

**REVIEW**  
**of a member of the Scientific Jury**  
**for obtaining the educational and scientific degree „Doctor“**  
**under the program „Finance, money circulation, credit and insurance“ (Finance)**  
**in D. A. Tsenov Academy of economics - Svishtov**

**Reviewer:** Assoc. Prof. Dr. Ivaylo Mihaylov Mihaylov, Burgas State University „Prof. Dr. Assen Zlatarov“, habilitated in the scientific specialty 05.02.05 „Finance, money circulation, credit and insurance“.

**Author of the dissertation:** PhD student Antonio Valentinov Dichev (D010223294), full-time form of study in the doctoral program „Finance, money circulation, credit and insurance“ (Finance) at the Department of Finance and Credit at the D. A. Tsenov Academy of Economics - Svishtov.

**Topic of the dissertation:** „Financial Risk Assessment Using Machine Learning“.

**Scientific advisor:** Assoc. Prof. Dr. Alexander Petrov Ganchev, Finance and credit department, D. A. Tsenov Academy of Economics – Svishtov and Assoc. Prof. Dr. Krasimira Borisova Slaveva, Department of Statistics and Applied Mathematics at the D. A. Tsenov University.

### **I. General presentation of the dissertation**

The basis for writing the review is the decision of the Faculty of Finance (protocol № 4/19 December 2025) at the Academic College „D. A. Tsenov“ - Svishtov, approved by order of the rector № 1370/22 December 2025. The review of the dissertation work was prepared in accordance with the regulatory requirements of the Law on the State Academic Research and Development of the Republic of Bulgaria and is in accordance with the requirements of the Academic College „D. A. Tsenov“ - Svishtov for the composition and structure of the content.

The subject of the development are the specific algorithms, tools and methods of machine learning that can be used for quantitative modeling and building effective tools for assessing the main types of financial risk - credit, market and operational.

The object of research in the dissertation is financial risk.

In structural terms, the presentation of the dissertation is presented as follows: introduction, three chapters, conclusion, bibliography and appendices. The development includes 197 standard pages, of which 167 pages are main text, 43 tables and 34 figures. The structure of the dissertation is coherent, with a clearly expressed balance between the theoretical overview and the empirical research. The bibliography contains 130 sources, of which 7 are in Bulgarian and 113 in English, which indicates a high degree of literary awareness and knowledge of international research on the topic. The selected sources are relatively new and show that the doctoral student is well-versed in current scientific developments and trends in the field.

A 16-page appendix is presented to the dissertation, which includes a dictionary of specific terms in Bulgarian and English, a list of abbreviations used, tables with values specific to the study, graphs and diagrams.

### **II. Assessment of the form and content of the dissertation**

In the introductory part of the dissertation, the author substantiates the relevance and scientific significance of the problem under study, based on the fact that the exponential growth of digitalization in recent years has led to a significant increase in the volume of data subject to research and analysis, which makes them a key resource for decision-making and management in the financial sector. It is noted that artificial intelligence technologies are gaining particular relevance, which, when processing large amounts of data, allow the identification of difficult-to-recognize dependencies, essential for the construction of risk assessment models. In support of his theses, the author proves that according to a number of modern studies in the field of technological innovations in the financial sector, the so-called „machine learning“ emerges as the AI technology with the most significant potential for generating added value. This justifies the increased academic efforts in recent years to research the possibilities and effective application of AI technology in financial and economic activity, both as a stand-alone innovation and in combination with financial instruments.

I believe that the research thesis formulated by the author is correctly presented and has discussion potential. It states: „the application of machine learning methods can significantly improve financial risk assessment through easier detection of otherwise hidden dependencies and interactions, automated processing of large volumes of data, including the ability to quickly adapt to dynamically changing conditions“.

The author aims to identify the potential added value of applying machine learning methods in the assessment of different types of financial risk, with the choice of algorithms and methods based on a comparative analysis between two groups of approaches: the established classical techniques for assessing financial risk and the algorithms developed within the framework of machine learning.

To achieve this goal, doctoral student Antonio Dichev defines seven tasks that outline the logic of the development:

First, to identify the main categories of financial risk with the greatest materiality and potential for added value of machine learning as a quantitative assessment tool.

Second, to distinguish, through a transparent and reasoned approach, the methods that are recognized as machine learning and those that the financial services sector traditionally uses in risk assessment.

Third, to trace the regulatory framework regarding the application of algorithms using artificial intelligence and machine learning in financial risk management.

Fourth, to select financial risk assessment methods that are representatives of the machine learning group and those that are representatives of the classical ones.

Fifth, to study and identify the main and appropriate quantitative indicators and criteria for evaluating and analyzing the performance of the different algorithms and methods.

Sixth, to apply the selected risk assessment algorithms appropriately, in a manner and in an environment that the author, established practice and literature review have identified as having the highest potential.

Seventh, to make a thorough, based on comparable data samples and in an appropriate manner, comparison of the performance of the different groups of risk assessment methods.

The first chapter is introductory to the topic and is dedicated to the theoretical foundations and concepts of financial risk and machine learning. Basic concepts, concepts and theoretical

aspects of the types of risk are defined. The author systematizes and critically reviews contemporary research on machine learning and its application in risk assessment processes. Additionally, the current regulatory framework governing the use of artificial intelligence and machine learning as tools to support assessment models is analyzed. The EU legal framework for artificial intelligence (EU AI act) is also examined, which sets the basis for how artificial intelligence technologies are to be managed and implemented in the member states. The review also includes ESG factors as a form of financial risk. At the end of the chapter, the main conclusions from the study are presented.

The second chapter examines the methodological aspects of financial risk assessment using classical tools and machine learning. Key quantitative indicators for credit, market and operational risk are derived. Key regulatory and analytical metrics such as probability of default, loss given default, value at risk, etc. are successively examined and analyzed, thereby creating an analytical basis allowing for a comparison between traditional and machine learning-based approaches. Based on the analysis, doctoral student Antonio Dichev reaches the relevant conclusions and inferences.

The third chapter is dedicated to the practical aspects of quantitative financial risk assessment. For this purpose, a comparative analysis of the performance between classical and machine learning methods has been made. In order to achieve truly applicable and scalable results, the study focuses on several key aspects of risk management that allow for quantitative modeling and subsequent empirical analysis. Based on the results of the individual methods and algorithms, a comparative analysis has been made between them. The study in this chapter also outlines the frameworks in which machine learning actually contributes to better risk management and the cases in which classical methods continue to outperform or be preferred.

In the conclusion of the dissertation, the author summarizes the results achieved from the main theoretical and empirical results achieved by the dissertation research and outlines the current problems and challenges related to the effectiveness and tools of machine learning. The realization of the set goals and objectives is reflected, with which the thesis of the dissertation is also argued.

For the development of the dissertation work, various scientific and research methods were used, such as: the methods of theoretical analysis and synthesis, comparative analysis, risk modeling using traditional methods and machine learning, validation analysis based on statistical tests and methods, SHapley Additive exPlanations (SHAP) analysis, and others. The results obtained are presented using a graphical method, which provides a visual representation of the research.

Doctoral student Antonio Valentinov Dichev has submitted a declaration of originality, in accordance with Art. 68, paragraph 2 of the Regulations for the Development of Academic Staff at the D. A. Tsenov University of Applied Sciences, with which he guarantees that the dissertation work is authentic and represents his own scientific production.

The volume of the dissertation work is fully sufficient for the study of the chosen topic. I believe that the style and language are at a good level, from the point of view of academic norms and standards.

The abstract of the dissertation is developed according to generally accepted requirements and is 31 pages long. It summarizes the author's theses and results of the conducted scientific research, which provide an overall picture of achieving the set goal. There is a reference to the

scientific and applied scientific contributions in the dissertation. A list of publications on the topic is also attached, which indicates: three articles published in peer-reviewed scientific publications, one of which is in English, and one scientific report, also published in peer-reviewed volumes. In the scientific production, doctoral student Antonio Dichev is the sole author of four publications and is co-author of one article. The publication activity is fully sufficient (the total number of points is 90) for awarding the educational and scientific degree „doctor“, according to the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria. At the time of preparation of the review, there is no data on citation of the presented publications.

### **III. Scientific and scientific-applied contributions of the dissertation**

The contributions are listed in the presented Summary of Contributions. The author has made four contributions of a scientific-theoretical and scientific-applied nature. The contributions are as follows:

*First*, the systematic analysis of the concept of financial risk assessment using machine learning methods outlines the key categories of financial risk, their role in modeling financial sustainability and shows that machine learning functions as a major catalyst for innovation in the study of economic and financial processes.

*Second*, the empirical analysis shows that machine learning-based risk assessment models outperform traditional approaches in most cases, confirming the high expectations for this type of tool.

*Third*, the application and resource limitations of machine learning-based financial risk assessment models are outlined, as well as the cases in which they fall short of classical approaches, which emphasizes the need for precise contextual selection and application.

*Fourth*, the broad-spectrum empirical analysis highlights key challenges and limitations in the practical application of machine learning-based financial risk management models and substantiates the conclusion that this approach represents a sustainable evolutionary stage in the development of quantitative methods in finance, rather than a temporary technological phenomenon.

### **IV. Critical notes and questions on the dissertation**

There are also some gaps and weaknesses in the doctoral student's work, which gives me reason to make the following critical remarks:

1. It would be good if all tables, figures and graphs at the end of the dissertation were presented in several appendices, rather than in one single 16-page appendix. The appendices are numbered to avoid ambiguity when citing them in the main text.

2. Despite its scientific value, in places the dissertation lacks a final stylistic polish. An additional stylistic edit would have given the work a more complete and academically sound appearance.

In connection with the defense of the dissertation, the following specific questions can be addressed to doctoral student Antonio Dichev:

1. What criteria do you use to compare the effectiveness of machine learning-based models with traditional models?

2. How do you interpret the cases in which traditional models outperform machine learning models?

3. How do you assess the balance between complexity, computational cost, and accuracy of different models?

#### **V. Summary assessment of the dissertation and conclusion**

In conclusion, I can summarize my opinion that the dissertation work submitted to me for review on the topic „*Financial Risk Assessment through Machine Learning*“ is dedicated to a topical and significant problem for science and business. The contributions contained in it in theoretical and scientific-applied terms meet the requirements of the Development of the Academic Staff in the Republic of Bulgaria Act and the Regulations for its implementation.

In view of the arguments presented, I give a positive assessment of the dissertation work and call on the scientific jury to vote positively for the award of the educational and scientific degree „doctor“ to **Antonio Valentinov Dichev** in the field of higher education 3. Social, economic and legal sciences, professional direction 3.8. Economics, scientific specialty „Finance, monetary circulation, credit and insurance“.

Date: January 20, 2026 г.

Prepared the opinion: .....

Assoc. Prof. Dr. Ivaylo Mihaylov