OPINION

of Prof. Dr. Maria Hristova,
Todor Kableshkov University of Transport, Sofia, Department of Mathematics and Informatics,
On Thesis for awarding educational and scientific degree PhD
in Professional Area 4.6 Informatics and Computer Science

Thesis Title: **RESEARCH ON NEURAL NETWORKS BASED CAPITAL MARKETS FORECASTING MODELS**

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Scientific Advisor: Acad. Ivan Popchev

General information

Veselin Lazarov Shahpazov is a Bachelor of Science in Marketing and he has a Master's Degree in Banking Management, graduated from Dimitar A. Tsenov Academy of Economics, Svishtov. Between 2011 and 2014 he has been a PhD student in the Intelligent Systems section of the Institute of Information and Communication Technologies. He has worked at Allianz Bank Bulgaria and since 2019 has been working at DV Asset management as Deputy Head of Portfolio Management Department and Licensed securities broker.

Content of the Doctoral Thesis

The Doctoral Thesis of Veselin Shahpazov is dedicated to research on neural networks based capital markets forecasting models.

The dissertation consists of 148 pages of text, 21 figures, 12 tables. Includes an introduction, four chapters, conclusion, list of author's publications on the subject of the thesis and citations, list of participation in projects, a bibliography.

The introduction presents the field of research and motivation of the author to work in this interdisciplinary field, defines the purpose of the dissertation and formulates six tasks. The purpose is up-to-date, and the solution of the tasks assigned implies the possibility of application in practice.

Chapter 1 examines the traditional analytical methods used to forecast capital markets. Neural network development periods have been reviewed and methods for forecasting capital markets with artificial intelligence approaches have been presented.

Chapter 2 analyzes neural networks based capital markets forecasting models. 53 selected articles in the field of neural networks are summarized and analyzed, and in particular their ability to predict the stock market. In order to illustrate the study and form a conclusion, a table with summerized results of all articles reviewed is presented.

Chapter 3 contains the results of the research on neural networks based capital markets forecasting models. After the presentation on the Bulgarian stock market, its research for the purpose of forecasting is shown. A hybrid model of neural networks and systems based on rules for capital market forecasting is presented to predict the composition of the Sofix index before this being made by other market participants.

In Chapter 4 the author offers guidelines for future research in the field.

The conclusion (Chapter 5) summarizes the results achieved, summarizing that the research results on prediction capabilities of the three types of neural networks could be considered as useful. The conclusion is that the hybrid model is viable and applicable in a low-liquid and under-developed capital market.

Results of Doctoral Thesis

The main scientific and applied contributions achieved in the dissertation can be formulated as follows:

- Research of the possibilities for forecasting capital markets with neural networks have been presented.
- A research on the current state of the forecasting of capital markets with neural networks is presented.
- As part of the research on the Bulgarian stock market, which is the subject of forecasting, a presentation of the Bulgarian regulated capital market on the face of BSE - Sofia was made and the main qualitative and quantitative differences between it and the developed stock exchanges around the world were determined.
- A hybrid model of neural networks and systems based on forecasting rules for a poorly developed and low liquid capital market such as Bulgarian is proposed.
- The experiments carried out with the hybrid model presented in the real conditions on the Bulgarian capital market, on the basis of data from past periods, confirm its capabilities.
- Based of the knowledge gained from the study of previous researches in the field, an attempt to select an appropriate neural network structure for the purposes of forecasting a low liquid financial market, such as the Bulgarian one, is made.

The results achieved in the dissertation are original and consistent with the stated goal and tasks.

Publications related to the Doctoral Thesis

The PhD student has presented six publications reflecting the results obtained in the dissertation. The publications are in specialized scientific editions and are published between 2013 and 2019. Five of them are in English, two of them are single-authored papers and in the rest of the articles Veselin Shahpazov is the leading author.

On my opinion the dissertation results are properly presented to the scientific community and the Doctoral Thesis and the results obtained are a personal work of Veselin Shahpazov.

Six citations of one of the publications are listed, which confirms the relevance of the thesis topic and the significance of the results.

Abstract

The abstract corresponds to the volume (35 pages) and content of the requirements of the Rules for the Specific Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at the Institute of Information and Communication Technologies – BAS.

Critical Remarks and Recommendations

The contributions to the dissertation should be more clearly and concretely defined, not just as a summary of the results achieved.

There are stylistic, linguistic and grammatical errors noticed in the doctoral thesis. The dissertation could have been better formatted.

Recommendation - in his future work the author should strive to publish the results of his research in scientific journals with impact factor and impact rank.

Summary

The dissertation contains scientific-applied and applied results, which represent an original contribution to science and meet the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the implementation of the ZRASRB and the Rules for the specific conditions for the acquisition of scientific degrees and for academic positions of the Institute of Information and Communication Technologies - BAS.

I consider that the PhD student has a thorough theoretical knowledge in the field of Informatics and proven capabilities for independent scientific research. All this gives me solid evidence of positive assessment and I recommend the honorable scientific jury to award the educational and scientific degree "Doctor" in the field of higher education: 4. Natural sciences, mathematics and informatics, professional area 4.6 Informatics and Computer science to Veselin Lazarov Shahpazov.

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Sofia

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(Prof. Dr. Maria Hristova)