

# Machine learning methods and models, predictive analytics and applications

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**Abstract.** This is an introductory text to a collection of articles selected from the MPSESM-XII conference: Modern Problems of Modelling Socio-Economic Systems, which took place in Kharkiv, Ukraine, on April 9-10th, 2020. Due to quarantine measures in connection with COVID-19, several sections were working on June 25th, 2020 on the basis of S. Kuznets Kharkiv National University of Economics <https://ek.hneu.edu.ua/>. The following is a brief overview of the main scientific schools on modelling systems, of the results of their work.

**Key words:** predictive analytics, machine learning methods, Data Science applications for economics, business, healthcare

## 1 Introduction

The current stage of development of systems is characterized by the strengthening of globalization and digitalization trends, which is confirmed by the dynamics of the index of the level of globalization of macroregions (KOF Globalization Index, 2019) and the index of the level of development of information and communication technologies (ICT Development Index, 2019). The current trends lead to a qualitative change in the conditions for the functioning of socio-economic systems and business structures (hereinafter SES) at various levels of the hierarchy. In particular, the main features of the external environment for the functioning of SES are:

increased competition, which turns out to be more and more aggressive in the global market. This forces the SES management to look for new strategies for innovative development, which are aimed at creating value innovation, reconstructing market boundaries, creating a new space free from competition;

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wide opportunities for changing business models and optimizing the company's business processes. Networked forms of business organization are becoming more and more widespread, virtual corporations that have almost no assets, unite geographically distributed groups of employees who create a digital asset, a virtual product that is implemented in the Internet space;

increased volatility of the external environment. Globalization and digitalization, on one hand, provide ample opportunities for outstripping growth in sectors with a high level of international competitiveness, and, on the other hand, they cause the emergence of new risks and threats in the field of financial, energetical, environmental, etc. security. It is no coincidence that the last decades have been characterized by permanently recurring financial, economic, social, etc. crises of a strong severity due to the resonant interaction of cycling factors, an increase in the likelihood of infection by a crisis from partner countries.

The changed conditions for the functioning of the SES require the improvement of the model basis of information and analytical control systems, which make it possible to analyze poorly predictable trends, to identify patterns of development and cause-and-effect relationships in a multifactorial space, when the dynamics of the development of research objects is determined by thousands of rapidly changing factors, to diagnose unfavorable trends in their early stages and to develop preventive management solutions to ensure safe, sustainable and competitive development of SES.

## **2 MPSESM: main scientific schools**

MPSESM is an international scientific and practical conference, which, since 2009, has been bringing together scientists from different countries in the field of problems of developing a model basis for information and analytical control systems. The following scientific schools function within the framework of the conference:

*Predictive analytics and econometric modelling.* The main focus of research by scientists of this scientific school is modelling the dynamics of financial markets, optimizing portfolio and trading strategies, developing adequate models for predicting the characteristics, state and behavior of systems under conditions of uncertainty and risk, of incomplete information and increasing turbulence of the external environment. So, within the framework of this direction, a methodological approach has been developed, which, using simple random number generators and a number of hypotheses about the properties of a random process, the socio-demographic characteristics of the sample, allows you to form a random sample with indicators: gender, age, health status and the likelihood of contracting a certain disease, which depends on gender, age and health status, for which it is possible to obtain expert assessments at the given points. The developed approach enables healthcare professionals to model and predict various morbidity processes for

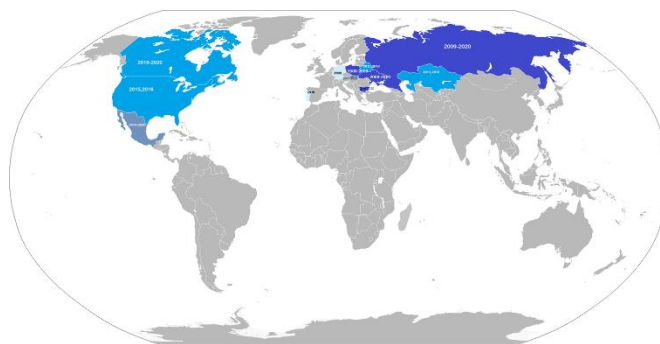
a particular population, assess possible social and economic risks, determine the need for the necessary resources for treatment and implementation of preventive programs aimed at reducing morbidity. The proposed approach is recommended for use in the design of an information and analytical system for the formation of a comprehensive anti-crisis program for leveling the consequences of the "shock" of COVID-19. According to experts, the following developments recognized as interesting which study the possibility of using models with multifactor volatility to predict the price of derivatives, using the Hobson-Rogers models to study the dynamics of the PFTS index and find the volatility of the value of financial instruments. Models of forecasting systemic transformations in the resort and recreational economy, which allow decision makers to carry out scenario analysis and parameterization of strategies that ensure their sustainable development, also aroused quite high interest.

*Models for assessing and analyzing the development of territories.* Within the framework of this scientific school, the focus of research is concentrated on the problem of uneven development. This direction is in the trend of studies by Stiglitz (2013), Piketty (2014), which indicate an increase in uneven development, increased economic concentration, widening inequality in income and wealth, which threatens the long-term prosperity and sustainable development of SES. Numerous international institutions such as the World Bank, IMF, OECD and WEF also attach high importance to the identified problems of economic growth, inequality and sustainability, the need to form an effective strategy for inclusive economic growth. These problems are considered in the works of Ukrainian scientists (Klebanova et al., 2011), which propose a model basis for assessing the unevenness and cyclical development of territories to form a balanced development strategy that ensures sustainable development of both individual regions and the state as a whole. According to experts, within the framework of the designated research area, the proposed selective adaptive model for predicting the index of uneven territorial development was of particular interest, which allows for both structural and parametric adaptation of the forecasting system and, on this basis, to increase the validity of medium-term forecasts.

*Methods and models of Data Science, Machine learning: analytical research in economics.* This scientific school is aimed at the development of knowledge management technologies, cognitive management as a systematic management of the processes through which knowledge is identified, accumulated, distributed and applied in an organization to improve its performance. Within the framework of this direction, priority tasks are the ones of pattern recognition, identification of classes of situations, classification of situations for which differentiated control strategies can be developed. These tasks are effectively solved using machine learning and Data Science methods. Within the framework of this direction, the most interesting, according to experts, were the developments related to the use of cluster analysis methods to determine the optimal locations of business structures, to identify homogeneous groups of customers for which differentiated digital marketing strategies can be developed; to the use of machine

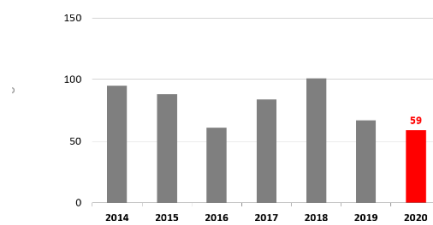
learning methods to assess the sustainability of the competitive positions of global audit companies, to assess the risk of lending to companies in the agro-industrial sector.

It should be noted that the scientific schools represented at the MPSESM conference have a wide geography (Fig. 1). We thank scientists from Slovakia, Poland, Bulgaria, Slovenia, Greece, Austria, Lithuania, Great Britain, Ukraine, Russia, Mexico, Canada, who took part in the organization and work of the conference.



**Fig. 1.** Geography of MPSESM conference participants

59 papers were submitted to the conference (Fig. 2).



**Fig. 2.** Number of publications (VI-XII international scientific research conference MPSESM)

The submitted papers were double-blind peer-reviewed by the program committee members using the conference management system <http://mpsesm.org/>. 7 selected publications formed the basis of this collection of articles.

### 3 Conclusions

The institutional environment of the conference was represented by 47 research centers, universities, IT companies. In particular, such as "KODA" (Ukraine-Germany), "Ukrainian Management-Intellect" (Ukraine). The conference was attended by

125 scientists, including 47 Doctors of Sciences, 4 corresponding members of the academies of sciences. We thank the participants for interesting reports and look forward to further cooperation in the field of predictive analytics and econometric modelling; modelling the development of territories; modelling of security systems; system analysis and design of decision support systems; modelling financial processes; information technology in business and education; development of reflexive control models; application of machine learning and data science methods for analytical research in economics and business.

### References

1. *KOF Globalisation Index*. (2020). Retrieved from: <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>
2. *ICT Development Index*. (2019). Retrieved from: <https://www.itu.int/en/ITU-D/>
3. Piketty, T. (2014). *Capital in the Twenty-First Century*. Cambridge, MA: Harvard University Press
4. Stiglitz, J. (2013). *The Price of Inequality: How Today's Divided Society Endangers Our Future*. Retrieved from: <http://www.pas.va/content/dam/accademia/pdf/es41/es41-stiglitz.pdf>
5. Klebanova, T., Kizim, N., Guryanova, L., Chagovets, L., Chernova, N., Trunova, T. (2011). *Models for assessing the unevenness and cyclical dynamics of the development of territories*. Kharkiv, Kh.: PH "INZHEK"