# Machine Learning in Finance [5th module, 2024-2025 academic year]

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## TAs: [To be announced]

### **Course description**

The aim of this course is to introduce students to the fundamental concepts of supervised machine learning (ML) and its applications in finance. During the lectures, we will cover key ML methods—including classification and regression trees, ensemble techniques, and artificial neural networks—without delving deeply into technical details (though several proofs will be presented, and a solid mathematical background is required to follow the material). In homework assignments, students will learn how to apply these methods to financial problems such as index trading, derivative pricing, volatility forecasting, and portfolio selection. Students will also gain practical experience in working with financial data using ML techniques. In addition, participants will learn basic Python commands and complete practical exercises.

### Course requirements, grading, and attendance policies

Students are assumed to have sufficient background in econometrics and finance theory (e.g., they are expected to be familiar with the meaning of volatility). Each week a problem set dedicated to practical application of concepts covered in lectures will be distributed. Completing this homework will be counted for 66% of the final grade. The 2-hour-long final written format A4 exam will give 34% of the final grade.

### Course contents

The set of topics may change as the course progresses. We intend to cover the following topics:

- Basic concepts of ML
- Regularization in liner models with application to index tracking
- Classification and regression trees with application to Fama-French five-factor model
- Random forest, bagging and boosting with application to default predictions to shadow CDS pricing and default predictions
- Introduction to Artificial Neural Networks (ANN)

- Recurrent ANN for predicting financial time series, e.g., volatility forecasting
- ML in portfolio choice problems

Description of course methodology

Lectures will be delivered in English.

The course will involve a significant amount of self-study, as students are expected to complete homework assignments focused on applying the material covered in lectures to real-world data. These assignments are considered an essential part of the learning process, not merely a component of evaluation.

Course materials Required textbooks and materials The main textbooks are

James, G., Witten, D., Hastie, T., Tibshirani, R., & Taylor, J. (2023). An Introduction to Statistical Learning: with Applications in Python. Springer.

Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed.). Springer.

Additional materials Additional reading materials —research papers on specific topics — will be suggested throughout the course.

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.