REVIEW OF THE DISSERTATION THESIS

Applicant:	Ing. Evelyn Toseafa Faculty of Economics and Administration Institute of System Engineering and Informatics University of Pardubice
Title of dissertation:	Forecasting Regional Financial Performance using Soft-Computing Methods
Study program:	System Engineering and Informatics
Supervisor:	prof. Ing. Petr Hájek, Ph.D. Science and Research Centre Faculty of Economics and Administration, University of Pardubice
Reviewer:	doc. Ing. Miloslav Hub, Ph.D. Institute of System Engineering and Informatics Faculty of Economics and Administration, University of Pardubice

The submitted dissertation thesis of Ing. Evelyn Toseafa deals with the problem of regional financial performance prediction using various soft computing methods. The dissertation thesis is divided into 7 chapters (excluding the list of references, list of figures, etc.) and has 128 pages.

Topicality of the dissertation thesis

The dissertation entitled "Forecasting Regional Financial Performance Using Soft-Computing Methods" presents a highly topical research that addresses the complex and evolving area of forecasting the financial performance of regional entities using advanced soft-computing methodologies. The increasing importance of regional financial health in national and global economies, coupled with the intricate nature of assessing and predicting this performance, makes this study both timely and relevant. The topicality of the thesis is further underscored by its alignment with current trends in financial modelling, where there is a growing appreciation of the potential of soft computing methods to deal with the complexity and uncertainty inherent in financial data. The integration of various computational techniques to form a hybrid predictive model reflects a forward-looking approach that is likely to inspire further research in this area.

Achievement of dissertation thesis objectives

The dissertation thesis aims to develop and validate a novel hybrid model for forecasting regional financial performance using a range of soft computing techniques such as machine learning methods including random forest, XGBoost, support vector machines, neural networks and fuzzy rule-based systems. This approach is particularly relevant given the current trend towards using computational intelligence and machine learning to improve predictive accuracy in various domains, including financial forecasting. In addition, the emphasis of the dissertation on cost-sensitive learning and its application to minimise misclassification costs in credit rating classification for sub-sovereign entities underscores the practical implications of the research in improving decision-making processes in financial assessment. The experimental validation using Moody's datasets further enhances the credibility and applicability of the proposed model.

The dissertation thesis also sets several specific objectives to achieve the goal, including feature selection, comparison of the proposed model with baseline and state-of-the-art methods, addressing imbalanced data issues, employing machine learning methods, and ensuring the accountability of the best performing prediction models using SHAP values. The thesis outlines a clear methodology for feature selection using both wrapper and filter methods to reduce the dimensionality of the feature space and increase the accuracy of predictive models. A thorough comparison of the proposed models with existing baseline and state-of-the-art machine learning methods is performed. The thesis also proposes the use of data balancing methods to deal with the class imbalance problem.

The thesis appears to comprehensively achieve its stated objectives by systematically addressing the challenges of forecasting regional financial performance through a novel hybrid model of soft computing methods. The detailed methodology, together with the emphasis on feature selection, comparative analysis, data balancing, advanced machine learning techniques, statistical approaches and model explainability, suggests a thorough and rigorous approach to achieving the aims of the thesis.

Methodology, results and contributions of the dissertation thesis

The structured approach to the research, starting with a comprehensive review of the state-of-the-art in regional financial performance forecasting, through a detailed explanation of the proposed methodology, to the presentation and discussion of experimental results, demonstrates a thorough and methodical treatment of the subject.

The thesis uses benchmark datasets from Moody's credit rating agency, which is a reputable source, providing a solid foundation for the research. The use of a range of soft computing methods, including ensemble classifiers and cost-sensitive approaches, is a strong aspect of the methodology. The incorporation of XGBoost, known for its performance in various machine learning competitions, and the innovative use of the complementary log-log model add depth to the research methodology. One of the key strengths of this thesis is its focus on the application of a novel hybrid method that integrates feature selection, class balancing and ensemble classifiers within a cost-sensitive prediction framework. The thesis proposes the use of data balancing methods, such as random oversampling and SMOTE, to address the problem of unbalanced data that is common in the context of regional financial performance assessments. The inclusion of cost-sensitive ensemble learning and meta-cost approaches indicates a comprehensive evaluation strategy that addresses the challenges of imbalanced data in sub-sovereign credit rating prediction. This is a significant contribution given the inherent challenges in predicting regional financial performance, such as the complexity of the financial indicators involved, the need for precise and accurate predictions, and the management of imbalanced data, which is common in credit rating classification.

Critically, although the results are promising, further validation across different datasets and more recent time periods would strengthen the generalisability of the findings. The complexity of the hybrid model may also pose challenges for implementation in practice. Simplification or modularisation of the model could improve its usability. A more detailed comparison with traditional machine learning and statistical methods could provide a clearer picture of the advantages and limitations of the proposed soft computing approach.

In conclusion, the dissertation represents a significant contribution to the field of financial performance forecasting, particularly in the context of regional entities. Its relevance is marked by the innovative application of soft computing methods to address a complex and highly relevant problem, making it a notable addition to the body of knowledge in financial and computational intelligence research.

Formal quality of the dissertation thesis

The thesis is well organised, with a clear structure that facilitates understanding. The language used is formal and appropriate for an academic dissertation. Ensuring consistent formatting throughout the document, particularly in the bibliography and appendices, would enhance the formal quality of the thesis. Items in the reference list are not given according to ISO 690. Otherwise, the work is on a good technical level, it is written clearly and comprehensibly.

Publication activity of the author

An overview of the author's own publications is given in the appendix. The applicant is co-author of 1 article in a journal with impact factor, 2 articles in journals with SJR (for one of the articles she is the first author) and three other articles in journals indexed in EBSCO or Google Scholar. She is also co-author of two papers in conference proceedings indexed in WoS. The most significant publications are in the Q3 category but are not in line with the dissertation field. However, the other publications are in line with the focus of the dissertation. The author's publication activity is therefore at an appropriate level.

Questions and final evaluation

During the defence of the dissertation thesis, the candidate should comment on the following questions:

1. Justify the absence of deep learning neural networks. Were there any soft computing methods you considered but ultimately decided against, and if so, what were the reasons for their exclusion?
2. What steps would be necessary to ensure the model's generalization and adaptability to various regions with potentially differing economic and financial dynamics?
3. What are the implications of the SHAP values in Figure 7 for regional management?

Evelyn Toseafa's dissertation "Forecasting Regional Financial Performance using Soft-Computing Methods" meets the requirements for a dissertation thesis in Systems Engineering and Informatics, and therefore I recommend it for defence.

In Pardubice, March 11, 2024

doc. Ing. Miloslav Hub, Ph.D.