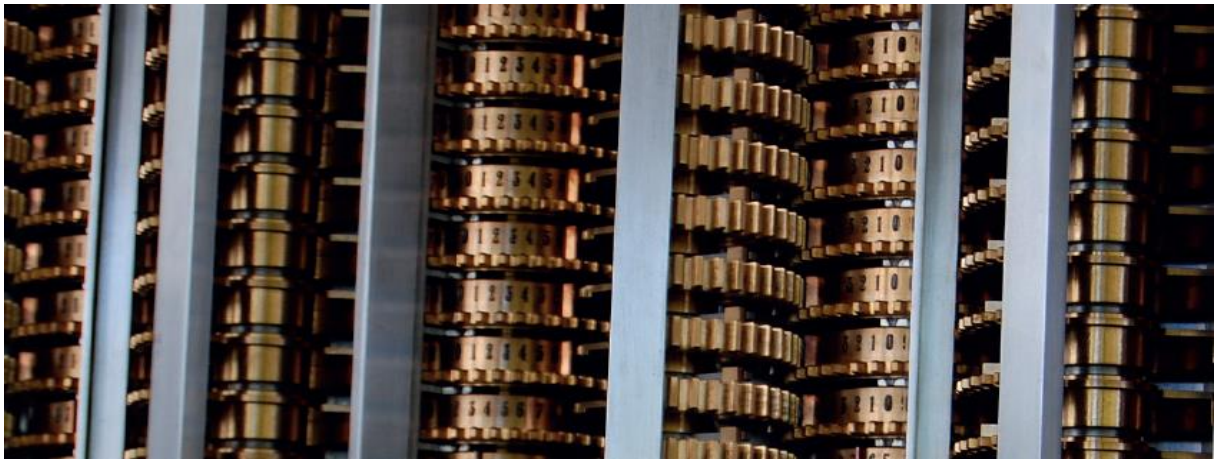
Program

Remote **2nd One-Day Workshop** on

Machine Learning for Finance



December 18, 2020

Ca' Foscari University of Venice

[*On the Net*]

Patronages

Ca' Foscari University of Venice

Department of Economics

VERA

Venice centre in Economic and Risk Analytics for public policies

EGONON

risk management & advisor

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Schedule

Morning

09:50-10:00	Openings
10:00-10:30	E. Vittori, *M. Trapletti*, M. Restelli: ***Option hedging with risk averse Reinforcement Learning***
10:30-11:00	*G. Anese*, M. Corazza, M. Costola, L. Pelizzon: **Impact of market sentiment on stock return and volatility**
11:00-11:30	*E. Barucci*, M. Bonollo, F. Poli, E. Rroji: ***A machine learning algorithm for stock picking built on information based outliers***
11:30-11:45	Break
11:45-12:15	I. Kyriakou, P. Mousavi, J.P. Nielsen, *M. Scholz*: **Short-term exuberance and long-term stability: A simultaneous optimisation of stock return predictions for short and long horizons**
12:15-12:45	*A. Flori*, D. Regoli: ***Revealing pairs-trading opportunities with Long Short-Term Memory Networks***
12:45-14:15	Break

Afternoon

14:15-14:45	M. Azzone, E. Barucci, G. Giuffra, *D. Marazzina*: **A Machine Learning model for lapse prediction in life insurance contracts**
14:45-15:15	Oleksandr Castello, *M. Resta*: **Parsimonious yield curve models on the trial: An application to BRICs countries**
15:15-15:45	G. Amici, M. Bianchetti, F. Brina, B. Lari, M. Mezzetti, A. Peroni, *P. Rossi*: ***Deep Learning from market data***
15:45-16:00	Break
16:00-16:30	L. W. Cong, *K. Tang*: ***AlphaPortfolio: Single-step portfolio construction through Reinforcement Learning and economically interpretable AI***
16:30-17:00	*E. Vittori*, M. Bernasconi, F. Trovò, M. Restelli: ***Dealing with transaction costs in portfolio optimization: Online gradient descent with momentum***
17:00-17:30	*G. di Tollo*, J. Andria, S. Ghilardi: **Gender analysis and attention to gender: An experimental framework**
17:30-17:40	Closings

General information

Organizer

Marco Corazza (corazza@unive.it)
Department of Economics, Ca' Foscari University of Venice

Remote attendance

- The attendance is **free**.
- The workshop will be streamed via the **Zoom** platform offered by the Department of Economics of the Ca' Foscari University of Venice.
- For receiving the meeting's **address**, **ID** and **passcode**, it is necessary to communicate the email address of the attendee to the organizer at the email address **corazza@unive.it**.
- All the attendees are kindly asked to keep the microphone in **off mode** all presentation long.

Talk

30 minutes for presentation and questions.

Time

GMT+1\UTC+1 (Please, check your local time)

Conference webpage

www.unive.it/[TBA]

Abstracts

Deep Learning from market data

Giovanni Amici – University of Bologna (I)
Marco Bianchetti – University of Bologna; and Banca Intesa SpA (I)
Federico Brina – University of Bologna (I)
Behnam Lari – University of Bologna (I)
Matteo Mezzetti – University of Bologna (I)
Alessio Peroni – University of Bologna (I)
Pietro Rossi – University of Bologna (I); Prometeia SpA (I)

Machine Learning has worked his way into pricing several years ago. In this context we say pricing meaning 'pricing according to a model'. After all, learning how to price is just learning a function depending on a very limited number of parameters. Neural network have proven time over time to be quite effective in learning functions so it was a natural venue to apply them in this context. At the beginning it was just simple models, albeit if applied to complex payoffs like options on portfolios. Next step was to export the methodology to more complex models. A pricing model, be it an IR or FX of Stocks is defined by few parameters. The standard way to exploit the model is to 'calibrate' the parameters to market data and then, with calibrated parameters, proceed to price assets not quoted in the market. The calibration procedure is quite delicate and must be done frequently to catch every single glitch of the market. The idea behind this work is to use artificial neural network not only to price but even to replace the calibration procedure. In a 'standard' ANN approach we would train the network using model parameters. We try to replace model parameters with market data so

that, once trained, the network can provide reliable results without need of calibration. We test these concepts on toy model with available (semi) analytical solutions with the stochastic volatility Heston model and the One factor Hull & White model.

Impact of market sentiment on stock return and volatility

Gianluca Anese – European Central Bank (DE)
Marco Corazza – Ca' Foscari University of Venice (I)
Michele Costola – Ca' Foscari University of Venice (I)
Loriana Pelizzon – Ca' Foscari University of Venice (I)

Many authors have shown that investors are not fully rational and that investor sentiment can have an impact on stock prices. As investor sentiment is not directly measurable, different proxies have been used by researchers. In addition, progress in Natural Language Processing has contributed to the development of new sentiment measures based on text sources obtained by news providers and social media. This work deals with a classification problem on financial news data and defines a reliable proxy for investor sentiment using supervised Machine Learning techniques. In particular, LSTMs networks are adopted. The resulting sentiment proxies are used as exogenous variables in the mean and variance equations of a GARCH model in order to check the existence of a relationship among them and stock returns and among them and volatility.

A Machine Learning model for lapse prediction in life insurance contracts

Michele Azzone – Polytechnic University of Milan (I)
Emilio Barucci – Polytechnic University of Milan (I)
Giancarlo Giuffra – Polytechnic University of Milan (I)
Daniele Marazzina – Polytechnic University of Milan (I)

In this work, we use the Random Forest methodology to predict the lapse decision of life contracts by policyholders. The methodology outperforms the classical logistic model in describing the phenomenon. We use global and local interpretability tools to investigate how the model works. We show that

non economic features (time passed from the incipit of the contract and the time to expiry, as well as the insurance company) play a significant effect in determining the lapse decision while economic/financial features (except the disposable income growth rate) play a limited effect. The analysis shows that linear models, such as the logistic model, may not be adequate to capture the heterogeneity of financial decisions.

A machine learning algorithm for stock picking built on information based outliers

Emilio Barucci – Polytechnic University of Milan (I)
Michele Bonollo – Polytechnic University of Milan (I)
Federico Poli – Polytechnic University of Milan (I)
Edit Rroji – University of Milan-Bicocca (I)

We build an algorithm for stock selection based on indicators of time series of stocks (return, volume, volatility, bid-ask spread) that should be associated with the dissemination of private information in financial markets. We use a machine learning algorithm for the identification of the most relevant indicators for the prediction of stock returns and to define a trading strategy. The procedure combines a sequential inclusion of predictors with a classification algorithm for the trading signal. We apply the methodology to two sets of stocks belonging respectively to the EUROSTOXX50 and the DOW JONES index. Performance is smoother than in the BuyHold strategy and yields a higher risk-adjusted return, in particular in a turbulent period. However, outperformance vanishes when transaction costs (5-15 basis points) are inserted.

Parsimonious yield curve models on the trial: An application to BRICs countries

Oleksandr Castello – University of Genoa
M. Resta – University of Genoa

Our study focus blinks the eye to those countries which are actually under the microscope of financial investors and generally referred by the acronym BRICS (that is: Brazil, Russia, India, China and since 2010 South Africa). We are interested in evaluating whether the yield curve can be an effective tool

to investigate the behaviour of those countries because of their growing importance in promoting a different governance of the world's economy and multipolarity in international relations. To such aim we compare the effectiveness of two alternative approaches: we fit the behaviour of BRICS countries yield curves using parametric models in the Dynamic Nelson-Siegel family and Machine Learning tools with a focus on Artificial Neural Networks (ANN). For the parametric model we use time-varying decay parameters that achieve good in-sample fitting performances. We then show that an ad-hoc tuning of Machine Learning tools tailored on the features of each country, makes possible to get superior in-sample fit performance. Major strengths of the work include: (a) using time-varying decay parameters that ensures optimal parameters estimation for each date and result in a significant improvement of the fitting abilities; (b) a technique for tuning ANN that makes possible to obtain superior performances than parametric models; (c) a freshly-new developed R package with estimation routines and visual facilities to support creating 3D-term structure representations of the yield curve.

AlphaPortfolio: Single-step portfolio construction through Reinforcement Learning and economically interpretable AI

Lin William Cong – Cornell University (USA)
Ke Tang – Tsinghua University (CN)

We propose direct optimization of investors' objectives via reinforcement learning, an alternative to the widely-adopted two-step portfolio-management paradigm entailing estimating distributions of asset returns. Building upon recent breakthroughs in AI, we develop neural-network-based multi-sequence models tailored to distinguishing features of economic and financial data. The resulting AlphaPortfolio yields stellar out-of-sample performances (e.g., Sharpe ratio above two) that are robust under various economic and trading restrictions. Moreover, we use polynomial-feature-sensitivity and textual-factor analyses to project the model onto linear regression and natural language spaces uncover key market signals, firms' financials, etc., including their rotation and non-linearity, that drive

investment performance. Overall, we highlight the utility of reinforcement deep learning in social sciences, especially finance, and provide novel "economic distillation" procedures for interpreting AI and big data models.

Gender analysis and attention to gender: An experimental framework

Giacomo di Tollo – Ca' Foscari University of Venice (I)
Joseph Andria – University of Palermo (I)
Sara Ghilardi – Ca' Foscari University of Venice (I)

Gender aspects are gaining more and more attention for policy makers, practitioners and faculties. They also have a great importance for funding purposes, since many calls for proposals by national and international agencies require a gender plan and/or an analysis of the gender aspect, especially referring to the extent to which a candidate research project affects differently men and women. In this context, we want to understand whether there exists a relationship between the gender diversity of corporate boards of directors and the way a business articulates gender aspects on their corporate communications and activities on the Internet. To achieve this goal, we created a set of meaningful keywords, coming from EU regulations, gender plan descriptions of EU funded projects, and gender-related literature. Then, we shall use business intelligence tools to determine the occurrences of such keywords on the websites of the firms considered. Our goal is to determine the relationship between the occurrence of these keywords and the relative presence of women in a firm board of directors, in order to understand whether the board's gender diversity is somewhat correlated to the way a business "talks" about gender aspects in its website. A neural network analysis is also devoted to this goal.

Revealing pairs-trading opportunities with Long Short-Term Memory Networks

Andrea Flori – Polytechnic University of Milan (I)
Daniele Regoli – Intesa Sanpaolo SpA (I)

The reversal effect documented by Fama (1965), Jegadeesh (1990), Jegadeesh and Titman (1993), and Lehmann (1990) states that stocks that

have recently performed poorly will probably undergo a larger market reversal in the future. Scholars and practitioners have struggled to challenge the efficiency of financial markets applying different techniques in search of investment opportunities and several approaches have been proposed to extract valuable information from financial data (see, e.g., Andreou et al. 2008, Heaton et al. 2017, Gu et al. 2018, Schnaubelt et al. 2020, among others). Following a growing literature that exploits a large-scale use of deep learning concepts to spot patterns in financial markets, we propose a deep learning approach to complement investors practices aimed to identify pairs trading opportunities. Pairs trading relies, in fact, on the apparent profitability of a strategy in which stocks with similar past performances start to exhibit opposite, possibly temporarily, market patterns. Hence, we refer to the reversal effect, consisting in the fact that temporarily market deviations are likely to correct and finally converge again, to generate valuable pairs trading opportunities based on the application of Long Short-Term Memory Networks (LSTMs). Specifically, we employ such approach to create an outcome for the probability of a stock having an increasing performance in the near future compared to its cointegrated peers. We show that strategies relying on such predictions can improve portfolio performances providing predictive signals whose information content goes above and beyond the one embedded in both prices and returns gaps.

Short-term exuberance and long-term stability: A simultaneous optimisation of stock return predictions for short and long horizons

Ioannis Kyriakou – University of London (GB)
Parastoo Mousavi – University of London (GB)
Jens Perch Nielsen – University of London (GB)
Michael Scholz – University of Graz (AT)

The fundamental interest of investors in econometric modelling for excess stock returns usually focuses either on short- or long-term predictions to reduce individually the investment risk. In this paper, we present a new simple model that accounts contemporaneously for short- and long-term predictions. By combining the different horizons, we can exploit the lower long-term variance to further reduce the short-term variance which is

susceptible to speculative exuberance. Different combinations of short and long horizons as well as definitions of excess returns, for example, concerning the traditional short-term interest rate but also the inflation, are easily accommodated in our model. We show that the estimated relationship between excess stock returns and the predictive variables under the inflation benchmark is stable across different horizons which is especially important for long-term real savings for pension products. We conclude the paper with a study of stock market predictions during the recent Covid-19 pandemic.

Dealing with transaction costs in portfolio optimization: Online gradient descent with momentum

Edoardo Vittori – Polytechnic University of Milan; Intesa SanPaolo SpA (I)
Martino Bernasconi – Polytechnic University of Milan
Francesco Trovò – Polytechnic University of Milan
Marcello Restelli – Polytechnic University of Milan (I)

Outperforming the markets through active investment strategies is one of the main challenges in finance. The random movements of assets and the unpredictability of catalysts make it hard to perform better than the average market, therefore, in such a competitive environment, methods designed to keep low transaction costs have a significant impact on the obtained wealth. This work focuses on investing techniques to beat market returns through online portfolio optimization while controlling transaction costs. Such a framework differs from classical approaches as it assumes that the market has an adversarial behavior, which requires frequent portfolio rebalancing.

Option hedging with risk averse Reinforcement Learning

Edoardo Vittori – Polytechnic University of Milan; Intesa SanPaolo SpA (I)
Michele Trapletti – Intesa SanPaolo SpA (I)
Marcello Restelli – Polytechnic University of Milan (I)

In this work we show how risk-averse reinforcement learning can be used to hedge options. We apply a state-of-the-art risk-averse algorithm: Trust Region Volatility Optimization (TRVO) to a vanilla option hedging environment, considering realistic factors such as discrete time and

transaction costs. Realism makes the problem twofold: the agent must both minimize volatility and contain transaction costs, these tasks usually being in competition. We use the algorithm to train a sheaf of agents each characterized by a different risk aversion, so to be able to span an efficient frontier on the volatility-p&l space.