic systems and in robotics.

Competencies / intended learning achievements

Upon successful completion of this module, the students have a good overview of the estimators of functions that characterize data generating mechanisms but do not require restrictive model assumptions. They have also learnt about the application of these estimators in the areas of big data and machine learning. In addition, they have acquired basic knowledge of modern nonparametric statistical methods and their use for data-driven classification, pattern recognition, function estimation, and predictions. They know selected application examples of the presented techniques, especially from the field of engineering (e.g. system identification for prediction and control). In each case, they are able to critically assess the possibilities and limitations of the use of the methods.

The students have developed a skilled, precise and independent handling of the terms, propositions and techniques taught in the lecture. They understand the proofs presented in the lecture and are able to comprehend and explain them.

Literature

From [MAT-62-21-K-7] **Statistical Learning and Selected Applications** (/mhb/courses/MAT-62-21-K-7/):

- R. A. Berk: Statistical Learning from a Regression Perspective,
- C. Bishop: Pattern Recognition and Machine Learning,
- K. Murphy: Machine Learning: A Probabilistic Perspective,
- J. Franke: Lecture Notes on Nonparametric Statistics.

Requirements for attendance (informal)

Classical regression analysis, e.g. from the module [MAT-60-12-M-4] (/mhb/modules/MAT-60-12-M-4/) *Regression and Time Series Analysis*.

Modules:

- [MAT-10-1-M-2] Fundamentals of Mathematics (M, 28.0 LP) (/mhb/modules/MAT-10-1-M-2/)
- [MAT-14-14-M-3] Stochastic Methods (M, 9.0 LP) (/mhb/modules/MAT-14-14-M-3/)

Requirements for attendance (formal)

None

References to Module / Module Number [MAT-62-21-M-7]

Course of Study	Section	Choice/Obligation
[MAT-88.B84-SG] M.Sc. Actuarial and Financial Mathematics (/mhb/FB-MAT/cos-579/)	Statistics and Computational Methods	[WP] Compulsory Elective
Module-Pool	Name	
[MAT-62-MPOOL-7 (/mhb/modulepools/MAT-62-MPOOL-7/)]	Specialisation Statistics (M.Sc.)	
[MAT-AM-MPOOL-7 (/mhb/modulepools/MAT-AM-MPOOL-7/)]	Applied Mathematics (Advanced Modules M.Sc.)	