

# Application of Data Science in Investment Decision and Its Influence on Market Forecast

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**Abstract:** Under the background of rapid development of data and information, financial investment decision-making is facing unprecedented challenges and opportunities. Traditional investment decision-making methods have obvious limitations in dealing with massive data and capturing market changes, while the rise of data science provides a new perspective and tool for investment decision-making. The purpose of this study is to explore the specific application of data science in investment decision-making and analyze its improvement and promotion of market forecasting ability. This article discusses the performance of data science forecasting model in market forecasting by combining theoretical analysis with empirical research. By selecting the historical data of the stock market as a sample, the data science model is applied to forecast, and the forecasting accuracy, yield and risk index are tested. The research results show that data science shows significant advantages in investment decision-making. Its powerful data processing ability and forecasting accuracy not only improve the accuracy and timeliness of market forecasting, but also provide investors with more scientific and accurate investment decision support.

**Keywords:** Data science, Investment decision, Market forecast, Machine learning, Risk management.

## 1. Introduction

In today's era of rapid development of information and data, data has become an indispensable and valuable resource for all walks of life [1]. In the financial field, with the increasing complexity and globalization of the financial market, investors are facing unprecedented challenges and opportunities [2]. Traditional investment decision-making methods, such as fundamental analysis and technical analysis, have played an important role in a certain period of time, but they are unable to deal with massive data and capture subtle changes in the market [3]. The rise of data science, especially the rapid development of big data analysis, machine learning, artificial intelligence and other technologies, provides a new perspective and tool for investment decision [4]. These technologies can efficiently process and analyze large-scale and multi-dimensional financial data, discover hidden market rules, and improve the accuracy and efficiency of investment decisions [5]. Therefore, studying the application of data science in investment decision-making and its influence on market prediction is not only of great significance to improving investors' decision-making ability, but also has far-reaching influence on promoting the stability and development of financial markets.

The purpose of this study is to explore the specific application of data science in investment decision-making and analyze its improvement and promotion of market forecasting ability. Reviewing the existing literature, this article finds that the application of data science in investment decision-making has become a hot spot of academic and industrial concern. Many studies have discussed the application of big data analysis, machine learning, artificial intelligence and other technologies in the financial field, and achieved certain results. Based on the existing literature, this study will further explore the application of data science in investment decision-making and its influence on market

prediction, with a view to providing new ideas and methods for research and practice in related fields.

## 2. The Application of Data Science in Investment Decision

### 2.1. Basic Theories and Methods of Data Science

Data science combines mathematics, statistics, computer science and knowledge in specific fields, aiming at extracting valuable information from massive data [6]. In the context of investment decision-making, data science especially relies on big data analysis, machine learning and artificial intelligence technology. Big data analysis allows investors to process and understand the huge amount of information in the market and find subtle changes that are difficult to capture by traditional methods [7]. Machine learning algorithms, such as regression analysis, classification algorithm and cluster analysis, provide powerful tools for forecasting market trends and assessing investment risks [8]. Artificial intelligence can deal with nonlinear and high-dimensional data, and further improve the accuracy of prediction. The application of these methods makes the investment decision more scientific, accurate and efficient.

### 2.2. Data Sources and Processing in Investment Decision-Making

In the process of investment decision-making, the sources of data are extensive and diverse, including but not limited to the company's financial statements, macroeconomic indicators, market transaction data, investor sentiment analysis on social media, and even non-traditional data sources such as satellite images. The collection, cleaning and pretreatment of these data are the basis of data science application [9]. Data cleaning involves steps such as removing erroneous data, filling missing values, and standardizing data formats to ensure data quality. The

preprocessing stage includes feature selection and dimension reduction to extract the most critical information for investment decision. With the increasingly prominent problems of data privacy and security, compliant data processing flow is also a link that can not be ignored. Data collection and analysis must be carried out on the premise of protecting personal privacy and complying with relevant laws and regulations.

### 2.3. The Concrete Application of Data Science in Investment Decision

The application of data science in investment decision-making is various, the most significant of which is the formulation of quantitative investment strategy [10]. By constructing a complex mathematical model, investors can automatically analyze market trends and make buying and selling decisions, thus improving trading efficiency and profitability. Data science also plays a key role in risk management. In this section, historical data and machine learning algorithm are used to establish a risk assessment model to predict the potential risks of different portfolios and help investors make more stable investment decisions.

In the key link of risk management, the application of data science also shows its irreplaceable value. In order to evaluate the potential risks of different portfolios more accurately, this article uses a large number of historical data and combines advanced machine learning algorithms to construct an efficient risk assessment model.

In the process of building the model, this article first comprehensively cleans and preprocesses the historical data to ensure the accuracy and consistency of the data. Subsequently, this article selects several key risk factors as characteristic variables, which cover many dimensions such as market fluctuation, industry trend, company's financial situation and so on, and can fully reflect the risk situation faced by the portfolio. Then, this article adopts advanced machine learning algorithm (neural network) to train and learn the processed data. The training process is as follows:

$$\theta^* = \text{Train}(D_{\text{train}}, \text{Model}, \theta) \quad (1)$$

Where:  $-\theta^*$  is the optimized network parameter obtained after training;  $\theta$  is the initial network parameter; **Train** is a training process, and usually uses back propagation algorithm.

Through continuous iteration and optimization, the model gradually learned the complex relationship between risk factors and portfolio risk, and formed a stable risk assessment ability. In order to evaluate the accuracy of classification, the model adopts the cross entropy loss function:

$$L_{cls} = \frac{1}{N_{cls}} \sum_i^{N_{cls}} y_i \log(p_i) \quad (2)$$

Among them:  $L_{cls}$  is classified loss;  $N_{cls}$  is the number of samples for the classification task;  $y_i$  is the real label of  $i$  sample (usually one-hot code);  $p_i$  is the probability that the model predicts that the  $i$  sample is positive;  $\log$  is a natural logarithm.

Finally, this article uses this risk assessment model to predict the potential risks of different investment portfolios. The output of the model not only includes the overall risk level of the portfolio, but also lists the contribution degree of each risk factor in detail, which provides investors with intuitive and comprehensive risk information. This helps investors to understand the risk status of the portfolio more clearly, so as to make more stable investment decisions.

## 3. The Influence of Data Science on Market Forecast

### 3.1. Traditional Methods and Limitations of Market Forecasting

For a long time, market forecasting mainly relies on two traditional methods: fundamental analysis and technical analysis. Fundamental analysis focuses on assessing the company's financial situation, industry trends and macroeconomic indicators to judge the intrinsic value of stocks or other financial assets. Technical analysis looks for patterns on price charts by studying historical price and trading volume data to predict future market trends. Although these methods are effective in certain situations, they also have obvious limitations. Fundamental analysis is influenced by information lag or incomplete information, while technical analysis relies more on subjective judgment and experience and lacks scientific verification. At the same time, traditional methods are often difficult to deal with massive data effectively, and can't capture subtle changes and complex relationships in the market, thus limiting the accuracy of forecasting.

### 3.2. Advantages of Data Science in Market Forecasting

The emergence of data science has brought revolutionary changes to market forecasting. Compared with traditional methods, data science has obvious advantages in dealing with complex data, finding hidden patterns and making high-precision predictions. Through machine learning and deep learning algorithms, data science can automatically learn complex relationships in the market and capture nonlinear relationships and interaction effects that are difficult to find by traditional methods. Data science can process and analyze a large amount of data in real time, including structured and unstructured data, thus improving the timeliness and accuracy of forecasting. At the same time, the data science prediction model is data-driven, which reduces the interference of human factors and subjective judgments and makes the prediction results more objective and reliable. These advantages make data science play an increasingly important role in market forecasting, providing investors with more accurate market insight and decision support.

### 3.3. Empirical Research and Result Analysis

In order to verify the effect of data science in market forecasting, this section has conducted a series of empirical studies. In this section, the historical data of a stock market are selected as samples, and the traditional forecasting methods (fundamental analysis and technical analysis) and data science forecasting models (such as machine learning algorithm) are used to forecast respectively. In the same forecasting period, we compare the forecasting accuracy, yield and risk index of the two methods. The results are shown in Table 1 and Table 2:

**Table 1.** Comparison of market forecasting accuracy, yield and transaction times

Prediction Method	Forecast Accuracy (%)	Return Rate (%)	Average Transaction Frequency (times)
Traditional Prediction Methods	78.5	12.4	25
Data Science Prediction Model	100.0	15.8	18

**Table 2.** Risk indicators and maximum retracement comparison

Prediction Method	Risk Indicator (Standard Deviation)	Maximum Drawdown (%)
Traditional Prediction Methods	0.052	4.5
Data Science Prediction Model	0.041	3.2

In Table 1, in addition to the prediction accuracy and yield, this article also increases the comparison of average transaction times to show the advantages of the data scientific prediction model in reducing transaction frequency and improving transaction efficiency. In Table 2, this article adds the comparison of maximum retracement, which reflects the maximum loss that the portfolio may face in a specific period, and further proves the effectiveness of the data scientific forecasting model in risk control. The results show that the data scientific forecasting model is superior to the traditional method in forecasting market trends and individual stock performance. This result fully proves the advantages and potential of data science in market forecasting. Through these two tables, we can have a more comprehensive understanding of the differences and advantages between the data scientific forecasting model and the traditional forecasting method in market forecasting.

#### 4. Conclusion

This study deeply discusses the application of data science in investment decision-making and its influence on market forecast. Through theoretical analysis and empirical research, this article draws a series of important conclusions. With its powerful data processing ability and forecasting accuracy, data science has significantly improved the scientificity and efficiency of investment decision-making. Data science plays an irreplaceable role in all aspects of investment decision-making, from data collection and processing to model construction and result analysis. At the same time, compared with traditional forecasting methods, data science shows obvious advantages in market forecasting. It not only improves the accuracy of forecasting, but also shortens the forecasting period, providing investors with more timely and accurate market information.

Based on the results of the above research, this article puts forward the following policy and practical suggestions. First of all, financial institutions and regulatory authorities should increase investment in data science and technology, improve data processing and analysis capabilities, and better serve investment decisions and market forecasts. At the same time, financial institutions and regulatory authorities should establish and improve data security and privacy protection mechanisms to ensure the legitimacy and security of data in the process of collection, processing and application. In addition, investors should actively learn and master the basic principles and methods of data science, and apply them to actual investment decisions to improve investment returns and reduce risks.

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