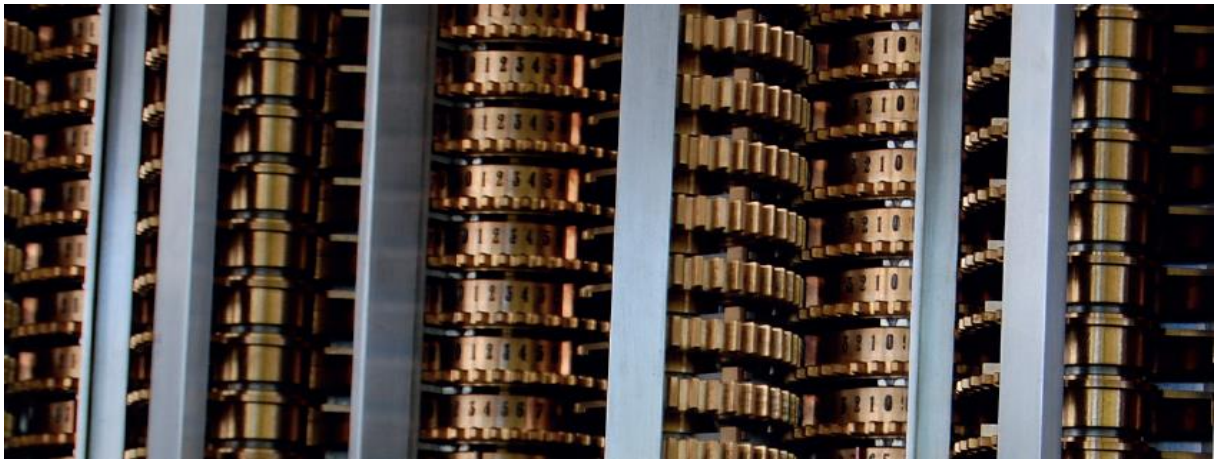
Program & Abstracts

3rd One-Day International Workshop on

Machine Learning for Finance



December 17, 2021

Ca' Foscari University of Venice

[*On the Net*]

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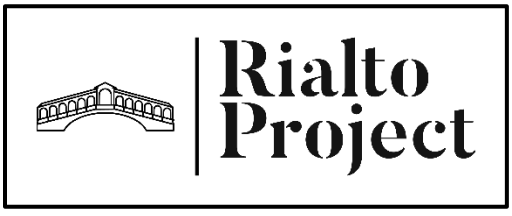

Rialto
Project

Scientific Direction and Organization: **Marco Corazza** (**corazza@unive.it**)

Program

Morning

08:50-09:00	**Opening addresses** • Corazza M.: Department of Economics, Ca' Foscari University of Venice • Bernasconi M.: Head of the Department of Economics, Ca' Foscari University of Venice • Donati R.: Redexe S.r.l.
09:00-09:30	He X., Cong L.W., Feng G., He J. **Asset pricing with Panel Trees under global split criteria**
09:30-10:00	Barbopoulos L.G., Dai R., Putniņš T., Saunders J.A. **Market Efficiency in the age of Machine Learning**
10:00-10:30	Caliciotti A., Corazza M., Fasano G. **Regression models and Machine Learning approaches for Bitcoin price forecast**
10:30-11:00	Kumar P. **Deep Hawkes process for high-frequency market making**
11:00-11:30	Lam D.K., Ravagnani A., Tsaknaki I.-Y., Bormetti G., Lillo F. **Short-term prediction of CO2 emission futures price with limit order book data**

11:30-11:40	Break

11:40-12:10	Alameer A.A., Alshehri K. **Conditional Value-at-Risk for quantitative trading: A Direct Reinforcement Learning approach**

12:10-12:40	Daluiso R., Nastasi E., Pallavicini A., Polo S. **Reinforcement Learning for options on target volatility funds**
12:40-13:10	Dell'Era M. **Local volatility and Hopfield Neural Network**
13:10-13:40	Garcin M., Stéphan S. **Credit scoring using neural networks and SURE posterior probability calibration**

13:40-14:00	Break

Afternoon

14:00-14:30	Goudenège L., Molent A., Zanette A. **Moving average options: Machine Learning and Gauss-Hermite quadrature for a double non-Markovian problem**
14:30-15:00	Jaydip S., Dutta A., Mehtab S. **Portfolio optimization using Deep Learning models - A comparative study of risk-based portfolio design approaches**
15:00-15:30	Lillo F., Livieri G., Marmi S., Solomko A., Vaienti S. **Analysis of bank leverage via dynamical systems and deep neural networks**
15:30-16:00	Salko A. **New insights on Loss Given Default for Shipping Finance: Parametric and non-parametric estimations**
16:00-16:30	Scholz M. **Forecast combinations for benchmarks of long-term stock returns using Machine Learning methods**

16:30-16:40	Break

16:40-17:10	Ameridad B., Cattaneo M., Luciano E., Kenett R. **AI and Adversarial AI in insurance: Background, examples and future implications**

17:10-17:40	Gnoatto A., Picarelli A., Reisinger C. **Deep XVA Solver - A Neural Network based counterparty Credit Risk management framework**
17:40-18:10	Mansouri S., Momtaz P.P. **Financing sustainable entrepreneurship: ESG measurement, valuation, and performance in token offerings**
18:10-18:40	Modina M., Zedda S. **A quantitative identification and description of the default syndromes affecting the Italian SMEs**
18:40-19:10	Carrillo Menéndez S., Hassani B. **Expected Shortfall reliability – Added value of traditional statistics and advanced Artificial Intelligence for market risk measurement purposes**

19:10-19:15	Closings

General information

Scientific Direction and Organization

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 to the email address **corazza@unive.it**.
- All the attendees are kindly asked to keep the microphone in **mute mode** all presentation long.

Talk

- Workshop language: **English**.
- **30 minutes** per presentation and questions.
- The first speaker of each session is kindly asked to be the **Chair** of the session itself.

Time

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

Workshop webpage

https://www.unive.it/data/agenda/3/55613

Publications

Facultative submission of papers to the international journal **Mathematical Methods in Economics and Finance** (**https://unive.it/m2ef**), included in the MathSciNet list of journals and in the Italian National Agency for the Evaluation of Universities and Research Institutes list of journals.

Submission and Important deadlines

- Papers have to be submitted via email to the email address **m2ef@unive.it**.
- Please, papers have to be written according to the journal **formatting guidelines** (the template file is downloadable from the journal website).
- Submission of papers: **February 11th, 2022**
- Reviewing of papers: **March 4th, 2022**
- Submission of the final version of papers: **March 25th, 2022**

Notes

- **Journal ISSNs**: 1971-6419 (print), 1971-3878 (online).

- **Advisory Board**:
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Abstracts

Note

The abstracts are alphabetically ordered according to the surname of the first author.

Conditional Value-at-Risk for quantitative trading: A Direct Reinforcement Learning approach

Alameer, Ali A. – King Fahd University of Petroleum and Minerals (SA)
Alshehri, Khaled – King Fahd University of Petroleum and Minerals (SA)

We propose a convex formulation for a trading system with the Conditional Value-at-Risk as a risk-adjusted performance measure under the notion of Direct Reinforcement Learning. Due to convexity, the proposed approach can uncover a lucrative trading policy in a "pure" online manner where it can interactively learn and update the policy without multi-epoch training and validation. We assess our proposed algorithm on a real financial market where it trades one of the largest US trust funds, SPDR, for three years. Numerical experiments demonstrate the algorithm's robustness in detecting central market-regime switching. Moreover, the results show the algorithm's effectiveness in extracting profitable policy while meeting an investor's risk preference under a conservative frictional market with a transaction cost of 0.15% per trade.

AI and Adversarial AI in insurance: Background, examples and future implications

Ameridad, Behnaz – McMaster University (CA)
Cattaneo, Matteo – Reale Mutua Group (IT)
Luciano, Elisa – University of Torino (IT)
Kenett, Ron – KPA Group (US)

This paper describes the rapid and dynamic pace of Artificial Intelligence (AI) and Machine Learning (ML) developments that have revolutionized the insurance sector. AI content-based processing of information includes image and video analysis, facial recognition and automated decision making for

claims management and fraud detection. The paper focuses on adversarial AI, namely on the creation of input data slightly altered to mislead a ML system and make it produce incorrect predictions. It provides a case study of the impact of adversarial AI in health insurance. Not only can the model be fooled for detecting the malignancy of patients, but a higher level of perturbation can increase the success rate of the attack by lowering the accuracy of the system. We deem important, for insurance companies ready to adopt AI technologies, to be aware of the consequences of adversarial attacks. We conclude with policy recommendations, consistent with the current regulatory framework.

Market Efficiency in the age of Machine Learning

Barbopoulos, Leonidas G. – The University of Edinburgh (UK)
Dai, Rui – University of Pennsylvania (US)
Putniņš, Tālis J. – University of Technology Sydney (AU)
Saunders, Anthony – New York University (US)

As machines replace humans in financial markets, how is informational efficiency impacted? We shed light on this issue by exploiting a unique data-set that allows us to identify when machines access important company information (8-K filings) versus when humans access the same information. We find that increased information access by cloud computing services significantly improves informational efficiency and reduces the price drift following information events. We address identification through exogenous power and cloud outages, a quasi-natural experiment, and instrumental variables. We show that machines are better able to handle linguistically complex filings, less susceptible to bias from negative sentiment and less constrained in attention/processing capacity than humans.

Regression models and Machine Learning approaches for Bitcoin price forecast

Caliciotti, Andrea – University of Rome "La Sapienza" (IT)
Corazza, Marco – Ca' Foscari University of Venice (IT)
Fasano, Giovanni – Ca' Foscari University of Venice (IT)

We carry on a long term analysis for Bitcoin price, which is currently among the most renowned crypto assets available on markets other than Forex. In the last decade Bitcoin has been under spotlights among traders all world wide, both because of its nature of pseudo-currency and for the high volatility its price has frequently experienced. Considering that Bitcoin price has earned over five orders of magnitude since 2009, the interest of investors has been increasingly motivated by the necessity of accurately predicting its value, not to mention that a comparative analysis with other

assets as silver and gold has been under investigation, too. This paper reports two approaches for a long term Bitcoin price prediction. The first one follows more standard paradigms from regression and least squares frameworks. Our main contribution in this regard fosters conclusions which are able to justify the cyclic performance of Bitcoin price, in terms of its Stock-to-Flow. Our second approach is definitely novel in the literature, and indicates guidelines for long term forecasts of Bitcoin price based on Machine Learning methods, with a specific reference to Support Vector Machines. Both these approaches are inherently data-driven, and the second one does not require any of the assumptions typically needed by solvers for classic regression problems.

Expected Shortfall reliability – Added value of traditional statistics and advanced Artificial Intelligence for market risk measurement purposes

Carrillo Menéndez, Santiago – Universitad Autonoma de Madrid (ES)
Hassani, Bertrand – Université Paris 1 Panthéon-Sorbonne (FR)

The Fundamental Review of the Trading Book is a market risk measurement and management regulation recently issued by the Basel Committee. This reform, often referred to as "Basel IV", intends to strengthen the financial system. The newest capital standard relies on the use of the Expected Shortfall. This risk measure requires to get sufficient information in the tails to ensure its reliability, as this one has to be alimented by a sufficient quantity of relevant data (above the 97.5 percentile in the case of the regulation or interest). In this paper, after discussing the relevant features of Expected Shortfall for risk measurement purposes, we present and compare several methods allowing to ensure the reliability of the risk measure by generating information in the tails. We discuss these approaches with respect to their relevance considering the underlying situation when it comes to available data, allowing practitioners to select the most appropriate approach. We apply traditional statistical methodologies, for instance distribution fitting, kernel density estimation, Gaussian mixtures and conditional fitting by Expectation-Maximisation as well as AI related strategies, for instance a Synthetic Minority Over-sampling Technique implemented in a regression environment and Generative Adversarial Nets.

Reinforcement Learning for options on target volatility funds

Daluiso, Roberto – Intesa Sanpaolo S.p.A. (IT)
Nastasi, Emanuele – Marketz S.p.A. (IT)
Pallavicini, Andrea – Intesa Sanpaolo S.p.A. (IT)

Polo, Stefano – X Numeris S.r.l. (IT)

In this work we deal with the funding costs rising from hedging the risky securities underlying a target volatility strategy (TVS), a portfolio of risky assets and a risk-free one dynamically rebalanced in order to keep the realized volatility of the portfolio on a certain level. The uncertainty in the TVS risky portfolio composition along with the difference in hedging costs for each component requires to solve a control problem to evaluate the option prices. We derive an analytical solution of the problem in the Black and Scholes (BS) scenario. Then we use Reinforcement Learning (RL) techniques to determine the fund composition leading to the most conservative price under the local volatility (LV) model, for which an a priori solution is not available. We show how the performances of the RL agents are compatible with those obtained by applying path-wise the BS analytical strategy to the TVS dynamics, which therefore appears competitive also in the LV scenario.

Local volatility and Hopfield Neural Network

Dell'Era, Mario – Citigroup Inc. (UK)

In Quantitative Finance, numerical methods are commonly used for the valuation of financial quantities. Derivative price models are often multi-dimensional and moreover, closed-form solutions are not available. Over the time different numerical methods have been developed and introduced in literature, to solve partial differential equations or integral equations. To this list of numerical approaches, in the recent literature, appear more often the use of Neural Networks. The mathematical foundation that allows the Neural Networks to approximate financial quantities and not only, is the "Universal Approximation Theorem". In this paper we are going to introduce instead of the classic Back-Propagation algorithm, the Boltzmann machine algorithm applied to a Hopfield Network to estimate the Local Volatility $\sigma(S_t,t)$, in order to speed up the calibration process, which often is time consuming and becomes a key problem to overcome.

Credit scoring using neural networks and SURE posterior probability calibration

Garcin, Matthieu – Ecole Supérieure d'Ingénieurs Léonard de Vinci (FR)
Stéphan, Samuel – Université Paris 1 Panthéon-Sorbonne (FR)

In this article we compare the performances of a logistic regression and a feed forward neural network for credit scoring purposes. Our results show that the logistic regression gives quite good results on the dataset and the neural network can improve a little the performance. We also consider different sets of features in order to assess their importance in terms of prediction accuracy. We found that temporal features (i.e. repeated

measures over time) can be an important source of information resulting in an increase in the overall model accuracy. Finally, we introduce a new technique for the calibration of predicted probabilities based on Stein's unbiased risk estimate (SURE). This calibration technique can be applied to very general calibration functions. In particular, we detail this method for the sigmoid function as well as for the Kumaraswamy function, which includes the identity as a particular case. We show that stacking the SURE calibration technique with the classical Platt method can improve the calibration of predicted probabilities.

Moving average options: Machine Learning and Gauss-Hermite quadrature for a double non-Markovian problem

Goudenège, Ludovic – Fédération de Mathématiques De Centralesupélec (FR)
Molent, Andrea – Università degli Studi di Udine (IT)
Zanette, Antonino – Università degli Studi di Udine (IT)

Evaluating moving average options is a tough computational challenge for the energy and commodity market as the payoff of the option depends on the prices of a certain underlying observed in a moving window so, when a long window is considered, the pricing problem becomes high dimensional. We present an efficient method for pricing Bermudan style moving average options, based on Gaussian Process Regression and Gauss-Hermite quadrature, thus named GPR-GHQ. Specifically, the proposed algorithm proceeds backward in time and, at each time-step, the continuation value is computed only in a few points by using Gauss-Hermite quadrature, and then it is learned through Gaussian Process Regression. We test the proposed approach in the Black-Scholes model, where the GPR-GHQ method is made even more efficient by exploiting the positive homogeneity of the continuation value, which allows one to reduce the problem size. Positive homogeneity is also exploited to develop a binomial Markov chain, which is able to deal efficiently with medium-long windows. Secondly, we test GPR-GHQ in the Clewlow-Strickland model, the reference framework for modeling prices of energy commodities. Finally, we consider a challenging problem which involves double non-Markovian feature, that is the rough-Bergomi model. In this case, the pricing problem is even harder since the whole history of the volatility process impacts the future distribution of the process. The manuscript includes a numerical investigation, which shows that GPR-GHQ is very accurate and it is able to handle options with a very long window, thus overcoming the problem of high dimensionality.

Deep XVA Solver - A Neural Network based counterparty Credit Risk management framework

Gnoatto, Alessandro – University of Verona (IT)
Picarelli, Athena – University of Verona (IT)
Reisinger, Christoph – University of Oxford (UK)

In this paper, we present a novel computational framework for portfolio-wide risk management problems, where the presence of a potentially large number of risk factors makes traditional numerical techniques ineffective. The new method utilises a coupled system of BSDEs for the valuation adjustments (xVA) and solves these by a recursive application of a neural network based BSDE solver. This not only makes the computation of xVA for high-dimensional problems feasible, but also produces hedge ratios and dynamic risk measures for xVA, and allows simulations of the collateral account.

Asset pricing with Panel Trees under global split criteria

He, Xin – City University of Hong Kong (HK)
Cong, Lin W. – Cornell University (US)
Feng, Guanhao – City University of Hong Kong (HK)
He, Jingyu – City University of Hong Kong (HK)

We introduce a class of interpretable tree-based models (P-Trees) for analyzing panel data, with iterative and global (instead of recursive and local) splitting criteria to avoid overfitting and improve model performance. We apply P-Tree to generate a stochastic discount factor model and test assets for cross-sectional asset pricing. Unlike other tree algorithms, P-Trees accommodate imbalanced panels of asset returns and grow under the no-arbitrage condition. P-Trees also graphically capture nonlinearity and interaction effects and accommodate regime-switching and interactions between macroeconomic states and firm characteristics. For example, P-Tree identifies inflation as the most important macro predictor with regime-switching in U.S. equity data. Based on multiple pricing, prediction, and investment metrics, we find that (boosted or time-series) P-Trees outperform standard factor models and PCA latent factor models. An equal-weighted portfolio for five factors generated by P-Trees delivers an excess alpha of 1.09% against the Fama-French 3-factor benchmark, producing an annualized Sharpe ratio of 1.98 out of sample. Data-driven cutpoints in P-Trees reveal that long-run reversal, volume volatility, and industry-adjusted market equity drive cross-sectional return variations, consistent with variable importance analysis using random forests.

Portfolio optimization using Deep Learning models - A comparative study of risk-based portfolio design approaches

Jaydip, Sen – Praxis Business School (IN)
Dutta, Abhishek – Praxis Business School (IN)
Mehtab, Sidra – Praxis Business School (IN)

Portfolio Optimization is the task of identifying a set of capital assets and their respective weights of allocation, which optimizes the risk-return pairs. Optimizing a portfolio is a computationally hard problem. The problem gets more complicated if one has to optimize future return and risk values, as predicting future stock prices is equally challenging. Following the seminal work of Markowitz on the minimum-variance portfolio, several propositions have been made for different approaches to portfolio optimization. Many future stock price prediction proposals also exist based on methods like multivariate regression, ARIMA, VAR, ARIMAX, Granger causality, time series forecasting, Machine Learning, and Deep Learning. This work proposes a systematic approach for building robust portfolios of stocks from nine critical sectors of the Indian stock market. The nine sectors are first chosen, and for each sector, the ten most significant stocks are identified as per their listing in the National Stock Exchange. The historical prices of these ninety stocks are automatically scraped from the Yahoo Finance website using their ticker names. Based on the historical prices for five years, hierarchical risk parity portfolio and hierarchical equal risk contribution portfolio are built for the nine sectors. Two Deep Learning-based models (an attention-based LSTM model and a convolutional LSTM model) are also designed for predicting future stock prices. Eight months after constructing the portfolios, the actual return and the predicted return as computed by the predictive models are derived. The actual and the predicted results are compared for evaluating the efficacy of the Deep Learning models. Further, the return and volatility values for the sectors provide us with an idea about the current return on investment and the risk associated with each sector. The work has three significant contributions. First, the work presents a systematic approach for constructing portfolios of two types, hierarchical risk parity portfolio and the hierarchical equal risk contribution portfolio, for nine critical economic sectors of India, using their historical prices for the last five years. These portfolios can serve as illustrative guidance for the investors. Second, the work proposes two robust Deep Learning models (an attention-based LSTM and a convolutional LSTM) for forecasting the future prices of stocks. Finally, the results of the study will provide an insight into the current profitability and risk associated with stocks of different sectors.

Deep Hawkes process for high-frequency market making

Kumar, Pankaj – Copenhagen Business School (DK)

High-frequency market making is a liquidity-providing trading strategy that simultaneously generates many bids and asks for a security at ultra-low latency while maintaining a relatively neutral position. The strategy makes a profit from the bid-ask spread for every buy and sell transaction, against the risk of adverse selection, uncertain execution and inventory risk. We design realistic simulations of limit order markets and develop a high-frequency market making strategy in which agents process order book information to post the optimal price, order type and execution time. By introducing the Deep Hawkes process to the high-frequency market making strategy, we allow a feedback loop to be created between order arrival and the state of the limit order book, together with self- and cross-excitation effects. Our high-frequency market making strategy accounts for the cancellation of orders that influence order queue position, profitability, bid-ask spread and the value of the order. The experimental results show that our trading agent outperforms the baseline strategy, which uses a probability density estimate of the fundamental price. We investigate the effect of cancellations on market quality and the agent's profitability. We validate how closely the simulation framework approximates reality by reproducing stylized facts from the empirical analysis of the simulated order book data.

Short-term prediction of CO2 emission futures price with limit order book data

Lam, Duy K. – Scuola Normale Superiore di Pisa (IT)
Ravagnani, Adele – Scuola Normale Superiore di Pisa (IT)
Tsaknaki, Ioanna-Yvonni – Scuola Normale Superiore di Pisa (IT)
Bormetti, Giacomo – Università di Bologna (IT)
Lillo, Fabrizio – Università di Bologna (IT)

We investigate the short time predictability of CO2 emission futures (EUA) price comparing eight different techniques: Logistic Regression, Random Forest, Gradient Boosting, Support Vector Machine, and Deep Learning methods (FNN, CNN, GRU-LSTM, α-RNN). Prediction of price using Limit Order Book (LOB) data is a notoriously hard task exacerbated in our case by spiky and non-stationary dynamics, missing data, and great diversity across investigated days. We predict the next mid-price change and the mid-price change after a fixed time window. This analysis is extended by a threshold approach which allows us to examine whether LOB states can predict market instabilities. As a first step, we use the current state of the LOB as predictor. Then, we abandon the Markov assumption by employing previous LOB states

and order flows as features. In the threshold approach, two simple predictors tracking the local level of volatility and trend are also considered. We focus on the market microstructure data of the EUA asset for the period April–July 2021. The results show that all the methods outperform the naïve classifier, which always predicts the most frequent event in the training set. Moreover, results of all methods are comparable and Deep Learning does not always outperforms the other methods.

Analysis of bank leverage via dynamical systems and deep neural networks

Lillo, Fabrizio – Università di Bologna (IT)
Livieri, Giulia – Scuola Normale Superiore (IT)
Marmi, Stefano – Scuola Normale Superiore (IT)
Solomko, Anton – Scuola Normale Superiore (IT)
Vaienti, Sandro – Aix Marseille Université (FR)

We consider a model of a simple financial system consisting of a leveraged investor that invests in a risky asset and manages risk by using Value-at-Risk (VaR). The VaR is estimated by using past data via an adaptive expectation scheme. We show that the leverage dynamics can be described by a dynamical system of slow-fast type associated with a unimodal map on [0,1] with an additive heteroscedastic noise whose variance is related to the portfolio rebalancing frequency to target leverage. In absence of noise the model is purely deterministic and the parameter space splits in two regions: (i) a region with a globally attracting fixed point or a 2-cycle; (ii) a dynamical core region, where the map could exhibit chaotic behavior. Whenever the model is randomly perturbed, we prove the existence of a unique stationary density with bounded variation, the stochastic stability of the process and the almost certain existence and continuity of the Lyapunov exponent for the stationary measure. We then use deep neural networks to estimate map parameters from a short time series. Using this method, we estimate the model in a large dataset of US commercial banks over the period 2001-2014. We find that the parameters of a substantial fraction of banks lie in the dynamical core, and their leverage time series are consistent with a chaotic behavior. We also present evidence that the time series of the leverage of large banks tend to exhibit chaoticity more frequently than those of small banks.

Financing sustainable entrepreneurship: ESG measurement, valuation, and performance in token offerings

Mansouri, Sasan – Goethe-University Frankfurt (DE)
Momtaz, Paul P. – UCLA (US)

Sustainable Entrepreneurship (SE) seeks to attain profitability and sustainability goals. A major research gap concerns the economic attractiveness of SE for entrepreneurs and investors. The question is ambiguous because sustainability orientation creates costly constraints, while startups cannot fully appropriate their positive externalities. We relate startups' Environment, Society and Governance (ESG) properties obtained from a machine-learning approach (www.SustainableEntrepreneurship.org) to SE valuation and performance in token offerings. Startups with salient ESG goals are able to raise financing at more favorable valuations, incentivizing entrepreneurs to adopt ESG goals in the first place. However, their post-funding performance is weaker than in conventional startups, suggesting that investors incur a relative financial loss for backing sustainability-oriented entrepreneurs. Both valuation and post-funding performance are weaker in ESG startups with pre-existing binding constraints.

A quantitative identification and description of the default syndromes affecting the Italian SMEs

Modina, Michele – University of Molise (IT)
Zedda, Stefano – University of Cagliari (IT)

In this paper, we analyze a panel of of 74,128 Italian small and medium sized companies (SMEs), which includes both the firms' financial variables and confidential information from the lending relationship, for identifying the main syndromes bringing the Italian SMEs to default through financial ratios. After the data cleaning, we firstly select, through a machine learning data driven process, the variables mostly significant in assessing the default risk. Then, the data coming from defaulted firms, for each of the main sectors of activity, are grouped through a cluster analysis, and each cluster is described by comparing its financial ratios average values with the average value of the healthy firms of the same sector; Finally, we compare the results obtained on each sector to verify if the syndromes recur over sectors. Results show that a significant share of the corporate insolvencies are characterized by a set of recurrent signs and symptoms, so that the main syndromes affecting the Italian SMEs can be identified. We also show that the syndromes recur over sectors, even if specific values characterize each

sector. This is the first study aimed at identifying and describing the syndromes affecting SMEs and bringing them to default, by means of balance sheet ratios.

FNew insights on Loss Given Default for Shipping Finance: Parametric and non-parametric estimations

Salko, Aida – Sapienza University of Rome (IT)

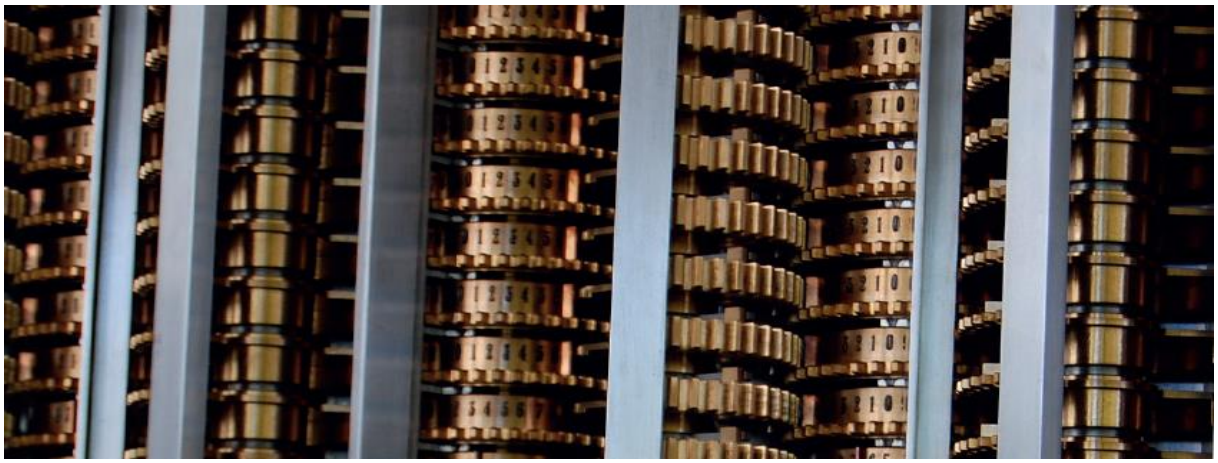
This study analyzes different parametric and non-parametric modeling methods for estimating the Loss Given Default (LGD) of bank loans for shipping finance. The shipping industry is related to several different risks which create the need for a more detailed loss modeling for the banks. We use a unique database of defaulted loans in European banks involved in shipping finance. The main goal of this study is twofold: to compare the performance of alternative LGD modeling methodologies in shipping finance and to provide some insights into what drives LGD in the shipping industry. We find that non-parametric methods, especially random forest, lead to a remarkable increase in the prediction accuracy and outperform the traditional statistical models in terms of both in-sample and out-of-sample results. Furthermore, we use a variable importance measure built on the idea of the permutation importance, to analyze the risk drivers with the greatest effects on the LGD prediction accuracy for shipping finance. We find that most of the models consider the energy index to be of paramount importance and ranked as the most important risk driver of accurate LGD predictions in shipping finance. The result highlights the dominant role played by crude oil prices which can deteriorate the financial health of shipping firms and therefore affect the LGDs of shipping loans.

Forecast combinations for benchmarks of long-term stock returns using Machine Learning methods

Scholz, Michael – University of Klagenfurt (AT)

Forecast combinations are a popular way of reducing the mean squared forecast error when multiple candidate models for a target variable are available. We apply different approaches to finding (optimal) weights for forecasts of stock returns in excess of different benchmarks. Our focus lies thereby on nonlinear predictive functions estimated by a fully nonparametric smoother with the covariates and the smoothing parameters chosen by cross-validation. Based on an out-of-sample study, we find that individual nonparametric models outperform their forecast combinations. The latter are prone to in-sample over-fitting and in consequence, perform poorly out-of-sample especially when the set of possible candidates for combinations is

large. A reduction to one-dimensional models balances in-sample and out-of-sample performance.



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https://www.unive.it/data/agenda/3/55613

Scientific Direction and Organization: **Marco Corazza** (**corazza@unive.it**)