Bank Loan Strategy Based on Evaluation and Decision Model

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Abstract. In real life, in the face of small and medium-sized enterprises lacking mortgage assets, banks usually provide loans to enterprises with strong strength and stable supply-demand relationship according to credit policies, transaction notes information of enterprises and influence of upstream and downstream enterprises, and can give preferential interest rate to enterprises with high reputation and small credit risk. In order to better meet the application of the model in real life, the enterprise loan mode is introduced, and the risk assessment of each loan mode is carried out according to the actual situation. Finally, the fuzzy neural network model is introduced. The enterprise loan mode and three secondary indicators are taken as the input of the fuzzy neural network. Finally, a three-level index: loan risk assessment is obtained. Using Python program to preprocess the data, the original indicators in the given materials are extracted as the first level indicators, and then on the basis of the first level indicators, the main factor analysis and other methods are used to analyze the characteristics and scoring of the second level indicators. Then, the entropy weight is established to obtain the higher-level index loan tendency, and the loan propensity and enterprise reputation are used as parameters to establish the decision-making Model, step by step to get the bank's quota allocation, interest rate, and finally get the bank allocation plan. In order to supplement the unknown data, this paper uses the known information to forecast the whole process of the unknown quantity, and then uses the data to forecast. First of all, it forecasts whether the default occurs, adds the predicted value to the whole eigenvalue, then forecasts the reputation rating, and finally completes the reasonable supplement of location data. TOPSIS model, SPSS software simulation machine learning, Fisher discriminant analysis

Keywords: Fisher discriminant analysis, fuzzy neural network, TOPSIS principal component analysis.

1. Introduction

Due to the relatively small scale and lack of mortgage assets, the credit policy, transaction note information and the influence of upstream and downstream enterprises of small and medium-sized enterprises are usually used as the basis for banks to provide loans to enterprises with strong strength...
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and stable supply-demand relationship, and to give preferential interest rates to enterprises with high reputation and small credit risk. The bank first evaluates the credit risk of small and medium-sized enterprises according to their strength and reputation, and then determines whether to make loans and credit strategies such as loan amount, interest rate and term according to credit risk and other factors. In this paper, a series of problems are solved for a bank to determine the loan amount, annual interest rate, loan term, 123 enterprises with credit records, 302 enterprises without credit records and the relationship between loan interest rate and customer churn rate.

2. Seeking bank credit strategy based on TOPSIS method

TOPSIS method, also known as the distance method of superior and inferior solutions, is a common comprehensive evaluation method. It can make full use of information entropy to calculate the weight of each index to carry out objective assignment. In the TOPSIS method, the positive and negative ideal solutions of evaluation problems are constructed, and the Euclidean distance between the data in each scheme and the ideal solution is calculated to rank the alternatives. Each high-level index obtained by data preprocessing is used as the original data for objective assignment, Euclidean distance is calculated, and the bank loan tendency to each enterprise is obtained (the higher the tendency value, the stronger the willingness to loan). Finally, the preliminary loan scheme is obtained by sorting. The matrix of the original data is positive. Very large indicators generally represent benefits, and very small indicators generally represent costs. The conversion of very small indexes into very large ones is called index normalization. The conversion process is to use matlab to calculate the maximum value of the smallest index column in the matrix, and use the difference between the maximum value and the column to complete the conversion. Since each high-level index in the original data is already a very large index, it does not need to be converted. The forward matrix is obtained by standardizing the data. The number of enterprises evaluated is n and the number of evaluation indexes is m. The positive matrix X is as follows:

\[ X = \begin{bmatrix} x_{11} & \cdots & x_{1m} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nm} \end{bmatrix} \]

After processing the original data with TOPSIS model, a table with 123 loan propensity is obtained, which is arranged in descending order as shown in the following table:

| Enterprise code | Enterprise strength | Corporate reputation | Enterprise stability | Credit index | Loan propensity |
|-----------------|---------------------|----------------------|---------------------|--------------|----------------|
| E1              | 17.28151113         | 5                    | 17.09235137         | 13.72637767  | 0.040499       |
| E4              | 4.731916075         | 3                    | 8.613161397         | 3.358299907  | 0.017482       |
| E15             | 0.23724923          | 5                    | 8.720916461         | 3.988630752  | 0.013695       |
| E122            | -0.527864386        | 1                    | 14.82682828         | -0.867369103 | 0.01301        |
| E2              | 1.494924009         | 5                    | 0.797274662         | 3.187111811  | 0.011878       |
| ...             | ...                 | ...                  | ...                 | ...          | ...            |
| E99             | 0.105840609         | 1                    |                     |              |                |

Table. 2 Ranking table of loan propensity of enterprises with credit rating

| Enterprise code | Loan propensity | Credit rating |
|-----------------|-----------------|---------------|
| E1              | 0.040499        | 4             |
| E4              | 0.017482        | 2             |
| E15             | 0.013695        | 4             |
| E2              | 0.011878        | 4             |
| E16             | 0.011388        | 4             |
| ...             | ...             | ...           |
| E99             | 0.105840609     | 1             |


According to the establishment process of the strategy selection model and the credit rating, the
customers with very low rating are screened out and the loan service is not allowed. For example, the
credit rating of the customer with enterprise code number E99 in the table is 1, which belongs to the
customer with extremely low credit rating and does not provide loan service, and so on, a list of
enterprises providing loan service by the bank is obtained, and the quota is allocated according to the
quota allocation algorithm, as shown in the table (the exact amount is not given, the result of the quota
allocation algorithm cannot be determined, so the total loan amount is calculated here Allocation
strategy when the quota is 50 million yuan)

| Enterprise code | Loan propensity | Credit rating | loan limit |
|-----------------|-----------------|---------------|------------|
| E1              | 0.040499        | 4             | 1000000    |
| E4              | 0.017482        | 2             | 1000000    |
| E15             | 0.013695        | 4             | 1000000    |
| E2              | 0.011878        | 4             | 1000000    |
| E16             | 0.011388        | 4             | 1000000    |
| ...             | ...             | ...           | ...        |
| E110            | 0.0044762       | 2             | 100000     |

This paper uses MATLAB to import the profit calculation formula to generate the discrete graph
corresponding to the change of bank profit with interest rate, and observe the general growth trend of
its profit. Calculate the interest rate corresponding to profit maximization.

| Enterprise code | Loan propensity | Credit rating | loan limit | Annual interest rate | Three-year total profit estimate |
|-----------------|-----------------|---------------|------------|----------------------|----------------------------------|
| E1              | 0.040499        | 4             | 1000000    | 0.1425               | 1.70E+05                        |
| E4              | 0.017482        | 2             | 1000000    | 0.1425               | 1.63E+05                        |
| E15             | 0.013695        | 4             | 1000000    | 0.1425               | 1.70E+05                        |
| E2              | 0.011878        | 4             | 1000000    | 0.1425               | 1.70E+05                        |
| E16             | 0.011388        | 4             | 1000000    | 0.1425               | 1.70E+05                        |
| E28             | 0.011367        | 3             | 1000000    | 0.15                 | 1.69E+05                        |
| E31             | 0.011017        | 4             | 1000000    | 0.1425               | 1.70E+05                        |
| ...             | ...             | ...           | ...        | ...                  | ...                              |
3. Risk assessment model based on fuzzy neural network

The traditional credit evaluation system generally only considers enterprise reputation, financial status and other indicators. However, considering that the actual loan mode has a greater impact on loan risk, this paper determines to build a risk assessment model by integrating the actual loan method. Considering the limitation of neural network in credit evaluation, we decide to use fuzzy neural network to evaluate the risk, which can better analyze and forecast the fuzzy vector. The steepest descent algorithm model is shown in Fig. 2.

![Fig. 2 Schematic diagram of steepest descent algorithm model](image)

4. Analysis of the impact of sudden situation on credit strategy

The purpose is to highlight the impact of emergencies on the industry, and different industries are affected by different degrees. Data will be changed because of sudden changes, so we first classify the industries. Finally, we call the National Bureau of statistics to compare the data of the first quarter of 2020 in different industries in the first quarter of the year with the same period in 2019 to reflect the different changes of enterprises in different industries in the face of emergencies. According to the report released by the China enterprise reform and Development Research Association on March 28, 2020, the self-employed are seriously affected by the epidemic. Due to the small scale of operation and the relatively weak ability to fight against emergencies, the self-employed have encountered serious obstacles in returning to work and production after the outbreak of the epidemic, and the operational difficulties are particularly prominent due to the superposition of multiple factors. Under the influence of the epidemic situation, according to the survey results, the sales revenue of the self-employed in the first half of the year decreased by 34.4% compared with the same period of last year. Therefore, this data can be used as the impact rate of emergencies affected by the epidemic situation for self-employed workers, which can be obtained by other industries. Suppose that the ratio of increase and decrease of sales revenue of industry I to that of quarter J in the same period of last year is \( p(I, J) \)

\[
k = \frac{\sum p(i, j)}{n}
\]

Where \( n \) is the number of quarters and \( K \) is the average affected rate. Therefore, this paper uses \( K \) to represent the impact of the epidemic on the I industry, sets the impact rate of emergencies, modifies the data such as the impact rate of emergencies, the sales volume of enterprises, the stability of upstream and downstream enterprises, and finally obtains the adjustment strategy combined with the strategy model.

5. Model evaluation

(a) The model is established from a rigorous and comprehensive way. Using SPSS, pycham, Excel and other public software for data processing, the accuracy is high, which makes the reliability of data analysis high, thus greatly increasing the reliability of the model. The established model is closely combined with the reality of real life, and try to restore the influence of some important factors in real
life on the model and results, such as the consideration of loan mode in the establishment of risk assessment model. In the model, machine learning and fuzzy neural network are used to predict the data, which has a certain prospective and practical value. Under the background of making loan strategy for enterprises by banks, we can predict the reputation and default probability of enterprises to a certain extent, so as to reduce the loan risk and potential loss of banks to a certain extent. This also has certain application value in real life, so that banks can better maintain bank interests in the face of loans from newly arrived enterprises to make more reasonable decisions. To a certain extent, the loan strategy model can also help banks to make better loan strategies, so as to ensure the maximization of bank interests under the premise of considering various factors. This model can also be extended to automobile, real estate and other industries to analyze the industry users.

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