



RESEARCH ARTICLE

Assessment of the Potential of Intelligent Data Analytics Models and Artificial Intelligence Methods in E-Commerce Tax Administration

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ABSTRACT

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The article develops a computational and methodological approach to assessing the potential of intelligent data analytics models in the tax administration of e-commerce, which is especially relevant in the modern world, where there is an annual increase in the digital footprint of online commerce and an increased concentration of operations on marketplaces with a simultaneous gradual transition of tax administrations from after-the-fact control to a risk-based interaction model. Within the framework of the approach under study, a two-circuit evaluation logic is proposed, where the empirical contour characterizes the structure and scale of digital data, and the criterion contour allows comparing groups of methods according to a number of selected principles. A scenario block for assessing the risks of using artificial intelligence has also been separately formed, including the initial risk priority, the limiter effect, and the residual risk. Based on the expert-analytical scale, it is shown that classification, anomaly detection, and text analytics have the greatest potential for tax administration tasks in e-commerce in limited service-control scenarios; at the same time, predictive and clustering models require stricter data verification and management interpretation. The scientific novelty consists in the formalization of the relationship "tax task – data – method – risk – management result" and in the proposal of calculation tools suitable for the preliminary selection of scenarios for the introduction of artificial intelligence into the digital tax circuit

INTRODUCTION

E-commerce has become one of the most data-intensive segments of the economy. According to Data Insight, an analytical company specializing in online retail, the Russian retail e-commerce market exceeded RUB 13 trillion in 2025, with more than 8 billion orders. The largest general-purpose marketplaces accounted for the majority of orders and a substantial share of sales, representing more than 80% of all orders (Data Insight, 2026). From the perspective of tax administration, this development changes the very nature of tax control: the object of analysis is no longer limited to an individual tax return or document but primarily encompasses the continuous digital trail generated by transactions, payments, receipts, order statuses, product listings, logistics events, and communications.

It should also be noted that the use of artificial intelligence (AI) in analytics is becoming increasingly widespread among tax administrations in different countries. At the same time, the Organisation for Economic Co-operation and Development (OECD) emphasizes that AI should not be regarded as an autonomous tax analytics tool but rather as an element or component of a broader tax ecosystem that must also include legal rules, organizational procedures, data infrastructure, and human expertise.

In recent years, Russian practice has likewise been moving toward greater digital maturity in tax control. The Federal Tax Service (FTS) of Russia publishes tax audit statistics using Form No. 2-NK

(Federal Tax Service of Russia, 2025, January 22), while within the tax monitoring framework it separately addresses data standardization, process automation, big-data processing, and the use of artificial intelligence (Gibadullina, Rastegaeva, 2025; Muzalev, 2024). A survey assessing the digital maturity of tax monitoring participants involved 381 companies representing 23 industries (Federal Tax Service of Russia, 2025, October 22). Consequently, the issue is no longer whether digitalization is generally appropriate, but rather which intelligent data analytics (IDA) and AI models can produce measurable administrative outcomes without compromising legality, explainability, or the trust of compliant taxpayers (President of the Russian Federation, 2019).

MATERIALS AND METHODOLOGIES

The study's information base comprises publicly available analytical and statistical sources on the e-commerce market, materials published by the Federal Tax Service (FTS) of Russia, and scholarly publications concerning the application of AI in the public sector (Muzalev, 2025), tax monitoring, and risk management (State Duma of the Federal Assembly of the Russian Federation, 2006). Methodologically, the study combines systems analysis, expert-analytical scaling, scenario-based risk management, and criteria-based comparative assessment of method groups (Svistunova, Muzalev, 2021). AI is considered not as a universal means of technological modernization but as a set of specific and limited application scenarios: intelligent routing of inquiries, preliminary document verification, scoring-based prioritization, predictive control, automation of analytical audits, and proactive preventive services.

Risk is assessed using a five-point expert scale covering five parameters: the probability of risk occurrence; the magnitude of consequences; data sensitivity; the ethical and legal vulnerability of the result; and the degree to which the algorithmic signal is beyond effective control. The scores are normalized by dividing them by 5, after which the integrated priority of scenario-specific risk is calculated, including an additional interaction term reflecting the combined effect of the magnitude of consequences and ethical and legal vulnerability:

$$PR_j = \sum_{k=1}^5 \left(w_k * \frac{S_{j,k}}{5} \right) + \lambda * \frac{S_{j,2}}{5} * \frac{S_{j,4}}{5}$$

where PR_j is the integrated risk priority for the j -th scenario;

$S_{j,k}$ is the expert score assigned to the k -th risk parameter for the j -th scenario;

w_k is the weight assigned to the parameter;

λ is the interaction coefficient.

The index k takes values from 1 to 5. Accordingly, $S_{j,1}$ denotes the probability of risk occurrence; $S_{j,2}$ the magnitude of consequences; $S_{j,3}$ data sensitivity; $S_{j,4}$ ethical and legal vulnerability; and $S_{j,5}$ the uncontrollability of the algorithmic signal.

The following weights are applied in the study: probability of occurrence, 0.20; magnitude of consequences, 0.25; data sensitivity, 0.20; ethical and legal vulnerability, 0.20; and uncontrollability of the signal, 0.15, with $\lambda = 0.15$. These weights represent the authors' expert-analytical assumptions and may be refined when internal operational data from the FTS of Russia become available.

Residual risk is determined by considering the combined effectiveness of risk-mitigation controls:

$$E_j = 1 - \prod (1 - e_{jm}); \quad PR_j = PR_j * (1 - E_j)$$

where E_j is the combined effectiveness of the risk-mitigation measures for the j -th scenario; e_{jm} is the effectiveness of the m -th risk control for the j -th scenario.

This approach is consistent with the concept of a risk-oriented AI lifecycle presented in the NIST AI Risk Management Framework through the functions Govern, Map, Measure, and Manage, as well as with international approaches to AI transparency, fairness, and human oversight.

The potential of each group of methods is assessed using an integrated indicator for the m -th method group:

$$P_m = 0.25R_m + 0.2D_m + 0.2V_m + 0.15C_m + 0.1(6 - I_m) + 0.1(6 - O_m)$$

where R_m is the domain relevance of the method, that is, the extent to which it is suitable for addressing specific tasks;

D_m is data availability;

V_m is the verifiability of the result, that is, whether the result can be validated and/or explained;

C_m is the maturity of the digital environment, that is, whether the infrastructure required to apply the method is already available;

I_m is implementation complexity;

O_m represents operational constraints.

All criteria are assessed on a scale from 1 to 5. The greater the implementation complexity and operational constraints, the more strongly they reduce the method's overall potential.

The resulting potential-assessment model is presented in Figure 1.

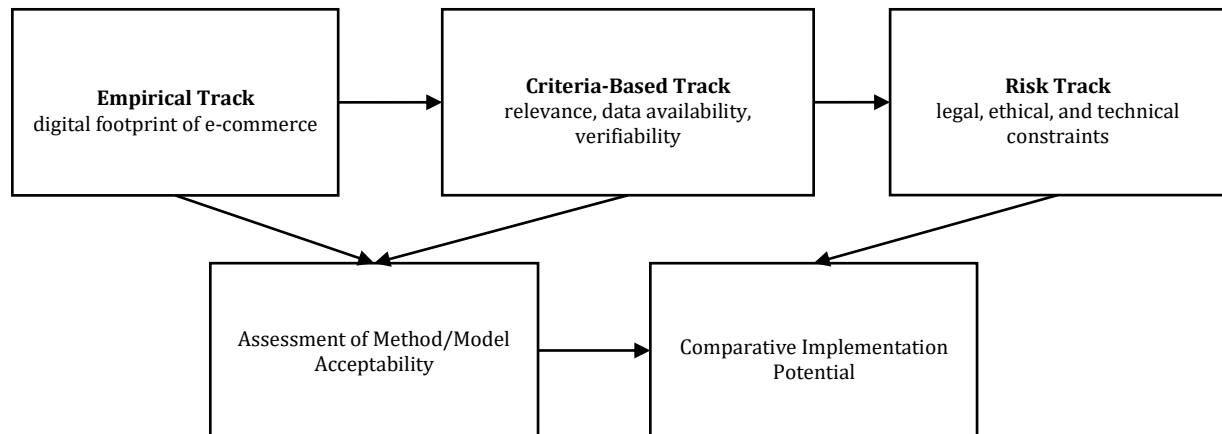


Figure 1: Dual-track model for assessing the potential of intelligent data analytics and artificial intelligence considering scenario-specific risk

Source: Compiled by the authors.

RESULTS

The first research finding is the differentiation of AI application scenarios according to the tax administration function, expected effect, and predominant risk. In the tax administration of e-commerce, risk cannot be considered separately from a specific process: the same technology may be relatively safe when used to route routine inquiries but highly sensitive when applied to the scoring-based prioritization of cases for tax scrutiny. Therefore, the assessment of a model's potential should begin not with the selection of an algorithm but with the identification of the administrative function, the type of data involved, and the possible consequences of an error (Table 1).

Table 1: AI application scenarios in the tax administration of e-commerce and their predominant risks

Scenario	Tax administration function	Sensitivity	Predominant risk	Key safeguard
Intelligent routing of inquiries	Allocation of messages by type and area of responsibility	Moderate	Misclassification and delayed response	Protocol for rerouting incorrectly assigned inquiries
Preliminary document verification	Identification of formal deficiencies and incomplete information	Elevated	Unjustified rejection of documents or failure to detect a deficiency	Control threshold and manual review of disputed cases
Scoring-based prioritization	Ranking cases according to the level of attention required	Critical	Non-transparent intensification of tax scrutiny	Explainability of the criteria and manual review
Predictive control	Forecasting the probability of	Very high	Model drift and inaccurate predictions	Periodic validation and performance

	irregularities			monitoring
Automation of analytical audits	Large-scale comparison of multiple datasets	Very high	Technical errors propagated at scale	Testing on heterogeneous datasets
Proactive preventive services	Prevention of common errors	High	Disproportionate service intervention	Restrictions on automated recommendations

Source: Compiled by the authors.

The quantitative assessment indicates that the highest level of sensitivity is associated with scoring-based prioritization because the output of such a model may indirectly affect the intensity of subsequent administrative scrutiny (Figure 2).

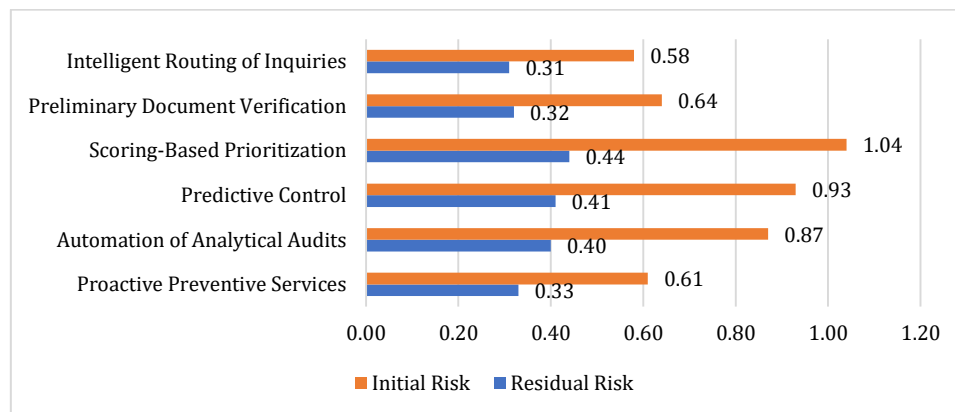


Figure 2: Assessment of the Initial and Residual Risks Associated with AI Application Scenarios

Source: Compiled by the authors.

Predictive control and the automation of analytical audits also fall within areas of elevated risk. In the former case, the key limitation is model drift, whereas in the latter, it is the propagation of errors across large volumes of digital data. Service-oriented scenarios have a lower initial risk; however, they are the most directly visible to taxpayers and are therefore particularly important for maintaining trust in digital interaction.

It is particularly important to note that risk reduction is achieved not by excluding AI from tax administration but by procedurally limiting its role. In sensitive cases, artificial intelligence should generate an analytical signal but should not replace a legally significant decision (Lyutova, 2023). This approach is consistent with the principle of human oversight established in international AI ethics frameworks and with the requirements for trustworthy AI systems, including reliability, safety, transparency, explainability, privacy, and the management of harmful bias.

The second research finding is the development of an applied matrix aligning methods, data, and tax administration tasks. E-commerce data are heterogeneous and include transaction time series, cash register equipment data, electronic document details, processing statuses, inquiry histories, explanatory texts, and behavioral characteristics of digital-market participants. Therefore, a method should primarily be assessed in terms of its applicability to a specific type of data and the intended administrative outcome (Table 2).

Table 2: Alignment of Method Groups with Tax Administration Tasks and E-Commerce Data Types

Method group	Tax administration task	Data type	Expected effect	Limitation
Classification	Routing and categorization of cases	Structured form fields, statuses, and textual features	Faster initial processing	Quality of data labeling
Clustering	Identification of hidden behavioral groups	Seller profiles and transaction histories	Detection of non-obvious segments	Difficulty in interpreting clusters
Anomaly detection	Identification of atypical transactions	Receipts, payments, document details, and time series	More targeted tax control	Sensitivity to data noise
Forecasting	Estimation of the probability of	Time series and response histories	Early prioritization of cases	Model drift

	irregularities			
Sequence analysis	Examination of event chains	Timestamps, statuses, and sequences of transactions	Understanding behavioral patterns	Incomplete event sequences
Text analytics	Processing of inquiries and explanations	Free text, messages, and product descriptions	Reduced front-office workload	Linguistic ambiguity

Source: Compiled by the authors.

As noted above, the availability of large volumes of digital data does not in itself guarantee the effectiveness of AI, as each method requires the input data to meet specific requirements. For example, classification requires stable class definitions; anomaly detection depends on complete transaction series and stable indicators of normal behavior; and forecasting requires sufficiently long and comparable time series. Accordingly, the final assessment of the potential of each method group must take into account both the extent to which the available input data satisfy these criteria and the subsequent verifiability of the administrative conclusions derived from them.

The third research finding is the development of integrated indicators for each group of methods and their comparative assessment against the criteria specified above (see Materials and Methods). The resulting values are presented in Figure 3.

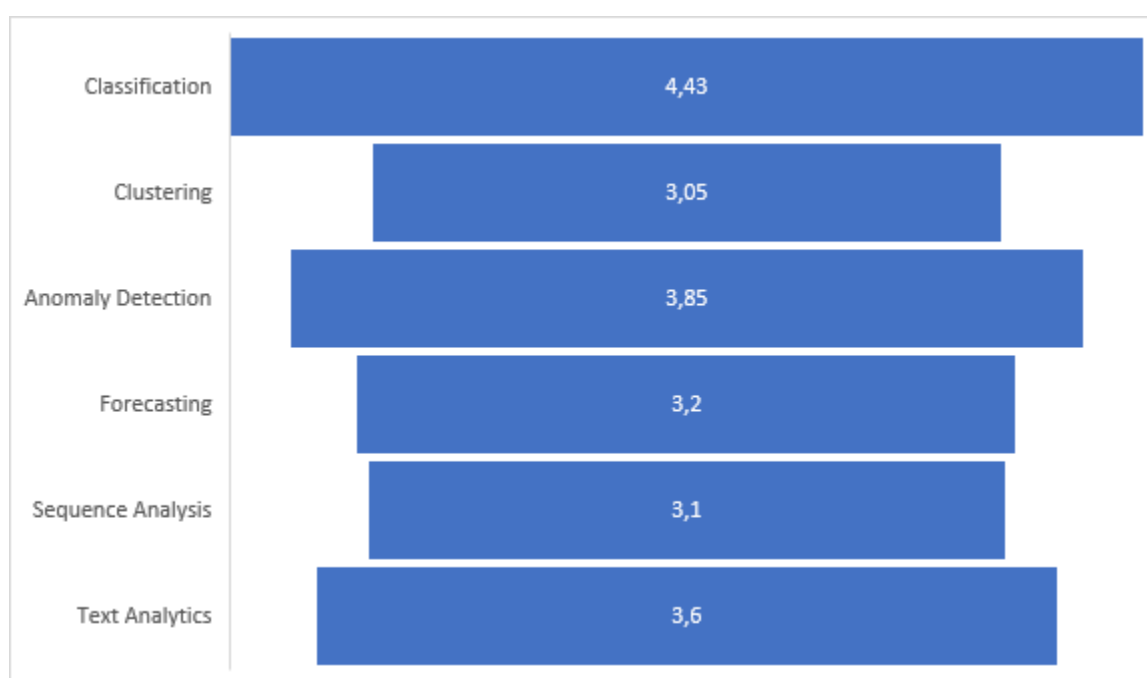


Figure 3: Integrated Assessment of the Potential of Method Groups

Source: Compiled by the authors.

The analysis produced the following findings:

Classification is the most balanced group of methods because of its high domain relevance, sufficient data availability, and comparatively high degree of result explainability.

- Anomaly-detection methods have considerable practical value for analyzing online sales, identifying suspicious transactions, and detecting gaps in the digital trail.
- Text analytics demonstrates medium-to-high application potential, with an integrated score of 3.60, owing to its broad capabilities for processing taxpayer inquiries and explanations. However, its use is constrained by the considerable heterogeneity of the available data.
- Clustering and sequence analysis received the lowest scores, at 3.05 and 3.10, respectively. This is attributable to the lower verifiability of their results, their stringent data requirements, and the relatively limited readiness of the digital infrastructure for their implementation. Nevertheless, these findings should not be regarded as grounds for excluding these methods from the digital tax administration environment. Rather, they indicate the need for more mature methodological support.

Forecasting has considerable potential for predictive control but, like the preceding methods, currently faces limitations associated with data availability and technical capabilities.

CONCLUSION

The findings confirm that the potential of AI and intelligent data analytics in the tax administration of e-commerce cannot and should not be assessed exclusively in terms of a model's technical capabilities. In the field of taxation, the key issue is not merely whether an algorithm can identify a potentially unlawful pattern, but whether the resulting output can be verified, explained, and appropriately used in accordance with legal requirements. As emphasized in the international agenda, AI has considerable potential not only to optimize the existing processes of tax administrations but also to transform their operating models. Such transformation, however, must be implemented systematically, taking into account not only the regulatory framework but also staff competencies, data quality, and the level of technological development.

In the Russian e-commerce market, the use of intelligent data analytics in tax administration substantially increases the cost of methodological errors because an inaccurate model may replicate false signals on a large scale. Consequently, the practical implementation of the methods under consideration should proceed gradually, beginning with lower-risk scenarios and subsequently moving toward more sensitive analytical and control applications. This transition should be accompanied by the accumulation of statistical data on the quality of the results obtained, feedback, and the number of cases requiring manual re-examination.

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A STATEMENT OF ORIGINALITY

The authors confirm that the above-mentioned manuscript has not previously been published in Russian and is not currently under consideration by another journal.

Generative Artificial Intelligence

The authors confirm that no part of the manuscript submitted to the editorial office was created using automated text- or image-generation systems or other artificial intelligence tools, such as ChatGPT, except for the use of neural networks in the processing of research data.

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