Machine Learning for Finance

ECO M-MaLeFi

UNIVERSITÄT

Content and learning outcome

Content	The course introduces machine learning methods from an applied perspective, emphasizing their use in financial contexts such as stock price prediction and portfolio construction. Its primary objective is to develop a deep understanding of the bias–variance trade-off and its implications across major machine learning models, including both supervised and unsupervised approaches. The final module of the course focuses on reinforcement learning techniques and their relevance to decision-making problems in finance. Lectures are complemented by hands-on sessions in which students implement the discussed models in Python.
Learning outcome	Upon successful completion of the module "Machine Learning," students will be able to: 1. **Explain core machine learning methods — both supervised and unsupervised approaches — as well as reinforcement learning techniques — using a solid theoretical foundation**, and apply them to financial contexts such as stock price prediction and portfolio construction, while critically assessing their underlying assumptions, strengths, and limitations. 2. **Analyze and interpret the bias–variance trade-off in depth**, and apply this understanding to evaluate model performance and generalization in real-world financial applications. 3. **Select, justify, and adapt appropriate machine learning models for specific financial problems**, taking into account data characteristics, objective functions, and practical constraints such as interpretability and computational feasibility. 4. **Implement, train, and validate machine learning models in Python**, using standard tools and libraries (e.g., scikit-learn, TensorFlow, PyTorch), and document results through effective coding practices and visualizations. 5. **Evaluate model performance rigorously**, assessing robustness, overfitting, and predictive accuracy, while critically reflecting on the limitations and risks of model predictions in financial decision-making. 6. **Communicate the results of machine learning analyses clearly, precisely, and professionally**, both in written reports and oral presentations, including the transparent presentation of assumptions, findings, and their practical implications for financial applications. 7. **Understand and apply reinforcement learning in financial decision-making contexts**, such as algorithmic trading or dynamic portfolio management, and critically discuss the challenges and opportunities of these approaches in real-world settings.

Competence level			
	x 1 Knowledge	x 3 Application	5 Evaluation
	x 2 Understanding	4 Analysis	6 Synthesis

Teaching and learning methods

Type of course/ learning methods	Topic	Language of instruction	Group size	Contact time	Workload [h]
Lecture	Machine Learning for Finance	English	30	3	45
Classroom Excercise	Machine Learning for Finance	English	30	1	15
Self-study					165

Prerequisites

obligatory	none
recommended	none

Degree program allocation

Study Program/Study Field/Module Number/Lecture Number	obligatory/ elective	Semester
M.Sc. Economics/Finance/332124036/332024036	Elective	2nd

Requirements for the awarding of credit points (ECTS)				Credits
Prerequisites for participation	none			7.5
Types of Assessment Examination language	Graded exam, English			
Course Cycle		**Workload**	**Duration**	
Winter semester		**180 h**	**1 Term**	
Summer semester	x			
Module coordination				
Teaching person	See https://basis.uni-bonn.de			
Module coordinator	Prof. Dr. Hendrik Hakenes			
Institute/Department	Department of Economics			
Further Information				
	Students must bring their own devices. Implementation of models will be trained by coding during the classroom exercise.			

** export into other study programs is only possible if contract between faculties exists*