A Survey of Quantitative Trading Based on Artificial Intelligence

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Abstract. With the advent of the era of artificial intelligence and big data, the intelligent quantitative trading derived from the combination of artificial intelligence and quantitative trading has gradually become a new trend in stock investment. This paper reviews the application of artificial intelligence in quantitative trading and its advantages over traditional quantitative trading, and summarizes whether intelligent quantitative funds can replace the traditional financial position of fund manager. At present, artificial intelligence can not completely replace human investment, will only be used as an auxiliary investment tool and a choice of investment methods.

Keywords: Artificial Intelligence · Machine Learning · Quantitative Trading · Stock Investments

1 Introduction

Quantitative trading emerged from the 1960s to the 1980s and has been developed in international markets for at least 50 years. Its development is inseparable from the maturity of modern financial theory and the progress of computer technology. In 1952, Dr. Markowitz creatively put forward the asset portfolio theory. Combining mathematical statistics and financial theory, he used the method of mean-variance optimization to select the investment portfolio, which provided the theoretical basis for the subsequent quantitative investment [1]. In 1964, Sharp et al. proposed CAPM capital asset pricing model, which defined the relationship between asset risk and expected rate of return under capital market equilibrium, making it possible to estimate the portfolio price of risky assets. In 1971, Barclays Investment Management launched the world's first passive quantitative fund, marking the beginning of quantitative investment [2]. Simons founded Medallion Fund in 1988 and generated annualized returns of up to 35% over the next 30 years, setting off a boom in quantitative trading. When the global financial crisis broke out in 2008, traditional fund companies suffered severe impact, but some quantitative investment funds stood out. After that, quantitative trading developed rapidly, the strategies of quantitative funds gradually entered the era of refinement and high frequency, and the application of artificial intelligence in quantitative strategies became more and more extensive [3].

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2 Quantitative Trading Meets Artificial Intelligence

2.1 Application of Machine Learning in Quantitative Trading

Quantitative trading refers to the use of computer technology to screen out the high probability events that can bring excess returns from massive historical data as characteristic factors. Based on these factors, investment strategies can be formulated to reduce the impact of investor sentiment fluctuations and obtain returns. With the advent of the era of big data, massive data provide sufficient and comprehensive analysis data for quantitative transactions, and expand a new value space for the application of artificial intelligence. Machine learning, as the core part of artificial intelligence, plays an important role. The following describes the application of machine learning from three aspects: data extraction, data processing, and construction strategy.

2.1.1 Data Extraction

There is a large amount of big data, which is full of structured, semi-structured and unstructured data. Traditional computer technology is only suitable for processing structured data, but it is difficult to deal with the latter two. Artificial intelligence technology is good at obtaining images, sounds, videos and other information from the Internet, which can improve the research efficiency and accuracy of analysts and save time and cost. In text data, natural language text analysis combined with machine learning algorithms makes the process more efficient [4]. Xiang Wei et al. extracted fragments of annual reports of listed companies, trained semantic approximation models on massive data based on deep learning technology, realized subtle differences in the development of regional branch companies in different years, and realized auxiliary analysis at the micro level [5]. On the image data, machine learning image recognition models can even be combined with satellites to calculate oil reserves by observing the downward movement of oil barrel caps. In all kinds of traffic data, machine learning technology and multi-dimensional high-frequency big data are used to analyze, and the operating rate of enterprises and factories is judged from the micro level, and the profit and loss status is inferred based on the trend of commodity prices.

2.1.2 Data Processing

Machine learning to a vast amount of data dimension reduction, we can store the unstructured data into structured data and analysis, and to build knowledge map and the listed companies and its upstream and downstream firms, industry, macro economic entity with events such as rapidness, scale, and automated analysis, deduce the internal logic relationship and a key characteristic factors. In 2018, Kensho, an American artificial intelligence company, was acquired by S&P Global, largely because of Kensho's core technology of constructing knowledge graphs through machine learning, cloud algorithms and other technologies to efficiently complete intelligent investment analysis.

2.1.3 Constructing Strategy

When multiple factors are extracted from historical data, it is usually difficult for humans to deal with the nonlinear relationship between multiple factors and stock prices. Machine

learning algorithms such as random forest, ensemble learning and neural network can be used to mine the nonlinear relationships and construct investment strategies, which are expected to exceed the investment returns of linear relationships. In addition, with the development of reinforcement learning, intelligent quantitative trading can continuously improve the investment strategy to pursue the maximization of returns.

2.2 Common Machine Learning Algorithm

2.2.1 Traditional Machine Learning Algorithm

Decision tree: Extract the influencing factors of the company's motivation to participate in annual report fraud, and realize the model of predicting financial fraud data by learning factors in historical data through different degrees of decision tree algorithm [6].

Ensemble learning: improve the computing speed of multi-factor stock selection strategy by building multiple learning modules.

Clustering algorithm: The clustering method is used to find out the stocks with strong growth in the short term and the momentum characteristics to construct the investment portfolio, so as to achieve higher returns in the short term.

Bayesian statistics: Use Bayesian statistical method to predict the future spread to assist arbitrage trading [6].

2.2.2 Deep Learning Algorithm

Deep learning algorithms are most commonly used in financial text analysis. Text mining and sentiment classification are used to analyze financial news, social media and other text information, so as to realize the prediction of stock prices and stock trends [7]. Common algorithms mainly include convolutional neural network (CNN), recurrent neural network (RNN) and long short-term memory neural network (LSTM). CNN is mainly used in the field of image recognition and natural language processing, which can automatically extract the required features. RNN is mainly used to process language, audio and other time series data for sentiment analysis. Its disadvantage is that it does not support long-term memory and faces gradient disappearance problem [7]. LSTM makes up for the shortcomings of RNN and plays a crucial role in the analysis of context relations.

2.2.3 Reinforcement Learning Algorithm

Q-learning algorithm is an earlier reinforcement learning algorithm, which can optimize and adjust the proportion of stock investment in the process of continuous trial and error to cope with the changing quantitative investment environment.

2.2.4 Deep Reinforcement Learning Algorithm

Deep reinforcement learning gives full play to the advantages of deep learning and reinforcement learning, that is, the features acquired by deep learning in the securities market are taken as the state of reinforcement learning to promote artificial intelligence to make correct buying and selling decisions and improve returns [8]. For example,

FRDNN algorithm uses deep neural network (DNN) to extract stock data features and input them into cyclic reinforcement learning model (RRL), on which trading behavior is made. The TFJ-DRL model weights the features extracted by deep learning, and the action of the last trading decision is added to the reinforcement learning algorithm to achieve better results. DDPG algorithm is applied to portfolio management by limiting weight and dispersing risk.

2.3 Advantages of Intelligent Quantitative Trading Over Traditional Quantitative Trading

At present, traditional quantitative trading is mainly based on traders' analysis and judgment of various influencing factors of stock prices to construct trading strategies. In general, intelligent quantitative trading can acquire more data and a wider range of data independently. After processing it, it can conduct logical deduction and find out many characteristic factors that have not been paid attention to by traditional quantitative trading. Secondly, the traditional quantitative trading strategy is often realized through the establishment of mathematical models to find the rules in the market, but the market is dry and changing, the rules found may only be temporary, once the market is unstable income will be reduced or even losses, artificial intelligence more emphasis on the learning process, the formation of the machine's own investment decisions, can be constantly updated [9]. Thirdly, through artificial intelligence algorithm, knowledge graph and other technical means, the market can be predicted to a certain extent, a more effective strategy model can be built, and a better strategy can be selected. In addition, the financial market changes rapidly, when the market suddenly major negative, human usually can not immediately obtain relevant information and timely response to the assessment of risk, traditional quantitative trading is naturally exposed to this risk. With the assistance of artificial intelligence, intelligent quantitative trading can monitor the market environment 24 h a day and grasp the market direction at any time. Moreover, the judgment made through the model is also more effective. When the capital market encounters a "black swan" event, it can automatically execute operation instructions to make a timely response, greatly reducing losses [10].

3 Future Outlook

3.1 Future Development Trend

At present, the combination of artificial intelligence and traditional quantification has achieved a lot of results. With the continuous development of artificial intelligence and big data, the intelligence degree of quantitative transaction is bound to be thriving. In recent years, intelligent quantitative trading has gradually gained the attention and favor of major investment institutions. In the future, increasing the proportion of the financial market can be expected. However, to make the machine reliable and effective to deal with unexpected events, the adaptive ability of machine intelligence needs to be improved. Although there are a certain number of algorithms provided by machine learning for quantitative investment, the effect of traditional financial theories and models in strategy construction cannot be ignored, and further empirical research in this respect is

also expected to achieve results. In terms of man-machine communication, intelligent quantitative investment combined with the successful experience of investors' active investment to realize seamless human-machine interactive intelligent investment needs to be further explored. In terms of investor service, there have been a number of artificial intelligence-based quantitative investment companies in China, and they have launched different intelligent quantitative investment strategies according to customers' risk preferences, which will be more popular in the future. In addition, the world's first ETF fund AI Powered Equity ETF with artificial intelligence investment has been listed on the New York Stock Exchange in 2017, and the first domestic equity fund with artificial intelligence investment, Zheshang Intelligent Industry Preferred Hybrid A, has also been established in 2019. There will be more intelligent quantitative funds issued in the future. For investors to choose.

3.2 Can Smart Quantitative Funds Replace Fund Managers in the Future?

Although artificial intelligence can solve many difficult problems that humans cannot solve, can it replace fund managers? We put forward some disadvantages of artificial intelligence. First, the technology of artificial intelligence is not perfect enough at present. Crunching data and making investment decisions are two relatively separate tasks, with current technology, machines cannot seamlessly combine. It is also possible for artificial intelligence to make mistakes when collecting data, leading to incorrect analysis results. Artificial intelligence can operate 24 h a day, but humans can't monitor artificial intelligence 24 h a day, so when artificial intelligence a little deviation, the loss is often staggering. Second, if artificial intelligence is widely used in the market, the winning strategy of artificial intelligence may become invalid. If they hope to achieve excess returns again, they will need to invest in new strategies that may not necessarily outperform their competitors. Third, artificial intelligence conducts data analysis based on big data, and the data sources may touch on corporate information protection, personal privacy protection and other issues, which will involve privacy and ethical principles. Fourth, AI collects data through the Internet with a certain lag, such as the inability to effectively obtain due diligence information, and the key internal information that the company does not disclose but can be obtained privately by people.

To sum up, artificial intelligence is not omnipotent. Perhaps with the progress of science and technology, intelligent quantitative funds can obtain more and more substantial and stable returns, and investors can invest according to their own risk preferences. However, intelligent quantitative funds do not have the effect of replacing fund managers. As the spirit of all things, human beings prefer to exert their own subjective initiative and do not want to be replaced. Therefore, it can be concluded that human beings will not lose their dominant position in the capital market, and artificial intelligence will only play an auxiliary role or become another investment choice. However, the application of artificial intelligence in the securities market is still the trend. We should explore and adapt to this new change.

4 Conclusion

This paper reviews the role of artificial intelligence in quantitative trading by extracting information from big data, processing data to obtain characteristic factors, and constructing investment strategies. It is still a trend in the investment community to summarize the advantages of intelligent quantitative trading and predict its future. At the same time also put forward the intelligent quantitative fund cannot replace the fund manager this view. In this paper, the concept and implementation of various machine learning algorithms are not thoroughly introduced. The main purpose is to let readers understand the current development situation and difficulties, and to trigger readers to think about the future of intelligent quantitative trading. And provide reference for investors to invest intelligent quantitative fund.

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