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OPTIMIZING E-COMMERCE SALES VOLUME AND EVALUATING EFFICIENCY USING ARTIFICIAL INTELLIGENCE-BASED MODELS

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Annotation: The article examines the potential of artificial intelligence-based models for optimizing sales volumes and improving the economic efficiency of e-commerce enterprises in Uzbekistan. The study analyzes recent trends in the development of Uzbekistan's e-commerce market and identifies the main factors influencing online sales. Particular attention is paid to machine learning models such as XGBoost and LSTM for demand forecasting, inventory optimization, personalized marketing, and pricing decisions. The research also considers the institutional and infrastructural characteristics of Uzbekistan's developing digital economy. Based on the analysis, practical recommendations are proposed for integrating AI technologies into e-commerce management and improving the competitiveness of Uzbek digital businesses.

Keywords: artificial intelligence, e-commerce, machine learning, XGBoost, LSTM, sales forecasting, demand forecasting, digital economy, Uzbekistan, sales optimization.

Аннотация: В статье исследуются возможности использования моделей искусственного интеллекта для оптимизации объема продаж и повышения экономической эффективности предприятий электронной коммерции Узбекистана. Проанализированы современные тенденции развития рынка электронной торговли и основные факторы, влияющие на объем онлайн-продаж. Особое внимание уделено применению моделей машинного обучения XGBoost и LSTM для прогнозирования спроса, оптимизации товарных запасов, персонализации маркетинга и принятия ценовых решений. Учитываются институциональные и инфраструктурные особенности формирующейся цифровой экономики Узбекистана. На основе проведенного анализа разработаны практические рекомендации по внедрению технологий искусственного интеллекта в управление электронной торговлей.



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Ключевые слова: искусственный интеллект, электронная коммерция, машинное обучение, XGBoost, LSTM, прогнозирование продаж, прогнозирование спроса, цифровая экономика, Узбекистан, оптимизация продаж.

Annotatsiya: Ushbu tezisda O'zbekistonda elektron tijorat savdo hajmini optimallashtirish va korxonalar samaradorligini oshirishda sun'iy intellektga asoslangan modellarni qo'llash imkoniyatlari tadqiq etiladi. Elektron tijorat bozorining so'nggi yillardagi rivojlanish dinamikasi tahlil qilinib, onlayn savdoga ta'sir etuvchi asosiy omillar aniqlanadi. Talabni prognozlash, zaxiralarni boshqarish, marketingni shaxsiylashtirish va narxlarni optimallashtirishda XGBoost hamda LSTM modellarining imkoniyatlari ko'rib chiqiladi. Tadqiqot O'zbekiston raqamli iqtisodiyotining institutsional va infratuzilmaviy xususiyatlarini hisobga oladi. Yakunda elektron tijorat korxonalarida sun'iy intellektidan samarali foydalanish bo'yicha amaliy takliflar ishlab chiqiladi.

Kalit so'zlar: sun'iy intellekt, elektron tijorat, mashinaviy o'qitish, XGBoost, LSTM, savdoni prognozlash, talabni prognozlash, raqamli iqtisodiyot, O'zbekiston, savdoni optimallashtirish.

The rapid digitalization of economic activity has fundamentally changed the mechanisms through which businesses interact with consumers, organize sales processes, manage inventories, and make strategic decisions. E-commerce has become one of the most important components of the digital economy because it allows businesses to reach consumers without traditional geographical limitations, reduce transaction costs, expand product markets, and collect large volumes of real-time information about customer behavior. However, the rapid expansion of digital trade also increases the complexity of managerial decision-making.

E-commerce companies have to determine what products should be offered, in what quantity, at what price, to which customers, and at what time. Under such conditions, conventional approaches based exclusively on historical averages or managerial intuition are increasingly insufficient. Artificial intelligence (AI) provides an opportunity to transform e-commerce management from a reactive model into a predictive and adaptive management system. Machine learning algorithms can identify nonlinear relationships between sales and factors such as price, promotions, seasonality, customer activity, product characteristics, advertising expenditure, and previous

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purchasing behavior. Consequently, AI-based models can support more accurate sales forecasting, inventory management, customer segmentation, personalized recommendations, dynamic pricing, fraud detection, and marketing optimization. This issue is particularly important for Uzbekistan, where the e-commerce market is developing rapidly but remains at an earlier stage of digital maturity compared with the largest global e-commerce markets. According to the National Statistics Committee, the officially measured annual e-commerce trade volume increased from 6.0 billion soums in 2016 to 15,211.5 billion soums in 2024. The increase between 2023 and 2024 alone was from 13,263.8 billion to 15,211.5 billion soums.

More recent information indicates an even stronger expansion. According to data reported by the National Agency of Perspective Projects, e-commerce sales in Uzbekistan reached approximately 22.7 trillion soums in 2025, while the number of e-commerce platforms increased from 36 in 2024 to 115 in 2025. The share of e-commerce in total retail trade increased from approximately 3.7% to 4.6%.

The application of artificial intelligence in e-commerce has become an important research direction within digital economics, information systems, marketing, and operations management. Contemporary research increasingly emphasizes the transition from descriptive analytics toward predictive and prescriptive analytics, in which algorithms do not simply describe previous sales but support future business decisions. Zhang and Wu (2025) investigated the use of XGBoost for e-commerce sales forecasting and data-driven marketing strategies. Their research emphasizes the ability of XGBoost to identify nonlinear relationships between multiple explanatory variables and sales performance. The model can also provide a basis for more personalized marketing decisions. The methodological framework of the study is based on a combination of economic analysis, statistical analysis, machine learning, and efficiency evaluation. The central idea is to treat e-commerce optimization as an integrated decision-making problem rather than simply a sales forecasting task.

The dependent variable is defined as the future sales volume of a product, category, or e-commerce business. The explanatory variables may include historical sales, product price, discount level, advertising expenditure, number of website visits, conversion rate, customer activity, product rating, seasonality, day of week, month, holidays, stock availability, and delivery characteristics. For Uzbek e-commerce enterprises, additional variables should be considered. These include regional

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differences between Tashkent and other regions, payment method, delivery distance, exchange-rate dynamics for imported products, changes in household purchasing power, local holidays, Ramadan-related demand patterns, and marketplace-specific promotional campaigns.

The development of Uzbekistan's e-commerce market demonstrates that the potential economic value of AI-based sales optimization is increasing. Official statistical data show that annual e-commerce trade volume increased from 1,002.5 billion soums in 2020 to 5,978.7 billion soums in 2021 and 10,886.8 billion soums in 2022. It subsequently reached 13,263.8 billion soums in 2023 and 15,211.5 billion soums in 2024. This long-term growth indicates a structural transformation rather than a temporary increase in online transactions. At the same time, data for 2025 reported by the National Agency of Perspective Projects indicate that online sales reached approximately 22.7 trillion soums and represented around 4.6% of total retail trade. The number of platforms increased more than threefold, from 36 to 115.

The growing number of e-commerce platforms also increases competitive pressure. When the number of platforms increases from 36 to 115, customers obtain more alternatives and switching costs may decrease.

Consequently, companies must compete not only through product prices but also through delivery speed, personalized recommendations, customer service and digital experience. In this environment, AI can become a source of competitive advantage. A business capable of forecasting customer demand more accurately can maintain lower inventories without increasing stock-out risk. A company capable of identifying high-value customers can allocate marketing expenditure more effectively. A marketplace capable of personalizing recommendations can increase conversion rates and average order value.

At the national level, the use of AI in e-commerce can also contribute to broader economic objectives. Increased digital sales may improve market transparency, formalize business transactions, support tax administration, expand opportunities for small enterprises and facilitate access to national markets for businesses located outside major urban centers.

Nevertheless, AI should not be viewed as an automatic solution. Poor-quality data can generate poor predictions. Inadequate model validation can result in incorrect inventory decisions. Excessive personalization can negatively affect consumer trust if



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customers perceive the system as intrusive. Therefore, AI efficiency should be evaluated simultaneously from economic, technological and institutional perspectives.

A particularly important direction for Uzbekistan is the development of localized AI models. International models trained on data from the United States, China or Western European markets may not fully capture the purchasing behavior of Uzbek consumers. Local models should therefore incorporate Uzbek-specific variables, including regional purchasing patterns, local holidays, payment preferences, delivery infrastructure, language characteristics, product seasonality and household consumption behavior.

The research demonstrates that artificial intelligence-based models can become an important instrument for optimizing e-commerce sales volume and improving the economic efficiency of digital businesses in Uzbekistan. The rapid expansion of the national e-commerce market creates an increasingly large data environment in which traditional decision-making methods become less effective.

Official statistics indicate that Uzbekistan's annual e-commerce trade volume increased substantially between 2016 and 2024, reaching 15.21 trillion soums in 2024. More recent regulator-reported data indicate approximately 22.7 trillion soums of online sales in 2025, while the number of e-commerce platforms increased to 115.

The analysis confirms that XGBoost is particularly suitable for structured e-commerce data containing information about prices, promotions, advertising, product characteristics and customer activity. LSTM is more appropriate for sequential data in which seasonality, trends and long-term temporal dependencies are important. Therefore, the most effective approach for many businesses may be a hybrid system combining different algorithms rather than relying on one model.

For Uzbekistan, the implementation of AI should be closely linked to economic efficiency. Businesses should not evaluate AI projects only according to prediction accuracy. Instead, they should measure changes in sales, gross margin, inventory turnover, stock-out frequency, advertising return, customer retention and operational costs.

The following strategic recommendations can be proposed. First, e-commerce businesses should establish centralized databases that integrate website, marketplace, social-media, payment and logistics data. Second, companies should introduce automated demand forecasting systems based on XGBoost, LSTM or hybrid algorithms.

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Third, AI-based customer segmentation and recommendation systems should be introduced to improve marketing efficiency. Fourth, inventory decisions should be linked directly to forecast demand and forecast uncertainty. Fifth, dynamic pricing systems should consider demand elasticity, competition, procurement costs and exchange-rate risks. Sixth, AI efficiency should be evaluated through economic indicators such as additional profit, ROI, inventory turnover and marketing cost per conversion.

At the institutional level, Uzbekistan should continue developing a regulatory and technological environment that encourages responsible AI adoption. Data quality standards, cybersecurity requirements, consumer protection and transparency of algorithmic decision-making should develop alongside digital commerce. The government's objective of increasing e-commerce volume to 30 trillion soums during 2026–2030 further strengthens the importance of improving the technological efficiency of digital trade.

Ultimately, the competitive advantage of Uzbek e-commerce businesses will increasingly depend not only on the size of their digital audience but on their ability to transform data into accurate economic decisions. AI-based forecasting and optimization can provide such a mechanism by connecting customer behavior, demand prediction, pricing, inventory, marketing and profitability within a unified decision-making system.

Thus, the transition from conventional e-commerce management toward AI-driven predictive and prescriptive management should be considered one of the important directions for strengthening the competitiveness and sustainability of Uzbekistan's digital economy.

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