



Exchange programme Vrije Universiteit Amsterdam

Vrije Universiteit Amsterdam - Exchange programme Vrije Universiteit Amsterdam - 2024-2025

Exchange

Vrije Universiteit Amsterdam offers many English-taught courses in a variety of subjects, ranging from arts & culture and social sciences, neurosciences and computer science, to economics and business administration.

The International Office is responsible for course approval and course registration for exchange students. For details about course registration, requirements, credits, semesters and so on, please [visit the exchange programmes webpages](#).

Machine Learning for Econometrics and Data Science

Course Code	E_EDS3_MLEDS
Credits	6
Period	P4
Course Level	300
Language Of Tuition	English
Faculty	School of Business and Economics
Course Coordinator	dr. J.N. van Brummelen
Examiner	dr. J.N. van Brummelen
Teaching Staff	dr. J.N. van Brummelen
Teaching method(s)	Computer lab, Lecture, Study Group

Course Objective

The aim is to provide you with the theoretical foundations of what Machine Learning actually is and what it can claim to achieve. More specifically, the aim is to equip you with the necessary notions, concepts and mathematical tools to understand what underpins virtually all supervised learning algorithms and to derive fundamental learning guarantees.

Course Content

Machine learning originates from computer science and statistics with the goal of exploring, studying, and developing learning systems, methods, and algorithms that can improve their performance by learning from data. This course is designed to provide students an introduction to the main foundations of machine learning. We adopt principles from probability (Bayes rule, conditioning, expectations, independence), linear algebra (vector and matrix operations), and calculus (gradients, Jacobians) to propose a formal analysis of the performance of machine learning algorithms.

Focusing on the supervised learning framework, we formalise the problem of learning to predict based on a sample of 'examples'. We introduce the notions of predictor, generalisation risk, Bayes risk and target function, empirical risk, models and empirical risk minimisation, learning rules, approximation and estimation error decomposition, and derive learning guarantees under different classification and regression frameworks. We relate these notions to machine learning principles such as model selection, overfitting, and techniques such as cross-validation. We also study support vector machines and relate them to the theoretical notions that we treat in the course.

Additional Information Teaching Methods

Lectures (4 hours, each week) and Tutorials (2 hours, each week)

Method of Assessment

Written exam and an assignment

Literature

Main reference:

M. Mohri, A. Rostamizadeh, A. Talwalkar, Foundations of Machine Learning (Second Edition, 2018), MIT Press.

Supplementary:

T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction (Second Edition, 2009), Springer.

Additional Information Target Audience

The course is targeted at students in the bachelor track Econometrics and Data Science (EDS), but is also suitable for students in the main Econometrics and Operations Research (EOR) bachelor track or students enrolled in other

bachelors who are interested in the foundations of machine learning. For those who come from other programmes, it is important to know that knowledge of calculus and probability theory at an intermediate level is required to be able to follow this course. Also, basic programming skills in Python or R are required.

Explanation Canvas

All course materials will be made available on Canvas.

Recommended background knowledge

Intermediate level of Linear Algebra, Calculus, Probability Theory, Statistics and Econometrics.