моделлардан фойдаланмоқда. Ўзбекистон банклари ушбу тажрибаларни маҳаллий шароитга мослаштириб, улардан фойдаланиш стратегиясини ишлаб чиқиши мумкин.

СИ технологияларини самарали қўллаш учун банкларда ахборот технологиялари инфратузилмасини кучайтириш зарур. Бу жараён замонавий серверлар, маълумотлар базаси тизимлари ва сунъий интеллект платформаларини жорий этишни талаб қилади. Банклар фаолиятини рақамлаштириш сунъий интеллектнинг аниқ ва тезкор таҳлил қилиш қобилиятини оширади.

Ўзбекистонда сунъий интеллектни (СИ) банкларда жорий этиш истиқболлари жуда кенг бўлиб, бу банк фаолиятини рақамлаштириш, кредит рискларини самарали бошқариш ва молиявий хизматларни автоматлаштириш имкониятини беради. Мамлакатда банк тизимида рақамли технологияларни кенг татбиқ этиш жараёни жадаллашмоқда, бу эса сунъий интеллект учун мустаҳкам инфратузилма яратиш имконини беради.

СИ жорий этилиши банкларга кредит бериш жараёнини тезлаштириш, мижозларнинг молиявий ҳолатини аниқроқ таҳлил қилиш ва хавфларни олдиндан прогноз қилиш имкониятини тақдим этади. Айниқса, кредит ско́ринг тизимларини автоматлаштириш орқали қарз олувчиларнинг тўлов қобилиятини баҳолаш самарадорлиги ошади. Бу банкларга хавфларни камайтириш ва муаммоли кредитлар улушини қисқартириш имконини беради.

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OPTIMIZING FINANCIAL MARKET ANALYTICS: ADVANCING STATISTICAL ANALYSIS OF BIG DATA STREAMS WITH NEUROTECHNOLOGIES AND MACHINE LEARNING

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Abstract. This manuscript proposes a new model that integrates neurotechnology with machine learning techniques in an attempt to boost the statistical analysis of big data streams, specifically in relation to the turbulent

financial marketplace. The proposed model enables real-time processing, real-time anomaly detection, and predictive analysis, and in doing so, helps in strengthening decision-making processes and minimizing financial vulnerabilities. Empirical evaluations exhibit high predictive accuracy, adaptability, and high potential for personalized financial interventions, in tune with current trends and future trends in the financial marketplace.

Keywords: financial market, big data, statistical analysis, neurotechnologies, machine learning, digital transformation

Аннотация. В данной статье разработана инновационная модель, объединяющая нейротехнологии и машинное обучение для совершенствования статистического анализа потоков больших данных, в частности в контексте развивающегося финансового рынка. Предлагаемый подход обеспечивает обработку данных в реальном времени, адаптивное обнаружение аномалий и прогнозный анализ, что способствует улучшению процесса принятия решений и управления рисками в сфере финансов. Экспериментальные исследования демонстрируют высокую точность прогнозирования, масштабируемость и значительный потенциал для персонализированных финансовых вмешательств, что соответствует современным тенденциям и перспективам развития финансового рынка.

Ключевые слова: финансовый рынок, большие данные, статистический анализ, нейротехнологии, машинное обучение, цифровая трансформация.

Introduction. The financial marketplace is undergoing a rapid transformation fueled by digitalization, globalization, and growing complexity in financial instruments. Today, financial institutions generate a lot of information derived from electronic trading platforms, social networks, economic statistics, and past marketplace transactions. With such an information explosion, unprecedented avenues for deeper insights into the marketplace have emerged, but conventional statistical techniques often have difficulty in dealing with velocity, volume, and variety in such information flows (Chen, Mao, & Liu, 2014; Cont, 2001).

The advances in neurotechnologies and machine learning have made it feasible to model complex, non-linear relations in high-dimensional datasets (Schmidhuber, 2015; Ait-Sahalia, 2002). In this work, a new model is proposed that leverages such techniques for a deeper analysis of financial markets, at the same time resolving current impediments in risk management and planning at a strategic level.

Methods

Data Collection and Preprocessing

Data for this study were aggregated from multiple sources, including:

- Electronic Trading Platforms: Real-time price and volume data.
- Financial News and Social Media: Application of textual information for sentiment analysis purpose.

• Economic Indicators: Economic factors such as Gross Domestic Product (GDP), inflation, and interest rates.

• Historical Market Data: Transaction records and historical price movements.

Preprocessing steps included:

• Data Cleaning and Normalization: Removing noise and standardizing formats.

• Data Integration: Merging datasets from diverse sources.

• Dimensionality Reduction: Techniques such as Principal Component Analysis (PCA) utilized for reducing complexity (Aggarwal, 2014).

Model Development

The integrated model is designed along three principal dimensions:

1. Technological Dimension:

• Real-Time Processing: Utilizes stream processing frameworks (e.g., Apache Kafka) and machine learning libraries (TensorFlow, Scikit-learn) for continuous data ingestion.

• Adaptive Windowing: Dynamically adjusts analysis windows based on emerging trends.

• Anomaly Detection: Implements deep learning models (e.g., CNNs, RNNs) to identify unusual market behavior.

2. Financial Analytical Dimension:

• Predictive Modeling: Uses machine learning algorithms to forecast market trends, price movements, and volatility.

• Risk Assessment: Quantifies market risk in real time via neural network-based models.

• Market Sentiment Analysis: Analyzes textual data from news and social media to gauge sentiment shifts.

3. Decision Support Dimension:

• Personalized Recommendations: Provides tailored insights for financial analysts.

• Enhanced Transparency: Generates clear, actionable visualizations of market trends.

• Collaborative Analysis: Integrates multi-source data to support comprehensive market analysis.

Implementation and Evaluation

The model was implemented in a simulated trading environment using Python. Key components included:

• Neural Network Architectures: Developed with TensorFlow and Keras.

• Machine Learning Algorithms: Employed for clustering, classification, and regression tasks using Scikit-learn.

• Stream Processing: Managed by Apache Kafka for real-time data handling.

Evaluation metrics included prediction accuracy, anomaly detection rate, and processing latency. *Table 1* summarizes the performance metrics.

Table 1. Key Performance Metrics of the Integrated Model

Metric	*Traditional Methods*	*Proposed Model*	*Improvement (%)*
Prediction Accuracy	75%	88%	+17%
Anomaly Detection False Rate	25%	15%	-40%
Processing Latency (ms)	300	180	-40%

Results

Experimental evaluations indicate that the proposed model significantly outperforms traditional statistical methods:

- Forecasting: The model achieved approximately 17% higher prediction accuracy in forecasting market trends.
- Anomaly Detection: There was a significant drop of 40% in false positive rates, thus improving early warnings for market disruptions.
- Real-Time Responsiveness: Real-time processing and adaptive windowing reduced latency by 40%, supporting rapid decision-making capabilities.

The model demonstrated robust scalability, efficiently processing high-frequency data streams while integrating diverse datasets. This confirms its suitability for large-scale financial market applications.

Feedback from financial analysts highlighted that the model's actionable insights contributed to:

- Increased Risk Management: Real-time and early detection of market anomalies and risk events was attained.
- Informed Decision-Making: Regulatory compliance and strategic interventions were supported through data analysis recommendations.

Discussion

The amalgamation of neurotechnology and machine learning with statistics in relation to voluminous volumes of streaming information yields a significant edge in financial market analysis. The model’s ability to process information in real-time, adapt to detect outliers, and make reliable forecasts of trends effectively counteracts traditional approaches' weaknesses (Chen, Mao, & Liu, 2014; Schmidhuber, 2015).

A range of complications, nevertheless, require consideration:

- Data Security: Protecting sensitive financial information is paramount.
- Needs for Infrastructure: High-performance computational infrastructure requirements could discourage smaller financial institutions' use of such technology.
- Integration of Information: Having high-quality and uniform information at its disposal in a variety of sources is critical in providing reliable analysis.

Research in the future must include developing uniform data governance structures, economically sound approaches for its implementation, and thorough assessments of its impact on financial market stability.

Conclusion

This manuscript proposes a new model that integrates neurotechnology with machine algorithms with a view to improving the statistical analysis of voluminous data streams in the financial sector. The model shows significant improvements in real-time processing, predictive accuracy, and outlier detection, and in the process, enables better decision-making and risk management approaches. Despite early indications of positive performance, additional studies and extended use in modern financial market analysis must occur in order to maximize its full potential.

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ТИЖОРАТ БАНКЛАРИДА КРЕДИТЛАШ МЕХАНИЗМЛАРИНИ РАҚАМЛАШТИРИШ ЙЎНАЛИШЛАРИ

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