Investment Trends, Quantitative Strategies & Machine Learning

Professor: José Suárez-Lledó
E-mail: jose.suarez-lledo@bsm.upf.edu
Office hours: by appointment

Course Description

Several trends that have gained traction in the recent past will shape the near future in financial markets and the investment practice. The increasing automation of financial analysis, portfolio management or financial advice, the use of quantitative models to analyze and trade securities, the fast-growing availability of data, computational power, and analytical tools to extract valuable information, are relevant examples of such trends. Being well-equipped with the knowledge to successfully navigate such competitive markets will be of critical importance.

This reflects on the programmes of Master's in Finance at top business schools around the globe, which feature a significant amount of quantitative and technical content. However, most such curricula present to a large degree mainstream standard content that, while relevant and providing top-notch quantitative skills, still do not address some of these trending topics or do so with theoretically oriented courses.

Being aware that it is not feasible to cover all the fields that underlie the above-mentioned trends, this course will focus on a subset of topics that are forecast to have a preeminent role in coming years: Robo-advisors, smart-indexing, and quantitative investment strategies.

Objectives

The objective of the course is two-fold:

- Introduce the students to the main concepts in the areas outlined above: robo-advisors, smart-indexing and quantitative investing. This will involve discussing the theoretical and mathematical underpinning whenever necessary.

- Take those concepts to the data. This is very much an applied course where students will have the opportunity to cover all the steps from data gathering to model development to model/strategy implementation and back-testing.

The classwork for this course will heavily involve critical thinking, to understand and dissect the financial products that are presented to them, and creative thinking, in the form of idea generating discussions to design investment strategies that can be put to the test.

Methodology

As mentioned, sessions will include some theoretical discussion of concepts and ideas, but they will be predominantly empirical and applied. On a first stage, topics or student ideas will be presented and analysed/challenged with the rest of the class. On a second stage, students will work in groups to retrieve the data and test the concepts discussed or develop, implement and back-test their ideas. A third stage will involve presenting the results and brainstorming for improvements in models/ideas.

The above will be implemented using computer programming language. Students can ultimately choose what programming language/software to employ in their work, but the course will be taught with Python, as in many areas of finance seems to have become the preferred option.

Student groups will have to submit their work on each assignment (one solution per group) and all group members will receive the same grade. Individual assessments will be based on a final project and student's interaction in class as well as their presentations.

The competences, the learning outcomes, the assessment elements and the quality of the learning process included in this Teaching Plan will not be affected if during the academic trimester the teaching model has to switch either to a hybrid model (combination of face-to-face and on-line sessions) or to a complete on-line model.

Evaluation criteria

In order to pass the course, you should get at least 50 points out of 100, according to the following distribution:

Assignments/Homework: 50 % (if more than 1) or 40% (if only 1)
Individual Assessment: 20 %
Final assignment: 30 % (is more than 1 assignment, otherwise 40%)

Students who fail the course during regular evaluation will be allowed ONE re-take of the examination/evaluation. If the course is again failed after the retake, students will have to register again for the course the following year.

For those students who pass the retake exam the final grade will again consider the scores from problem sets and project. However, the average obtained from that will be mapped to an interval between 5 and the minimum grade among those who passed the final on the first attempt.

Students are required to attend 80% of classes. Failing to do so without justified reason will imply a zero grade in the participation/attendance evaluation item and may lead to suspension from the program

In case of a justified no-show to an exam, the student must inform the corresponding faculty member and the director(s) of the program so that they study the possibility of rescheduling the exam (one possibility being during the "Retake" period). In the meantime, the student will get

an "incomplete", which will be replaced by the actual grade after the final exam is taken. The "incomplete" will not be reflected on the student's Academic Transcript.

Plagiarism is to use another's work and to present it as one's own without acknowledging the sources in the correct way. All essays, reports or projects handed in by a student must be original work completed by the student. By enrolling at any UPF BSM Master of Science and signing the "Honor Code", students acknowledge that they understand the schools' policy on plagiarism and certify that all course assignments will be their own work, except where indicated by correct referencing. Failing to do so may result in automatic expulsion from the program."

Contents

1. **Robo-Advisors & Smart Indexing**
    a. Definition, global map of robo-advisors in developed markets, recent popularity
    b. Profile mapping, investing process automation, portfolio design.
    c. Index construction
    d. Main Smart-Beta product map (funds, ETFs) and their usage in the industry
    e. Fees, performance, and key benchmark statistics

2. **Quantitative Investment Strategies**
    a. Strategies with Macroeconomic drivers and factors
        i. Macroeconomic Factors
        ii. Market Factors from Arbitrage Pricing Theory
    b. Strategies with fundamental and technical indicators
        i. Momentum, volume, volatility
    c. Statistical Arbitrage/Pairs Trading
        i. Mean reversion strategies
        ii. Trees and PCA to identify Pairs
    d. Building a trading system:
        i. Generating and implementing investment strategies
        ii. Obtaining data, data cleaning, model development
        iii. Back-testing: techniques, biases
    e. Asset Allocation & Risk Management
        i. Beyond the Efficient Frontier: Risk parity, Hierarchical Risk Parity, mapping probabilities to portfolios
        ii. Risk Metrics, Constant Proportion Portfolio Insurance (CPPI) and market regimes
        iii. Scenario simulations & Portfolio Optimization
    f. Machine Learning in Finance
        i. Main algorithms and their application to finance and economics
        ii. Main Quantitative Funds using ML and their strategies
        iii. Lasso, Ridge
        iv. Tree-based models
            1. Classification and regression trees
            2. Random Forests
        v. Neural Nets
        vi. KNN and Hidden Markov Chains for Macroeconomic Forecasting

Reading Materials/ Bibliography/Resources

Some textbooks include:

- Chan E.; Quantitative Trading: How to Build your Own Algorithmic Trading Business, Wiley
- Chan E.; Algorithmic Trading: Winning Strategies and their Rationale, Wiley
- Hastie, Tibshirani, Friedman; The Elements of Statistical Learning, Springer
- Sironi, P.; Modern Portfolio Management: from Markowitz to Probabilistic Scenario Optimization, Risk Books
- Fabozzi and Markowitz; The Theory and Practice of Investment Mangement, Wiley
- Ang, A.; Asset Management: a Systemic Approach to Factor Investing, Oxford
- Kula G., Raab M., Stahn S.; Beyond Smart Beta, Wiley Finance
- Meucci, A.; Risk and Asset Allocation, Springer Finance (Ch. 3, 4, 5)
- Litterman and the Quantitative Resources Group; Modern Investment Management: and equilibrium approach, Wiley Finance
- Grinold and Kahn; Active Portfolio Management, McGraw-Hill
- Lopez de Prado, M.; Machine Learning for Asset Managers, Cambridge Elements Quantitative Finance, 2020
- Dixon M., Halperin I., Bilokon P.; Machine Learning in Finance, from theory to practice, Springer, 2020

Academic Papers:

- Noguer, M. and Srivastava, S., 2020, Deep Reinforcement Learning for Asset Allocation in US Equities

Bio of Professor

Jose Suarez-Lledo is advisor to the (Gestion Boutique VIII) Global Gradient fund. Heavily involved in the development of Machine Learning tools and Factor Models applied to investment strategies, portfolio management and the design of robo-advisors. Jose is also a free-lance Financial Consultant. Before this, he partnered with Kernel Analytics as credit risk director to offer advanced consulting services, focusing on forefront econometric & statistical techniques as well as Machine Learning models.

He previously worked in CaixaBank as a Manager at the Financial Markets division within the Strategic Planning & Research department, where he was in charge of developing market analysis & forecasting models for financial variables, as well as the analysis reports that the department publishes regularly for clients and investors. Prior to that Jose worked at the Capital Planning & Forecasting department developing models and solutions as part of the methodological framework that allows the bank to generate capital projections.

Before joining CaixaBank Jose was a Director at Moody's Analytics based in London. As part of the Credit Analytics team he designed macro-econometric models for key economic and financial variables as well as retail and corporate credit models. Dr. Suarez-Lledo's team provided consulting support to major industry players and implemented stress-testing solutions to quantify portfolio risk under alternative macroeconomic scenarios. Jose is also actively involved in speaking at credit events and economic conferences worldwide and has published his research both in practitioner and academic publications.

Before being part of Moody's Analytics, Jose held a research position at the Universidad Autonoma of Barcelona where he focused on illiquid financial markets and the dynamics of asset prices and credit. Jose holds an MSc and a PhD in Economics from the University of Pennsylvania and has published his research both in practitioner and academic journals.