Doctoral School in Finance and Economics

Course ID Machine Learning in Asset Pricing

1. Course details

Semester:	1
Credit rating:	15 TU, 0 ECTS
Pre-requisite(s):	
Lecturer(s):	Gabriel Kaiser
Administrator:	Roswitha Glorieux
Tutor(s):	
Seminar times and rooms:	Semester Course
Tutorial times and rooms:	TBA
Communications	**It is important that students should regularly read their University e-mails, as important information will normally be communicated this way.**
Mode of assessment:	Hand-in project and class participation
Examination Periods:	
Course WebPage:	Moodle.uni.lu

2. Aims and objectives

Aims
The aim of this course is to give a broad introduction to Machine learning/Artificial intelligence and its application in finance, specifically asset pricing and portfolio management using R. The course consists of 4 parts. In the first part, we introduce the very basics of machine learning and discuss main concepts. We divide this section into Unsupervised and Supervised Patter Recognition, Feature Subset Selection and Neural Networks. In the second part, standard asset pricing problems are reviewed. In the third part, recent research papers in finance will be discussed and replicated (Rmarkdown similar to Jupitar Notebook). Finally, participants are asked to replicate or implement a project on a machine learning technique on economic questions and datasets of their own choice. In the former case, you should only try to replicate the main table of the corresponding research paper. I can also provide a list of papers for replication purposes.
Learning Objectives
On completion of this course students will have a basic understanding of some machine learning techniques. Further, students will understand that the majority of AI is based on econometrics or game theory. Finally, students will be able to analyse datasets using basic machine learning techniques with the code provided.

3. Plan of semester Summer semester dates

time slot: 9-12h
15.01.2020 room: BC A.16
16.01.2020 room: BC A.17
06.02.2020 room: BC A.16 9-12h
13.02.2020 room: BC A.16 9-12h
14.02.2020 room: BC A.16 9-12h

4. Course details (by topics)

The course is highly interactive. Students are required to have read the lecture notes before coming to class. All relevant papers are discussed and replicated in class.

5. Reference list/ Bibliography

Black, Fischer, and Robert Litterman. "Global portfolio optimization." Financial analysts journal 48.5 (1992): 28-43.

Ledoit, Olivier, and Michael Wolf. "Honey, I shrunk the sample covariance matrix." The Journal of Portfolio Management 30.4 (2004): 110-119.

Brandt, M. W., Santa-Clara, P., & Valkanov, R. (2009). Parametric portfolio policies: Exploiting characteristics in the cross-section of equity returns. The Review of Financial Studies, 22(9), 3411–3447.

DeMiguel, V., Martin Utrera, A., Nogales, F. J., & Uppal, R. (2017). A portfolio perspective on the multitude of firm characteristics.

Horowitz, J. L. (2016). Variable selection and estimation in high-dimensional models. Canadian Journal of Economics 48(2), 389–407

Freyberger, J., Neuhierl, A., & Weber, M. (2017). Dissecting characteristics nonparametrically (Tech. Rep.). National Bureau of Economic Research.

Kaiser G. (2019). Sparse Supervised Learning of Market Anomalies: Nonlinearities in the Cross-section and Timeseries. (WP.)

Gu, S., Kelly, B., & Xiu, D. (2018). Empirical asset pricing via machine learning (Tech. Rep.). National Bureau of Economic Research.

6. Books

Wood, Simon N. Generalized additive models: an introduction with R. CRC, 2017.

Hastie, Trevor, Robert Tibshirani, and Martin Wainwright. Statistical learning with sparsity: the lasso and generalizations. Chapman and Hall/CRC, 2015.

James, Gareth, et al. An introduction to statistical learning. Vol. 112. New York: springer, 2013.

Bühlmann, Peter, and Sara Van De Geer. Statistics for high-dimensional data: methods, theory and applications. Springer Science & Business Media, 2011.

Harezlak, Jaroslaw, David Ruppert, and Matt P. Wand. Semiparametric Regression with R. Springer, 2018.

7. Further information about assessment

Examination(s)	1	
Weighting:	50%	50%
Date:	09.02.2020	During the course
Length:	20 min	
Structure:	Presentation	Submission of computer code and discussion of research results