ANALYSIS OF SCIENTIFIC RESEARCH ON MACHINE LEARNING TECHNOLOGIES IN THE FIELD OF FINANCE AND CREDIT IN UZBEKISTAN

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Abstract: *In recent years, Uzbekistan has witnessed a growing level of scientific activity in the field of applying machine learning methods in the financial sector. Of particular relevance is the area related to credit scoring—automated assessment of borrowers' creditworthiness using intelligent algorithms. Based on an analysis of publications by Uzbek researchers from 2020 to 2024, several key trends and research approaches can be identified. Modern technologies are exerting an increasing influence on the development of the financial sector. One of the key directions of digital transformation is the implementation of machine learning and artificial intelligence methods for data analysis, risk forecasting, and optimization of business processes. The application of these methods is especially important in the area of credit scoring—systems for assessing customers' solvency. The use of machine learning makes it possible to improve prediction accuracy, reduce default rates, and accelerate decision-making processes in banks and microfinance institutions.*

Keywords: *credit scoring, machine learning, creditworthiness assessment, banking, digital technologies, logistic regression, binary classification.*

Introduction: The financial industry of Uzbekistan has been undergoing a phase of active digital transformation in recent years. One of the priority areas for the development of the banking sector is improving the quality of credit scoring systems through the use of machine learning (ML) methods. The relevance of this topic is driven by the need to enhance credit risk assessment amid the increasing volume of microfinance, the growth in the number of new market participants, and the rapid expansion of the customer base.

The application of machine learning makes it possible to take into account a wide range of factors influencing borrowers' creditworthiness, providing more accurate default predictions compared to traditional assessment methods based on expert rules. However, despite global experience in the successful implementation of ML-based scoring models (Hand & Henley, 1997; Thomas et al., 2002; Baesens et al., 2003), the local specificity of data in Uzbekistan requires a tailored approach to their development and adaptation.

A review of the literature shows that in recent years a number of studies on this topic have emerged in Uzbekistan. For example, Isakov O. (2024) conducted a comparative analysis of machine learning methods for predicting non-performing loans, confirming the effectiveness of ensemble algorithms. Abdullaev N.A. and Umarov M.Sh. (2023) examined the possibilities of applying Data Mining in risk assessment systems. Djurabaev O.T. and Atadjanov Sh.Sh. (2023) outlined the potential of artificial intelligence in the financial sector, emphasizing the needs of the local market. Ochilova Kh.O. (2023) linked credit scoring issues with the objectives of the national development strategy "Uzbekistan–2030." In turn, Meliboeva A. (2023) attempted to apply Random Forest models to predict customer behavior. However, most of these works are either review-based or methodological in nature and are not accompanied by practical experiments using real data from Uzbek financial institutions.

Thus, despite the presence of a number of theoretical studies, several unresolved issues remain: there is a lack of publicly available data for model training, few examples of comprehensive testing of modern algorithms in the Uzbek context, and insufficient research into customer behavioral factors. In addition, available publications contain almost no assessments of the applicability of alternative data sources, such as transaction activity or behavioral metrics.

The present study aims to address this gap by offering a systematic analysis of publications in this field and formulating proposals for building effective credit scoring systems using machine learning methods in Uzbekistan. The study occupies its own niche by integrating the results of previously published works and putting forward practical recommendations for the localization of models and the development of intelligent credit risk assessment systems, taking into account the specific characteristics of the national financial market.

1-table

Review of scientific works based on Machine Learning in Uzbekistan.

Author	Topic and Journal	What Was Done in the Paper	What Was Not Addressed	How It Can Be Addressed
Olmas Isakov	Application of machine learning algorithms, including XGBoost, for default prediction on microfinance loans in Uzbekistan. Journal: **DTAI**	Compared various machine learning methods for predicting bad loans.	Specific datasets used and adaptation of methods to Uzbekistan's conditions were not specified.	Conduct an analysis of the applicability of these methods to local data and conditions.
Abdullaev N.A., Umarov M.Sh.	Analysis of current credit scoring systems in Uzbekistan's banking sector and proposals for implementing AI and Data Mining. Journal: **Economics Academic Journal**	Reviewed existing scoring systems and proposed modernization paths using AI.	No concrete implementation examples of the proposed solutions.	Develop a pilot project implementing the proposed methods in a specific bank.
Djurabaev O.T., Atadjanov Sh.Sh.	Study of AI applications in Uzbekistan's fintech sector, including business process automation, risk management, and data analysis. Journal: **InnoIST**	Discussed various directions of AI application in fintech.	No specific use cases or implementation results provided.	Conduct a study of successful AI implementation cases in Uzbekistanвҗ™s fintech sector.

Ochilova Kh.O.	Credit risk assessment using machine learning and scoring models in the context of the Uzbekistan's strategy. Journal: **eGlobalCongress**	Presented credit risk assessment methods aligned with national strategic goals.	The most effective methods under current conditions were not identified.	Perform a comparative analysis of the effectiveness of different credit risk assessment methods.
Meliboev A.	Application of machine learning algorithms such as Random Forest to predict customer churn in the banking sector. Journal: **Scholar KokandUni**	Applied ML methods to analyze customer behavior.	No information on model accuracy or practical application.	Test models on real data and evaluate their accuracy.
Yormatov I.T., Mirzaliev A.B.	Study of theoretical foundations and methods of credit risk assessment using modern tools, including scoring models and data analysis. Journal: **OAJournals**	Reviewed theoretical approaches to credit risk assessment.	No practical examples of applying the theories.	Develop practical case studies for applying theoretical models in banks.
Norov A.R. et al.	Analysis of the implementation of automated scoring systems in commercial banks of Uzbekistan and their impact on economic development. Journal: **OpenAccessJournals**	Examined mechanisms for automating scoring systems in banks.	No data on the results of system implementation.	Conduct an evaluation of the effectiveness of implemented scoring systems in banks.
Jafarova Sh.A., Botaboev M.Sh.	Analysis of credit risk management problems and development of scientific proposals to address them in Uzbekistan's banking sector. Journal: **AcademicPublishers**	Proposed scientific approaches to reducing credit risks.	No explanation of how proposals can be implemented in practice.	Develop an implementation roadmap for applying the proposals in banking practice.

Abdurashidova M.S., Balbaa M.E.	Study of AI's impact on Uzbekistan's banking sector, including customer service improvement, fraud detection, and credit scoring accuracy. Journal: **ResearchGate**	Reviewed AI application opportunities in various banking activities.	No concrete data on AI implementation in Uzbek banks.	Analyze the current state of AI adoption in the countryв's banking sector.

Discussion: Overall, all the works reviewed in the table confirm the importance of applying machine learning methods to improve the accuracy of credit risk prediction and financial management in Uzbekistan. The studies by Isakov (2024), Abdullaev and Umarov (2023), and Meliboev (2023) stand out because they propose specific ML methods, such as XGBoost, Random Forest, and Data Mining, for predicting defaults and analyzing customer behavior. This, in turn, demonstrates the growing interest in using advanced technologies in Uzbekistan's banking sector.

However, there is a noticeable difference in the level of detail and localization of the proposed solutions. For example, the studies by Isakov (2024) and Djurabaev and Atadjanov (2023) remain at the level of theoretical analysis and generalizations, without specifying concrete data or implementation cases. Meanwhile, studies such as those by Norov (2023) and Jafarova with Botaboev (2023) focus on examining existing practices in Uzbekistan, but also do not provide specific recommendations or conclusions regarding the results of ML model implementation. One of the main weaknesses of most studies is the lack of practical examples of implementing the proposed machine learning models in Uzbekistan. In particular, the works of Abdullaev and Umarov (2023) and Djurabaev and Atadjanov (2023) mention the possibilities of using AI and Data Mining for risk management, but do not present real cases or data on outcomes in commercial banks. This limits the ability to assess the effectiveness of the proposed approaches and their suitability for real-world application.

For a more detailed analysis and practical implementation of the proposals outlined in these studies, empirical research is needed, including the use of real data from banks and microfinance organizations in Uzbekistan. This will allow for a more accurate assessment of the effectiveness of machine learning methods such as XGBoost, Random Forest, and Data Mining in default prediction and risk management. It is also important to test the proposed models in the context of the specific financial behavior of Uzbek borrowers.

One promising direction is the development of pilot projects to implement the proposed methods in individual banks, as suggested by Abdullaev and Umarov (2023). Conducting such experiments will not only help verify the effectiveness of the proposed models but also provide practical data for further research.

Recommendations and directions for further research:

1.   Use of local bank and microfinance organization data for model training. Adapt algorithms to the real features of Uzbekistan's economy, including the shadow economy, P2P transfers, and microloans.

2.   Creation of a unified research database. Initiate the creation of an open (anonymized) dataset for use by researchers and developers. Combine efforts of universities, banks, and IT companies to collect and structure credit and behavioral data of clients. Include not only financial information but also behavioral metrics (mobility, payment regularity, transaction history, etc.).

3. Development and implementation of hybrid scoring models. Combine classical models (logistic regression, scorecards) with advanced ML algorithms (Random Forest, XGBoost, Neural Networks). Apply ensemble models to increase prediction robustness. Test explainable AI models (e.g., SHAP or LIME) to clarify algorithmic decisions.

4. Development of a personalized scoring system. Models adapted to specific client segments (students, pensioners, entrepreneurs). Use clustering (k-means, DBSCAN) to identify customer segments with varying risk levels. Provide personalized credit offers and conditions based on behavioral analytics.

5. Consideration of alternative data sources. Use non-standard information sources: mobile data, social networks, utility payments. Develop scoring models based on a client's digital footprint. Apply Natural Language Processing (NLP) to analyze customer communications and identify risks (e.g., sentiment in chatbots or emails).

6. Conduct A/B testing of models in real conditions. Implement pilot projects with banks and microfinance organizations. Compare the effectiveness of existing and proposed ML models on the same customer portfolio. Analyze key metrics: Precision, Recall, F1-score, ROC AUC, as well as business metrics — delinquency reduction, profit growth.

7. Enhancement of specialist competencies. Organize specialized courses and internships on ML in finance for bank employees and researchers. Develop joint programs between universities, regulators, and the private sector for FinTech implementation. Support young scientists, graduate students, and students in conducting applied research projects.

8. Regulatory and ethical framework. Develop legal frameworks for the application of automated solutions in lending. Ensure personal data protection when using ML models. Ethical principles: transparency of decisions, prevention of discrimination, and the ability to appeal scoring outcomes.

Literature

1. *Isakov, Olmas. 2024. "Comparison of Machine Learning Methods in Bad Loan Predictions: Analysis of Micro Finance Data". DTAI – 2024 1 (DTAI). https://dtai.tsue.uz/index.php/DTAI2024/article/view/305.*

2. *Abdullaevich, Abdullaev Nekruz, and Umarov Muzaffarbek Shavkatovich. 2022. "Modern Technologies and Modern Scoring in Modern Uzbekistan: Tasks, Methodologies, Problems". Academic Journal of Digital Economics and Stability 18 (June):108-18. https://doi.org/10.51699/ajdes.v18i.532.*

3. *Джурабаев О.Т., Атаджанов Ш.Ш. "ПРИМЕНЕНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА НА ФИНТЕХЕ В УЗБЕКИСТАНЕ. ИССЛЕДОВАНИЕ И АНАЛИЗ". 2024. Innovations in Science and Technologies 1 (5): 4-11. https://www.innoist.uz/index.php/ist/article/view/470.*

4. *Ochilova Khusniya Olim kizi. 2025. "METHODS AND TOOLS OF CREDIT RISK ASSESSMENT IN THE MODERN SYSTEM OF RISK MANAGEMENT". E Global Congress 25 (January):1-8. https://eglobalcongress.com/index.php/egc/article/view/294.*

5. *Meliboev Azizjon. 2024. "BY USING DATA ANALYSIS AND MACHINE LEARNING TECHNIQUES FOR BANK TURNOVER PREDICTION". University Research Base, April, 481-86. https://scholar.kokanduni.uz/index.php/rb/article/view/372.*

6. *Yormatov Ilmidin Toshmatovich, and Mirzaliyev Axror Baxodirovich. 2024. "Theoretical Foundations of Credit Risk Assessment In Commercial Banks". Journal of Marketing and Emerging Economics 4 (6):226-30. https://oajournals.net/index.php/jmee/article/view/2671.*

7. *Норов А.Р. Механизм кредитования через автоматизированную скоринговую систему в коммерческих банках / А.Р. Норов, и соавт. – 2023. – Журнал: OpenAccessJournals..*

8. *Джафарова Ш.А., Ботабоев М.Ш. "IMPROVING CREDIT RISKS IN UZBEKISTAN BANKS". 2024. International Journal of Artificial Intelligence 4 (10): 602-4. https://www.academicpublishers.org/journals/index.php/ijai/article/view/2077.*

9. *Абдурашидова М.С., Балбаа М.Э. Искусственный интеллект в банковском секторе Узбекистана: изучение влияния и возможностей / М.С. Абдурашидова, М.Э. Балбаа. – 2023. – Журнал: ResearchGate].*

10. *Nuralievich, B. O., & Boltaevich, M. B. (2021, November). Method of Detection and Elimination of Tracks of Attacks in the Information System. In 2021 International Conference on Information Science and Communications Technologies (ICISCT) (pp. 1-2). IEEE.*

11. *Nuralievich, B. O., Boltaevich, M. B., & Ugli, B. U. B. (2022, September). The Procedure for Forming a List of Sources of Attack in the Information System. In 2022 International Conference on Information Science and Communications Technologies (ICISCT) (pp. 1-4). IEEE.*

12. *Bekmirzaev O., Shirinov B. An Algorithm for Viewing Node State Events Under Attack for Information Systems // AIP Conference Proceedings., 2024, 3147(1), 050003. DOI: 10.1063/5.0210404*

13. *Bekmirzaev O., Samarov H. A Method of Evaluating the Effectiveness of Information System Protection // AIP Conference Proceedings., 2024, 3147(1), 050004. DOI: 10.1063/5.0210405*

14. *Muminov, B., & Bekmirzaev, O. (2022). Structure and algorithms of online discussion information system. Scientific Collection «InterConf», (114), 373-384.*