Valid from 2025.FS

Module description: Advanced Quantitative Methods

Module Code	w.MA.XX.AQM.19HS
ECTS Credits	3
Language of Instruction/Examination	English
Module Description	This module provides a comprehensive exploration of predictive modeling and evaluation techniques, covering both theory and practical application. The course delves into key concepts such as mean squared error (MSE) for model evaluation, distinguishing between in-sample and out-of-sample performance metrics. We explore various regression methods, including regularized linear and binary regressions, with a focus on improving prediction accuracy and avoiding overfitting through tuning parameter optimization. Students will gain hands-on experience with variable selection techniques, crucial for building parsimonious and effective models. Additionally, the module introduces natural language processing (NLP), covering aspects like topic modeling, as well as advanced methods like multilevel regression for hierarchical data analysis. A special emphasis is placed on understanding the mechanics behind Naive Bayes and Logistic Regression classifiers, including implementing their loss functions from scratch and testing these on real-world datasets. As part of the practical components, students see how these models function in practice, exploring their strengths and limitations. Moreover, sentiment analysis is studied, providing a detailed look into how text data can be used for prediction and analysis.
Organizational Unit	Institut für Wealth & Asset Management
Module Coordinator	Ruben Seiberlich
Deputy Module Coordinator	Marc Weibel
Program and Specialization	• Banking and Finance
Legal Framework	Academic Regulations MSc in Banking and Finance dated 29.09.2011, Appendix to the Academic Regulations for the degree program in Banking and Finance, first adopted on 28.08.2012
Module Category	**Module Type** Compulsory
Prerequisite Knowledge	Advanced knowledge in statistics and quantitative methods as well as fundamental Python programming skills.
Contribution to Program Learning Objectives (by the concerned Module)	• Professional Competence • Methodological Competence • Social Competence • Self-Competence

Module description: Advanced Quantitative Methods

Contribution to Program Learning Objectives

Professional Competence
- Knowing and Understanding Content of Theoretical and Practical Relevance
- Apply, Analyze, and Synthesize Content of Theoretical and Practical Relevance
- Evaluate Content of Theoretical and Practical Relevance

Methodological Competence
- Problem-Solving & Critical Thinking
- Scientific Methodology
- Work Methods, Techniques, and Procedures
- Information Literacy
- Creativity & Innovation

Social Competence
- Written Communication
- Oral Communication
- Teamwork & Conflict Management
- Intercultural Insight & Ability to Change Perspective

Self-Competence
- Self-Management & Self-Reflection
- Ethical & Social Responsibility
- Learning & Change

Module Learning Objectives

Students...
- are familiar with matrix and vector notations and can operate with them in Python.
- understand the bias-variance trade off and the mean squared error concept.
- know how to detect autocorrelation, heteroskedasticity, and multicollinearity and know how to mitigate it.
- understand model (mis)specifications, overfitting, and in-sample vs. out of-sample predictions.
- understand the concepts of integration and co-integration as well as the concept of stationarity and how it can be detected.
- are familiar with robust methods, model selection, and regularization.

Module Content
- Model evaluation
- Ridge and lasso penalities in linear regressions
- Tuning parameter optimization
- Regularized binary response models
- Variable selection techniques
- Fundamental natural language processing (NLP) techniques
- Sentiment analysis

Links to other modules

This module is linked to the following modules:
- w.MA.XX.IN.19HS
- w.MA.XX.DLE.19HS
- w.MA.XX.MLE.19HS
- w.MA.XX.QIS.19HS
- w.MA.XX.QNM.19HS

Digital Learning Resources
- Practice and Application Exercises (with Key)

Methods of Instruction
- Lecture
- Problem-Oriented Teaching
- Exercises
- Project Work
- Interactive Instruction

Social Settings Used:
- Group Work

Type of Instruction

	Classroom Instruction	Guided Self-Study	Autonomous Self-Study
Lecture	28 h	-	
Excercise	-	-	
Project Work	-	22 h	
Seminar	-	-	
Total	**28 h**	**22 h**	**40 h**

Module description: Advanced Quantitative Methods

Performance Assessment

End-of-module exam	Form	Length (min.)	Weighting
-			
Permitted Resources			

Others	Assessment	Format	Length (min.)	Weighting
Python coding	Grade	Gruppenarbeit	0	60.00
Written assignment	Grade	Einzelarbeit	45	40.00

Classroom Attendance Requirement

None

Compulsory Reading

Recommended Reading

- Seifert, B. & Gasser, T. (1996). Finite-sample variance of local polynomials: analysis and solutions. Journal of the American Statistical Association, 91 (433), pp. 267- 275.
- Hastie, T., Tibshirani, R. & Friedman, J. (2009). The Elements of Statistical Learning. Springer. ISBN 978-0-387-84857-0.

Comments