

# Credit Decision of Small, Medium and Micro Enterprises

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## Abstract

Microfinance is an important means of poverty alleviation, developing and improving rural and urban financial services for low-income groups and micro enterprises, and developing low-end financial market. The safest and most reliable is bank credit. Through data mining and using the credit decision-making model based on fuzzy comprehensive evaluation method, banks can select the equilibrium point of risk and return faster, more accurately and more controllably. First, small and micro enterprises are divided into two categories: those with and without credit records. For an enterprise with a credit history and a credit rating, nine items of data such as net income, net income variance, total tax amount, tax amount variance, number of trading activities, proportion of invalid trading activities, number of effective inputs, number of invalid inputs and reputation should be obtained. Secondly, the time series prediction model with seasonal characteristics is used to predict the development trend of the above indicators in the next year. On this basis, the weight of each index in the credit risk evaluation system is calculated by entropy weight method, and the results are verified by principal component analysis. Then, using the analytic hierarchy process, the decision-making problem, that is, the loan amount of the bank to each enterprise, is decomposed into different hierarchical structures. The relative weight vector is determined by solving the characteristic vector of the judgment matrix. After passing the consistency test, it is determined that the combined weight vector can be used as the final decision-making basis. Finally, in order to maximize the bank's income, the objective programming model is used to solve the optimal annual interest rate. For enterprises without credit records, first grade them according to the enterprise flow, and then carry out other processing. At the same time, the lending strategies of banks under extreme special circumstances such as COVID-19 are also considered.

## Keywords

Micro credit; Time series analysis; Entropy weight method; Analytic hierarchy process.

## 1. Introduction

Microfinance refers to the small amount, short-term credit loans provided to low-income people and microenterprises, which are mainly used for production and simple business activities. Microfinance is an important means to help the poor, develop and improve rural and urban financial services for low-income people and micro enterprises, so as to develop low-end financial market. The report on China's Regional Financial Operation (2020) issued by the central bank pointed out that in the next stage, the prudent monetary policy should be more flexible and appropriate, put the support for the development of the real economy in a more prominent position, give further play to the role of monetary and credit policies in promoting economic structural adjustment, create a good monetary and financial environment for the financing of small and micro enterprises and private enterprises, and increase the support for small and micro enterprises Credit support for private enterprises.

## 2. Background and Assumptions

### 2.1. Practical Principles of Bank Lending

Banks usually provide loans to enterprises with strong strength and stable supply-demand relationship according to credit policies, enterprise transaction bill information and the influence of upstream and downstream enterprises, and can give preferential interest rates to enterprises with high reputation and low credit risk. The bank first evaluates the credit risk of small, medium-sized and micro enterprises according to their strength and reputation, and then determines whether to lend and credit strategies such as loan limit, interest rate and term according to credit risk and other factors.

### 2.2. Make the Following Assumptions

- (1) As it is a small, medium-sized and micro enterprise, we believe that the net income is the money earned by the enterprise from selling goods minus the cost price;
- (2) The enterprise has no malicious tax evasion;
- (3) As long as the enterprise has the ability, it will not default;
- (4) The enterprise has not encountered any emergencies in recent years;
- (5) The loan term of each enterprise is one year;
- (6) The default situation and frequency of the enterprise are related to its reputation level;
- (7) The bank's annual interest rate is not affected by the market and other external factors;
- (8) It is assumed that the negative invoice is the transaction failure record of the current day.

## 3. Model Analysis

### 3.1. Distribution Quota of Each Enterprise

We use the time series prediction model with seasonal characteristics to predict the development trend of the above indicators in the next year. On this basis, the weight of each index in the bank enterprise credit risk evaluation system is obtained by using the entropy weight method. In addition, principal component analysis was used to verify whether the results were reasonable. Then, using the analytic hierarchy process, the decision-making problem, that is, the loan amount of the bank to each enterprise, is decomposed into different hierarchical structures.

#### 3.1.1 Time Series with Seasonal Characteristics

The seasons mentioned here can be natural seasons or sales seasons of certain products. Obviously, there are many seasonal time series in the economic activities of different enterprises. For example, the data generated by the production and sales of air conditioners and seasonal clothing. For the prediction of seasonal time series, it is very difficult to fit completely mathematically. However, the purpose of prediction is to find the change trend of time series and be as accurate as possible. Therefore, the seasonal coefficient method can be used.

To do this, you need to understand the credit rating of the enterprise and the invoices and bills of purchase and sales items. After a series of calculations, MATLAB can be used to obtain the estimated values of annual net income and variance, total tax amount and variance, variance of total trading volume and cancelled trading volume, proportion of voided number, monthly average input and output, enterprise reputation and so on.

#### 3.1.2 Entropy Weight Method

After obtaining the estimated values of annual net income and variance, total tax amount and variance, variance of total trading volume and cancelled trading volume, proportion of voided number, monthly average input and output, enterprise reputation and other items in 2020, you

can choose to use entropy weight method to determine the weight of the above items. However, since the reputation of the enterprise is a condition we must consider, we decided to calculate the weight of the other eight conditions by entropy weight method to screen out the main influencing factors. In information theory, information entropy is a measure of information uncertainty. Generally speaking, the greater the amount of information, the smaller the entropy, and the greater the utility of information; On the contrary, the smaller the amount of information, the greater the entropy, and the smaller the utility value of information. The entropy method is a weighting method to determine the index weight coefficient by calculating the information entropy of the observed value of each index and according to the impact of the relative change degree of each index on the whole system.

### 3.1.3 Analytic Hierarchy Process

After obtaining the weight of each index, we comprehensively consider the enterprise reputation and the above eight indexes, decompose the complex problem into multiple constituent factors in a hierarchical way of thinking, and form a recursive hierarchical structure according to the dominant relationship of these factors. Through layer-by-layer comparison, we determine the overall ranking of the relatively important decision-making schemes, so as to provide a basis for analysis, decision-making Provide quantitative basis for predicting or controlling the development of things.

Step 1: establish the tomographic structure diagram.

Step 2: construct a comparison matrix. In order to reduce the subjective factors of the analytic hierarchy process, we use the weights of various indicators calculated by the entropy weight method in the previous step as the basis to obtain the proportional scale value. According to the results of the entropy weight method, we get the weight ranking of eight indicators, and then comprehensively consider the reputation rating, we can get the influence degree of the factors of the criterion layer on the target layer. Then we use the eigenvalue method to determine the relative weight vector. In order to verify the reliability of the results, a consistency test should be carried out.

Step 3: determine the combination weight vector sum and conduct the combination consistency test.

## 3.2. Calculation of Interest Rate

We use the goal programming model to maximize the income of the bank by using the allocated amount of each enterprise. We should fit the annual interest rate of bank loans with the value of customer churn rate, and obtain the fitting formula and fitting image of customer churn rate, customer churn rate and annual interest rate of bank loans. According to the above objective function, the annual interest rate and preference of each enterprise can be obtained under the condition of meeting the constraints.

## 3.3. Small and Micro Enterprises without Credit Rating

Like enterprises with credit rating, we should first process the data predicted by time series through entropy weight method and analytic hierarchy process. We can get the weight of the other eight indicators without corporate reputation.

According to the special treatment of the actual situation, only some enterprises may meet the loan limit range of the bank. According to the relevant national policies, we should strengthen the credit support for small and micro enterprises and private enterprises. Therefore, enterprises with low quantitative results and unable to meet the minimum loan limit will be given the minimum limit, Enterprises exceeding the maximum amount shall lend according to the maximum amount. The remaining funds are allocated according to the weight of qualified enterprises. If there is still excess, they will be allocated again until all enterprises meet the conditions and the funds are allocated.

### 3.4. Consider the Impact of COVID-19

COVID-19 has lost its value as the basis of evaluation when the financial situation of the enterprise has undergone significant changes or suffered severe inflation. However, considering that the impact of the new crown pneumonia epidemic is mostly short-term, it also takes other factors of the enterprise into account, and it is still weighting the credit risk and debt ratio of each enterprise. Take the debt ratio as the main evaluation basis. Then, combined with the mathematical ideas such as fuzzy comprehensive evaluation method, the data processing of each enterprise finally obtains a weight vector. The bank adjusts the credit strategy according to the weight vector. The greater the weight, the more Bank assistance is needed to overcome the difficulties.

Step 1: determine the evaluation index  $u$  and evaluation set  $V$ , where  $V$  can be divided into key assistance, depending on the situation, and no assistance.

Step 2: determine the weight vector matrix  $A$  and construct the weight judgment matrix  $R$ , and calculate the weight vector with the help of the weighted average method to measure the importance of various evaluation indicators. Then the data are properly processed to obtain the membership degree of the normalized index about the grade.

Step 3: build the fuzzy comprehensive evaluation matrix  $B$  and get the evaluation results.

## 4. Conclusions

### 4.1. Model Evaluation

This paper uses fuzzy analytic hierarchy process to establish a model to solve the problem of formulating credit strategy and credit adjustment strategy. According to the seasonal time prediction model to predict the future development of each enterprise, and then combined with entropy weight method and analytic hierarchy process to calculate a combination weight vector. The greater the weight of the enterprise, the bank's credit strategy is more inclined to the enterprise.

Enterprises with and without credit records use entropy weight method to calculate the weight of various indicators and principal factor analysis method to verify the rationality of the obtained weight vector, which is convenient for further analysis and processing by analytic hierarchy process. When COVID-19 is considered, fuzzy evaluation is used. By analyzing the characteristics and effects of emergencies, the index is weighted to make the results more accurate and truer.

### 4.2. Disadvantages of the Model

Due to the large amount of known data and data to be solved in the process of solving the model, subjective judgment is added to the analysis and processing of some data, so there are some errors, which also leads to errors in the calculation results of the model.

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