



The Investigation of Credit Score Evaluation Based on Machine Learning Methods

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Abstract. With advancements in artificial intelligence and finance, numerous academics have delved into credit risk assessment using machine learning techniques. Credit scores are vital for the stability of financial institutions both in China and abroad. Traditional methods of identifying user defaults can no longer accommodate the diverse data types, large user volumes, and high accuracy needed for modern risk prediction. Many scholars have employed machine learning methods, yielding significant research results that demonstrate these techniques' strong predictive and generalization capabilities. Consequently, conducting a literature review and researching development trends in this area is of great importance. This review can offer valuable insights into the evolving landscape of credit risk assessment and highlight the benefits and challenges associated with the integration of machine learning in this field. By understanding these developments, financial institutions can enhance their risk management strategies, ultimately contributing to a more stable and efficient financial system. The ongoing research in this domain underscores the potential of machine learning to revolutionize credit risk assessment and drive innovation in financial services.

Keywords: credit score, machine learning, deep learning.

1 Introduction

With the development of the Chinese economy, people have begun to pursue a higher quality of life. In order to stimulate the economy and encourage financial innovation, the government has gradually relaxed financial regulatory policies, resulting in an upward trend in the total amount of bank loans in recent years. According to statistics from the China Banking and Insurance Regulatory Commission, the total amount of loans at the end of 2022 reached 347996.2 billion yuan, a rise in 20337.7 billion yuan compared to the beginning of the year [1]. However, at the same time, banks are increasingly threatened by credit risk, and the non-performing loan balance of commercial banks has always shown an upward trend. Meanwhile, data also shows that the balance of non-performing loans at the end of 2022 reached 2982.9 billion yuan, an increase of 135.9 billion yuan compared to the beginning of the year [1]. In order to improve the accuracy of personal credit risk assessment models and reduce the personal credit risk faced by banks, experts and scholars have made many efforts

in exploring the influencing factors of personal credit risk and improving assessment methods.

Early scholars used subjective evaluation for credit scoring. Subsequently, in order to reduce subjective factors in credit ratings, a large number of mathematical and statistical methods were adopted. In 1936, Fisher was the first to propose dividing the population into different groups, which was known as Fisher discriminant analysis [2]. David Durand distinguished between good and bad loan applications based on this [3]. Eisenbeis used discriminant analysis in the field of credit [4]. Generally speaking, credit scoring models use logistic regression models. As a well-known statistical method, logistic regression models are used to evaluate the credit value of borrowers due to their simplicity and transparency in prediction. For example, an improved Synthetic Minority Over-Sampling Technique (SMOTE) oversampling algorithm combining logistic regression principles and considering variable importance to synthesize auxiliary samples is proposed, which has certain application value [5]. However, in recent literature, many have proposed the idea of combining artificial intelligence technology in the financial field. For example, Xing proposed a stock prediction system based on deep neural networks [6]. This system studied the problem of multi factor quantitative stock selection from the perspective of stock financial indicators and stock price trends and proposed a method of constructing a stock selection model based on stock trend recognition algorithm. Xue and her research team have conducted research on the efficiency of data cleaning and feature engineering using different machine learning models. This study demonstrates that machine learning can improve the accuracy of banks in assessing personal credit risk [7]. Therefore, it is feasible to directly model the conditional probabilities of data and predicted categories through the discriminative models in the subfield of artificial intelligence technology, namely machine learning, to help major banks or credit systems better judge customer credit scores. Thanks to the rapid development of machine learning and finance, there are increasingly more methods to assist credit scoring through machine learning. At the same time, as credit scores are increasingly used in people's daily lives, society's attention to credit scores is also increasing. Therefore, it is necessary to conduct research on the current progress in this field.

The remainder of the paper is organized as follows. Firstly, this study will introduce the algorithm and learning models for credit score calculation in Section 2. Then, in Section 3, this study will discuss whether this algorithm has value in the current field and the challenges it will face in the future. Finally, Section 4 will summarize the paper and present conclusions of this review.

2 Method

2.1 Machine Learning Methods

Usually, the workflow of machine learning includes data preparation, model construction, model training, and model testing. This article only introduces algorithms in machine learning methods.

2.2 Traditional Machine Learning Models

Decision Tree. Decision tree is a divide and conquer decision-making process. Through a tree's branch nodes, a complex prediction problem can be structurally separated into multiple subproblems and further subdivided into two or more simpler subsets. Recursive partitioning is used to constantly separate the dataset based on rules. The collection of branch nodes shrinks and the number of questions to be answered progressively gets simpler as the tree gets deeper. When the depth of a branch node or the simplicity of the problem satisfies a certain stopping rule, the branch node will stop splitting, which is the top-down stopping threshold Cutoff Threshold method; Some decision trees also use a bottom-up pruning method .

An example of applying decision trees in the field of credit scoring is to establish a new personal credit evaluation prediction model using the decision tree C5.0 algorithm [8]. Researchers used the decision tree C5.0 algorithm to establish a model and found that the decision tree algorithm can provide a very intuitive explanation and is suitable for in-depth analysis of a certain attribute.

Random Forest. Random forest is a scalable and easy-to-use machine learning algorithm that can achieve good classification results in most cases even without parameter tuning. Due to its flexibility and diversity, the random forest algorithm has become one of the most commonly used machine learning algorithms, often used to solve classification and regression problems.

An example of the application of random forests is that Xiao and his team proposed a personal credit evaluation model based on a random forest combination classification algorithm in their research [9]. Through research, it has been found that the random forest combination classifier model has higher prediction accuracy and stability in the application of personal credit evaluation.

Logistic Regression. There are many similarities between logistic regression and multiple linear regression analysis. They essentially have the same model forms. It is not necessary to know the data type of X in order to conduct logistic regression analysis to examine the effect of X on Y. Y must be categorical data; therefore, dependent on the number of possibilities in Y, corresponding data analysis techniques should be applied. X might be quantitative or categorical data. Binary logistic regression analysis, multi class logistic regression analysis, and ordered logistic regression analysis are the three broad categories into which it can be separated.

Here is an example of the application of logistic regression model in credit score. Xu and her research team proposed a SMOTE oversampling method that considers variable importance to synthesize auxiliary samples based on the principles and characteristics of logistic regression models, which can improve the anti-sample influence performance of logistic regression models [10].

2.3 Deep Learning Methods

CNN. Convolutional Neural Network (CNN) is a deep learning model that has achieved great success in the field of computer vision. Their design inspiration comes from the visual system in biology, aimed at stimulating the way human vision processes. In the past few years, CNN has made significant progress in image

recognition, object detection, image generation, and many other fields, becoming an important component of computer vision and deep learning research.

Wang and his team proposed a personal credit evaluation model based on LSTM algorithm and CNN algorithm in their research. Through research, it has been found that the random forest combination classifier model has higher prediction accuracy and stability in the application of personal credit evaluation.

3 Discussion

According to the previously mentioned methods, it is not difficult to see that the main methods currently used in credit scoring systems are concentrated in the traditional machine learning and deep learning regions. Compared to the two, machine learning algorithms are simple and easy to understand, with fast processing speed and stable performance. Deep learning algorithms can process large amounts of high-dimensional data, automatically learn features, and improve the accuracy and efficiency of data processing. When applying these two algorithms, traditional machine learning can bring better interpretability, and in terms of cost, deep learning requires expensive high-end GPUs to train in a reasonable time with a large amount of data. Traditional machine learning algorithms only require a decent CPU to train well, without the need for the best hardware. In addition, it can iterate faster and try many different technologies in a shorter amount of time.

However, at the same time, deep learning predicts more accurately through deep networks compared to traditional machine learning, and more accurate data results are more important in credit evaluation. Moreover, traditional machine learning requires feature engineering to analyze datasets, while when using deep learning, simply uploading the dataset to a deep network is usually sufficient to achieve good performance.

Therefore, this article believes that using a deep learning credit scoring system is the algorithm that can provide better results. However, regarding the current development of deep learning, future studies still need to continue to improve its interpretability and reduce the cost of deep learning. At the same time, protecting customer privacy is also important. Banks need to protect customer data to prevent it from being hacked into models and causing data leakage. The data in the credit scoring system is very sensitive and can easily have different data distributions for different customers. Therefore, it is best to improve the applicability of the algorithm to help solve the distribution differences of parameters and help banks better conduct credit ratings; For this, researchers can try to combine transfer learning with deep learning models to help algorithms adapt to credit score calculation data, in order to better assist banks in measuring credit scores and helping their customers.

4 Conclusion

This literature systematically reviews the most commonly used machine learning and deep learning models in credit scoring systems and compares the performance of

classical machine learning models and deep learning models. Although there is limited literature on the use of deep learning in credit scoring systems, compared to classical machine learning models, deep learning models still demonstrate great potential in application and credit scoring systems. Future studies should focus further on applying deep learning models to credit scoring and investigate models that can lower the cost of deep learning, including integrating transfer learning and deep learning models to make them more flexible.

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