Application of Deep Learning Method to Capital Assets Pricing

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Abstract. The key problem of financial assets allocation is the price of assets. Assets pricing is the core content of Modern Finance, and revealing the law of assets pricing is always a hot spot of finance research. In recent years, deep learning technology has been applied in the research process of assets pricing and achieved good effect. This paper introduced the theory and characteristics of deep learning, started from extracting and utilizing nonlinear information, effectively processing time series data, and intellectual prediction model, and explored the application of deep learning method in the capital assets pricing. Meanwhile, this paper explores the applicability and limitations of deep learning methods and discusses possible future research trends in learning-based asset pricing.

Keywords: Assets Pricing; Deep Learning; Characteristics.

1. Introduction

With the rapid development of Internet information technology at present, since the deep learning neural network model is close to the structural characteristics of human brain thinking, so deep learning model has gradually become a synonym of artificial intelligence (AI), and has been widely applied in various industries by virtue of internet information technologies. In financial field, the fundamentals quantization investment is becoming a new development direction of financial field. Applying deep learning model on fundamentals quantization investment can expand the fundamentals quantization investment assets management business, and meanwhile increase its assets management efficiency. Now, there are few studies on the application of deep learning to capital assets pricing in the academic circle. Therefore, studying the application of deep learning model to capital assets pricing can not only help academic circle to make in-depth investigation on the inner mechanism of capital assets pricing under capital market economics system with Chinese characteristics, but also have great significance in promoting the effective rise of return on capital assets.

2. Principle and Characteristics of Deep Learning

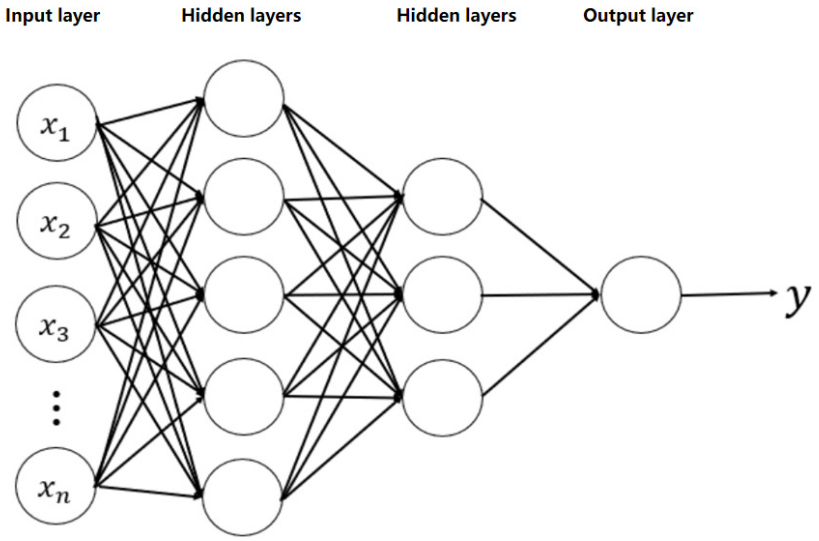

Fig 1. Deep learning model with multiple hidden layers

Deep learning model is also called deep neural network (DNN) model, which is inspired by the neural network of biological brains. Since deep learning was proposed in 2006, it has developed and extended to more than ten deep learning frameworks including deep neural network (DNN) and convolution neural network (CNN), which have been widely used in multiple fields such as computer vision, agricultural informatics, bioinformatics, and natural language processing (NLP) and achieved good results. In the process of application, deep learning model is able to expand "deep" information in the model, and uses different functions to perform data conversion, so as to realize deep learning model application. Deep learning model is characterized by modelling, standardization and feature learning, in which feature learning is the major characteristic. Feature learning refers to the ability of automatically extracting data required from massive original data, and combining the data in a hierarchy from high to low. Especially for bigger data set, the application of deep learning model can promote the processing efficiency of massive data.

3. Application of Deep Learning to Capital Assets Pricing

3.1 Extract and Utilize Nonlinear Information

Deep learning model application includes dozens of applied technologies such as linear algebra, probability and informatics, machine vision and image identification, and natural language processing. In the application of deep learning model to capital assets pricing, the nonlinear information can be used more conveniently and effectively by virtue of deep learning model. In traditional capital assets pricing models, they often adopted traditional linear regression model to extract financial big data information factors, but they ignored the data properties like potential information factors, sparsity and non-linearity existing in financial big data. While, the application of deep learning model could effectively extract the nonlinear information feature of financial market from massive financial data, and it can expand "deep" data information and meanwhile analyze the financial data information, enabling it to quickly obtain the financial data required.

3.2 Effectively Process Time Series Data

In previous capital assets pricing model applications, there was a problem of "short-time memory" in financial data processing. When deep learning model is applied to capital assets pricing model, we can use the long short-term memory network model (LSTM) and recurrent neural network (RNN) of deep learning model to remedy this problem, and enhance the processing efficiency of time series data. In the process of application, deep learning model can filter out "noise" information through forget unit, making different assets types to match to different memory lengths.

3.3 Intellectual Prediction Model

When deep learning model group as the synonym of AI is used in capital assets pricing field, it can effectively give play to its "intellectual" predictability. By introducing a "discriminator", we can build a generative adversarial network (GAN) in capital assets pricing field. At the time of introducing "game" process, it will general a module to acquire the prediction data and further realize the predictability of capital assets pricing.

4. Analysis and Discussion

4.1 Merits of Applying Deep Learning to Capital Assets Pricing Field

Deep learning model has good predictability. Particularly when it is used in capital assets pricing field, it can effectively predict large capitalization stocks. Compared to small capitalization stocks, large capitalization stocks have lower financial friction, so their prices can better reflect market fundamentals. The integration of large capitalization stock prediction and deep learning model makes it possible to obtain any responsible function on the basis of using the infinite dimensional neural

network dimension of deep learning model and combining the strong fitting capability of neural network, so as to effectively support the prediction of large capitalization stocks.

When deep learning model is applied to capital assets pricing model, it effectively combines with probability model, making deep learning model to possess certain inference capability based on original capabilities and to add stochastic factors in specific application. This improves the inference capability of deep learning model.

4.2 Weaknesses of Deep Learning Applied to Capital Assets Pricing Field

As capital assets pricing is highly sensitive to financial data, so the accuracy of relevant data is very strictly required. Since the development of deep learning model, as the application time increases constantly, the hidden layers of deep learning model applied to capital assets pricing also increase day by day. However, with the increase of data scale, there will be a process of gradient disappearance. Considering that the weight won't update with it, so the accuracy of fitted data obtained will greatly reduce.

During the application of deep learning model, the variable part mainly includes the composition and framework of deep learning model. When deep learning model is applied to capital assets pricing and it finishes the construction, in order to obtain target values, it builds many weight learning algorithms in the model. But as the application time lasts longer, the parameters to study gradually rise, resulting in the enlargement of neural network freedom in deep learning model. Thus, in the face of neural network training, deep learning model is easily to collapse due to local minimum and can't eject.

4.3 Optimization Measures for Applying Deep Learning to Capital Assets Pricing Field

To improve the deep learning model in capital assets pricing, it is feasible to aim at the high accuracy problem of relevant data in capital assets pricing and combine with the ensemble empirical mode decomposition (EEMD) to make further improvement. The addition of EEMD into deep learning model can increase "white noise" in the target signal of financial data, and perform EMD decomposition on the target signals added with "white noise". After repeating above operations, the influence of "white noise" on capital assets pricing model can be eliminated to the maximum extent.

Introduce multi-scale data in deep learning model. Multi-scale data is an important development direction of spatial database. Combing multi-scale data with deep learning model, we can analyze data information from multiple scales and perspectives, thereby strengthening the prediction performance of deep learning model.

Build a cross-market deep learning model. In capital market, except stocks, there are multiple transaction markets including foreign exchanges, oil, futures and bulk commodities. On basis of that deep learning model is mainly used in stock market field, the establishment of a cross-market deep learning model can better cover the data of various transaction markets, and is of great significance to the development of the whole capital assets pricing field.

5. Conclusion

After more than ten years of development, deep learning model has been widely applied to computer vision, agricultural informatics, bioinformatics, natural language processing and so on, with major significance on social development. This study is based on deep learning model and investigates on the application situation, merits, weaknesses and optimization of the model in capital assets pricing. In the research process, it is found that it is possible to greatly boost the high-quality development of financial market by enhancing the application of deep learning model. Particularly, the model can be effectively applied to capital assets pricing by virtue of the big data and artificial intellectual perspectives, to elevate the level of capital assets pricing. In future, the wide application of deep learning model to financial market field will become a tendency of market development. This

requires scholars to intensify the application study of deep learning model and provide a foundation for its application.

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