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Editorial

Opening the 21st Century Technologies to Industries: On the Special Issue *Machine Learning for Society*

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Machine learning techniques, more commonly known today as artificial intelligence, are playing an increasingly important role in all aspects of our lives. Their applications extend to all areas of society where similar techniques can be accommodated to provide efficient and interesting solutions to a wide range of problems. In this Special Issue entitled *Machine Learning for Society* [1], we present some examples of the applications of this type of technique. From the valuation of unlisted companies to the characterization of clients, through the detection of financial crises or the prediction of the behavior of the exchange rate, this group of works presented here has in common the search for efficient solutions based on a set of historical data, and the application of artificial intelligence techniques. The techniques and datasets used, as well as the relevant findings developed in the different articles of this Special Issue, are summarized below.

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1. Stock Market Crisis Forecasting Using Neural Networks with Input Factor Selection [2]

The aim of this article [2] is to validate the use of neural networks to forecast the severity of financial market crises by combining microeconomic, macroeconomic and financial parameters. For this, a dataset of 30 variables was used, covering the period between January 1971 and May 2021. A financial crisis was defined as a period of time between two peaks during which the S&P 500 index lost more than 20% of its value, and according to this criterion six periods of crisis were established.

The development of a dimensional reduction technique based on variable inclusion iterative analysis, together with a forward forecast training model connected to a single-layer neural network with three neurons, constitute the main contribution of this study. According to the findings of the article, the model selected through the suggested method performs better than the model used as a reference in terms of accuracy and stability. The chosen model achieved an accuracy rate of 91% compared to 83% for the previously published reference model. Additionally, since the chosen model requires a limited number of input variables, and therefore fewer parameters to estimate, the model thus defined enjoys high robustness against overfitting.

2. Recurrent Neural Networks and ARIMA Models for Euro/Dollar Exchange Rate Forecasting [3]

For governments, financial institutions, and investors, understanding how the exchange rate will behave over the short, medium and long term is crucial since this information reflects the country's economic health. As a consequence, this has relevant implications

for estimating the cost of goods in international trade. In this paper, Escudero, Alcocer and Paredes [3] propose an in-depth and comparative analysis of different forecast models to assess short/long term accuracy using EUR/USD exchange rate data. In particular, three methods were studied: Autoregressive Integrated Moving Average (ARIMA), Elman-type recurrent neural network (RNN) and short-long-term memory (LSTM). To carry out this work, the evolution of the daily exchange rate was considered during a period of 21 years (1998–2019) using different window intervals.

The average accuracy for LSTM in the 22-day window was 71.76%, which satisfactorily compared with previous studies. The authors conclude that LSTM fits better in the short term (up to a maximum accuracy of 95.99% in some observations). On the other hand, Elman networks turned out to be more suitable for long-term analysis. It should also be noted that LSTM networks offered an advantage over Elman networks in capturing complex patterns and non-linearities in the data, and therefore should be incorporated in future analyses with all types of windows. For this reason, the authors suggested as next steps the study and development of combined and hybrid models, which may improve the results presented here.

3. A Big Data Approach to Customer Relationship Management Strategy in Hospitality Using Multiple Correspondence Domain Description [4]

Previous studies have highlighted the effectiveness of simple Big Data tools, such as Bootstrap resampling techniques, in determining client profiles. However, these tools lack the ability to provide managers with information about the relationships between various features and categories (cross-relationships). This study [4] was conducted following a three-step analysis method. First, Multiple Correspondence Analysis (MCA) described the interactions between categories and features. Second, bootstrap resampling provided insights into the statistical variability of the feature maps. Finally, kernel methods created visually interpretable domain descriptions based on confidence areas in the maps. The use of bootstrap resampling and confidence intervals allows us to enhance the interpretability and statistical robustness of the results. The methodology was applied to analyze the profiles of clients in an international hotel chain, focusing on nationality and differentiating between repeaters and first-timers. The results showed differences in expenditure and age among nationalities and highlighted the importance of marital status in the repeater profile. The study emphasized the significance of nationality in explaining expenditure variations and suggested strategies for targeting high-value segments, such as Spanish repeaters. This methodology offers a statistically robust approach to examining CRM profiles in the hospitality sector, enabling effective decision-making.

4. On the Differential Analysis of Enterprise Valuation Methods as a Guideline for Unlisted Companies Assessment (I): Empowering Discounted Cash Flow Valuation [5]

The two-fold work presented by Vayas-Ortega et al. [5,6] brings into perspective the practical interest application-rooted *On the Differential Analysis of Enterprise Valuation Methods as a Guideline for Unlisted Companies Assessment*. A comprehensive analysis is carried out in two steps. In Part (I), *Empowering Discounted Cash Flow Valuations* [5], the technical details of the problem are presented widely to the reader, as well as the relevance of company valuation today. Data analysis is carried out on sets of selected companies in different fields, comprising conventional linear regression techniques. Going beyond this point, in Part (II), *Applying Machine-Learning Techniques for Unbiased Enterprise Value Assessment* [6], a battery of nonlinear learning methods is scrutinized, showing that nonlinear data models can outperform linear ones in this field. The proposed methodology can be useful for practitioners in the field of company valuation, either for research purposes or for practical applications in real life.

5. On the Differential Analysis of Enterprise Valuation Methods as a Guideline for Unlisted Companies Assessment (II): Applying Machine-Learning Techniques for Unbiased Enterprise Value Assessment [6]

This article aims to explore the use of machine-learning (ML) techniques to improve the accuracy and reliability of enterprise valuation methods, especially for unlisted companies. The author reviews the limitations of traditional methods based on discounted cash flow (DCF), and proposes incorporating exogenous information from industry- and country-specific variables to enhance the predictive capabilities of ML models. The author performs an extensive analysis using 18 different ML techniques, such as supported vector machine regression, Gaussian process regression, decision trees, bagging trees and boosting trees, and compares their performance using various metrics, such as root mean square error, mean absolute error and R-squared. The author also applies feature selection methods to identify the most relevant variables for enterprise valuation.

The main findings of the article are that ML techniques can provide more accurate and unbiased estimates of enterprise value than DCF methods, especially when endogenous and exogenous variables are combined. The author also found that bagging trees, supported vector machine regression and Gaussian process regression are the most consistent and robust ML techniques for enterprise valuation. The author concludes that ML techniques can offer a valuable reference framework for valuing and benchmarking unlisted companies, as well as for assessing their credit risk.

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