

*DOI: <https://doi.org/10.30525/978-9934-26-356-9-46>*

## **APPLICATION OF MACHINE LEARNING FOR ECONOMIC TRENDS AND RISK PREDICTION**

Machine learning has become one of the most important and influential technologies in the world of economics today. The use of machine learning algorithms for data analysis and event prediction in financial markets has opened up new possibilities for forecasting economic trends and risks [1]. This article examines key aspects of using machine learning in economics and finance, including fundamental methods, challenges, and prospects.

Machine learning is a subfield of artificial intelligence that develops algorithms and models that enable computers to learn and make predictions based on data without explicit programming [2]. Machine learning relies on several key principles, including learning from data and automatic parameter tuning. This involves using large volumes of data to train models that attempt to uncover relationships between input variables (factors) and corresponding outcomes (outputs). The primary goal is the ability to generalize, meaning that models can make predictions for new, unseen data, avoiding overfitting to training data and distinguishing true patterns in data from random variations.

Additionally, machine learning is designed to work with uncertainty and noise in data. Models must be capable of accounting for factors that may affect prediction accuracy and identifying genuine dependencies in data while ignoring random deviations. These principles form the basis for creating reliable and effective machine learning models across various application domains [3].

Machine learning plays a crucial role in modern economics and entrepreneurship, helping to improve efficiency and provide competitive advantages to companies and organizations in all areas of activity.

The advantages of machine learning in contemporary economics and entrepreneurship include the following [4]:

1. Analyzing large volumes of data and using them to forecast economic trends, market movements, and product and service demand.
2. Optimizing logistics and production processes, warehouse stocking, production planning, and other business optimizations.

3. Predicting risks in investment portfolios and managing financial operations.
4. Analyzing customer behavior and creating personalized offers and recommendations.
5. Detecting unusual patterns and anomalies in financial transactions, aiding in fraud detection and cybersecurity.
6. Utilizing machine learning in scientific research and forecasting to develop new economic theories and models.

The primary step before applying machine learning methods in economic and financial analysis is the processing and preparation of financial data (Figure 1).



**Figure 1. Financial Data Processing Process**

Machine learning methods are widely used for analyzing financial data and forecasting economic trends. Here is an overview of several of them: linear regression to establish dependencies between economic variables; decision trees for classification in financial analysis; neural networks for processing complex economic data; clustering methods for grouping similar objects; time series analysis methods for forecasting dynamics; ensemble methods to improve prediction accuracy, and natural language processing (NLP) for text analysis [5].

It is worth noting that the choice of a machine learning method depends on the specific analysis tasks and data availability. Model validation and assessing their effectiveness in real-world conditions are also crucial aspects.

Machine learning models are used for forecasting various macroeconomic indicators such as GDP, consumer price indices, unemployment rates, and more. Key approaches include linear regression for modeling different types of dependencies, neural networks for analyzing complex and nonlinear relationships, and time series analysis methods such as ARIMA and exponential smoothing for forecasting over time. These approaches help analyze and predict key economic indicators, which is essential for decision-making in the fields of economics and finance [5].

The application of machine learning in economics and finance enables the prediction of various indicators, providing more accurate and dynamic

forecasts. It is essential to remember that the effectiveness of models depends on the quality and quantity of the data used, as well as the proper selection of algorithms based on the nature of the data and forecasting tasks.

Machine learning also plays a significant role in detecting and managing financial risks, enhancing forecasting methods, and analyzing complex financial systems [6]. The main aspects include:

1. Modeling financial risks.
2. Analyzing continuous changes in financial data.
3. Detecting anomalies and fraud.
4. Predicting credit risk.
5. Evaluating risks in investment portfolios.

A key tool for risk assessment in financial portfolios is Value at Risk (VaR) [3]. Machine learning is used to improve the accuracy of VaR calculations, considering more factors and complex interactions. Main methods include Monte Carlo method, deep learning models for VaR, ensemble algorithm models, and time series analysis.

Machine learning contributes to the development of more accurate and dynamic risk modeling and management methods in financial sectors, reducing potential losses and increasing the stability of financial institutions.

The use of machine learning in economics and finance raises numerous ethical aspects and challenges. Firstly, machine learning models, especially deep neural networks, can be extremely complex and opaque, making it challenging to understand how they make decisions and on what basis. Responsibility and bias issues are also crucial, as models are trained on historical data, which may reflect existing sociocultural patterns, potentially leading to incorrect or unfair decisions, especially in financial areas. The collection and analysis of financial data also highlight issues of personal data confidentiality, and the use of machine learning for automated decision-making raises questions of responsibility for these decisions, particularly in the case of adverse outcomes. Concentration of power is another concern, as developers and owners of machine learning models can wield significant influence over financial markets and the economy, which may lead to antitrust and competitive issues.

In conclusion, machine learning has extensive prospects in the field of forecasting economic trends and risks. Improvements in forecast accuracy are anticipated through the advancement of deep learning and advanced methods. The increase in available data sources, including sensor data and social media, will enable the creation of more complex models. Machine learning will also simplify risk detection and management in the financial sector, enhancing efficiency. Reducing social and cultural biases in machine learning models and increasing the ethics of their usage will become relevant through further research and development. Additionally, the automation of financial

portfolio and asset management makes investing more accessible and convenient. The future of machine learning in economic analysis will depend on data processing methods, algorithm development, regulation, and attention to ethical aspects and social consequences of its application.

### **References:**

1. Murphy, Kevin P. Machine learning : a probabilistic perspective / Kevin P. Murphy. MIT Press, 2012. 1067 p.
2. John Paul Mueller, Luca Massaron. Machine Learning for Dummies. Wiley, 2016. 70 p.
3. Jon Danielsson. Financial Risk Forecasting: The Theory and Practice of Forecasting Market Risk with Implementation in R and Matlab. Wiley; 1st edition (April 25, 2011). 304 p.
4. Robert H. Shumway, David S. Stoffer. Time Series Analysis and Its Applications: With R Examples. Springer; 4th ed. 2017 edition (April 19, 2017). 575 p.
5. John Kelleher, Brian Mac Namee, Aoife D'Arcy. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies. The MIT Press, 2015. 624 p.
6. Peter A. Flach. Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Intelligent Systems Laboratory, University of Bristol, United Kingdom, 2013. 540 p.