Machine learning of emerging markets in pandemic times

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Abstract. This is an introductory text to a collection of selected papers from the M3E2 2020 Summer: The Special Edition of International Conference on Monitoring, Modeling & Management of Emergent Economy, which was held in Odessa, Ukraine, on the July 13-18, 2020. It consists of short introduction and some observations about the event and its future.

Keywords: machine learning, prediction of emergent economy dynamics, COVID-19.

1   M3E2 2020 Summer at a glance

Monitoring, Modeling & Management of Emergent Economy (M3E2) is a peer-reviewed international conference focusing on research advances and applications of nonlinear dynamics methods, econophysics and complex systems methodology of emergent economy.

The M3E2 Conference occupies contributions in all aspects of Computational Finance, Economics, Risk Management, Statistical Finance, Trading and Market Microstructure, (Deep) Machine Learning technologies and tools, paradigms and models, relevant to modern financial engineering and technological decisions in the

modern age. There is urgent general need for principled changes in postclassic economy elicited by current models, tools, services, networks and IT communication.

M3E2 topics of interest since 2019 [15]:

— Complex cyberphysical systems, synergy, econophysics, economy of agents.
— Mathematical methods, models, informational systems and technologies in economics.
— Monitoring, modeling, forecasting and preemption of crisis in socio-economic systems.
— Models of global transformations.
— Experimental economics.
— The dynamics of emergent markets in post crisis period.
— Management of the state's economic safety and economic safety of economic agents.
— Modeling of hospitality sphere development.
— Prioritized ways of formation of the innovation model of Ukrainian economical development.
— The Global Challenges for Economic Theory and Practice in CEE Countries.
— (Deep) Machine Learning for prediction of emergent economy dynamics.
— Risk Management models in emergent economy.

This volume contains the selected papers presented at M3E2 2020 Summer: The Special Edition of International Conference on Monitoring, Modeling & Management of Emergent Economy held on July 13-18, 2020 in Odessa, Ukraine (fig. 1, 2, 3).

Fig. 1. Joint photo of conference participants: the national quarantine is ended?

There were 45 submissions selected. Each submission was reviewed by at least 2, and on the average 2.3, program committee members. The committee decided to accept 23 papers.

Fig. 2. Dr. Hanna Danylchuk and Prof. Vladimir Soloviev: the social distancing during talk on modelling of cryptocurrency market using fractal and entropy analysis in COVID-19 [3].

2   Proceedings overview

The article "Recurrence plot-based analysis of financial-economic crashes" [22] of Vladimir Soloviev, Oleksandr Serdiuk, Serhiy Semerikov and Arnold Kiv (fig. 3) considers the possibility of analyzing the dynamics of changes in the characteristics of time series obtained on the basis of recurrent plots. The possibility of using the studied indicators to determine the presence of critical phenomena in economic systems is considered. Based on the analysis of economic time series of different nature, the suitability of the studied characteristics for the identification of critical phenomena is assessed. The description of recurrent diagrams and characteristics of time series that can be obtained on their basis is given. An analysis of seven characteristics of time series, including the coefficient of self-similarity, the coefficient of predictability, entropy, laminarity, is carried out. For the entropy characteristic, several options for its calculation are considered, each of which allows the one to get its own information about the state of the economic system. The possibility of using the studied characteristics as precursors of critical phenomena in economic systems is analyzed. Authors demonstrated that the entropy analysis of financial time series in phase space reveals the characteristic recurrent properties of complex systems. The recurrence entropy methodology has several advantages compared to the traditional recurrence entropy defined in the literature, namely, the correct evaluation of the chaoticity level of the signal, the weak dependence on parameters. The characteristics were studied on the basis of daily values of the Dow Jones index for the period from 1990 to 2019 and daily values of oil prices for the period from 1987 to 2019. The behavior of recurrent entropy during critical phenomena in the stock markets of the USA, Germany and France was studied separately. As a result of the study, it was determined that delay time measure, determinism and laminarity can be used as indicators of critical phenomena. It turned out that recurrent entropy, unlike other entropy indicators of

complexity, is an indicator and an early harbinger of crisis phenomena. The ways of further research are outlined.

Fig. 3. Prof. Vladimir Soloviev and Prof. Arnold Kiv: the social distancing during talk on recurrence plot-based analysis of financial-economic crashes [22].

The article "Casual analysis of financial and operational risks of oil and gas companies in condition of emergent economy" [14] of Inesa Khvostina, Serhiy Semerikov, Oleh Yatsiuk, Nadiia Daliak, Olha Romanko and Ekaterina Shmeltser is devoted to control the risk that accompanies businesses in their day-to-day operations, and at the same time changing economic conditions make risk management an almost indispensable element of economic life. Selection of the main aspects of the selected phases of the risk management process: risk identification and risk assessment are related to their direct relationship with the subject matter (risk identification to be managed; risk analysis leading to the establishment of a risk hierarchy, and, consequently, the definition of risk control' methods) and its purpose (bringing the risk to acceptable level). It is impossible to identify the basic patterns of development of the oil and gas industry without exploring the relationship between economic processes and enterprise risks. The latter are subject to simulation, and based on models it is possible to determine with certain probability whether there have been qualitative and quantitative changes in the processes, in their mutual influence on each other, etc. The work is devoted to exploring the possibilities of applying the Granger test to examine the causal relationship between the risks and obligations of oil and gas companies. The analysis is based on statistical tests and the use of linear regression models.

The article "Complex networks theory and precursors of financial crashes" [23] of Vladimir Soloviev, Victoria Solovieva, Anna Tuliakova, Alexey Hostryk and Lukáš Pichl presents a systematic analysis of the dynamics of the largest stock markets in the world and cryptocurrency market. According to the algorithms of the visibility graph and recurrence plot, the daily values of stock and crypto indices are converted into a networks and multiplex networks, the spectral and topological properties of which are sensitive to the critical and crisis phenomena of the studied complex systems. This work is the first to investigate the network properties of the crypto index CCI30 and the

multiplex network of key cryptocurrencies. It is shown that some of the spectral and topological characteristics can serve as measures of the complexity of the stock and crypto market, and their specific behaviour in the pre-crisis period is used as indicators-precursors of critical phenomena.

Prof. Lukáš Pichl was the Professor of Information Science at Department of Natural Sciences, International Christian University, Mitaka, Tokyo, Japan. Lukáš Pichl, born in 1974, received his PhD from the Graduate University of Advanced Studies in 2000. Since 2001 he taught computer science in the University of Aizu, before joining the International Christian University in 2005. His field of specialization is time series analysis and machine learning algorithms for the analysis of economic data including cryptocurrencies. Prof. Pichl has published a number of papers in international journals; he is a member of ACM and IEEE Computer Society, and currently serves as an associate editor of the Journal of Economic Interaction and Coordination (Springer). Prof. Lukáš Pichl passed away on April 10, 2020 at the age of 46.

Fig. 4. Prof. Vladimir Soloviev: in the memory of Prof. Lukáš Pichl.

The article "Modeling the optimal management of the distribution of profits of an oil and gas company taking into account risks" [13] of Inesa Khvostina, Viktor Oliinyk, Valerii Yatsenko, Liliia Mykhailyshyn and Uliana Berezhnytska discusses the optimal management of the distribution of the net income of an oil and gas company, taking into account risks. The utility function for the investigated enterprise acts as an optimality criterion. The control parameter is the distribution of the shares of net income for its optimal distribution in the selected areas. As a numerical implementation of the proposed algorithm, the activity of a catch oil and gas enterprise in the period 2018-2022 is considered. The optimal distribution of the received net income is given taking into account the discount rate and deductions to the State budget of Ukraine. The

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proposed algorithm can be used for optimal management of the company's financial activities.

In the article "Scenario forecasting information transparency of subjects' under uncertainty and development of the knowledge economy" [17] of Hanna Kucherova, Anastasiia Didenko, Olena Kravets, Yuliia Honcharenko and Aleksandr Uchitel the topicality of modeling information transparency is determined by the influence it has on the effectiveness of management decisions made by an economic entity in the context of uncertainty and information asymmetry. It has been found that information transparency is a poorly structured category which acts as a qualitative characteristic of information and at certain levels forms an additional spectrum of properties of the information that has been adequately perceived or processed. As a result of structuring knowledge about the factor environment, a fuzzy cognitive model of information transparency was constructed in the form of a weighted digraph. Structural analysis and scenario forecasting of optimal alternatives of the fuzzy cognitive model made it possible to evaluate the classes of factors, identify their limited relations, establish the centrality of the roles of information transparency and information and communication security in the system built and evaluate their importance when modeling the situation self-development. Information visibility, reliability and availability have been found to have the strongest impact on the system. Taking into account different initial weights of the key factors – information transparency and information and communication security – the study substantiates the strategic ways for economic entities to achieve their goals in the context of uncertainty and information asymmetry, which allows us to use this approach as a tool for strategic management in the information environment.
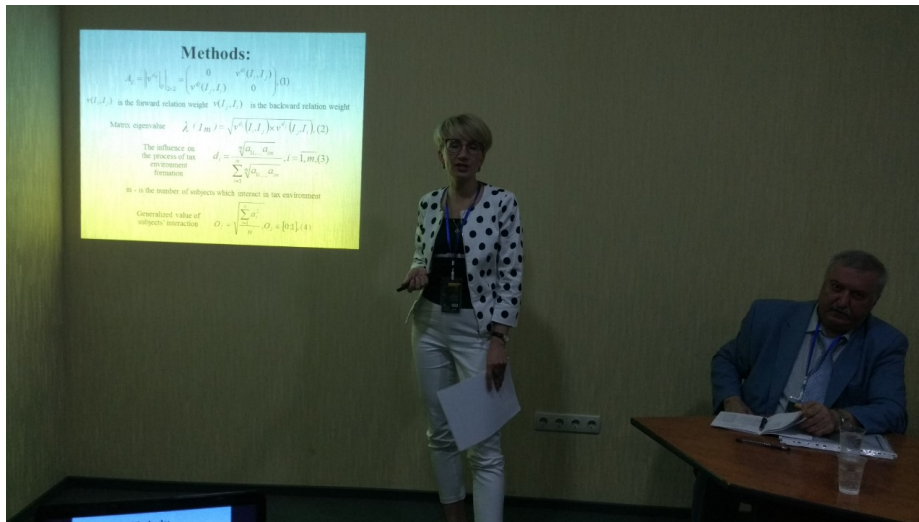

Fig. 5. Prof. Hanna Kucherova and Prof. Sultan Ramazanov: the social distancing during talk on scenario forecasting information transparency of subjects' under uncertainty and development of the knowledge economy [17].

The article "Use of simulation modeling for predicting optimization of repair works at oil and gas production enterprises" [5] of Iryna Hobyr, Vitalina Babenko, Sofiia Kafka, Yuliia Bui, Oksana Savko and Ekaterina Shmeltser is substantiated the expediency of using the methods of the queuing theory for supporting various business processes at enterprises. The task of mass service for the organization and management of repair services of oil and gas producing enterprises has been set. It is stated that the objective function of solving this task is the sum of costs for maintaining repair crews and the reduction of losses from well downtime. It is proved that to solve the problem of optimizing the process of repair work at the researched enterprises it is necessary to use modeling as one of the effective tools of prediction, which do not require to bring the researched models to a specific form and allows to predict systems in different states and industries. A simulation model of the organization of repair works in wells is given. Testing of simulation models is carried out on the example of the fields of the three largest oil and gas producing enterprises in the Western region of Ukraine, it allowed to establish the laws of distribution of failures of oilfield equipment on fields, the process of which includes operations related to the creation, transformation and implementation of random events, quantities and processes that cause random changes in the state of the system. And also, to make calculations of the optimal between-repairs periods, total costs of well servicing processes, losses from their downtimes and optimum quantity of crews at various options of intensity of failures.

Cluster analysis of the efficiency of the recreational forest use of the region by separate components of the recreational forest use potential is provided in the article "Fuzzy cluster analysis of indicators for assessing the potential of recreational forest use" [16] of Evstakhii Kryzhanivs'kyi, Liliana Horal, Iryna Perevozova, Vira Shyiko, Nataliia Mykytiuk and Maria Berlous. The main stages of the cluster analysis of the recreational forest use level based on the predetermined components were determined. Among the agglomerative methods of cluster analysis, intended for grouping and combining the objects of study, it is common to distinguish the three most common types: the hierarchical method or the method of tree clustering; the K-means Clustering Method and the two-step aggregation method. For the correct selection of clusters, a comparative analysis of several methods was performed: arithmetic mean ranks, hierarchical methods followed by dendrogram construction, K-means method, which refers to reference methods, in which the number of groups is specified by the user. The cluster analysis of forestries by twenty analytical grounds was not proved by analysis of variance, so the re-clustering of certain objects was carried out according to the nine most significant analytical features. As a result, the forestry was clustered into four clusters. The conducted cluster analysis with the use of different methods allows us to state that their combination helps to select reasonable groupings, clearly illustrate the clustering procedure and rank the obtained forestry clusters.

The problem of determining the investment priorities of the national economy development has been actuated in the article "Strategic priorities of innovation and investment development of the Ukraine's economy industrial sector" [24] of Valentyna Stadnyk, Pavlo Izhevskiy, Nila Khrushch, Sergii Lysenko, Galyna Sokoliuk and Tetjana Tomalja. It has been argued that the formation of institutional preferences for activation of industry investment processes should be carried out taking into account

the potential ability of each sectoral group enterprises to increase the added value. The scientific and methodical approach for sub-sectors investment attractiveness assessment has been formed on the example of the Ukrainian food industry. It has been recommended to use for this substantiated set of relative performance indexes which are duplicated in aggregate statistical state surveys based on the enterprise's financial statements. It has been formed the recommendations for the investment priorities of food industry development in Ukraine which are based on the appropriate calculations made by the TOPSIS and CRITIC methods. Methods of economic-statistical and comparative analysis were used for structural and dynamic characteristics of the Ukraine industrial enterprises activities. Given that innovation processes should also cover small and medium-sized industrial enterprises, whose resource opportunities are mostly limited, it is proposed to expand them within the framework of a strategic partnership. Graphic modeling methods have been used to visualize the process of building the business structures resource potential on the basis of their strategic partnership. The influence of the motivational environment on the value of organizational relations within the partnership has been formalized.

The article "Modelling of trade relations between EU countries by the method of minimum spanning trees using different measures of similarity" [2] of Hanna Danylchuk, Oksana Ivanylova, Liubov Kibalnyk, Oksana Kovtun, Tetiana Melnyk, Oleksandr Serdiuk and Vladimir Zaselskiy is devoted to the study of changes in relations between the countries of the European Union based on modeling and analysis of the structure of trade relations between countries. The article analyzes the dynamics of exports and imports of goods and services between the countries of the European Union on the basis of data taken for the period from 2006 to 2019. The study is based on one of the methods of cluster analysis, namely – the method of constructing minimal spanning trees. For the analysis the method of visualization of links is defined and the choice of the corresponding graphic representation is substantiated: the display of links using the dendrograms which carry more information in comparison with display of the minimum spanning trees in the form of a planar graph is chosen. Four different methods were used to construct the minimum spanning trees on the basis of which the visualization of links is performed: the Single link method, the averaged link method, the complete links method, and the Ward method. Based on the analysis of the results obtained using each of the methods, the best of them is selected, which is then used throughout the study. As a result of the study, suggests were made about the criteria by which clusters are formed within the European market. Such criteria are both the geographical neighborhood, which means mostly similar climatic conditions, and the common strategy of economic development of the country and the common strategy of behavior in the world market. In addition, a number of countries have been identified that are gradually moving to the use of their own economic strategies, as well as a number of countries seeking to align strategies of behavior in the world market. The influence of such factors as joining the integration union of new member states and global financial crises on the structure of trade relations is substantiated. Changes in the structure of relations between EU countries due to the influence of these factors are simulated. The study is of an applied nature and can be used in the future as a methodological basis for developing effective mechanisms for reformatting trade

relations between countries in the context of geoeconomic transformations and global financial crises.

The article "Modeling the assessment of credit risk losses in banking" [18] of Katerina Larionova, Tetyana Donchenko, Andriy Oliinyk, Hennadii Kapinos, Oleg Savenko and Olexander Barmak develops a model of credit risk assessment within the scope of the variability concept that can be used for verification of new methods for borrowers' credit capacity estimation, the acceptable level of credit risk forecasting and its early prediction. It is aimed to be used during the automated banking systems development. The proposed model of credit risk assessment has been tested on the basis of the data from one of the Ukrainian banks. To determine the adequacy of this model has been proved by the comparison analysis of the proposed model with the results obtained by the National Bank of Ukraine methodology.

The article "The impact of COVID-induced shock on the risk-return correspondence of agricultural ETFs" [11] of Andrii Kaminskyi, Maryna Nehrey and Nina Rizun advocate the risk-return correspondence for different investment asset classes forms as one of the pillars of modern portfolio management. This correspondence together with interdependency analysis allows us to create portfolios that are adequate to given goals and constraints. COVID-induced shock unexpectedly generated high uncertainty and turmoil. The article is devoted to the investigation path through shock by agricultural assets (presented by ETFs) in comparison with traditional assets. There were identified three time periods: before the shock, explicitly shock, and post-shock. At the explicit shock period was suggested estimation risk frameworks on the pair indicators: falling depth and recovery ratio. Basic attention focuses on comparison risk-return estimations prior to shock and post-shock. To this end was considered four approaches to risk measurement and were applied to the sample of agricultural ETFs. The results indicated differences in risk changing by the path from before shock to post-shock. Differences arise from choosing the approach of risk measuring. The variability approach reveals much growth of risk of traditional assets, but the Value-at-Risk approach indicates higher risk growth for agricultural ETFs. Combine together with relatively low correlation these estimations provide a clear vision of risk-return frameworks.

The article "Comparative analysis of the attractiveness of investment instruments based on the analysis of market dynamics" [19] of Nataliia Maksyshko, Oksana Vasylieva, Igor Kozin and Vitalii Perepelitsa continues the authors' research on solving the problem of choosing the most attractive investment instrument from a variety of alternatives, based on a comparative analysis of the dynamics for the respective markets. The nature of the dynamics affects the predictability level of the investor's income and is determined by finding out which hypothesis corresponds to the dynamics: the efficient market hypothesis, the fractal market hypothesis and the coherent market hypothesis. The methodology of comparative analysis developed by the authors is based on the use of statistical analysis methods combined with the methods of complex fractal analysis. It makes it possible to reveal the presence of deterministic chaos in the dynamics and to obtain estimates of the long-term memory in time series. The calculated characteristics of the fuzzy set of the memory depth for time series make it possible to draw conclusions about the financial instruments preference for the investor. The methodology developed by the authors is applied to

three markets. A comparative analysis of three instruments (gold, EUR/USD currency pair and Bitcoin cryptocurrency) was carried out. The dynamics of prices and profitability for financial instruments in the conditions before the onset of the COVID-19 crisis and during it is considered.
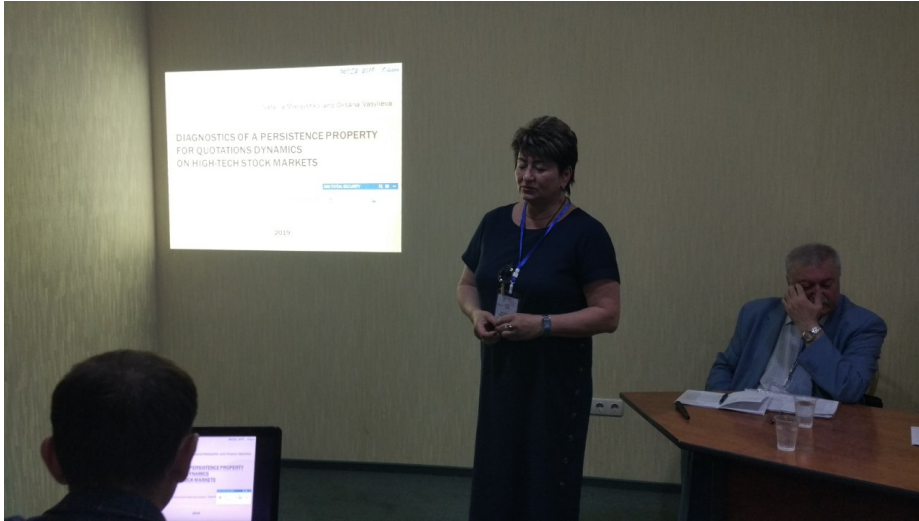

Fig. 6. Prof. Nataliia Maksyshko and Prof. Sultan Ramazanov: the social distancing during talk on comparative analysis of the attractiveness of investment instruments based on the analysis of market dynamics [19].

The article "Assessment of bank's financial security levels based on a comprehensive index using information technology" [12] of Nila Khrushch, Pavlo Hryhoruk, Tetiana Hovorushchenko, Sergii Lysenko, Liudmyla Prystupa and Liudmyla Vahanova considers the issues of assessing the level of financial security of the bank. An analysis of existing approaches to solving this problem. A scientific and methodological approach based on the application of comprehensive assessment technology is proposed. The computational algorithm is presented in the form of a four-stage procedure, which contains the identification of the initial data set, their normalization, calculation of the partial composite indexes, and a comprehensive index of financial security. Results have interpretation. Determining the levels of financial security and the limits of the relevant integrated indicator is based on the analysis of the configuration of objects in the two-scale space of partial composite indexes, which is based on the division of the set of initial indicators by content characteristics. The results of the grouping generally coincided with the results of the banks ranking according to the rating assessment of their stability, presented in official statistics. The article presents the practical implementation of the proposed computational procedure. To automate calculations and the possibility of scenario modeling, an electronic form of a spreadsheet was created with the help of form controls. The obtained results allowed us to identify the number of levels of financial security and their boundaries.

Fig. 7. Prof. Pavlo Hryhoruk before the talk on assessment of bank's financial security levels based on a comprehensive index using information technology [12]

The article "The cryptocurrencies risk measure based on the Laplace distribution" [9] of Petro Hrytsiuk and Tetiana Babych analyzed the daily returns of the most common cryptocurrencies: Bitcoin, Ethereum, XRP, USDT, Bitcoin Cash, Litecoin. It is shown that the asset returns are not normally distributed, but with good precision follow the Cauchy distribution and Laplace distribution. The analytical expressions for risk measure were obtained using the distribution function and the VaR technique. However, the risk assessment of the return obtained on the basis of the Cauchy distribution is twice as high as the risk assessment obtained on the basis of the Laplace distribution. Therefore, the question arises: what distribution law to use to measurement the cryptocurrency risk? The paper shows that the Laplace distribution is the most adequate basis for measuring of cryptocurrencies risk.

The article "Model for assessing and implementing resource-efficient strategy of industry" [21] of Nadiia Shmygol, Francesco Schiavone, Olena Trokhymets, Dariusz Pawliszczy, Viktor Koval, Ruslan Zavgorodniy and Andrii Vorfolomeiev determined that a number of scientists were involved in the development of a balanced system of indicators of the development of the oil and gas sector. Though an urgent scientific problem that needs further consideration is the development of a model of resource efficiency diagnostics in the oil and gas sector of the economy of Ukraine, taking into account the peculiarities of statistical monitoring. The scientific novelty of the paper is: this study improved the model of diagnostics of resource efficiency in oil and gas sector in the economy of Ukraine based on the additive-multiplicative compression of the formed system, which, unlike the existing ones, takes into account their variation while defining weighting coefficients which show the experts' system of preferences. It is reasonable to use the proposed model at the further economic assessment of the consequences of realization of resource-efficient strategy at enterprises of the oil and gas sector of the economy of Ukraine.

In the article "Fuzzy modelling of Big Data of HR in the conditions of Industry 4.0" [10] of Mykola Ivanov, Sergey Ivanov, Olexander Cherep, Nataliia Terentieva, Victoria Maltiz, Iulia Kaliuzhna and Vitaliy Lyalyuk a systematic methodology for analyzing and assessing the effectiveness of human resources based on fuzzy sets using big data technologies is used. Authors analyzed the big data construction method for our chosen approach using Industry 4.0. For the selected fuzzy sets, a set of sequence of procedures in the sequence of the method for assessing the effectiveness of human resources have been identified. Input and output membership functions for data mining have been developed. This article discusses process of building rules of fuzzy logic that allowed us to determine the degree of truth for each condition. The relevance achieved through the development of a methodology that includes eight procedures required for a comprehensive assessment of the economic efficiency of human resources. In this article, an approach to assessing the normative or average values of the performance of official duties by employees of an enterprise in many specialties, educational levels, levels of management, as well as taking into account the description of many positions, descriptions of compliance and interchangeability of positions, assessment of additional characteristics of employees and a description of many additional tasks and their characteristics is presented. The article presents a structural data-mining model for personnel assessment. The results of modeling the assessment of human resources is presented.

Fig. 8. Dr. Alexey Hostryk and Prof. Mykola Ivanov: the social distancing during talk on fuzzy modelling of Big Data of HR in the conditions of Industry 4.0 [10].

The article "Using non-metric multidimensional scaling for assessment of regions' economy in the context of their sustainable development" [8] of Pavlo Hryhoruk, Svitlana Grygoruk, Nila Khrushch and Tetiana Hovorushchenko is devoted to the solving the problems of regions' socio-economic development as strategic and most important for any country. In particular, the implementation of a new, active role of the region as a subject of sustainable development is important for the direct implementation of current regional policy. An important component of such a policy is the assessment of sustainable development of regions, which contributes to the timely detection of internal and external threats, the development of necessary stabilizing measures to prevent their negative impact, the formation of strategies aimed at sustainable regional systems. The economic system is an important subsystem of the region. The article proposes an approach to assessing the regions' economic development in the context of ensuring their sustainable development. Authors used the methods of multidimensional nonmetric scaling to solve this problem. The study aims to determine the structure of regions in the context of their sustainable development. Based on non-metric data reflecting the economic development of Ukraine's regions, two-dimensional space of latent scales was built based on multidimensional measures of proximity between them, and the positioning of regions in this space was carried out. The results received a semantic interpretation, which was improved by using the procedure of rotation of the scale space. The use of multidimensional non-metric scaling confirms its usefulness for the study of economic development of regions in the region and allows for their comparison and dynamics of their structure in the context of sustainable development.

The article "Predicting the economic efficiency of the business model of an industrial enterprise using machine learning methods" [6] of Liliana Horal, Inesa Khvostina, Nadiia Reznik, Vira Shyiko, Natalia Yashcheritsyna, Svitlana Korol and Vladimir Zaselskiy considers the problem of studying the impact of key determinants on the industrial enterprise business model economic efficiency and aims to build an optimal model for predicting the industrial enterprise business model effectiveness using neural boundaries. A system of key determinants key factors has been developed. Significant factors were later used to build neural networks that characterize the studied resultant trait development vector. The procedure for constructing neural networks was performed in the STATISTICA Neural Networks environment. As input parameters, according to the previous analysis, 6 key factor indicators were selected. The initial parameter is determined by economic efficiency. According to the results of the neural network analysis, 100 neural networks were tested and the top 5 were saved. The following types of neural network architectures, multilayer perceptron, generalized regression network and linear network were used. Based on the results of the neural network modeling, 5 multilayer perceptrons of neural network architectures were proposed. According to descriptive statistics, the best model was a multilayer perceptron, with the MLP 6-10-1 architecture, which identifies a model with 6 input variables, one output variable and one hidden layer containing 10 hidden neurons. According to the analysis of the sensitivity of the network to input variables, it was determined that the network is the most sensitive to the variable the share of electricity costs in total costs. According to the results of selected neural networks standard

prediction, the hypothesis of the best neural network was confirmed as Absolute res., Squared res, Std. Res for the neural network MLP 6-10-1 reached the optimal value and indicate that the selected model really has small residues, which indicates a fairly high accuracy of the forecast when using it.

The article "Modelling of cryptocurrency market using fractal and entropy analysis in COVID-19" [3] of Hanna Danylchuk, Liubov Kibalnyk, Oksana Kovtun, Arnold Kiv, Oleg Pursky and Galina Berezhna present the results of simulation for cryptocurrency market based on fractal and entropy analysis using six cryptocurrencies in the first 20 of the capitalization rating. The application of the selected research methods is based on an analysis of existing methodologies and tools of economic and mathematical modeling of financial markets. It has been shown that individual methods are not relevant because they do not provide an adequate assessment of the given market, so an integrated approach is the most appropriate. Daily values of cryptocurrency pairs from August 2016 to August 2020 selected by the monitoring and modelling database. The application of fractal analysis led to the conclusion that the time series of selected cryptocurrencies were persistent. And the use of the window procedure for calculating the local Hurst coefficient allowed to detail and isolate the persistant and antipersistant gaps. Interdisciplinary methods, namely Tsallis entropy and wavelet entropy, are proposed to complement the results. The results of the research show that Tsallis entropy reveals special (crisis) conditions in the cryptocurrency market, despite the nature of the crises' origin. Wavelet entropy is a warning indicator of crisis phenomena. It provides additional information on a small scale.

In the article "Econophysics of sustainability indices" [1] of Andriy Bielinskyi, Serhiy Semerikov, Oleksandr Serdiuk, Victoria Solovieva, Vladimir Soloviev and Lukas Pichl the possibility of using some econophysical methods for quantitative assessment of complexity measures: entropy (Shannon, Approximate and Permutation entropies), fractal (Multifractal detrended fluctuation analysis – MF-DFA), and quantum (Heisenberg uncertainty principle) is investigated. Comparing the capability of both entropies, it is obtained that both measures are presented to be computationally efficient, robust, and useful. Each of them detects patterns that are general for crisis states. The similar results are for other measures. MF-DFA approach gives evidence that Dow Jones Sustainability Index is multifractal, and the degree of it changes significantly at different periods. Moreover, authors demonstrate that the quantum apparatus of econophysics has reliable models for the identification of instability periods. Authors conclude that these measures make it possible to establish that the socially responsive exhibits characteristic patterns of complexity, and the proposed measures of complexity allow us to build indicators-precursors of critical and crisis phenomena.

The article "Asymptotic methods in optimization of multi-item inventory management model" [7] of Lidiia Horoshkova, Ievgen Khlobystov, Volodymyr Volkov, Olha Holovan, Svitlana Markova, Alexander Golub and Oleksandr Oliynyk describes the asymptotic methods for optimizing multi-item inventory model. To achieve the objective of the study, formulas of the optimal value of multi-item delivery frequency based on the asymptotic approach under conditions of minor changes in the input parameters have been obtained. The discrete increase in the execution costs and

inventory holding costs which depend on the "small parameter" as well as a gradual increase in periodic fluctuations in demand for products have been taken as variable parameters of the system. Easy-to-use analytical formulas for determining optimal order interval when ordering and inventory holding costs, as well as demand meet insufficient changes have been obtained. Testing of the proposed approach to the multi-item inventory model has been carried out on the example of HoReCa regional market segment. The proposed formulas allow to apply the obtained results for optimization and forecasting of decision-making in the system of procurement logistics of a company amid variation of input parameters describing changes of external and internal business environment.

The article "Modeling and prediction of the gas pipelines reliability indicators in the context of energy security of Ukraine" [25] of Halyna Zelinska, Irina Fedorovych, Uliana Andrusiv, Oksana Chernova and Halyna Kupalova based on the many years of experience in operation of the gas transportation system shows that the largest accidents with severe consequences arise due to untimely detection and elimination of gas leaks in underground gas pipelines. The decrease in the reliability of the gas transportation system functioning can be considered from the following two perspectives: the first perspective is the economic one – it leads to an increase in the economic expenses of an enterprise; and the second perspective is the social and environmental one – it results in emergence of a threat to public health, as well as loss of human and natural resources. Hence, the issue of modeling and prediction of the reliability indicators of natural gas transportation via gas pipelines becomes especially urgent because of the requirements for reliable operation of the system. It has been proven that the main problem leading to a decrease in the reliability of the gas transportation process is the significant deterioration of fixed assets, which requires investment of considerable financial resources in the gas transportation system of Ukraine (GTS). The article substantiates that it is possible to increase the reliability of operation of the line section of the main gas pipelines (LSMGP) through a high-quality system of repairs and equipment modernization. The main factor allowing to reduce the number of accidents is considered to be timely detection of damages on gas pipelines and their prediction. It has been determined that the failure rate depends on the diameter and number of lines of a gas pipeline. The authors propose to conduct a comprehensive diagnosis of the process of reliability of gas pipelines together with of their technical and economic indicators, based on the development of a system of measures to improve the safety of gas pipelines in Ukraine. A system of measures has been developed to improve the reliability of gas pipelines operation in Ukraine.

The article "Machine learning approaches for financial time series forecasting" [4] of Vasily Derbentsev, Andriy Matviychuk, Nataliia Datsenko, Vitalii Bezkorovainyi and Albert Azaryan is discusses the problems of the short-term forecasting of financial time series using supervised machine learning (ML) approach. For this goal, authors applied several the most powerful methods including Support Vector Machine (SVM), Multilayer Perceptron (MLP), Random Forests (RF) and Stochastic Gradient Boosting Machine (SGBM). As dataset were selected the daily close prices of two stock index: SP 500 and NASDAQ, two the most capitalized cryptocurrencies: Bitcoin (BTC), Ethereum (ETH), and exchange rate of EUR-USD. As features were used only the past

price information. To check the efficiency of these models was made out-of-sample forecast for selected time series by using one step ahead technique. The accuracy rates of the forecasted prices by using ML models were calculated. The results verify the applicability of the ML approach for the forecasting of financial time series. The best out of sample accuracy of short-term prediction daily close prices for selected time series obtained by SGBM and MLP in terms of Mean Absolute Percentage Error (MAPE) was within 0.46-3.71 %. The results are comparable with accuracy obtained by Deep learning approaches.

Fig. 9. The coronavirus sadness [20] of Prof. Andriy Matviychuk before the talk on machine learning approaches for financial time series forecasting [4]

3   Conclusion

The vision of the M3E2 2019 is provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of emergent economy.

The conference has successfully performing forum to transferring and discussing research result among the researcher, students, government, private sector or industries. Participants and presenters from several countries such as Italy, Israel, Japan, Lithuania, Poland, Ukraine have attended the conference to share their significant contribution in research related to Monitoring, Modeling & Management of Emergent Economy.

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We hope you enjoy this conference and meet again in more friendly, hilarious, and happiness of further M3E2 2021.

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