

Research on the formulation and optimization of credit strategy for small and medium sized enterprises

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Abstract: The growing ranks of small and medium-sized enterprises have brought great pressure on the credit funds of commercial banks. To improve the information of loan enterprises, strengthen the prediction of credit risk, and improve the credit profit, so as to maintain a stable number of loan enterprises and loan profits, will make the commercial banks and lending enterprises better development. Therefore, this paper uses the entropy weight method and linear regression analysis method, establishes the revised TOPSIS model, binary logistic regression model and ROC curve evaluation model, comprehensively uses MATLAB, lingo, SPSS and other software to solve, obtains the quantitative expression of credit risk and the influence of various factors on credit risk, so as to realize the optimal allocation of bank funds.

1. Introduction

Small and medium-sized enterprises often face the distrust of banks and other lending institutions because of their small scale and the lack of mortgage assets when making loans. They are in a disadvantageous position in the process of credit risk assessment. There are some problems such as difficult loan, low loan amount, high loan interest rate and short loan term^[1].

2. Problem analysis

We refer to the data of 123 enterprises with credit records and conduct quantitative analysis. Through simple classification and summary, we find that: there are 96 enterprises without default records, including 27 A-level enterprises, 37 B-level enterprises and 32 C-level enterprises; 27 enterprises have default records, including 1 B-level, 2-level C-level and 24-d-level enterprises^[2]. The default record can be used as one of the basis for us to judge its credit rating. There are 203339 valid and 7608 invalid invoices in the input invoice, and 151278 valid invoice and 11206 invalid invoice in the output invoice. For these data, we can use factor analysis or principal component analysis to preprocess the data.

After data preprocessing, we can set model indicators according to the enterprise's credit rating, default situation, operating profit (output invoice amount minus input invoice amount, excluding value-added tax), company strength (judged according to tax payment amount), proportion of effective invoice and loan amount, and use entropy weight method and gray comprehensive evaluation method to weight and establish the credit Loan risk model. When the risk threshold fitted by the model is within the level specified by the model (if the loan conditions are met by setting level C or above), the loan can be made.

To formulate a credit strategy, we need to consider the following four conditions: first, a fixed annual total amount of credit, we can assume a certain amount as a constant K; second, the simulation results of enterprise credit risk model; third, the relationship between the size of enterprise loan and the change of loan interest rate, the larger the loan amount, The lower the interest rate. Fourth, the balance between the interest rate of credit strategy and the rate of customer churn, considering how to maximize the profit or minimize the risk when the profit is fixed.

3. Modeling

Credit analysis is a systematic investigation and Research on the repayment ability of borrowers by commercial banks. The purpose is to prevent or try to avoid the risks that banks may encounter in the process of granting loans, and ensure the safety of bank operating funds. In this issue, when banks grant loans to small and micro enterprises, they should consider both credit risk and financial status^[3].

Interest rate division mainly adopts the mainstream interest rate setting mode of commercial bank loans: differential loan interest rate. The differential loan interest rate model mainly adopts the cost plus pricing method and the benchmark interest rate pricing method, and adopts different interest rates for different customers.

Among them, the cost plus pricing method is the cost oriented pricing method, that is, the pricing is based on the various costs (the cost of raising funds, default risk cost, management expenses, etc.) and profit requirements of commercial banks to provide loan services. The calculation formula of loan interest rate is: loan interest rate = management expense rate + capital cost rate + risk premium rate + target profit rate benchmark interest rate pricing is a market-oriented pricing method, that is, taking various basic interest rates as the standard, according to the borrower's credit status, loan period, guaranteed assets, loan amount and other conditions, and on this basis, add a certain price difference or multiply by a mark up coefficient. The calculation formula of loan interest rate is: loan interest rate = benchmark interest rate + risk premium rate + long-term loan term risk premium rate^[4].

The annual interest rate of the bank's loan is 4% - 15%. Combined with the latest benchmark loan interest rate of 4.35% (short-term loan interest rate of one year or less) issued by the people's Bank of China and the risk premium rate of the above two pricing rules, the annual loan interest rate is divided into four grades: A, B, C and D.

We decided to establish the following model with the goal of maximizing the bank's profit

$$\begin{cases} F_{\max} = 0.38Q(1-Y_A)X_A + 0.2Q(1-Y_{B_1})X_{B_1} + 0.17Q(1-Y_{B_2})X_{B_2} + 0.1Q(1-Y_{C_1})X_{C_1} + 0.1Q(1-Y_{C_2})X_{C_2} + 0.05Q(1-Y_D)X_D \\ Y_A = 0.669\ln(X_A) + 2.2386, Y_{B_1} = Y_{B_2} = 0.6506\ln(X_B) + 2.1576, Y_{C_1} = Y_{C_2} = 0.6586\ln(X_C) + 2.168 \\ Q_{\text{总}} \geq A_{\text{总}} + B_{1\text{总}} + B_{2\text{总}} + C_{1\text{总}} + C_{2\text{总}} + D_{\text{总}} \\ Y_A = 0.669\ln(X_A) + 2.2386, Y_{B_1} = Y_{B_2} = 0.6506\ln(X_B) + 2.1576, Y_{C_1} = Y_{C_2} = 0.6586\ln(X_C) + 2.168 \\ A_{\text{总}} \leq 0.38Q, B_{1\text{总}} \leq 0.2Q, B_{2\text{总}} \leq 0.17Q, C_{1\text{总}} \leq 0.1Q, C_{2\text{总}} \leq 0.1Q, D \leq 0.05Q \\ 4\% \leq X_A \leq 6\%, 6.01\% \leq X_{B_1} \leq 7.5\%, \dots, 13\% \leq X_D \leq 15\% \\ 10 \leq Q_j \leq 100, \sum_{(j=1, \dots, 123)} Q_j \leq Q \end{cases}$$

According to this constraint, the specific interest rate and credit amount of each enterprise can be calculated when the bank profit maximizes.

4. Model solving

The existing weighting methods mainly include subjective weighting method, objective weighting method and combination weighting method. Among them, the subjective weighting method is determined subjectively by expert scoring, but the disadvantage is that it relies too much on the experience of experts. Objective weighting methods mainly include entropy weight method, coefficient of variation method and so on. These methods mainly rely on the discrete degree of index data. According to the data processing capacity and the objectivity of the credit rating, the entropy weight method is used to modify the TOPSIS model, which greatly reduces the subjectivity.

Step 1: mark the six credit ratings as discrete variables, i.e. a = 1, B1 = 2, B2 = 3, C1 = 4, C2 = 5, d = 6. Because this index is a negative index, through the formula $\max -x$ The negative index is transformed into a positive index.

Step2: take the interest rate corresponding to each credit rating as a variable, i.e. $A \subseteq [4\%, 7\%] \dots, D \subseteq [13.01\%, 15\%]$ We take the interval average as the index variable, because the smaller the interest rate, the better, so we still need to follow the formula $\max -x$ The negative index is transformed into a

positive index.

Step 3: standardization of positive matrix by entropy weight method

According to the result, the nonnegative matrix is as follows:

$$Z = \begin{bmatrix} 5 & 8.5 \\ 4 & 6.25 \\ 3 & 4.75 \\ 2 & 3.25 \\ 1 & 1.75 \\ 0 & 0.5 \end{bmatrix}$$

We calculate the probability matrix, in which the formula of each element is as follows:

$$P_{ij} = \frac{z_{ij}}{\sum_{i=1}^n z_{ij}}$$

Easy to verify: that is to ensure that the probability sum corresponding to each index is 1.

Step 4: calculate the information entropy of each index, calculate the information utility value, and normalize the entropy weight of each index.

For the first index, the calculation formula of its information entropy is as follows:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (j = 1, 2, \dots, m)$$

The definition of information utility value is as follows

By normalizing the information utility value, we can get the entropy weight of each index

$$W_j = d_j / \sum_{j=1}^m d_j \quad (j = 1, 2, \dots, m)$$

Finally, the weight of the grade from A to D is about $W_j = (0.38, 0.2, 0.17, 0.1, 0.05)$.

From the enterprise flow, we can see the upstream and downstream of the enterprise, calculate the proportion of main customers and suppliers, roughly judge the turnover situation of the enterprise, and the loan situation required by the bank. Among them, we exclude the influence of void invoice. Of course, in addition, the higher the proportion of void invoices (the lower the effective invoice rate of sales items), the more unstable the business situation of the enterprise can be judged.

5. Conclusion

Under the background of commercial banks; widespread lending, this paper establishes a complete credit risk assessment model, analyzes the characteristics of the target enterprises lending behavior, measures the value of the target enterprise to the bank, and divides the status of the target enterprise according to the information of the target enterprises purchase and sale items, so that the bank can manage and formulate the target enterprise more effectively Credit strategy to develop and maintain the target enterprises, so as to achieve the purpose of gain.

The binary logistic regression model established and modified in this paper can be widely used in credit risk assessment and analysis, and has certain reference and practical significance for the analysis of target enterprises in real life, and can be extended to medical, aerospace and other research.

References

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