The Role Of Big Data In Consumer Demand Forecasting

Babaeva Sabinabonu Davronbek kizi

Student of the RIQ-3 group
Tashkent State Transport University
Department of Transport Economics
Tel.: +998 50 500 25 40
E-mail: babaevas044@gmail.com

ABSTRACT

In the context of digital economic transformation, Big Data technologies have become a crucial tool for analyzing and forecasting consumer demand. This article explores the theoretical foundations of Big Data and its application in modern demand forecasting approaches. Special attention is paid to data sources, analytical methods, and visualization techniques. The paper presents real-world cases from Amazon, Walmart, and Netflix, demonstrating the practical value of Big Data. A comparative analysis of data volume versus forecast accuracy is provided. The study highlights the strategic advantages, challenges, and future prospects of implementing Big Data technologies in demand analysis. The article concludes that Big Data is a strategic resource for enhancing supply chain efficiency, enabling personalized marketing, and supporting sustainable business growth in the digital economy.

Keywords:	Big Data, consumer demand, forecasting, behavioral analytics, machine learning, data visualization, digital economy.

In scientific literature, the term Big Data is interpreted as a set of technologies and approaches that allow processing huge volumes of heterogeneous information in real time. According to the 5V model, Big Data is characterized by the following properties: volume (Volume), speed of receipt (Velocity), variety of sources (Variety), reliability of data (Veracity) and their value (Value). These characteristics determine the specifics of working with Big Data and require new infrastructure and analytical solutions.

Consumer demand is a key category of microeconomics, reflecting the aggregate intention of consumers to purchase goods or services at certain prices. Previously, demand forecasting was based primarily on sales statistics and demographic indicators. With the advent of Big Data, it became possible to take into account not only transactional, but also behavioral, social and contextual data in forecasts, including information from social networks, search engines, mobile applications and CRM systems.

The main sources of Big Data used in demand forecasting include:
- online purchases and transactions,
- behavioral data (clicks, views),
- comments and product ratings,
- social networks and online discussions,
- geolocation data.

Analysis methods include machine learning (regressions, neural networks), natural language processing (NLP), time series (ARIMA,

LSTM), clustering and segmentation. The use of these methods allows not only to increase the accuracy of forecasts, but also to promptly adapt the sales strategy. To summarize the role of different Big Data sources in the demand forecasting process, the figure below shows an approximate distribution of their contribution to the overall data array.
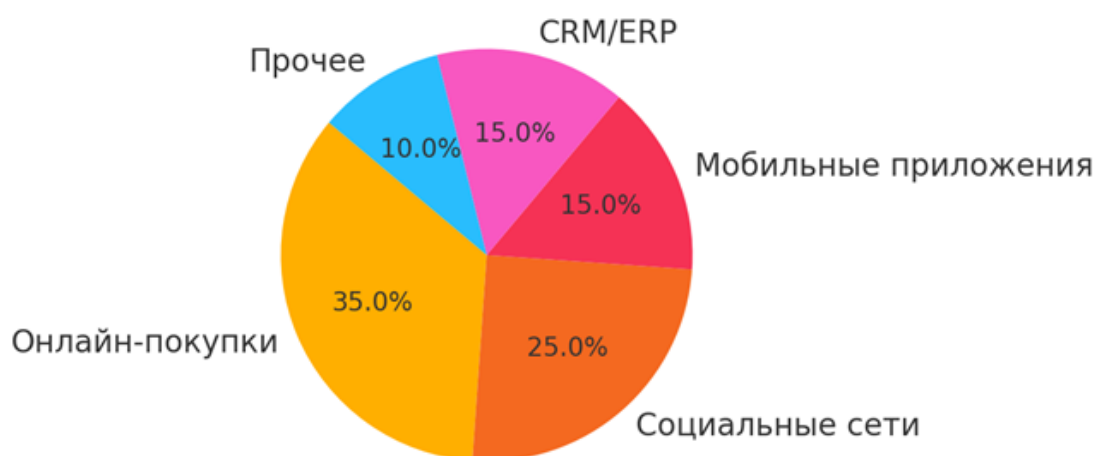

Figure 1. Distribution of Big Data sources in consumer demand analysis

The diagram shows that the main sources of information are online shopping (35%) and social networks (25%). Together, they form more than half of all data used in consumer behavior analytics. This emphasizes the importance of monitoring digital sales channels and customer interactions in real time.

Empirical studies show a direct relationship between the volume of data and the accuracy of demand forecasting. At the initial stages, an increase in the number of records leads to a significant improvement in the results of models, especially when using supervised learning algorithms. For a visual illustration, a graph of the dependence of forecast accuracy on the volume of processed data is presented below (Figure 2). It allows you to visually assess the effect of scaling Big Data when building analytical models.
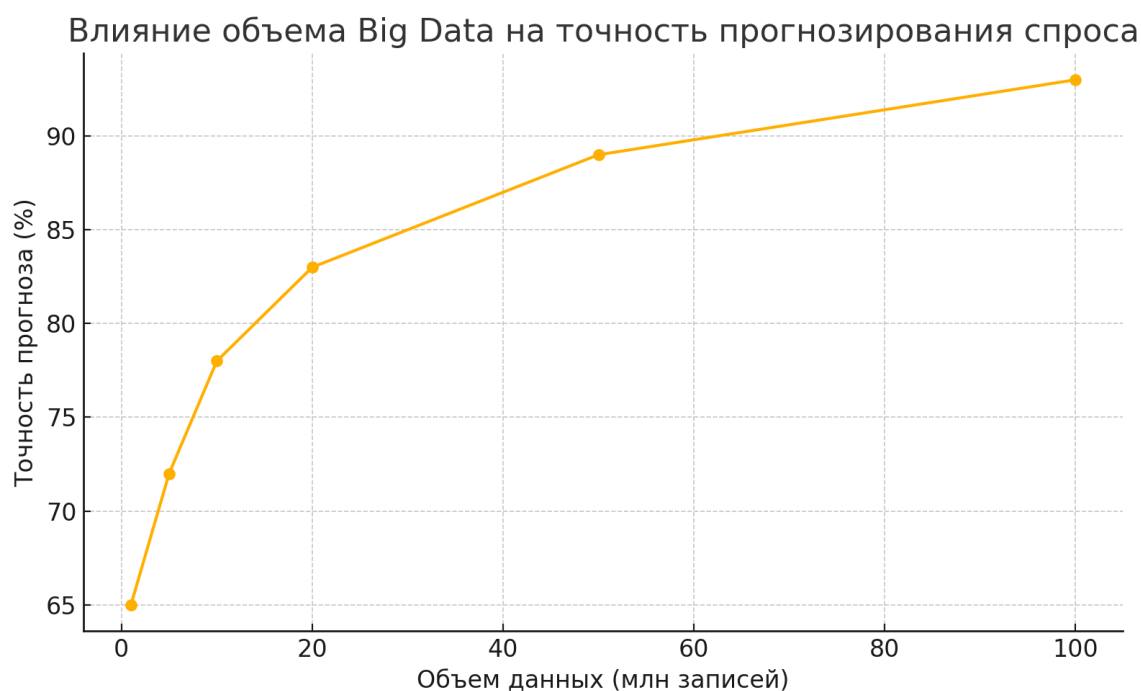
Figure 2. The Impact of Big Data Volume on Demand Forecasting Accuracy

The Impact of Big Data Volume on Forecast Accuracy	
Data volume (million records)	Forecast accuracy (%)
1	65
5	72
10	78
20	83
50	89
100	93

Table 1. Impact of Big Data Volume on Demand Forecasting Accuracy

As can be seen from the graph and table, forecast accuracy increases significantly with an increase in the training sample volume to 50 million records. After that, the increase becomes less pronounced, indicating that the model is saturated with data.

Practical Application of Big Data in Demand Forecasting

Many companies have already implemented big data analysis in their business processes. For example, Amazon uses behavioral analytics to predict which products a customer is likely to purchase. The system takes into account browsing history, time spent on a page, and even the time of day when the customer makes purchases. This approach allows for a 25–30% increase in conversion. Retail chains such as Walmart analyze not only sales, but also weather data, holidays, and local events to adjust stock levels at distribution centers. This helps minimize storage costs and avoid product shortages. Netflix uses Big Data to analyze user preferences and forecast demand for content. Based on the analysis of the behavior of millions of users, their own series, such as "House of Cards," were commissioned and launched, which brought high commercial success.

Benefits of Using Big Data for Business and the Economy

The use of big data in demand analysis provides businesses with a number of strategic advantages:
1. Increasing the accuracy of procurement and logistics planning
2. Personalization of marketing and offering relevant products
3. Reducing costs by optimizing the range
4. Increasing customer loyalty due to improved service
5. Faster identification of market trends

For the economy as a whole, this means more efficient allocation of resources, reduced product losses, and increased productivity.

Main challenges and limitations

Despite the potential, the widespread use of Big Data is accompanied by a number of challenges:
1. The need for a powerful computing infrastructure
2. High cost of storing and processing large amounts of data
3. Privacy issues and personal data protection
4. Lack of qualified specialists (Data Scientists, ML Engineers)

These problems require a comprehensive approach, including regulatory framework, investment in IT education and the development of ethical standards.

In the future, we can expect the role of Big Data to increase in real time: forecasts will be adapted every minute. The development of quantum computing, IoT and cloud platforms will speed up data processing. The geography of application will also expand - from megacities to rural markets. Algorithms will become more explainable due to the development of the XAI (Explainable AI) field.

Big Data has already become an integral part of the modern economy and business. Its use in demand forecasting allows companies to quickly respond to changes in consumer preferences, reduce costs and increase profits. To successfully use Big Data, it is necessary to consider not only technological, but also legal, ethical and personnel aspects. In the context of digital transformation, Big Data is becoming a strategic asset that can ensure sustainable development at the macro and micro levels.

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