

Deliverable information

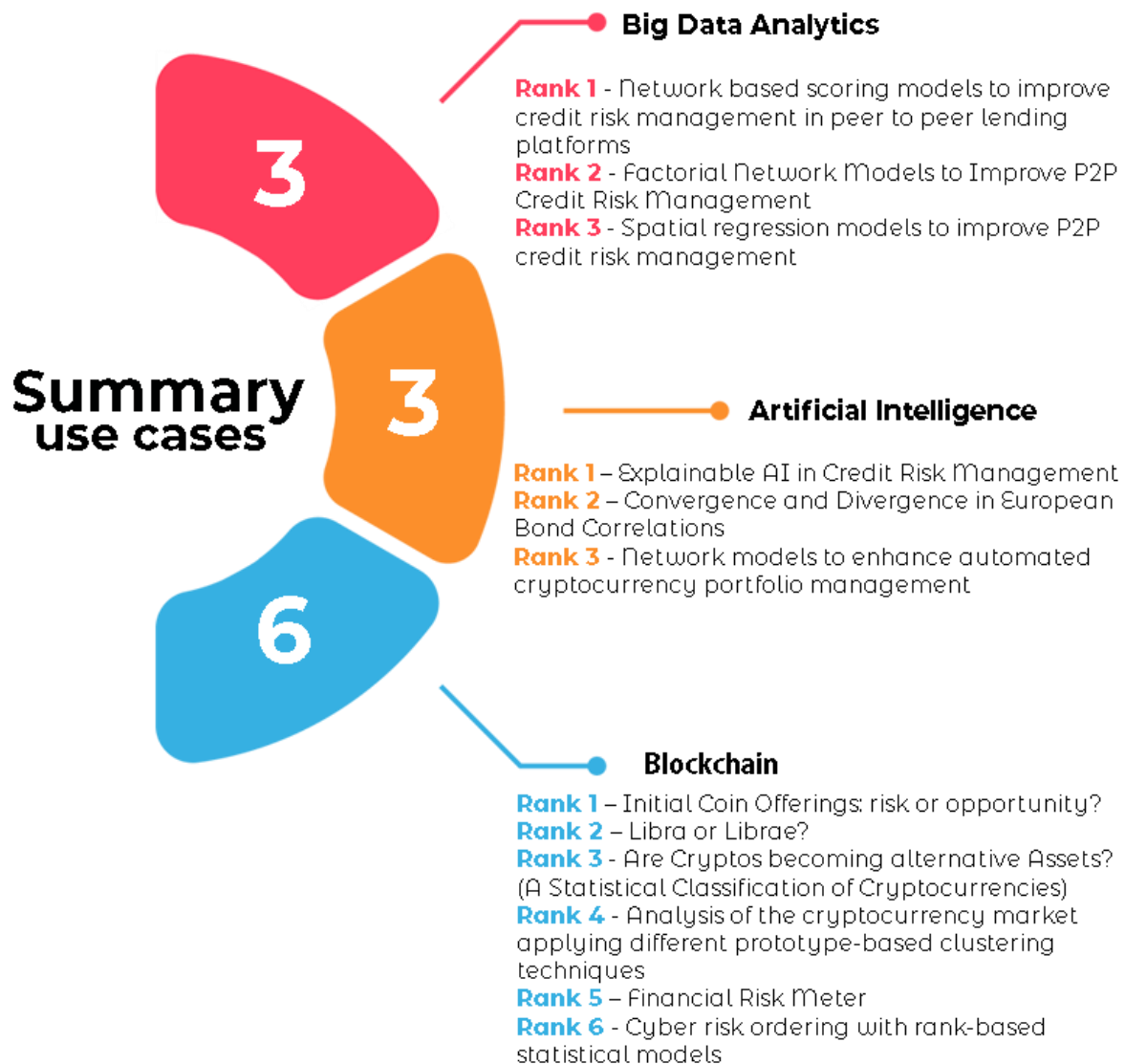
WP NO.	WP 7
DEL.	D7.7
DEL. NO.	D25
TITLE	Final evaluation Report
DESCRIPTION	ASE Bucuresti, based on the information received from all partners, will provide a final evaluation report on the risk management methodologies developed in the project, based on all received feedbacks, from supervisors, fintechs and banks. This includes the feedbacks collected from the participants to SupTech and RegTech workshops.
NATURE	Report
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Document information

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This deliverable D7.7 will be organized on the following topics:

- **Methodologies for BDA (Big Data Analytics) – use cases** (3 dimensions: Explainability / Predictive Accuracy / Utility)
- **Methodologies for AI (Artificial Intelligence) – use cases** (3 dimensions: Explainability / Predictive Accuracy / Utility)
- **Methodologies for BC (Blockchain) – use cases** (3 dimensions: Explainability / Predictive Accuracy / Utility)
- **Interactions with other EU projects and Cost Action**

1. Methodologies developed for BDA – Use Cases.

1.1. Use Case 1 - Network based scoring models to improve credit risk management in peer to peer lending platforms

Brief description of the Use Case:

Financial intermediation has changed extensively over the course of the last two decades. One of the most significant change has been the emergence of Fintech. In the context of credit services, Fintech peer to peer lenders have introduced many opportunities, among which improved speed, better customer experience and reduced costs. However, peer-to-peer lending platforms lead to higher risks, among which higher credit risk: not owned by the lenders, and systemic risks: due to the high interconnectedness among borrowers generated by the platform. This calls for new and more accurate credit risk models to protect consumers and preserve financial stability. In this paper we propose to enhance credit risk accuracy of peer-to-peer platforms by leveraging topological information embedded into similarity networks, derived from borrowers' financial information. Topological coefficients describing borrowers' importance and community structures are employed as additional explanatory variables, leading to an improved predictive performance of credit scoring models.

- ✓ 29 of Suptech events where the Use Case was presented.
- ✓ 1 Regtech + 3 Spin-offs events where the Use Case was presented.
- ✓ Best Use Case: 152 votes, considered best use case in BDA pillar.

Main points of received feedback and future developments of the Use Case

- The proposed methodology is innovative and can help the process of credit scoring.
- The use case identifies an approach for improving the predictive utility of credit risk models that is also practical. Often there is a trade-off between model complexity and usability. Most financial intermediaries are not willing to fundamentally change their approach or IT setting for slight improvements in predictive power.
- The use case presents a methodology founded in the traditional approaches already in place while at the same time improves predictive utility.
- ✓ The model is highly influenced by the methodology and data used to estimate the network of borrowers. Information on the financial flows existing between platforms' agents should be used to derive the underlying network.
- ✓ The prime focus on the case is to propose a novel methodology for credit scoring, drawing on concepts from graph theory, that would improve the predictive accuracy of the model. In addition to accuracy, regulators are becoming increasingly concerned about models' transparency and explain-ability. In this context, the work has been extended through the

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application of post-hoc explain-ability techniques that provide insights into the marginal impact of the input features to the model's predictions.

1.2. Use Case 2 - Factorial Network Models to Improve P2P Credit Risk Management

Brief description of the Use Case:

This use case investigates how to improve statistical-based credit scoring of SMEs involved in P2P lending. The methodology discussed in the use case is a factor network-based segmentation for credit score modeling. The approach first constructs a network of SMEs where links emerge from co-movement of latent factors, which allows us to segment the heterogeneous population into clusters. We then build a credit score model for each cluster via lasso logistic regression. We compare our approach with the conventional logistic model by analyzing the credit score of over 15000 SMEs engaged in P2P lending services across Europe. The result reveals that credit risk modeling using our network-based segmentation achieves higher predictive performance than the conventional model.

- ✓ 29 of Suptech events where the Use Case was presented.
- ✓ 1 Regtech event where the Use Case was presented.
- ✓ Best Use Case: 98 votes received and ranked second in the BDA pillar

Main points of received feedback and future developments of the Use Case

- A new approach that can improve statistical-based scoring for SMEs participating in a P2P system.
- By identifying separate clusters of SMEs (derived on the basis of the similarities of their financial characteristics), the approach can be used by any financial intermediary to build high-performing credit scoring models for each sub-population.
- The approach is practical as it draws on established methods already used by financial intermediaries for the task of credit scoring.
- ✓ The approach currently identifies only two sub-populations of connected and not-connected companies. The approach can be improved by considering higher number of clusters.
- ✓ The underlining networks are highly influenced by the information used to derive the latent factors. Augmenting the data set used can lead to different conclusions and provide further evidence of the usefulness of the approach.
- ✓ The practicality of the approach is also depended on the number of borrowers included in the dataset so its practicality can be affected by increasing the sample size.

1.3. Use Case 3 - Spatial regression models to improve P2P credit risk management

Brief description of the Use Case:

Calabrese et al. (2017) have shown how binary spatial regression models can be exploited to measure contagion effects in credit risk arising from bank failures. To illustrate their methodology, the authors of the use case have employed the Bank for International Settlements' data on flows between country banking systems. Here we apply a binary spatial regression model to measure contagion effects arising from corporate failures. To derive interconnectedness measures, we use the World Input-Output Trade (WIOT) statistics between economic sectors. Our application is based on a sample of 1185 Italian companies. We provide evidence of high levels of contagion risk, which increases the individual credit risk of each company.

- ✓ 29 of Suptech events where the Use Case was presented:

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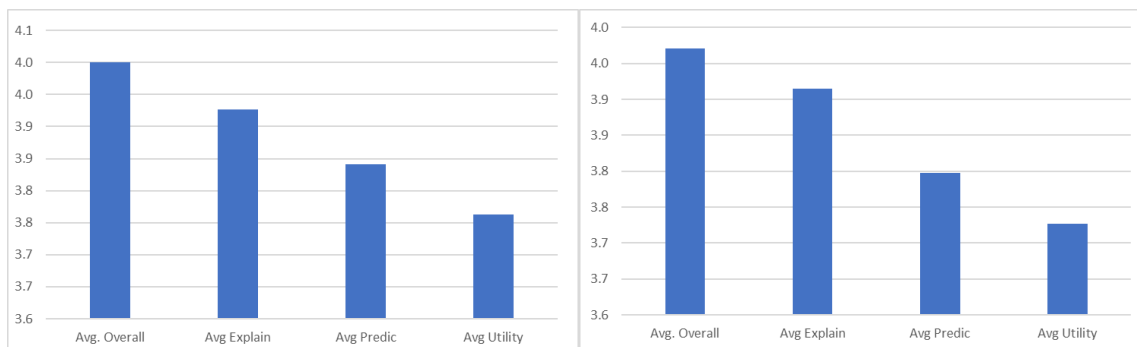
- ✓ 1 Regtech where the Use Case was presented:
- ✓ Best Use Case: 79 votes received, ranked third in the BDA pillar

Main points of received feedback and future developments of the Use Case

- The methodology is quite intensive in terms of code run time – for real world usability this would likely need to be improved to have reasonable run time of analysis.
- Some more graphical insights might also be useful to illustrate nodes in the network that are 'riskier'.
- More details on policy implications for supervisors / regulators should be added.
- ✓ An initial step would be to search for methodological / computing solutions to the code run times when handling large data.
- ✓ More consideration on what are the implications for supervisors or regulators to better inform policy.

Overall rating of BDA Use Cases:

Average evaluations for BDA Suptechs – all evaluations/without Consortium Partners



Main Open feedback received from the Participants to Suptech events and other Stakeholders:

The Big Data Analytics use cases were appreciated by the majority of the attendees as being interesting materials which bring under scrutiny interesting approaches. Some participants mentioned that the workshop was useful in giving context and details about analytics to the audience and also very useful information about risk models.

The audience appreciated also the presentation of the R code and the use of R. This aspect was appreciated by the more technical participants and on the other hand was sometimes considered a minus by the non-technical members of the audience.

One other strong point identified by the attendees was the fact that the BDA workshops contributed to structuring the critical thinking about the credit risk aspects.

On the other hand, participants signaled that the Workshops and therefore the use cases should have been developed more in the direction of practical examples. Being too theoretical and without too much straightforward practical utility for the supervisors and for the regulators was another aspect mentioned by the participants. Some have expressed the desire to see a lower focus on the technical mathematical and statistical aspects and more discussions on the practical implications of the results and of the findings of the use cases.

Another positive aspect identified by the participants for some workshops was related to the introductory materials prepared by some partners (materials related to R, statistical concepts and methods, risk measures, etc).

2. Methodologies developed for AI – Use Cases.

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2.1. Use Case 1 - Network models to enhance automated cryptocurrency portfolio management

Brief description of the Use Case:

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 over-performs several competing alternatives, maintaining a relatively low level of risk.

18 of Suptech events where the Use Case was presented.

2 Regtech + 4 Spin-off events where the Use Case was presented.

Best Use Case: received 27 nominations and was ranked third.

Main points of received feedback and future developments of the Use Case

- Regulators, academics and fintechs liked the approach and the application, and they have suggested to test it into hybrid portfolios
- Some people in the audience wanted to know more about cryptocurrencies themselves and how to invest in such innovative financial technologies
- Observations on the use of different network centralities were made
- ✓ the use of different modelling paradigms for asset network importance (spillover measures, Bayesian graphical models, etc.)
- ✓ the use of different approaches complementary or alternative to the Markowitz portfolio, such as higher-moments portfolio allocation
- ✓ the extension to hybrid portfolio, composed of alternative assets and cryptocurrencies

2.2. Use Case 2 - Convergence and Divergence in European Bond Correlations

Brief description of the Use Case:

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.

21 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 59 nominations and was ranked second.

Main points of received feedback and future developments of the Use Case

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- It was presented at about 20 international conferences and workshops in Europe and at the IMF in Washington.
- The use case paper was cited in the technical appendix «Contribution of Greek financial assistance programs to reduce spillover risks» of the report «Lessons from Financial Assistance to Greece» from the Independent Evaluator Joaquín Almunia on the ESM programme and at the ESM blog.
- In general, practitioners with financial market experience pointed out the usefulness of the tool to extract the statistically significant correlation influences for synchronous cross-sectional bond market movements and the possible application of the tool to deliver a risk signal for cross-sectional market divergence.
- ✓ Linking the resulting correlation influences to specific news events.
- ✓ Linking the resulting correlation influences to a quantitative indicator of news sentiment.
- ✓ Linking the resulting correlation influences to a VAR scheme for (co)-variance propagation across time using a lead-lag relationship that enables a causal analysis.

2.3. Use Case 3 - Explainable Machine Learning in Credit Risk Management

Brief description of the Use Case:

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 behavior.

12 of Suptech events where the Use Case was presented.

1 Regtech + 5 Spin-off events where the Use Case was presented.

Best Use Case: received 67 nominations and was ranked first.

Main points of received feedback and future developments of the Use Case

- Larger realistic data set
- Tool for workflow guidance to support a larger range of use cases emerging from the initial XAI approach
- ✓ Initiating and leading a project on trustworthy, explainable AI in the GAIA-X Finance & Insurance Data Space where the XAI use case is included and further developed
- ✓ Transforming the XAI use case to applications in asset management and publishing them in journals.
- ✓ A team of NVIDIA engineers improved the use case in several directions: much larger data set of millions of records (more realistic size of real-world problems), GPU-acceleration for considerable speed-up of computation time for use in real business, interactive visualizations and dashboards to support a larger range of use cases
- ✓ Presentation of the XAI use case and its main idea at numerous events, including the global GTC21.

2.4. Other proposed Use Cases presented in Suptechs but discarded from the final list of Use Cases

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2.4.1. Sovereign Risk Zones in Europe During and After the Debt Crisis

Brief description of the Use Cases:

Authors: Veni Arakelian, Petros Dellaportas, Roberto Savona and Marika Vezzoli

We employ a machine learning approach to build a European sovereign risk stratification using macroeconomic fundamentals and contagion measures, proxied by copula-based credit default swap (CDS) dependencies over the period 2008-2017, for France, Germany, Greece, Ireland, Italy, Portugal, and Spain. By adopting a recursive, partitioning strategy we detect specific risk zones varying from safe to high risk based on key predictors, and we construct their specification by assigning specific risk thresholds. While key macroeconomic fundamentals such as Debt/GDP and the unemployment rate remained the same and maintained the same risk thresholds during the sub-periods 2008-2013 and 2013-2017, the CDS spreads contagion dropped significantly over the post-Quantitative Easing years, lowering the corresponding risk thresholds. We estimate an impact on CDS spreads approximately of \$-105\$ basis points in the period 2013-2017 due to contagion mitigation.

Main points of received feedback and future developments of the Use Case

- Apply it also to other assets (e.g. stocks, bonds, mutual funds).
- ✓ Work should be done to modify the model to be used for asset allocation. In addition, to apply it to mutual funds, research should be conducted to identify the exogenous variables used at the random forest.

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

Brief description of the Use Cases:

Authors: Audrius Kabašinskas, Kristina Šutienė, Miloš Kopa, Kęstutis Lukšys and Kazimieras Bagdonas
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 Use Case, the second-pillar pension funds operating in Lithuania and Slovakia were 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.

Main points of received feedback and future developments of the Use Case

- The first recommendation (after presentation to Estonian supervisor) was to extend the scale of research and show how pension funds in Baltic States could be ranked. This was done and for Latvian and Lithuanian supervisors the extended version was presented. However, this improvement was not published in the paper.

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- As the calculation time of third order Stochastic Dominance is extremely dependant on selection of probability distribution the second recommendation was to reduce calculation time
- Third recommendation was to show how the proposed technique could be useful in portfolio management
- One more recommendation is related to fundamental research in field of multivariate Stochastic Dominance
- The decisions taken by the approach requires explainability, i. e. what are the reasons why some funds have been ranked high or low.
- The probability or confidence level of provided estimates for pension funds
- The recommendations for practical implementation such as how often calculations should be updated, what is the minimum data sample required, sensitivity analysis
- ✓ The prosed “ratio” was not perfect and required improvement because the meaning of it was a little bit misleading. This is now corrected and will be introduced in new paper that we plan to submit by the end of August 2021
- ✓ Moreover, we plan to extend the scale of instruments used and show how to use SD ratio to rank crypto-currencies.
- ✓ Robustness and Sensitivity analysis under some economic and financial developments should be done
- ✓ Use of some explainability technique to interpret obtained solutions

2.4.3. Individual Machine Learning-based Robo Advisory Portfolio Strategy Selection

Brief description of the Use Cases:

Authors: Ronald Hochreiter

We examine the problem of portfolio optimization in a contemporary and dynamic Robo-Advisory asset allocation framework to allow for further studies of the market risk impact if Robo-Advisory becomes mainstream. The question of how to optimally match various mid-term and long-term expectations of individuals using interpretable Machine Learning methods on top of various classical portfolio selection methods from Finance and OR, e.g. optimization-based risk modelling is considered. The main task is to enable individualized strategies for each client while allowing to combine each individual strategy easily into the tactical asset allocation of the investment company and is additionally accepted by the respective financial regulator.

Main points of received feedback and future developments of the Use Case

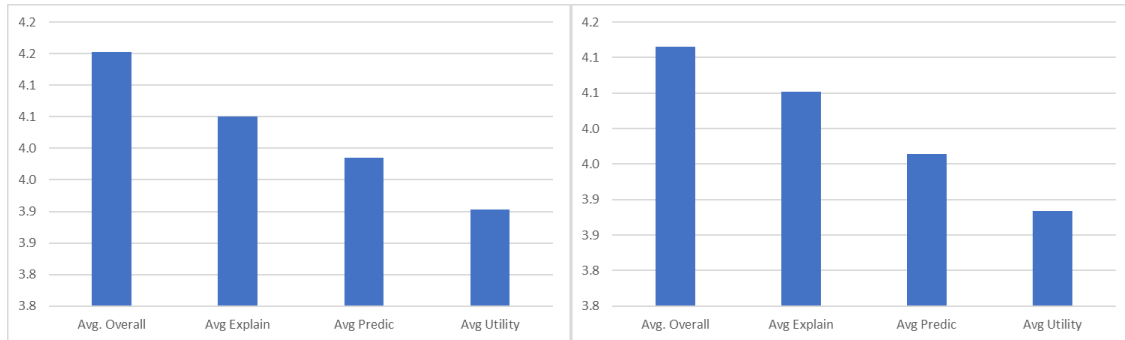
- All stakeholders are covered by the use case which makes the use case broadly useable
- Great to see what is possible in contemporary Robo Advisory using ML
- Might be even interesting to use for ESG purposes
- ✓ Explain the Machine Learning concepts behind the use-case in more detail
- ✓ Provide a rather complete simulation framework for regulators (not included now)
- ✓ Add a Machine Learning model comparison

Overall rating of AI Use Cases:

Average evaluations for AI Suptechs – all evaluations/without Consortium Partners

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Main Open feedback received from the Participants to Suptech events and other Stakeholders:

The XAI use case was appreciated by the majority of the audience of the Suptechs as being very interesting and useful and as focusing on one of the most important topics of the moment from the perspective of regulations and supervision. Another use case considered interesting but probably more suitable for central banks than for supervisors of the insurance sector was the FRM. The industry presentations (E.g. EY in Denmark) were considered very useful and interesting by the audience and were considered (where they were included) as an added value to the academic-technical presentation of the use cases.

Also for the Artificial Intelligence Suptechs the audience considered that sometimes the use cases were presented in a too technical manner and the sometimes the slides were not structured to facilitate the understanding for a non-technical audience (too much math).

The topics selected for the use cases were considered as having a high level of relevance and were in line with the important topics of the moment but sometimes more connections with the sector of supervision would have been a plus. These connections would have been very useful and should have been linked with the results and the findings of the papers-use cases. Therefore, a future direction that might be approached in the future is to start with the presented use cases and to go more in depth towards practical usability.

3. Methodologies developed for BC – Use Cases.

3.1. Use Case 1 - Initial Coin Offerings: risk or opportunity?

Brief description of the Use Cases:

Initial coin offerings (ICOs) are one of the several by-products of the cryptocurrencies world. Start-ups and existing businesses are turning to alternative sources of capital as opposed to classical channels like banks or venture capitalists. They can offer the inner value of their business by selling 'tokens', i.e. units of the chosen cryptocurrency, like a regular firm would do by means of an Initial Public Offering (IPO). The investors, of course, hope for an increase in the value of the token in the short term, provided a solid and valid business idea typically described by the ICO issuers in a white paper. However, fraudulent activities perpetrated by unscrupulous actors are frequent and it would be crucial to highlight in advance clear signs of illegal money raising. In this paper, we employ statistical approaches to detect what characteristics of ICOs are significantly related to fraudulent behavior. We leverage a number of different variables like: entrepreneurial skills, Telegram chats and relative sentiment for each ICO, type of business, issuing country, team characteristics. Through logistic regression, multinomial logistic regression and text analysis, we are able to shed light on the riskiest ICOs.

14 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

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Best Use Case: received 111 nominations and was ranked 1

Main points of received feedback and future developments of the Use Case

- The Methodology can be applied to ICO data with different features at disposal
- The results are useful for taking care of particular aspect relative to regulation and investors protection
- Utility relies on taking awareness of asymmetries of information
- Community behaviour proxies through textual analysis are useful for completing the available type of information
- ✓ Main improvement applied during research is the increase of sample
- ✓ The methodology of cross checking data revealed to be useful for fraud confirmation of many cases.
- ✓ The textual mining methodology revealed useful for different applications, such as credit scoring.
- ✓ Analysing features regarding the geopolitical and regulation situation might add a value.
- ✓ Analysing the ex post ICOs performances might be an added value.

3.2. Use Case 2 - Are Cryptos becoming alternative Assets? (A Statistical Classification of Cryptocurrencies)

Brief description of the Use Cases:

This use case provides insights for the separation of cryptocurrencies from other assets. Using dimensionality reduction techniques, we show that most of the variation among cryptocurrencies, stocks, exchange rates and commodities can be explained by tail, moment and memory factors of their log-returns. By applying various classification models, we are able to classify cryptocurrencies as a separate asset class, mainly due to the tail factor. The main result is the complete separation of cryptocurrencies from the other asset types, using the Maximum Variance Components Split method. Additionally, we show that cryptocurrencies tend to exhibit similar characteristics over time and become more distinguished from other asset classes (synchronic evolution).

15 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 41 nominations and was ranked 3rd.

Main points of received feedback and future developments of the Use Case

- The main difference between cryptocurrencies and classical assets, in terms of properties of the distribution of daily log-returns, is the tail behaviour.
- Cryptocurrencies exhibit a synchronic evolution i.e. individual cryptocurrencies develop similar statistical characteristics over time, allowing them to differentiate from classical assets.
- Cryptocurrencies may not be suitable for risk-averse investors, especially in bear market circumstances.
- Because of their high exposure to tail risk, conventional inference based on normal distribution appears to be inappropriate when it comes to the prudential treatment of cryptocurrencies.

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- Furthermore, since the volatility of cryptocurrencies and traditional assets differs by a factor of about 10, cryptocurrencies may require extra attention and monitoring, as their high volatility could jeopardize overall financial stability.
- ✓ In-depth analysis on market risk indicators for cryptocurrencies vs. classical assets.

3.3. Use Case 3 - Libra or Librae? Basket based stable coins to mitigate foreign exchange volatility spillovers

Brief description of the Use Cases:

The use case aims to assess, from an empirical viewpoint, the advantages of a stable-coin whose value is derived from a basket of underlying currencies, against a stable-coin which is pegged to the value of one major currency, such as the dollar. To this aim, we first find the optimal weights of the currencies that can comprise our basket. We then employ volatility spillover decomposition methods to understand which foreign currency mostly drives the others. We then look at how the stability of either stable-coin is affected by currency shocks, by means of VAR models and impulse response functions. Our empirical findings show that our basket based stable-coin is less volatile than all single currencies. This results are fundamental for policy making, and especially for emerging markets with a high level of remittances: a librae (basket based stable coin) can preserve their value during turbulent times better than a libra (single currency based stable coin).

15 of Suptech events where the Use Case was presented.

2 Regtech + 1 Spin-off, events where the Use Case was presented.

Best Use Case: received 47 nominations and was ranked 2nd.

Main points of received feedback and future developments of the Use Case

- The methodology provides a robust statistical framework but more details on economic implications would also be interesting.
- Following on from the previous point, more details on policy implications for supervisors / regulators of the impact of the libra stable-coin.
- ✓ Provide more details on the economics and policy implications of stable-coins.
- ✓ Regarding the methodology, it would be interesting to see it applied to different asset classes to compare various types of stable-coins.
- ✓ Moreover, it would be interesting to do some additional exercises to study how such a mechanism could work in practice.

3.4. Use Case 4 - Financial Risk Meter

Brief description of the Use Cases:

A systemic risk measure is proposed accounting for links and mutual dependencies between financial institutions utilizing tail event information. FRM (Financial Risk Meter) is based on Lasso quantile regression designed to capture tail event co-movements. The FRM focus lies on understanding active set data characteristics and the presentation of interdependencies in a network topology. The FRM indices detect systemic risk at selected areas and identify risk factors. In practice, FRM is applied to the return time series of selected financial institutions and macroeconomic risk factors. We identify

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companies with extreme "co-stress", and "activators" of stress. We present FRM@Americas and FRM@Europe as main examples. With the SRM@EuroArea and the FRM@iT raxx we extend to the government bonds and credit default swaps. We also show FRM-implied recession probabilities to predict recessions. Thereby, FRM indicates tail event behavior in a network of financial risk factors.

11 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 18 nominations and was ranked 5th.

Main points of received feedback and future developments of the Use Case

- Other measures appear more rapid in reaction, e.g. VIX, implied volatility. FRM is backward looking.
- FRM does not perform well for out-of-sample prediction
- The choice of Macro variables must be better explained and verified
- Explain the choice and conduct sensibility tests for different lengths of time window
- Application of FRM risk measure for financial applications beyond the systemic risk prediction
- ✓ A few follow-up projects with application of FRM for different channels were initiated, which take into the account received comments and recommendations. For example:
- ✓ FRM Crypto focuses on out-of-sample testing (e.g. R^2 , volatility of CRIX with different lags)
- ✓ FRM Crypto Conducts Robustness check of results for length of time windows
- ✓ FRM Asia conducts Testing of significance of macroeconomic risk variables in general and for different tau levels, analysis of dynamics and regimes detection for certain macroeconomic variables over time
- ✓ FRM Financial Risk Meter for Emerging Markets utilize FRM network centrality information in Lopez DePrado HRP-spirit portfolio allocation strategies
- ✓ A new portfolio allocation framework: Tail-event co-movement portfolio construction (TEC) utilizes FRM as a risk measure in Markowitz optimization problem

3.5. Use Case 5 - Analysis of the cryptocurrency market applying different prototype-based clustering techniques

Brief description of the Use Cases:

Since the appearance of Bitcoin, cryptocurrencies have experienced enormous growth not only in terms of capitalization but also in number. As a result, the cryptocurrency market can be an attractive arena for investors as it offers many possibilities, but a difficult one to understand as well. In this work, we aim to summarize and segment the whole cryptocurrency market in 2018 with the help of data analysis tools. We will use three different partitional clustering algorithms each of them using a different representation for cryptocurrencies, namely: yearly mean and standard deviation of the returns, distribution of returns, and time series of returns. Since each representation will provide a different and complementary perspective of the market, we will also explore the combination of the three clustering results to obtain a fine-grained analysis of the main trends of the market. Finally, we will analyse the association of the clustering results with other descriptive features of the cryptocurrencies, including the age, technological attributes, and financial ratios derived from them. This will help to enhance the profiling of the clusters with additional insights. As a result, this work offers a description of the market and a methodology that can be reproduced by investors that want to understand the main trends on the market

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7 of Suptech events where the Use Case was presented.
2 Regtech events where the Use Case was presented.
Best Use Case: received 22 nominations and was ranked 4th.

Main points of received feedback and future developments of the Use Case

- The regulators were interested in understanding the details of the implementation and the three-fold perspective obtained from analysing the first moments, the histogram and the time series was appreciated.
- The feedback of regulators also mentioned that it was a timely topic as regulators are setting up the 'dashboards' to monitor the crypto market.
- The approach on the study rely mostly on data mining techniques but actually many of the considered crypto assets has no interest from financial perspective as they cannot be directly traded on the market so it should be interesting to gather the findings more focus on the cryptocurrencies interesting from an investor perspective.
- ✓ Update the study using a more extended time window verifying the robustness or persistence on the associations in a dynamic way.
- ✓ Show how the clustering results could be used in a risk management or investment strategy. For example, how to use the information from the identified clusters for market risk estimation, for regulatory purposes or portfolio optimization in the cryptocurrency market.
- ✓ Apply the findings of the investigation to improve the performance of prediction models

3.6. Use Case 6 - Cyber risk ordering with rank-based statistical models

Brief description of the Use Cases:

In a world that is increasingly connected on-line, cyber risks become critical. Cyber risk management is very difficult; as cyber loss data are typically not disclosed. To mitigate the reputational risks associated with their disclosure, loss data may be collected in terms of ordered severity levels. However, to date, there are no risk models for ordinal cyber data. We fill the gap, proposing a rank-based statistical model aimed at predicting the severity levels of cyber risks. The application of our approach to a real-world case shows that the proposed models are, while statistically sound, simple to implement and interpret.

10 of Suptech events where the Use Case was presented.
2 Regtech events where the Use Case was presented.
Best Use Case: received 16 nominations and was ranked 6th.

Main points of received feedback and future developments of the Use Case

- extension of the proposed approach to additional machine learning models different from our proposed rank regression model when dealing with cyber data expressed according to ordinal levels describing the severity degree of cyber-attacks;
- extension of the proposed approach also to data expressed into a continuous scale (if available) and expressing the monetary losses caused by the occurrence of cyber-attacks.
- ✓ comparison with other explainable artificial intelligence methods (LIME, etc.), in addition to the standard Shapley value-based approach;
- ✓ application of the proposed approach to real cyber loss data expressed in terms of monetary losses (if available);

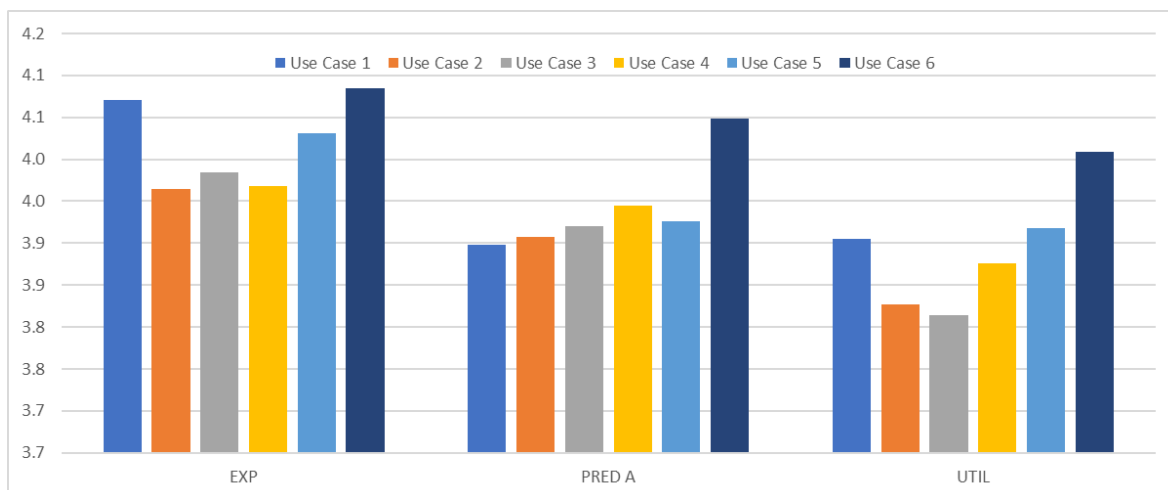
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- ✓ further investigation about the main properties associated with our approach (accurately predictive, explainable and robust) when implemented to data characterised by continuous nature rather than ordinal nature.

Overall rating of BC Use Cases:

Average evaluations for BC Suptechs – all evaluations/without Consortium Partners



Main Open feedback received from the Participants to Suptech events and other Stakeholders:

Basic presentation about blockchain technology are a very important plus for the non-technical audience activating in the field. Sometimes the basic information is much more useful than the very complex mathematical/statistical models for the understanding of the problem. The use cases should be presented less theoretical with a greater focus on the result and on their practical implications. Important added value would come from more interactions with the industry. More practical cases would have been a plus. Sometimes the explanations and the models presented are too technical. Sometimes simpler explanations from practitioners would have been a real plus. Sometimes the use cases seemed to be more work in progress than final conclusions and results. Therefore, would be very interesting to see further developments. Information about the cryptocurrencies are useful and increase the general knowledge. Presentation of the Ethereum is very informative. Fraud detection mechanism and initial coin offerings topics are of an increased interest. More information about cyber security and crypto-crimes would be of interest. More details about the smart contracts would be of interest. More information on the legal side and maybe the legal implications of the problem would be of high interest for the regulators and supervisors. Security related aspects would be very interesting to discuss in future events.

Interactions with other projects and Cost Action project

One important unintended output of the project is the **Cost Action 19130 - Fintech and Artificial Intelligence in Finance - Towards a transparent financial industry**. The Cost Action was created on the backbone of the Fintech Horizon 2020 project. The CA enlarges the network and is currently the largest Cost Action Network. The CA also takes also one of the pillars of the Fintech Horizon 2020 project and further develops it - <https://fin-ai.eu/>

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During the project we have also worked together with other Horizon2020 initiatives. Cybersecurity in Finance 30 October 2020: Fintech has been joined by several other H2020 projects tackling cybersecurity, including **SOTER, CRITICAL-CHAINS, FINSEC, CyberSec4Europe, CONCORDIA and SPARTA (CAPE Programme)**, to exchange knowledge, lessons learned and best practices on cybersecurity with a focus on the financial sector. The joint virtual event was attended by 80 participants.

Recent Security Advances in the Finance Sector 4 January 2021. The event has been an online training workshop on finance with the aim of understanding better the main security challenges faced nowadays by financial organizations and the newest solutions available to tackle them. The workshop stimulated a discussion about novel approaches in risk assessment and mitigation and help understand the role of leading technologies like Artificial Intelligence and Machine Learning in the resilience of financial institutions. During the workshop, H2020 projects SOTER, FIN-SEC and FIN-TECH presented their research on cybersecurity in the finance sector. The joint virtual event was attended by 50 participants.

Big Data Analytics - Final assessment of the methodologies presented in the Use Cases

The Big Data Analytics use cases were appreciated as being interesting materials which bring under scrutiny interesting approaches. The presentations were useful in giving context and details about analytics to the audience and very useful information about risk models.

A strong point is presentation of the R code and the use of R. This aspect was appreciated by the more technical participants to the workshops and on the other hand was sometimes considered a minus by the non-technical members of the audience.

One other strong point identified by the workshops attendees was the fact that the BDA workshops contributed to structuring the critical thinking about the credit risk aspects.

On the other hand, participants signaled that the Workshops and therefore the use cases should have been developed more in the direction of practical examples. Being too theoretical and without too much straightforward practical utility for the supervisors and for the regulators was another aspect mentioned by the participants. Some have expressed the desire to see a lower focus on the technical mathematical and statistical aspects and more discussions on the practical implications of the results and of the findings of the use cases.

Another positive aspect identified by the participants for some workshops was related to the introductory materials prepared by some partners (materials related to R, statistical concepts and methods, risk measures, etc.).

Another layer of feedback points out the idea to have an overview over a larger set of cases, especially as the cases were almost all centered around P2P lending, which is interesting but a restricted topic. Thorough understanding of modeling process is needed in managing the model risk related to nontraditional (AI or data driven) fintech models. Since the artificial intelligence affects insurance and financial sector in really many ways – speed and video recognition and statistical modelling will be (or are already) used. Ethical and legal aspects must be considered in early stage when introducing a new AI process and these would be of interest for supervisors. Two main directions are of interest: 1) AI technologies and 2) graphical illustrations of dependences between different processes powered by technology.

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Artificial Intelligence - Final assessment of the methodologies presented in the Use Cases

The XAI use case was appreciated by the majority of the audience of the Suptechs as being very interesting and useful and as focusing on one of the most important topics of the moment from the perspective of regulations and supervision. The topic was considered very useful and interesting by the audience and seen as an added value to the academic-technical presentation of the use cases.

Also for the Artificial Intelligence Suptechs the audience considered that sometimes the use cases were presented in a too technical manner.

The topics selected for the use cases were considered as having a high level of relevance and were in line with the important topics of the moment but sometimes more connections with the sector of supervision would have been a plus. These connections would have been very useful and should have been linked with the results and the findings of the papers-use cases. Therefore, a future direction that might be approached in the future is to start with the presented use cases and to go more in depth towards practical usability.

The general feedback points out on the use of various machine learning models (e.g. for Robo Advisory) and comparison with classical statistical tools.

Also, a larger realistic data set is required, and to initiate a project on trustworthy, explainable AI in the GAIA-X Finance & Insurance Data Space where the XAI use case is included and further developed.

Blockchain technologies - Final assessment of the methodologies presented in the Use Cases

Basic presentation about blockchain technology is a very important plus for the non-technical audience activating in the field. Sometimes the basic information is much more useful than the very complex mathematical/statistical models for the understanding of the problem. The use cases should be presented less theoretical with a greater focus on the result and on their practical implications.

Important added value would come from more interactions with the industry. More practical cases would have been a plus. Sometimes the explanations and the models presented are too technical. Sometimes simpler explanations from practitioners would have been a real plus.

Information about the cryptocurrencies are useful and increase the general knowledge. Fraud detection mechanism, initial coin offerings, cyber security and crypto-crimes, smart contracts topics are of an increased interest. More information on the legal side and maybe the legal implications of the problem would be of high interest for the regulators and supervisors, also the security related aspects. In-depth analysis on market risk indicators for cryptocurrencies vs. classical assets would be beneficial.

Feedback received from various stakeholders points out to that the use cases could benefit from using additional machine learning models and explainable artificial intelligence methods. The use cases have a robust statistical framework but more details on economic implications would also be interesting. Also, the stakeholders would like to see more details on policy implications for supervisors / regulators.