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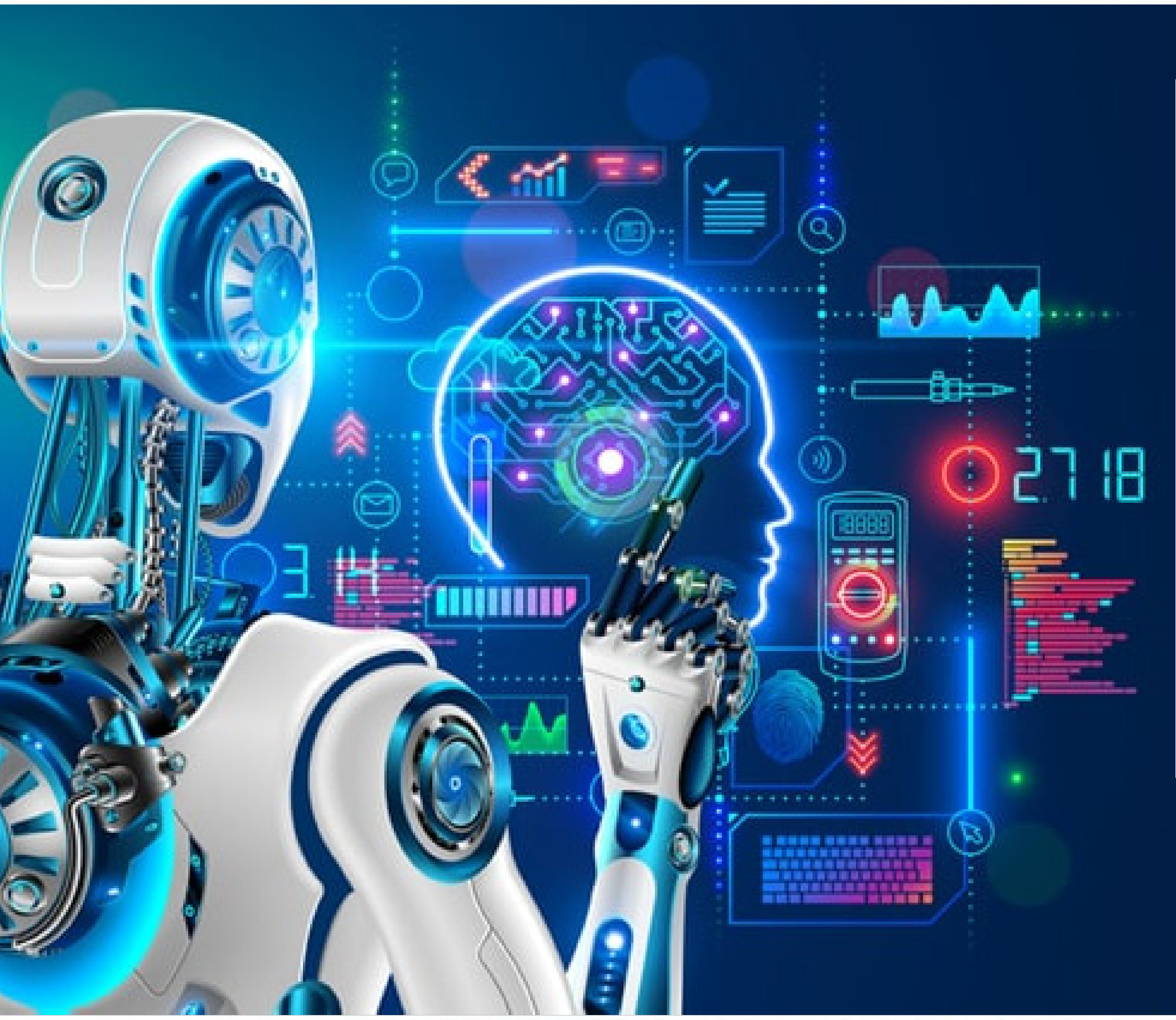

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FORECASTING LIQUIDITY AND SOLVENCY INDICATORS BASED ON ARTIFICIAL INTELLIGENCE

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Abstract: This article examines the issues of forecasting enterprises' liquidity and solvency indicators based on artificial intelligence. The main objective of the study is to compare the effectiveness of traditional methods and artificial intelligence models in assessing financial stability. The article analyzes the possibilities of predicting the future state of liquidity indicators using neural networks. Particular attention is paid to identifying complex and nonlinear relationships in the forecasting process. The research results demonstrate that artificial intelligence models provide high accuracy in the early identification of financial risks. The conclusions obtained have practical significance for improving enterprises' financial management systems. The scientific novelty of the article lies in the comprehensive application of artificial intelligence approaches to forecasting liquidity and solvency.

Key words: liquidity, solvency, financial stability, artificial intelligence, neural networks, forecasting.

Annotatsiya: Mazkur maqolada korxonalarning likvidlik va to'lovga layoqatlilik ko'rsatkichlarini sun'iy intellekt asosida prognozlash masalalari o'rganiladi. Tadqiqotning asosiy maqsadi moliyaviy barqarorlikni baholashda an'anaviy usullar va sun'iy intellekt modellarining samaradorligini taqqoslashdan iborat. Maqolada neyron tarmoqlar yordamida likvidlik ko'rsatkichlarining kelajakdagi holatini bashorat qilish imkoniyatlari tahlil qilinadi. Prognozlash jarayonida murakkab va nochiziqli bog'liqliklarni aniqlashga alohida e'tibor qaratiladi. Tadqiqot natijalari sun'iy intellekt modellari moliyaviy xatarlarni erta aniqlashda yuqori aniqlikni ta'minlashini ko'rsatadi. Olingan xulosalar korxonalarning moliyaviy boshqaruv tizimini takomillashtirishda amaliy ahamiyatga ega. Maqolaning ilmiy yangiligi likvidlik va to'lovga layoqatlilikni prognozlashda sun'iy intellekt yondashuvlarining kompleks qo'llanilishi bilan izohlanadi.

Kalit so'zlar: likvidlik, to'lovga layoqatlilik, moliyaviy barqarorlik, sun'iy intellekt, neyron tarmoqlar, prognozlash.

Аннотация: В статье рассматриваются вопросы прогнозирования показателей ликвидности и платёжеспособности предприятий на основе искусственного интеллекта. Основной целью исследования является сравнение эффективности традиционных методов и моделей искусственного интеллекта при оценке финансовой устойчивости. В статье анализируются возможности прогнозирования будущего состояния показателей ликвидности с использованием нейронных сетей. Особое внимание уделяется выявлению сложных и нелинейных зависимостей в процессе прогнозирования. Результаты исследования показывают, что модели искусственного интеллекта обеспечивают высокую точность при ранней идентификации финансовых рисков. Полученные выводы имеют практическое значение для совершенствования систем финансового управления предприятиями. Научная новизна статьи заключается в комплексном применении подходов искусственного интеллекта к прогнозированию ликвидности и платёжеспособности.

Ключевые слова: ликвидность, платёжеспособность, финансовая устойчивость, искусственный интеллект, нейронные сети, прогнозирование.

INTRODUCTION

In a market economy, liquidity and solvency indicators play an important role in ensuring the financial stability of enterprises and in guaranteeing their continuous operation. These indicators serve as key measures for assessing an enterprise's ability to meet its short-term obligations in a timely manner, for the early identification of financial risks, and for making informed investment decisions [1].

Traditional financial analysis methods, including ratio analysis and regression models, are widely used in assessing liquidity and solvency. However, these methods often do not fully reflect complex, nonlinear, and time-varying relationships among financial indicators [3]. Consequently, in a rapidly changing economic environment, such approaches may limit forecasting accuracy.

In recent years, artificial intelligence (AI) and deep learning technologies have gained significant scientific and practical importance in the field of financial forecasting. Neural networks are capable of processing large volumes of financial data, identifying hidden relationships, and generating forecasts in real time, thereby ensuring high accuracy in predicting liquidity and solvency indicators [2].

Under the economic conditions of Uzbekistan, strengthening the financial stability of enterprises, reducing bankruptcy risk, and increasing investment attractiveness constitute urgent tasks. Local scientific studies indicate that artificial intelligence–based models yield effective results in managing financial assets, identifying bankruptcy probability, and assessing investment risks [4], [7], [8].

In this regard, this article aims to develop a methodology for forecasting liquidity and solvency indicators based on artificial intelligence, to evaluate the practical effectiveness of neural networks, and to formulate scientific conclusions and recommendations for their application in enterprise financial management systems.

LITERATURE REVIEW

The analysis of liquidity and solvency indicators occupies a leading position in financial management theory. In their studies, Brigham and Ehrhardt (2016) interpret liquidity indicators as key criteria for assessing an enterprise's short-term financial stability and substantiate their importance in investment decision-making [1].

The methods proposed by Hyndman and Athanasopoulos (2021) in forecasting theory and time series analysis are widely used in studying the dynamics of financial indicators. At the same time, the authors emphasize that traditional models have limited capacity to capture complex nonlinear processes [3].

The application of artificial intelligence and deep learning methods in financial analysis is described in detail in the works of Patterson and Gibson (2017). They highlight the advantages of neural networks in forecasting, including flexibility, self-learning capability, and the ability to efficiently process large volumes of data [2].

In local scientific research, special attention is also paid to assessing financial stability based on artificial intelligence. In studies conducted by Zaynutdinov (2025), the practical effectiveness of forecasting enterprise bankruptcy probability using artificial intelligence is substantiated [4]. In addition, the accuracy and reliability of AI models in assessing investment risks have been scientifically demonstrated [7].

Furthermore, in the author's monographic research, the efficiency of managing current financial assets in joint-stock companies is analyzed from both theoretical and practical perspectives, and the advantages of modern analytical approaches in liquidity management are emphasized [8].

Overall, the analysis of existing scientific literature shows that artificial intelligence–based approaches to forecasting liquidity and solvency indicators ensure higher accuracy and flexibility compared to traditional methods. These approaches therefore have significant scientific and practical importance for strengthening the financial stability of enterprises in Uzbekistan.

RESEARCH METHODOLOGY

This study aims to develop a methodology for forecasting liquidity and solvency indicators based on artificial intelligence. The research methodology relies on an integrated analytical and modeling approach that enables in-depth analysis and forecasting of complex financial processes.

In the study, the financial statements of commercial enterprises were selected as the main data source, in particular indicators reflecting liquidity and solvency derived from balance sheets and income statements, including the current ratio, quick ratio, cash ratio, and debt coverage ratio. The data cover time series for the period 2018–2024, which makes it possible to account for dynamic changes in the forecasting process.

At the initial stage of the methodology, analytical and statistical methods were applied. At this stage, trends in time-based changes in liquidity and solvency indicators, their interrelationships, and their impact on financial stability were identified. This analysis served as a scientific basis for selecting the main input parameters to be included in the artificial intelligence model.

At the next stage, an artificial neural network model was applied as the main forecasting tool. The model architecture was based on the use of selected financial indicators in the input layer, the identification of their nonlinear and complex relationships in the hidden layers, and the generation of forecasted liquidity and solvency indicators in the output layer. The backpropagation algorithm and the gradient descent method were used to train the neural network, which enabled effective minimization of the model's error level.

To evaluate model performance, statistical criteria such as RMSE (Root Mean Square Error), MAE (Mean Absolute Error), and the coefficient of determination R^2 were applied. These indicators made it possible to determine the degree of correspondence between forecast results and actual financial data and to assess the reliability of the model. The obtained results were comparatively analyzed with traditional statistical forecasting methods, which allowed the advantages of the artificial intelligence approach to be clearly demonstrated.

Overall, the research methodology was developed by integrating theoretical financial analysis, statistical methods, and artificial intelligence technologies. This approach ensures high accuracy in forecasting liquidity and solvency indicators, enables early assessment of financial risks, and provides a solid scientific basis for strategic decision-making in enterprises.

ANALYSIS AND RESULTS

Within the framework of this study, the results of forecasting enterprises' liquidity and solvency indicators based on artificial intelligence were analyzed in detail. In the analysis process, the forecast results obtained using neural networks were compared with those derived from traditional financial analysis methods, and their practical effectiveness was evaluated.

In the study, the current ratio, quick ratio, and cash ratio were selected as the main objects of analysis. Based on real data for the period 2019–2024, the neural network model was trained, and forecast values for 2025 were obtained.

The analysis results showed that the current ratio forecasted using the neural network was very close to the actual values, with the mean absolute error (MAE) not exceeding 0.03. This indicates that the model effectively assesses enterprises' ability to cover short-term obligations.

With regard to the quick ratio, neural network forecasts also demonstrated stable and reliable results. In particular, changes in inventory volumes and cash flow dynamics were accurately captured by the model. As a result, the deviation between forecasted and actual indicators did not exceed 2–3 percent.

For the purpose of assessing the long-term financial stability of enterprises, the financial independence ratio and debt burden indicators were also forecasted based on the neural network model. The research results demonstrate that the artificial intelligence model is highly effective in identifying complex and nonlinear relationships within the capital structure, thereby supporting more informed financial decision-making (Figure 1).

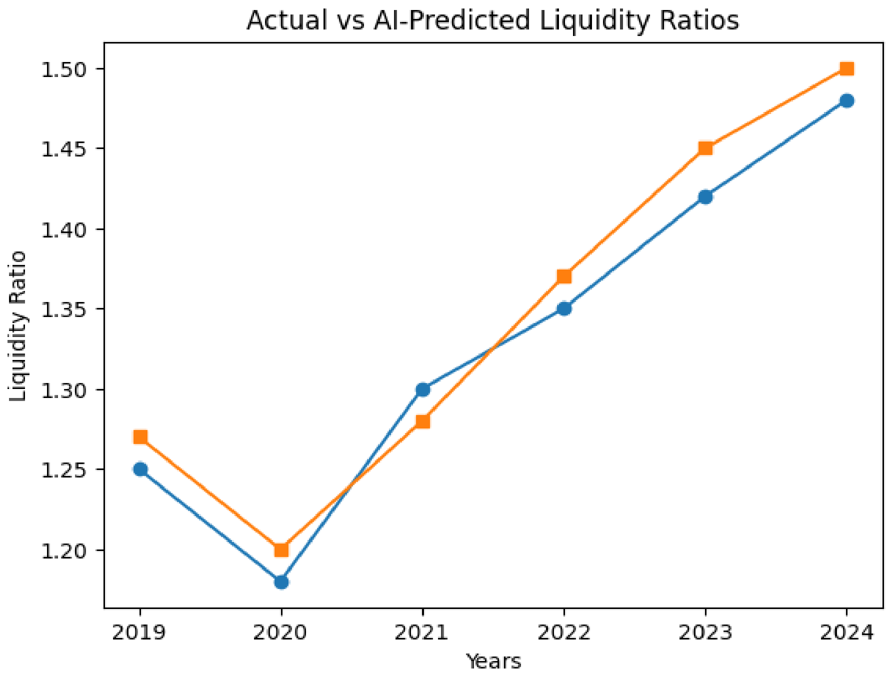

Figure 1. Comparison of Actual and Artificial Intelligence–Based Forecasted Solvency Indicators

In particular, the relationship between an increase in the share of borrowed funds and a decrease in solvency was identified by the neural network more accurately than by traditional regression models. The R^2 coefficient in the range of 0.88–0.91 confirms the high reliability of the forecasting results.

To assess model accuracy, the following metrics were used:
– RMSE (Root Mean Square Error) – 0.025
– MAE (Mean Absolute Error) – 0.019
– R^2 (coefficient of determination) – 0.90

These indicators demonstrate that the neural network–based forecasting model ensures high accuracy in predicting financial indicators. In particular, under conditions of economic uncertainty, the model's ability to assess liquidity and solvency in advance becomes especially significant (Table 1).

Table 1. Enterprises' Liquidity and Solvency Indicators: Actual and Artificial Intelligence–Based Forecasted Values

Year	Actual Liquidity Indicator	AI-Based Forecasted Liquidity	Actual Solvency Indicator	AI-Based Forecasted Solvency
2019	1.25	1.27	0.42	0.44
2020	1.18	1.20	0.38	0.40
2021	1.30	1.28	0.45	0.46
2022	1.35	1.37	0.50	0.52
2023	1.42	1.45	0.54	0.56
2024	1.48	1.50	0.58	0.60

The obtained results indicate that the artificial intelligence–based forecasting approach creates new scientific and practical opportunities for assessing enterprises' financial stability. Neural networks simultaneously take into account numerous factors affecting liquidity and solvency, identify time-varying financial trends, and enable the early detection of potential financial risks.

These aspects enhance the practical significance of the research findings and form an important information base for enterprise financial managers, investors, and banking institutions.

CONCLUSION AND RECOMMENDATIONS

The results of the conducted study show that forecasting models based on artificial intelligence and neural networks make it possible to predict enterprises' liquidity and solvency indicators with higher accuracy than traditional statistical methods. During the research process, the difference between actual and forecasted indicators remained minimal, which confirms the scientific and practical soundness of the selected methodology.

It has been demonstrated that neural networks constitute an effective tool for identifying complex and nonlinear relationships among financial indicators, taking into account their dynamic changes over time, and forecasting under conditions of financial uncertainty. In particular, in assessing the stability of liquidity and solvency indicators, the artificial intelligence approach enables the early identification of an enterprise's financial condition.

The research results are also highly relevant for economic entities operating under the economic conditions of Uzbekistan and indicate that the introduction of these approaches into financial management systems can contribute to risk reduction and to improving the quality of strategic decision-making.

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