



# FinTech HO2020 Project

## Deliverable 3.1

Grant agreement No. 825215 (Topic: ICT-35-2018 Type of action: CSA). 2021

# Document Information

---

Deliverable information	
WP NO.	WP3
DEL. REL. NO.	D3.1
DEL. NO.	D7
TITLE	Repository of papers in big artificial intelligence
DESCRIPTION	Repository of papers in artificial intelligence produced by consortium partners throughout the duration of the project.
NATURE	Document
EST. DEL. DATE	June 30 2021

Document information	
DATE	28/05/2021
WRITTEN BY	UCL and UNIPV
APPROVED BY	PAOLO GIUDICI (PC)

# 1

## Repository of AI research papers

---

The University of Pavia and the University College of London as WP3 Leader, with the support of all the Consortium, has developed the repository of papers related to artificial intelligence under the WP3. The repository of all research papers outputted regarding artificial intelligence. The material has been developed by individual partners and by collaborations from within the consortium. The papers have been presented at various academic conferences and have been published in Open Access Journals or have been archived by the authors to maintain an open access copy in an Open Access Repository e.g. Arxiv, SSRN.

Specifically, the final repository contains the following information about the papers.

- Title
- Authors
- Abstract
- Partners
- Journal
- Date
- Link (doi for open access articles and also SSRN for those not open access)

The papers are sorted by publication date.

# Title

Cryptocurrency market structure: connecting emotions and economics

# Authors

Tomaso Aste

# Abstract

I study the dependency and causality structure of the cryptocurrency market investigating collective movements of both prices and social sentiment related to almost two thousand cryptocurrencies traded during the first six months of 2018. This is the first study of the whole cryptocurrency market structure. It introduces several rigorous innovative methodologies applicable to this and to several other complex systems where a large number of variables interact in a non-linear way, which is a distinctive feature of the digital economy. The analysis of the dependency structure reveals that prices are significantly correlated with sentiment. The major, most capitalised cryptocurrencies, such as bitcoin, have a central role in the price correlation network but only a marginal role in the sentiment network and in the network describing the interactions between the two. The study of the causality structure reveals a causality network that is consistently related with the correlation structures and shows that both prices cause sentiment and sentiment cause prices across currencies with the latter being stronger in size but smaller in number of significative interactions. Overall this study uncovers a complex and rich structure of interrelations where prices and sentiment influence each other both instantaneously and with lead-lag causal relations. A major finding is that minor currencies, with small capitalisation, play a crucial role in shaping the overall dependency and causality structure. Despite the high level of noise and the short time-series I verified that these networks are significant with all links statistically validated and with a structural organisation consistently reproduced across all networks.

# Partners

- University College London

# Journal

Digital Finance

# Date of Publication

24 April 2019

## Link

<https://doi.org/10.1007/s42521-019-00008-9>

## Title

Crypto price discovery through correlation networks

## Authors

Paolo Giudici, Gloria Polinesi

## Abstract

We aim to understand the dynamics of crypto asset prices and, specifically, how price information is transmitted among different bitcoin market exchanges, and between bitcoin markets and traditional ones. To this aim, we hierarchically cluster bitcoin prices from different exchanges, as well as classic assets, by enriching the correlation based minimum spanning tree method with a preliminary filtering method based on the random matrix approach. Our main empirical findings are that: (i) bitcoin exchange prices are positively related with each other and, among them, the largest exchanges, such as Bitstamp, drive the prices; (ii) bitcoin exchange prices are not affected by classic asset prices, but their volatilities are, with a negative and lagged effect.

## Partners

- University of Pavia

## Journal

Annals of Operations Research

## Date of Publication

29 May 2019

## Link

<https://doi.org/10.1007/s10479-019-03282-3>

# Title

Assessment of Machine Learning Performance for Decision Support in Venture Capital Investments

# Authors

Javier Arroyo; Francesco Corea; Guillermo Jimenez-Diaz; Juan A. Recio-Garcia

# Abstract

The venture capital (VC) industry offers opportunities for investment in early-stage companies where uncertainty is very high. Unfortunately, the tools investors currently have available are not robust enough to reduce risk and help them managing uncertainty better. Machine learning data-driven approaches can bridge this gap, as they already do in the hedge fund industry. These approaches are now possible because data from thousands of companies over the world is available through platforms such as Crunchbase. Previous academic efforts have focused only on predicting two classes of exits, i.e., being acquired by other company or offering shares to the public, using only one or a few subsets of explanatory variables. These events are typically related to high returns, but also higher risk, making hard for a venture fund to get repeatable and sustainable returns. On the contrary, we will try to predict more possible outcomes including a subsequent funding round or the closure of the company using a large set of signals. In this way, our approach would provide VC investors with more information to set up a portfolio with lower risk that may eventually achieve higher returns than those based on finding unicorns (i.e., companies with a valuation higher than one billion dollars). We will analyze the performance of several machine learning methods in a dataset of over 120,000 early-stage companies in a realistic setting that tries to predict their progress in a 3-year time window. Results show that machine learning can support venture investors in their decision-making processes to find opportunities and better assessing the risk of potential investments.

# Partners

- Universidad Complutense de Madrid

# Journal

IEEE

## Date of Publication

30 August 2019

## Link

<https://doi.org/10.1109/ACCESS.2019.2938659>



## Title

Sentiment Analysis of European Bonds 2016–2018

## Authors

Peter Schwendner, Martin Schüle and Martin Hillebrand

## Abstract

We revisit the discussion of market sentiment in European sovereign bonds using a correlation analysis toolkit based on influence networks and hierarchical clustering. We focus on three case studies of political interest. In the case of the 2016 Brexit referendum, the market showed negative correlations between core and periphery only in the week before the referendum. Before the French presidential elections in 2017, the French bond spread widened together with the estimated Le Pen election probability, but the position of French bonds in the correlation blocks did not weaken. In summer 2018, during the budget negotiations within the new Italian coalition, the Italian bonds reacted very sensitively to changing political messages but did not show contagion risk to Spain or Portugal for several months. The situation changed during the week from October 22 to 26, as a spillover pattern of negative sentiment also to the other peripheral countries emerged.

## Partners

- Zurich University of Applied Sciences

## Journal

Frontiers in Artificial Intelligence

## Date of Publication

15 October 2019

## Link

<https://doi.org/10.3389/frai.2019.00020>

# Title

Sector Neutral Portfolios: Long Memory Motifs Persistence in Market Structure Dynamics

# Authors

Jeremy D. Turiel, Tomaso Aste

# Abstract

We study soft persistence (existence in subsequent temporal layers of motifs from the initial layer) of motif structures in Triangulated Maximally Filtered Graphs (TMFG) generated from time-varying Kendall correlation matrices computed from stock prices log-returns over rolling windows with exponential smoothing. We observe long-memory processes in these structures in the form of power law decays in the number of persistent motifs. The decays then transition to a plateau regime with a power-law decay with smaller exponent. We demonstrate that identifying persistent motifs allows for forecasting and applications to portfolio diversification. Balanced portfolios are often constructed from the analysis of historic correlations, however not all past correlations are persistently reflected into the future. Sector neutrality has also been a central theme in portfolio diversification and systemic risk. We present an unsupervised technique to identify persistently correlated sets of stocks. These are empirically found to identify sectors driven by strong fundamentals. Applications of these findings are tested in two distinct ways on four different markets, resulting in significant reduction in portfolio volatility. A persistence-based measure for portfolio allocation is proposed and shown to outperform volatility weighting when tested out of sample.

# Partners

- University College London

# Journal

Complex Networks and Their Applications VIII

# Date of Publication

25 November 2019

## Link

[https://doi.org/10.1007/978-3-030-36683-4\\_46](https://doi.org/10.1007/978-3-030-36683-4_46)

## Title

Analysing Social Media Forums to Discover Potential Causes of Phasic Shifts in Cryptocurrency Price Series

## Authors

Andrew Burnie, Emine Yilmaz and Tomaso Aste

## Abstract

The recent extreme volatility in cryptocurrency prices occurred in the setting of popular social media forums devoted to the discussion of cryptocurrencies. We develop a framework that discovers potential causes of phasic shifts in the price movement captured by social media discussions. This draws on principles developed in healthcare epidemiology where, similarly, only observational data are available. Such causes may have a major, one-off effect, or recurring effects on the trend in the price series. We find a one-off effect of regulatory bans on bitcoin, the repeated effects of rival innovations on ether and the influence of technical traders, captured through discussion of market price, on both cryptocurrencies. The results for Bitcoin differ from Ethereum, which is consistent with the observed differences in the timing of the highest price and the price phases. This framework could be applied to a wide range of cryptocurrency price series where there exists a relevant social media text source. Identified causes with a recurring effect may have value in predictive modelling, whilst one-off causes may provide insight into unpredictable black swan events that can have a major impact on a system.

## Partners

- University College London

## Journal

Frontiers in Blockchain

## Date of Publication

28 January 2020

## Link

<https://doi.org/10.3389/fbloc.2020.00001>

## Title

Explainable AI in Fintech Risk Management

## Authors

Niklas Bussmann, Paolo Giudici, Dimitri Marinelli and Jochen Papenbrock

## Abstract

The paper proposes an explainable AI model that can be used in fintech risk management and, in particular, in measuring the risks that arise when credit is borrowed employing peer to peer lending platforms. The model employs Shapley values, so that AI predictions are interpreted according to the underlying explanatory variables. The empirical analysis of 15,000 small and medium companies asking for peer to peer lending credit reveals that both risky and not risky borrowers can be grouped according to a set of similar financial characteristics, which can be employed to explain and understand their credit score and, therefore, to predict their future behavior.

## Partners

- Firamis
- University of Pavia

## Journal

Frontiers in Artificial Intelligence

## Date of Publication

24 April 2020

## Link

<https://doi.org/10.3389/frai.2020.00026>

## Title

Network Models to Enhance Automated Cryptocurrency Portfolio Management

## Authors

Paolo Giudici, Paolo Pagnottoni and Gloria Polinesi

## Abstract

The usage of cryptocurrencies, together with that of financial automated consultancy, is widely spreading in the last few years. However, automated consultancy services are not yet exploiting the potentiality of this nascent market, which represents a class of innovative financial products that can be proposed by robo-advisors. For this reason, we propose a novel approach to build efficient portfolio allocation strategies involving volatile financial instruments, such as cryptocurrencies. In other words, we develop an extension of the traditional Markowitz model which combines Random Matrix Theory and network measures, in order to achieve portfolio weights enhancing portfolios' risk-return profiles. The results show that overall our model overperforms several competing alternatives, maintaining a relatively low level of risk.

## Partners

- University of Pavia

## Journal

Frontiers in Artificial Intelligence

## Date of Publication

24 April 2020

## Link

<https://doi.org/10.3389/frai.2020.00022>

# Title

Dominance-Based Decision Rules for Pension Fund Selection under Different Distributional Assumptions

# Authors

Audrius Kabašinskas, Kristina Šutienė, Miloš Kopa, Kęstutis Lukšys and Kazimieras Bagdonas

# Abstract

The pension landscape is changing due to the market situation, and technological change has enabled financial innovations. Pension savers usually seek financial advice to make a personalised decision in selecting the right pension fund for them. As such, decision rules based on the assumed risk profile of the decision maker could be generated by making use of stochastic dominance (SD). In the paper, the second-pillar pension funds operating in Lithuania and Slovakia are analysed according to SD rules. The importance of the distributional assumption is explored while comparing the results of empirical, student-t, Hyperbolic and Normal Inverse Gaussian distributions to generate SD-based rules that could be integrated into an advisory solution. Moreover, due to the differences in SD results under different distributional assumptions, a new SD ratio is proposed that condenses the dominance-based relations for all considered dominance orders and probability distributions. The empirical results indicate that this new SD ratio efficiently characterises not only the preference of each fund individually but also of a group of funds with the same attributes, thus enabling multi-risk and multi-country comparisons.

# Partners

- Kaunas University of Technology

# Journal

Mathematics

# Date of Publication

4 May 2020

## Link

<https://doi.org/10.3390/math8050719>



# Title

Shapley-Lorenz eXplainable Artificial Intelligence

# Authors

Paolo Giudici and Emanuela Raffinetti

# Abstract

Explainability of artificial intelligence methods has become a crucial issue, especially in the most regulated fields, such as health and finance. In this paper, we provide a global explainable AI method which is based on Lorenz decompositions, thus extending previous contributions based on variance decompositions. This allows the resulting Shapley-Lorenz decomposition to be more generally applicable, and provides a unifying variable importance criterion that combines predictive accuracy with explainability, using a normalised and easy to interpret metric. The proposed decomposition is illustrated within the context of a real financial problem: the prediction of bitcoin prices.

# Partners

- University of Pavia

# Journal

Expert Systems with Applications

# Date of Publication

1 April 2021

# Link

<https://doi.org/10.1016/j.eswa.2020.114104>

## Title

Tail Risk Transmission: A Study of the Iran Food Industry

## Authors

Fatemeh Mojtahedi, Seyed Mojtaba Mojaverian, Daniel F. Ahelegbey, Paolo Giudici

## Abstract

This paper extends the extreme downside correlation (EDC) and extreme downside hedge (EDH) methodology to model the interdependence in the sensitivity of assets to the downside risk of other financial assets under severe firm-level and market conditions. The model is applied to analyze both systematic and systemic exposures in the Iranian Food Industry. The empirical application investigates (1) which company is the safest for investors to diversify their investment, and (2) which companies are the “transmitters” and “receivers” of downside risk. We study the return series of 11 companies and the Food Industry index publicly listed on the Tehran Stock Exchange. The data covers daily close prices from 2015–2020. The result shows that Mahram Manufacturing is the safest to hedge equity risk, and Glucosan and Behshahr Industries are the riskiest, while Gorji Biscuit is central to risk transmission, and Pegah Fars Diary is the main “receiver” of risk in turbulent times.

## Partners

- University of Pavia

## Journal

Risks

## Date of Publication

20 July 2020

## Link

<https://doi.org/10.3390/risks8030078>

# Title

Neural networks and arbitrage in the VIX

# Authors

Joerg Osterrieder, Daniel Kucharczyk, Silas Rudolf and Daniel Wittwer

# Abstract

The Chicago Board Options Exchange Volatility Index (VIX) is considered by many market participants as a common measure of market risk and investors' sentiment, representing the market's expectation of the 30-day-ahead looking implied volatility obtained from real-time prices of options on the S&P 500 index. While smaller deviations between implied and realized volatility are a well-known stylized fact of financial markets, large, time-varying differences are also frequently observed throughout the day. Furthermore, substantial deviations between the VIX and its futures might lead to arbitrage opportunities on the VIX market. Arbitrage is hard to exploit as the potential strategy to exploit it requires buying several hundred, mostly illiquid, out-of-the-money (put and call) options on the S&P 500 index. This paper discusses a novel approach to predicting the VIX on an intraday scale by using just a subset of the most liquid options. To the best of the authors' knowledge, this the first paper, that describes a new methodology on how to predict the VIX (to potentially exploit arbitrage opportunities using VIX futures) using most recently developed machine learning models to intraday data of S&P 500 options and the VIX. The presented results are supposed to shed more light on the underlying dynamics in the options markets, help other investors to better understand the market and support regulators to investigate market inefficiencies.

# Partners

- Zurich University of Applied Sciences

# Journal

Digital Finance

# Date of Publication

13 August 2020

## Link

<https://doi.org/10.1007/s42521-020-00026-y>

# Title

Will They Repay Their Debt? Identification of Borrowers Likely to Be Charged Off

# Authors

Raluca Caplescu, Ana-Maria Panaite, Daniel Traian Pele, Vasile Alecsandru Strat

# Abstract

Recent increase in P2P lending prompted for development of models to separate good and bad clients to mitigate risks both for lenders and for the platforms. The rapidly increasing body of literature provides several comparisons between various models. Among the most frequently employed ones are logistic regression, SVM, neural networks and decision tree-based ones. Among them, logistic regression has proved to be a strong candidate both because its good performance and due to its high explainability. The present paper aims to compare four pairs of models (for imbalanced and under-sampled data) meant to predict charged off clients by optimizing f1 score. We found that, if the data is balanced, Logistic Regression, both simple and with Stochastic Gradient Descent, outperforms LightGBM and K-Nearest Neighbors in optimizing f1 score. We chose this metric as it provides balance between the interests of the lenders and those of the platform. Loan term, DTI and number of accounts were found to be important positively related predictors of risk of charge off. At the other end of the spectrum, by far the strongest impact on charge off probability is that of the FICO score. The final number of features retained by the two models differs very much, because, although both models use Lasso for feature selection, Stochastic Gradient Descent Logistic Regression uses a stronger regularization. The analysis was performed using Python (numpy, pandas, sklearn and imblearn).

# Partners

- Bucharest University

# Journal

Management & Marketing

# Date of Publication

29 August 2020

## Link

<https://ssrn.com/abstract=3658606>

## Title

Explainable Machine Learning in Credit Risk Management

## Authors

Niklas Bussmann, Paolo Giudici, Dimitri Marinelli and Jochen Papenbrock

## Abstract

The paper proposes an explainable Artificial Intelligence model that can be used in credit risk management and, in particular, in measuring the risks that arise when credit is borrowed employing peer to peer lending platforms. The model applies correlation networks to Shapley values so that Artificial Intelligence predictions are grouped according to the similarity in the underlying explanations. The empirical analysis of 15,000 small and medium companies asking for credit reveals that both risky and not risky borrowers can be grouped according to a set of similar financial characteristics, which can be employed to explain their credit score and, therefore, to predict their future behaviour.

## Partners

- University of Pavia
- Firamis

## Journal

Computational Economics

## Date of Publication

25 September 2020

## Link

<https://doi.org/10.1007/s10614-020-10042-0>

## Title

Predictability and pricing efficiency in forward and spot, developed and emerging currency markets

## Authors

Valerio Potì, Richard Levich, Thomas Conlon

## Abstract

We study the predictability of forward and spot exchange rates of currencies of emerging and developed economies from 1994 to 2016. Our purpose is to shed light on the efficiency of currency markets and how and why it has evolved over this time. For the currencies of emerging economies, our analysis of rates of return on forward contracts finds some evidence of excess-predictability, especially in the earlier parts of the sample period, consistent with the view that this portion of the foreign exchange market has only become efficient in recent times. When we turn our attention to excess-returns computed from spot exchange rates and spot interest rates, however, we find much less predictability. In particular, over our full sample period, we find no evidence of excess-predictability, in contrast with the results reported by Hsu et al. (2016) but in agreement with Kuang et al. (2014). The different predictability of spot excess-returns and rates of return on forward contracts is a manifestation of the widespread violation of covered interest parity which emerged with the onset of the 2008 financial crisis.

## Partners

- University College Dublin

## Journal

Journal of International Money and Finance

## Date of Publication

October 2020

## Link

<https://doi.org/10.1016/j.jimonfin.2020.102223>



## Title

Matrix Evolutions: Synthetic Correlations and Explainable Machine Learning for Constructing Robust Investment Portfolios

## Authors

Jochen Papenbrock, Peter Schwendner, Markus Jaeger and Stephan Krügel

## Abstract

In this article, the authors present a novel and highly flexible concept to simulate correlation matrixes of financial markets. It produces realistic outcomes regarding stylized facts of empirical correlation matrixes and requires no asset return input data. The matrix generation is based on a multiobjective evolutionary algorithm, so the authors call the approach "matrix evolutions". It is suitable for parallel implementation and can be accelerated by graphics processing units and quantum-inspired algorithms. The approach is useful for backtesting, pricing, and hedging correlation-dependent investment strategies and financial products. Its potential is demonstrated in a machine learning case study for robust portfolio construction in a multi-asset universe: An explainable machine learning program links the synthetic matrixes to the portfolio volatility spread of hierarchical risk parity versus equal risk contribution.

## Partners

- Firamis
- Zurich University of Applied Sciences

## Journal

The Journal of Financial Data Science

## Date of Publication

2 Oct 2020

## Link

<https://doi.org/10.3905/jfds.2021.1.056>

SSRN: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3663220](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3663220)

## Title

Corporate Social Irresponsibility and Portfolio Performance: A Cross-National Study

## Authors

Maretno A. Harjoto, Andreas G. F. Hoepner, Qian Li

## Abstract

This article explores whether increasing fossil fuel divestment commitments are related to the reduction of capital flows into the oil and gas sector, based on an analysis of syndicated lending, equity and bond underwriting across 33 countries from 2000 to 2015. We find that increasing oil and gas divestment pledges in a country are associated with lower capital flows to domestic oil and gas companies. This effect is enhanced in more stringent environmental policy regimes and diminished in countries which heavily subsidise fossil fuels. However, the divestment movement may have an unintended effect, insofar as domestic banks situated in countries with high divestment commitments and stringent environmental policies provide more finance to oil and gas companies abroad. We explain these findings through the lens of institutional theory and show how both regulatory and socially normative elements of institutions shape this dynamic.

## Partners

- University College Dublin

## Journal

Journal of International Financial Markets, Institutions and Money

## Date of Publication

19 Oct 2020

## Link

<http://dx.doi.org/10.2139/ssrn.3683170>

# Title

Interpretable Machine Learning for Diversified Portfolio Construction

# Authors

Markus Jaeger, Stephan Krügel, Dimitri Marinelli, Jochen Papenbrock, Peter Schwendner

# Abstract

In this paper, the authors construct a pipeline to benchmark Hierarchical Risk Parity (HRP) relative to Equal Risk Contribution (ERC) as examples of diversification strategies allocating to liquid multi-asset futures markets with dynamic leverage ("volatility target"). The authors use interpretable machine learning concepts ("explainable AI") to compare the robustness of the strategies and to back out implicit rules for decision making. The empirical dataset consists of 17 equity index, government bond and commodity futures markets across 20 years. The two strategies are backtested for the empirical dataset and for about 100'000 bootstrapped datasets. XGBoost is used to regress the Calmar ratio spread between the two strategies against features of the bootstrapped datasets. Compared to ERC, HRP shows higher Calmar ratios and better matches the volatility target. Using Shapley values, the Calmar ratio spread can be attributed especially to univariate drawdown measures of the asset classes.

# Partners

- Firamis
- Zurich University of Applied Sciences

# Journal

# Date of Publication

November 13, 2020

# Link

<http://dx.doi.org/10.2139/ssrn.3730144>

## Title

Why to Buy Insurance? An Explainable Artificial Intelligence Approach

## Authors

Alex Gramegna and Paolo Giudici

## Abstract

We propose an Explainable AI model that can be employed in order to explain why a customer buys or abandons a non-life insurance coverage. The method consists in applying similarity clustering to the Shapley values that were obtained from a highly accurate XGBoost predictive classification algorithm. Our proposed method can be embedded into a technologically-based insurance service (Insurtech), allowing to understand, in real time, the factors that most contribute to customers' decisions, thereby gaining proactive insights on their needs. We prove the validity of our model with an empirical analysis that was conducted on data regarding purchases of insurance micro-policies. Two aspects are investigated: the propensity to buy an insurance policy and the risk of churn of an existing customer. The results from the analysis reveal that customers can be effectively and quickly grouped according to a similar set of characteristics, which can predict their buying or churn behaviour well.

## Partners

- University of Pavia

## Journal

Risks

## Date of Publication

14 December 2020

## Link

<https://doi.org/10.3390/risks8040137>

## Title

Significance, relevance and explainability in the machine learning age: an econometrics and financial data science perspective

## Authors

Andreas G. F. Hoepner, David McMillan, Andrew Vivian & Chardin Wese Simen

## Abstract

Although machine learning is frequently associated with neural networks, it also comprises econometric regression approaches and other statistical techniques whose accuracy enhances with increasing observation. What constitutes high quality machine learning is yet unclear though. Proponents of deep learning (i.e. neural networks) value computational efficiency over human interpretability and tolerate the ‘black box’ appeal of their algorithms, whereas proponents of explainable artificial intelligence (xai) employ traceable ‘white box’ methods (e.g. regressions) to enhance explainability to human decision makers. We extend Brooks et al.’s [2019. ‘Financial Data Science: The Birth of a New Financial Research Paradigm Complementing Econometrics?’ *European Journal of Finance* 25 (17): 1627–36.] work on significance and relevance as assessment criteria in econometrics and financial data science to contribute to this debate. Specifically, we identify explainability as the Achilles heel of classic machine learning approaches such as neural networks, which are not fully replicable, lack transparency and traceability and therefore do not permit any attempts to establish causal inference. We conclude by suggesting routes for future research to advance the design and efficiency of ‘white box’ algorithms.

## Partners

- University College Dublin

## Journal

The European Journal of Finance

## Date of Publication

03 Dec 2020

## Link

<https://doi.org/10.1080/1351847X.2020.1847725>

## Title

Does the fossil fuel divestment movement impact new oil and gas fundraising?

## Authors

Theodor F Cojoianu, Francisco Ascui, Gordon L Clark, Andreas G F Hoepner, Dariusz Wójcik

## Abstract

This article explores whether increasing fossil fuel divestment commitments are related to the reduction of capital flows into the oil and gas sector, based on an analysis of syndicated lending, equity and bond underwriting across 33 countries from 2000 to 2015. We find that increasing oil and gas divestment pledges in a country are associated with lower capital flows to domestic oil and gas companies. This effect is enhanced in more stringent environmental policy regimes and diminished in countries which heavily subsidise fossil fuels. However, the divestment movement may have an unintended effect, insofar as domestic banks situated in countries with high divestment commitments and stringent environmental policies provide more finance to oil and gas companies abroad. We explain these findings through the lens of institutional theory and show how both regulatory and socially normative elements of institutions shape this dynamic.

## Partners

- University College Dublin

## Journal

Journal of Economic Geography

## Date of Publication

21 December 2020

## Link

<https://doi.org/10.1093/jeg/lbaa027>

## Title

An Analytical EM Algorithm for Sub-Gaussian Vectors

## Authors

Audrius Kabašinskas, Leonidas Sakalauska, Ingrida Vaičiulytė

## Abstract

The area in which a multivariate  $\alpha$ -stable distribution could be applied is vast; however, a lack of parameter estimation methods and theoretical limitations diminish its potential. Traditionally, the maximum likelihood estimation of parameters has been considered using a representation of the multivariate stable vector through a multivariate normal vector and an  $\alpha$ -stable subordinator. This paper introduces an analytical expectation maximization (EM) algorithm for the estimation of parameters of symmetric multivariate  $\alpha$ -stable random variables. Our numerical results show that the convergence of the proposed algorithm is much faster than that of existing algorithms. Moreover, the likelihood ratio (goodness-of-fit) test for a multivariate  $\alpha$ -stable distribution was implemented. Empirical examples with simulated and real world (stocks, AIS and cryptocurrencies) data showed that the likelihood ratio test can be useful for assessing goodness-of-fit.

## Partners

- Kaunas University of Technology

## Journal

Mathematics

## Date of Publication

23 April 2021

## Link

<https://doi.org/10.3390/math9090945>



## Title

Adaptive Seriational Risk Parity' and other Extensions for Heuristic Portfolio Construction using Machine Learning and Graph Theory

## Authors

Markus Jaeger; Stephan Krügel; Jochen Papenbrock; Peter Schwendner

## Abstract

In this article, the authors present a conceptual framework named 'Adaptive Seriational Risk Parity' (ASRP) to extend Hierarchical Risk Parity (HRP) as an asset allocation heuristic. The first step of HRP (quasi-diagonalization) determining the hierarchy of assets is required for the actual allocation in the second step of HRP (recursive bisectioning). In the original HRP scheme, this hierarchy is found using the single-linkage hierarchical clustering of the correlation matrix, which is a static tree-based method. The authors of this paper compare the performance of the standard HRP with other static and also adaptive tree-based methods, but also seriation-based methods that do not rely on trees. Seriation is a broader concept allowing to reorder the rows or columns of a matrix to best express similarities between the elements. Each discussed variation leads to a different time series reflecting portfolio performance using a 20-year backtest of a multi-asset futures universe. An unsupervised representation learning based on this time series data creates a taxonomy that groups the strategies in high correspondence to the structure of the various types of ASRP. The performance analysis of the variations shows that most of the static tree-based alternatives of HRP outperform the single linkage clustering used in HRP on a risk-adjusted basis. Adaptive tree methods show mixed results and most generic seriation-based approaches underperform.

## Partners

- Firamis
- Zurich University of Applied Sciences

## Journal

Journal of Financial Data Science

## Date of Publication

Forthcoming

## Link

<https://ssrn.com/abstract=3806714>

## Title

Neural network middle-term probabilistic forecasting of daily power consumption

## Authors

Roberto Baviera and Michele Azzone

## Abstract

Middle-term horizon (months to a year) power consumption prediction is a major challenge in the energy sector, particularly when probabilistic forecasting is considered. We propose a new modeling approach that incorporates trend, seasonality and weather conditions as explicative variables in a shallow neural network with an autoregressive feature. Applying it to the daily power consumption in New England, we obtain excellent results for the density forecast on the one-year test set. We verified the quality of the power consumption probabilistic forecasting achieved not only by comparing the results with other standard models for density forecasting but also by considering measures that are frequently used in the energy sector, such as the pinball loss function and confidence interval backtesting.

## Partners

- Polytechnic University of Milan

## Journal

Journal of Energy Markets

## Date of Publication

02 March 2021

## Link

<https://doi.org/10.21314/JEM.2020.216> <https://arxiv.org/abs/2006.16388>

# Title

New contributions for the comparison of community detection algorithms in attributed networks

# Authors

Ana Rita Vieira, Pedro Campos, Paula Brito

# Abstract

Community detection techniques use only the information about the network topology to find communities in networks. Similarly, classic clustering techniques for vector data consider only the information about the values of the attributes describing the objects to find clusters. In real-world networks, however, in addition to the information about the network topology, usually there is information about the attributes describing the vertices that can also be used to find communities. Using both the information about the network topology and about the attributes describing the vertices can improve the algorithms' results. Therefore, authors started investigating methods for community detection in attributed networks. In the past years, several methods were proposed to uncover this task, partitioning a graph into sub-graphs of vertices that are densely connected and similar in terms of their descriptions. This article focuses on the analysis and comparison of some of the proposed methods for community detection in attributed networks. For that purpose, several applications to both synthetic and real networks are conducted. Experiments are performed on both weighted and unweighted graphs. The objective is to establish which methods perform generally better according to the validation measures and to investigate their sensitivity to changes in the networks' structure and homogeneity.

# Partners

- INESCITEC

# Journal

Journal of Complex Networks

# Date of Publication

13 December 2021

## Link

<https://doi.org/10.1093/comnet/cnaa044>