

MODULE SPECIFICATION • ELECTIVE

Economic and Financial Applications of Machine Learning

The aim of this course is to present several concrete applications of ML techniques in Economics and Finance.

10 CREDITS	15h CONTACT HOURS	85h PRIVATE STUDY	100h TOTAL STUDY
---------------	----------------------	----------------------	---------------------

COURSE CONVENOR

NAME Prof. Wouter Verbeke

OFFICE By appointment — please email to arrange a convenient time

COURSE STRUCTURE

Econ 629 is a 10-credit course and students are expected to input approximately 100 hours of study. The total number of contact hours is 15 hours, leaving 85 hours for private study. Delivery is by lectures — 15 hours across the first three weeks of term, comprising 10 hours of lectures and 5 hours of tutorials. Optional clinics run on the last day of the course.

During private study, balance the course material (the primary source) against the recommended textbooks: think critically about how these fit into the body of knowledge, perform the exercises, complete coursework and revise. You can expect to perform well only by working consistently through the year.

Prerequisite. Must have successfully completed ECON 7920.

MODULE PROGRAMME

LECT.	TOPIC	SESSION CONTENT
01	Developing a credit scorecard for credit risk management	- Introduction to credit scoring and credit risk management - Introduction to Basel I, II and III regulation, and PD, LGD and EAD modelling - Data preprocessing for PD modelling - Building PD models and postprocessing PD models - Developing a credit rating system
02	Developing an insurance fraud detection system	- Introduction to fraud detection - Descriptive analytics for fraud detection - Predictive analytics for fraud detection - Social network analytics for fraud detection - Feature engineering for fraud detection - Handling the imbalanced class distribution
03	Developing a customer churn and response model for customer management	- Predictive analytics for customer churn and response prediction - Prescriptive analytics for customer response modelling - Introduction to causal machine learning for treatment effect modelling - Profit-driven customer churn and response modelling - Cost-sensitive decision-making
04	Foundations of factor investing	- Historical perspective (Fama-French and the factor zoo) - Theoretical groundwork (partial equilibrium models) - Panel models - Practical application: portfolio sorts - Tutorial: Fama-MacBeth regressions
05	Data preparation and penalized models	- Missing data and outlier management - Penalized regressions - Sparse portfolios (to be coded during the tutorial)
06	Nonlinear models	- Tree methods - Neural networks - Tutorial: boosted trees with alternative libraries
07	Parameter tuning and backtesting	- The variance-bias trade-off and the different flavours of overfitting - Tuning methods (example: grid search) - Principles of backtesting - Tutorial: ML-powered backtests

KEY SKILLS

By the end of this course, students should have some knowledge and understanding of:

- Applied machine learning skills.** Ability to apply machine learning techniques in practical applications.
- Deployment of machine learning models.** Skills to deploy and test machine learning models in real-life projects.
- Practical application.** Hands-on experience in using machine learning for concrete applications.
- Real-life project implementation.** Applying machine learning skills to real-world projects.

- **Machine learning model testing.** Ability to rigorously test machine learning models for real-world scenarios.
- **Practical deployment expertise.** Expertise in deploying machine learning models in practical settings.
- **Problem-solving with ML.** Addressing real-world problems through the application of machine learning.
- **Knowledge of real-life ML challenges.** Understanding and navigating challenges specific to deploying ML models in real-life projects.

DESIRED OUTCOMES

By the end of this course, students should be able to:

- Analyse, appraise and interpret real data effectively
- Evaluate and interpret data in order to solve advanced complex problems in economics or finance
- Describe and explain their understanding of ML techniques, demonstrating enhanced knowledge of this area

ASSESSMENT

WEIGHTING	100% coursework
ISSUED	End of week 6
DUE	End of week 10 — four weeks for completion
SUBMISSION	Electronically via the Moodle site for this course
FEEDBACK	Returned within 4 weeks of the deadline, as marker's notes appended to the PDF of your coursework

Marking criteria and penalties are set out in the Economics Undergraduate Handbook and the general course information paper, available via the Current Student page of the university website under Academic Regulations.

COURSE TEXT & RECOMMENDED READING

Book chapters and online material. Copies of the lecture slides are made available on the course web pages, together with additional material and course announcements.

- Ang, A. (2014). Asset Management: A Systematic Approach to Factor Investing. Oxford University Press
- Baesens, B., Van Vlasselaer, V. and Verbeke, W. (2015). Fraud Analytics Using Descriptive, Predictive, and Social Network Techniques: A Guide to Data Science for Fraud Detection. Wiley
- Coqueret, G. and Guida, T. (2020). Machine Learning for Factor Investing. CRC Chapman Hall (2022 for the Python version)
- Scheuch, C., Voigt, S. and Weiss, P. (2023). Tidy Finance. CRC Chapman Hall
- Verbeke, W., Bravo, C. and Baesens, B. (2017). Profit Driven Business Analytics: A Practitioner's Guide to Transforming Big Data into Added Value. Wiley
- Van Gestel, T., Baesens, B. and Martens, D. Predictive Analytics: Techniques and Applications in Credit Risk Modelling. Oxford University Press