## **Laboratory of Data Analytics for Investments**

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***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

This course aims to supply an in-depth view of the principles and techniques used in the quantitative analysis of financial securities and investment portfolios. The students will gain an understanding of how to apply the scientific method to investment analysis from a theoretical and empirical perspective; the economic fundamentals and the main techniques used in portfolio construction and asset allocation; techniques and best practices for the study of investment portfolios; how to choose, design and train machine learning algorithms to perform securities’ analysis. The lectures will be complemented by a systematic series of applications using the Python programming language.

At the end of the course, the students will develop econometric analysis and perform empirical studies on financial and investment management topics.

***COURSE CONTENT***

*–* **Principles of the Scientific Method in Investment Analysis:** Theory, principles and steps of the scientific method; Experiment, design and execution; Implications of the scientific approach to investments analysis and research.

– **Introduction to Econometric and Financial Modeling:** Types of financial data and signal-to-noise-ratios; Common errors in data mining (e.g. over/underfitting) and investment-specific biases (e.g. survivorship  bias).

– **Essentials of Data Science for Portfolio Analysis:** The investment management lifecycle; Review of traditional techniques to security selection and portfolio construction; Handling investment objectives and constraints; Risk, return and risk-adjusted metrics; Analysis of the securities’ returns distribution.

– **Modeling and Forecasting Securities’ Returns:** Forecastability in Financial Markets; Efficient Market Hypothesis; Identifying, designing and assessing the robustness of return predictors; Review of major asset pricing models (e.g. CAPM, APT, Fama-French Model); Style Analysis and Performance Attribution.

– **Portfolio Construction and Asset Allocation Models:** Portfolio Construction using mean-variance approach; Modern Portfolio Theory and Efficient Frontier estimation techniques; Estimation and Analysis of the Variance-Covariance Matrix; Monte Carlo simulation and Resampled Efficient Frontier.

– **Volatility and Correlation Analysis with Machine Learning:** Application of Commonly-Used Machine Learning Algorithms (Classification, Regression, Neural Networks, Random Forest). Use of ML Algorithms for Forecasting Volatility and Correlation Analysis.

***READING LIST***

Slides and laboratory handouts will be distributed during the course:

·      Frank J. Fabozzi, Dessislava A. Pachamanova, *Portfolio Construction and Analytics*, Wiley, 2016

·        Yves Hilpisch, *Python for Finance*: Analyze Big Financial Data, O’Reilly, 2014

·      Marcos M. López de Prado, *Machine Learning for Asset Managers*, Cambridge University Press, 2020

***TEACHING METHOD***

Lectures with lab sessions.

***ASSESSMENT METHOD AND CRITERIA***

Final report on real analysis of financial data.

***NOTES AND PREREQUISITES***

Students should be acquainted with:

– Fundamentals of linear algebra;

– Random variables and the features of their probability distributions (mean, variance and standard deviation), as well as the characteristics of joint and conditional distributions (covariance and correlation, conditional expectation and variance); Gaussian distributions;

– Basics of Portfolio Management (e.g. economic analysis, investors expectations, Modern Portfolio Theory)

– Basics of Python programming languages (functions, variables’ types, logical expressions, notation).

*Office hours*

To be arranged via email.