Theory and Research of Financial Risk Prediction Based on Deep Learning

Yihong Zhao

Beijing University of Posts and Telecommunications

mchkzone@outlook.com

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Abstract: With the improvement of computing power and the improvement of machine learning theory, the deep learning has a more significant advantage in its nonlinear fitting ability. Thanks to the mature methods of data processing, the deep learning can use a variety of algorithmic structures such as BP neural network and DB network to make use of the informative indicator on the network to improve the accuracy of the prediction results of financial risk management. The optimization method in the deep learning and the processing method of data noise can also promote the growth and improvement of relevant theories of financial risk management. However, the financial market is complex and changeable. Any models of deep learning will face unfavorable results or even opposite predictions. Therefore, it is very important to construct a model of deep learning with stable effects and high speed.

1. Introduction

Financial markets are highly risky and have great uncertainty. Nowadays, the products of companies of financial securities are increasing, and there are often a large number of users behind the products. Stability and sustainable growth are obviously the top priorities, which reflects the importance of risk management. The occurrence of a series of financial crises such as the US financial crisis in 1929 and the US financial credit crisis in the 1980s shows that ubiquitous financial risks are increasingly becoming a huge threat to enterprises and governments. At the same time, the rapid development of computer technology, diversity of data information and application of data analysis technology has brought opportunities and challenges to management analysis of financial risk with characteristics of big data. Artificial intelligence began to be gradually applied in the field of financial risk management, leading to the reform of the industry. In the process of evolution, deep learning is the key to the development of AI application. Financial market is a dynamic system with non-parameter characteristics. It is a very challenging task to analyze and forecast financial data. But the traditional model of measurement equation or the model with parametric no longer has the abilities of analyzing and modeling the complex, high dimension, and financial market data with the noise. And the traditional artificial neural network method can't correct analysis modeling of such complex data, at the same time, the traditional machine learning method is very dependent on subjective design of modelers, which could easily lead to model risk. These methods have the problems of overfitting and slow convergence in application. The deep learning method provides a new idea for financial data analysis.

With the emergence and rapid development of machine learning in recent years, deep learning has a unique advantage in the ability to nonlinearly fit complex data. Therefore, deep learning is very suitable for processing and forecasting financial data with complex relationships. As a result, the field of financial risk management also needs deep learning as an important technology to apply.

2. Deep learning applied by financial risk management

Deep learning is a new field in machine learning research. Its motivation is to build and simulate a neural network for brain analysis of human and learning. It mimics the mechanism of the human

brain to interpret data such as images, sounds and texts.

The concept of deep learning stems from the study of artificial neural networks, which combines low-level features to form more abstract high-level features to discover nonlinear relationships between data.

In 1980, based on the traditional perceptron structure, the founder of deep learning, Professor G. Hinton used multiple structures of hidden layers to replace the single-layer structure of the perceptron. Multi-Layer Perceptron is the most representative. And multi-layer perceptron is also the earliest model of deep learning.

In 1984, Japanese scholar Fukushima Kunihiko proposed the original model Neocognitron of convolutional neural networks. In 1998, Y. LeCun proposed CNN, one of the commonly used models for deep learning. In 2006, G. Hinton proposed the concept of deep learning, and then his team proposed one of deep learning models, the deep belief network, in the article "A fast Learning Algorithm for Deep Belief Nets", and gave an efficient Semi-supervised algorithm: layer-by-layer greedy algorithm to train the parameters of deep belief network, breaking the deadlock that is difficult to train in deep network for a long time. Since then, a great wave of deep learning has been set up among major governments, universities and enterprises. In 2009, Yoshua Bengio proposed another popular model of deep learning, Stacked Auto-Encoder, which uses an automatic encoder instead of the restricted Boltzmann machine, the basic unit of the deep belief network, to construct a deep network.

Deep learning has attracted the attention of scientific research institutions and industries since its inception in 2006. Initially, the application of deep learning was mainly in the field of image and speech. In June 2012, Google Chief Architect Jeff Dean and Stanford University Professor Andrew Ng led the famous Google Brain project, using 160,000 CPUs to build a deep neural network and applying it to image and speech recognition, which was a great success. In addition, deep learning has also gained widespread attention in the search field. Today, deep learning has been widely used in the image, speech, natural language processing, and big data feature extraction. The rapid development of deep learning in the past half century has laid the foundation for its application in the field of financial risk management.

2.1 Application of deep convolutional neural network in financial risk management

CNN can be used to predict possible risks in the financial sector. The deep learning requires optimized parameters and sufficient training data to adjust the neural network weights to appropriate values. LECUN V et al. proposed LeNet-5 in 1998, and LeNet-5 has been successfully applied to the field of handwritten character recognition. Li Zhuo proposed a deep learning VaR measurement method, based on the loss sequence itself to construct a model of deep learning, and found that this method is more accurate than the VaR calculation under the ARCH family model. Based on this, Han Zhengyi broadened the bank's risk monitoring and management ideas, applied the deep neural network method, used in the field of credit risk monitoring, and optimized the training method of the model. After testing, the effect was found to be significant. CNN is able to automatically learn features from data, replacing artificially designed features, and the deep structure makes it more expressive. Recently, some scholars have used deep neural networks as the basic structure, and established a model of deep learning based on the probability of occurrence of real events, so as to predict the price. The model can be applied not only to the joint distribution of the optimal selling price and the optimal buying price at the time outside the analysis sample, but also to analyze other behaviors of the limit order book.

It can be seen that CNN has been widely used in the field of financial risk management, and it still has considerable prospects in this field.

2.2 Application of deep brief network in financial risk management

The deep belief network can provide quantitative analysis decisions for financial management by establishing corresponding deep learning financial time series data analysis models. In 2014, Kuremoto T et al. used a three-layer DBN network to predict chaotic time series. In 2015, Ding

Weixing trained to generate a five-layer deep learning transaction fraud detection system based on the deep belief network model, and after processing the data, he tested the model's transaction fraud recognition effect. In the same year, Shen F et al. used the improved DBN network to achieve more accurate exchange rate than the traditional method. It can be seen that DBN can measure and warn risks very well.

2.3 Application of back propagation network in financial risk management

In 2000, scholar Wang Zhiyu proposed a method based on artificial neural network for financial risk management in China, but subjectively derived the classification of expectation of financial risk and financial risk. Later, Wu Chongfeng refined the financial risk forecasting process and applied it to the analysis of the 1997 Asian currency crisis. In 2015, Yang Jiequn believed that deep learning was an effective method to deal with stock index futures. The deep learning network was used in the forecast of stock index futures. Based on BP neural network and other algorithms, a deep learning network model was established for comparative analysis. Finally, a system of network prediction for transactions was designed based on transaction choices. In addition, the effective management of financial products and tools can effectively avoid non-systematic risks in some financial markets.

3. The achievements and dilemmas of deep learning in the field of financial risk management

3.1 The achievements of deep learning in the field of financial risk management

When the deep learning is not emerging, it is difficult to solve the problem of forecasting with complex indicator in the field of financial risk management. On the one hand, using traditional methods to predict the defects that are difficult to mine features of complex data, and traditional methods can not accurately reflect the characteristics of the financial market. It is easy to overlook a lot of external causes, such as policy changes, economic development level, behavior person associated with market expectations and the change of psychological factors. These factors add to the difficulty of discovering the hidden logic of economic theory. On the other hand, the traditional model is overly dependent on the researcher's subjective design and contains subjective factors, which leads to the imperfection of the design. In addition, the traditional linear method requires strong "linear" assumptions, while the traditional machine learning method cannot handle the noise signal well. These two points fundamentally restrict the application of traditional methods in risk prediction.

The deep learning makes up for the shortcomings of traditional methods in risk management. Firstly, because neural networks are inherently capable of fitting complex functions, neural network fitting ability is very strong, and very complex nonlinear mapping can be done. Secondly, deep neural networks can be used to extract abstract features of financial markets, and the extracted features have stronger generalization performance than the specific settings.

3.2 The dilemmas of deep learning in the field of financial risk management

It is undeniable that although the deep learning network has unique advantages in prediction of financial risk, it also has problems and challenges. First of all, it is the problem of neural network modeling. Financial markets have huge amounts of data, and often only complex models can fully exploit the information in massive data. As deep learning becomes more powerful, it is often more valuable to unearth financial market rules. In this case, the quality of the indicator becomes the key to the accuracy of the entire management of financial risk. In order to find better indicators, it is necessary to repeatedly explore, and this often takes several years in time. Secondly, the development and application of the model of deep learning have changed the traditional operation mode of many financial businesses and made financial supervision face new challenges. Under the existing financial supervision system, it is difficult to define the responsibility of risk events caused by the fault of Fintech. All of these make the application of deep learning have some problems. Finally, it is the parameter optimization of neural networks. Neural network parameters are very important for neural networks. By changing such parameters, it is possible to make a big change in

the financial risk prediction results. If neural network relies solely on the initial parameters and does not perform parameter optimization, it may adversely affect model performance and prediction accuracy.

4. Prospects for the application of deep learning networks in financial risk management

The application of deep learning in financial risk management can greatly reduce the burden of enterprises and the regulatory pressure of the government. It can also promote the investment and development of society in the field of deep learning. However, there are still many challenges in its application. On the one hand, we need to improve the selection of indicator and the construction of model algorithms to make the effect of prediction more accurate. On the other hand, we need more policy support and increase the cultivation of talents. The investment of related large funds will improve the existing financial supervision system. Deep learning has always been one of the main research areas of artificial intelligence. It is not perfect. In the new financial risk management field, it is normal to encounter certain obstacles and difficulties, and any technological progress is the same. Rational use of deep learning will definitely promote the renewal and transformation of financial risk management.

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