Credit Decision-making of Micro, Small and Medium-sized Enterprises

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Abstract

In this paper, we assign points to enterprises according to the 4 grades of credit rating, find out the total profit, profit rate and invoice rejection rate of these enterprises, adopt cluster analysis method, and use Spss software to classify the strength of enterprises, combined with the comprehensive credit risk scores of these enterprises, and give corresponding credit strategies. In addition, a Z-score model is established, and through quantitative analysis of the data, Python is used to integrate the data to obtain the input and output tax rates and profit margins. Finally, we analyze the main factors of the customer churn rate caused by the possible unexpected factors of the enterprise and combine the Mpai linear regression to obtain the relationship between the customer churn rate and the annual interest rate, and use the Z-score model to get 302 companies. Corporate grades and adjusted credit strategies.

Keywords

Cluster Analysis Method; Z-Score Model; Mpai Software; Linear Regression Mode; Python Software.

1. Research Background

With the development of society, the rapid development of small, medium and micro enterprises has also become an important part of my country's national economic development. However, in general, due to the small scale of small, medium and micro enterprises and the lack of mortgageable assets, capital financing is relatively difficult, so bank credit has become an important source of funds for enterprises. Therefore, banks often evaluate credit risk according to the credit policy, the transaction bill information and the credit risk of the enterprise [3]. At the same time, the bank will also decide whether to issue loans according to the strength of the enterprise, the influence of upstream and downstream enterprises and whether the supply and demand relationship is stable. The bank will also judge whether to lend, the range of the loan amount given, whether the interest rate is preferential, the extension of the term and other credit strategies based on factors such as credit risk [4].

In this paper, we quantitatively analyze the data, and obtain the bank's credit strategy for these enterprises, and obtain the total profit and profit rate of these enterprises, and the invalidation rate of invoices. Using the cluster analysis method, the enterprise strength is divided into three grades by Spss, and divided into three grades: A, B and C. According to the strength and reputation of enterprises, quantitative integration and comprehensive rating are carried out to obtain the credit risk of these enterprises. Then, using the Z-score model, the data is quantitatively analyzed, using the cluster analysis method in the data, and using Spss to rate the strength of the enterprise, and obtain the solvency and business ability of the enterprise. The total amount of loanable funds is divided into grades, and comprehensive evaluation is carried out.

Due to the new crown epidemic, most companies have been affected in many ways. Inflation, customer turnover, employee turnover and many other factors [1]. Among them, there are

factors that affect the annual interest rate of bank loans. For example, the loss of customers will affect the reputation and reputation of the company; the loss of customers will cause the decline of corporate reputation, which will affect the acquisition of policy support and bank loans; the loss of customers will lead to a decline in efficiency, which will affect the employees' impact on the company. loyalty will be affected. The credit risk of each enterprise and the impact on each enterprise are comprehensively considered with the customer churn rate as the main unexpected factor, and the corresponding annual interest rate and credit strategy are obtained by linear regression using Mpai software [2].

2. Systematic Cluster Analysis

We use Excel to rate and score according to the credit rating. It is divided into 4 grades, as shown in table 1. Filter according to default risk in the data, as shown in table 2.

123 enterprise credit score table						
Enterprise	grade	discount				
E7,E2,E9,E8,E16,E15,E13,E6,E24,E18,						
E22,E31,E48,E17,E54,E42,E59,E19,E64,	А	1				
E84,E26,E88,E81,E91,E89,E27,E1						
E10,E12,E30,E28,E32,E38,E34,E58,E61,						
E63,E43,E20,E23,E5,E62,E51,E57,E60,	в	2				
E70,E67,E74,E37,E65,E76,E33,E85,E35,	Б	2				
E95,E98,E93,E97,E71,E106,E79,E66,E21,E83,E45						
E3,E4,E14,E25,E39,E40,E41,E50,E55,E49,E46,E11,E47,E78,E73,E						
68,E53,E44,E75,E69,E90,E77,E72,E86,E92,E80,E94,E105,E56,E1	С	3				
04,E110,E96,E87						
E36,E52,E82,E103,E111,E107,E117,E112,E100,E109,E101,E123,						
E116,E120,E118, E115,E108,E122,E119,E114,E113,E121,	D	4				
E102,E99						

Table 1. 123 enterprise credit rating score table

Table 2. Default rates corresponding to 123 companies	5
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Corporate credit rating corresponds to default rate					
А	0%				
В	1.47%				
С	5.89%				
D	100%				

It can be seen from table 2 that the corporate reputation is divided into 4 grades. In order to quantitatively analyze it, they are divided into $\{1\sim4\}$ points respectively. The lower the score, the higher the reputation. It can be seen from Table 2 that the default rate of grade D is 100% and can be filtered out.

Use Spss to set the independent variables as the company's input and total sales invoices, and the dependent variables as the total profit and profit rate of these companies. The clustering dendrogram and analysis are obtained, as shown in Figure 1 and Table 3.



Figure 1. 123 companies' strength classification chart

123 companies' strength score table						
Grade Discount Enterprise						
А	1	E27				
В	2	E66,E67				
С	3	Ei, i∈ 〔1,123, i≠27, 66, 67				

Table 3. 1	23 com	panies' st	trength so	ore table
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From Fig. 1 and table 3, it can be seen that the strength of these entrepreneurs is graded and divided into A, B, and C. A is the highest enterprise, and it is downgraded in turn. And the lower the score, the higher the strength.

To sum up, the credit risks of these 123 companies are quantitatively integrated. Enterprises with lower combined scores according to the strength and credit rating of these enterprises have less natural credit risk [5]. As shown in table 4.

Quantitative integration of credit risk of 123 companies						
Comprehensive grade	Comprehensive score	Enterprise				
RA+	2	E27,				
RA	3	-				
RB+	4	E1,E2,E6-E9,E13,E15- E19,E22,E24,E26,E31,E42,E48,E54,E59,E64,E66,E67,E81,E84,E 88,E89,E91				
RB	5	E5,E10,E12,E20,E21,E23,E28,E30,E32- E35,E37,38,E43,E45,E51,E57,E58,E60- E63,E65,E70,E71,E74,E76,E79,E83,E85,E93,E95,E97,E98,E106				
RC+	6	E3,E4,E11,E14,E25,E29,E39,E40,E41,E44,E46,E47,E49,E50,E53, E55,E56,E68,E69,E72,E73,E75,E77,E78,E80,E86,E87,E90,E92,E 94,E96,E104,E105,E110,				
RC	7	E36,E52,E82,E99-E103,E107-E109,E111-E123				

Table 4. Comprehensive scores of credit risk of 123 companies

From whether the bank grants credit to the enterprise, it mainly analyzes the strength of the enterprise and the stability of the supply and demand relationship [6]. The strength of strength analyzes the company's operating profit, and the stability of supply and demand analyzes the

invalidation rate of invoices. We refer to the invoice risk control monitoring indicators and find that the invalid invoice rate is greater than 50%, which may reflect the abnormal invoice of the company, which means that the supply and demand relationship of the company is unstable and fluctuates greatly. And the operating profit \geq 8%, the larger the indicator, the stronger the comprehensive profitability of the enterprise, and the stronger the strength.

To sum up, according to the quantitative analysis of the credit risk of the enterprise, the comprehensive analysis shows that the higher the credit rating of the enterprise, the stronger the strength, the more stable the relationship between supply and demand, and the more credit lines granted by Natural Bank (within a certain range), Lending rates will also decrease accordingly, and vice versa.

3. Z-Score Model

Using Python data to organize, and quantitative analysis of these 302 companies. Then use SPSS software and cluster analysis method to make these enterprise strength ratings (302 enterprises cluster analysis dendrogram). The solvency and operating capacity of the enterprise (the amount of operating profit is used to represent the strength), as shown in table 5.

	Table 5. Strength analysis of 302 companies								
	302 companies' strength score table								
Grade	Discount	Enterprise							
А	1	E124,E125							
В	2	E126,E127							
С	3	E191							
D	4	E128,E129,E131,E132,E139,E140,E153,E156,E160,E161,E197							
Е	5	E130,E133-E138,E141-E152,E154,E155,E157-E159 E162-E190,E192-E196,E198-E425							

Table F Churchelle analysis of 202 communities

Since the discriminant function in the Z-score model is divided into two types: Z1 (listed company) and Z2 (unlisted company), small and medium-sized micro-enterprises are generally unlisted companies, so the Z_2 discriminant function is used, which can be expressed as:

$$Z_2 = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$
(1)

Among them, using the Excel table, the Z_2 value of these 302 companies is calculated, according to the Z-score model, for non-listed companies. When the Z_2 value is greater than 2.9, the bankruptcy and default risks are small; when the Z_2 value is less than 1.23, the bankruptcy and default risks are large. When the value of Z_2 is between the two, it indicates that the financial situation of the enterprise is worrying, and there is a certain risk of bankruptcy, as shown in table 6.

According to the data in table 5 and table 6, the company's solvency and operational capabilities are organically combined using Excel tables, and then a comprehensive evaluation is carried out to predict the credit risk of the company's default possibility. The corresponding credit strategy is derived, as shown in table 7.

Z ₂ > 2.9	Customer financially sound	E388,E389,E390,E391,E392,E393,E394,E395,E397, E398,E399,E400,E401,E403,E405,E406,E407,E408, E409,E410,E412,E413,E414,E415,E418,E421,E422, E425
1.23 < Z ₂ < 2.9	Customer situation is worrying	E174,E177,E179,E180,E184,E189,E195,E201,E206, E208,E209,E213,E218,E219,E220,E221,E222,E225, E232,E237,E242,E248,E249,E251,E252,E253,E257, E259,E260,E262,E271,E277,E278,E279,E280,E282, E283,E284,E286,E287,E288,E292,E295,E297,E300, E308,E320,E322,E323,E326,E327,E334,E335,E339, E346,E355,E361,E396,E402,E404,E411,E416,E423
Z ₂ < 1.23	Customers have greater risk of bankruptcy and violation	E124,E125,E126,E128,E129,E130,E131,E132,E133, E134,E135,E136,E137,E138,E139,E140,E141,E142, E143,E144,E145,E146,E147,E148,E150,E151,E152, E154,E155,E156,E157,E158,E159,E160,E162,E163, E164,E165,E166,E167,E168,E169,E170,E173,E175, E178,E181,E182,E187,E188,E191,E198,E200,E217, E223,E224,E226,E227,E229,E231,E239,E264,E265, E281,E291,E293,E299,E304,E312,E324,E325,E352, E373,E378,E381,E384,E417,E419,E420,E424

Table 6. Z_2 value classification table of 320 enterprises

Table 7. Quantitative integration of credit risk of 302 companies

	Quantitative integration of credit risk of 302 companies							
Comprehensive gradeOverall ratingsCredit strategyEnterprise								
RAA+	4	0-1 billion	E124,E125,E127					
RAA	5	0-8 ten million	E126					
RBB+	6	0-6 ten million	E153,E161,E191,E197,E388-E395,E397-E401,E403, E405,E410,E412,E415,E418,E421,E422,E425					
RBB	7	0-4 ten million	E128,E129,E131,E132,E139,E140,E149,E156,E160, E171,E172,E174,E176,E177,E179,E180,E183-E186, E189,E190,E192-E196,E199,E201-E216,E218-E222, E225,E228,E230,E232-E238,E240-E263,E266-E290, E292,E294-E298,E300-E303,E305-E311,E313-E323, E326-E351,E353-E377,E379,E380,E382,E383,E385- E387,E396,E402,E404,E411,E416,E419,E423					
RCC+	8	0-2 ten million	E130,E133-E138,E141-E148,E150-E152,E154,E155, E157-E159,E162-E170,E173,E175,E178,E181,E182,E 187,E188,E198,E200,E217,E223,E224,E226,E227,E2 29,E231,E239,E264,E265,E281,E291,E293,E299,E30 4,E312,E324,E325,E352,E373,E378,E381,E384,E417, E420,E424					

4. Influencing Factors

The COVID-19 epidemic has certain risks for enterprises, such as customer loss, artificial loss and inflation. The problem of customer loss is considered and analyzed separately.

Using linear regression in MPAI, the relationship between the annual interest rate and the customer churn rate is:

A-level enterprise:

$$Y = -0.098 + 7.524 * loan annual interest rate$$
(2)

Table 8. The linear relationship between the credit rating of A-level companies and the
customer churn rate

	Linear regression analysis results n=30												
	Unsta coe	ndardized fficients	Standardized coefficient									Adjust	F
	В	Standard error	Beta	l	P	VIF		R^2	Ľ				
Constant	-0.098	0.045	-	-2.159	0.040*								
Loan annual interest rate	7.524	0.452	0.955	16.632	0.000***	1.000	0.911	0.908	F=276.616 P=0.000***				
	Dependent variable: customer churn rate												

B-level companies:

Y = -0.118 + 7.351 * loan annual interest rate(3)

Table 9. The linear relationship between the credit rating of B-level companies and the
customer churn rate

	Linear regression analysis results n=30										
	Ur co	standardized efficients	Standardized coefficient	L			t D VIE			Adjust	F
	В	Standard error	Beta	t	Р	VIF	к^2	R^2	Ľ,		
Constant	-0.118	0.040	-	-2.928	0.007**	-					
Loan annual interest rate	7.351	0.401	0.962	18.322	0.000***	1.000	0.926	0.923	F=335.712 P=0.000***		
	Dependent variable: churn rate is 1										

C-level companies:

$$Y = -0.138 + 7.468 * loan annual interest rate$$
(4)

Table 10. The linear relationship between the credit rating of C-level companies and the
customer churn rate

	Linear regression analysis results n=30								
	Unsta coe	ndardized fficients	Standardized coefficient					Adjust	
	В	Standard error	Beta	ĩ	Ł	VIF	K^2	R^2	Г
Constant	-0.138	0.038	-	-3.640	0.001**	-			
Loan annual interest rate	7.468	0.378	0.967	19.759	0.000***	1.000	0.935	0.933	F=390.410 P=0.000***
	Dependent variable: churn rate1								

According to the differentiation of reputation grades, the data grades are paired, and the results are shown in table 11.

302 corporate credit scores			
Z score	Grade	Total loan	Enterprise
Z ₂ > 2.9	А	0~1 billion	E388-E395,E397-E401,E403,E405-E410,E412- E415,E418,E421,E422,E425
1.23 < Z ₂ < 2.9	В	0~7 ten million	E174,E177,E179,E180,E184,E189,E195,E201,E206,E208,E209,E213, E218,E219,E220,E221,E222,E225,E232,E237,E242,E248,E249,E251, E252,E253,E257,E259,E260,E262,E271,E277,E278,E279,E280,E282, E283,E284,E286,E287,E288,E292,E295,E297,E300,E308,E320,E322, E323,E326,E327,E334,E335,E339,E346,E355,E361,E396,E402,E404, E411,E416,E423
Z ₂ < 1.23	С	0~4 ten million	E124-E126,E128-E148,E150-E152,E154-E160,E162- E170,E173,E175,E178,E181,E182,E187,E188,E191,E198,E200,E217, E223,E224,E226,E227,E229,E231,E239,E264,E265,E281,E291,E293, E299,E304,E312,E324,E325,E352,E373,E378,E381,E384,E417,E419, E420,E424

Table 11. Credit scores of 302 companies

5. Conclusion

In this paper, we assign points to enterprises according to the four grades of credit rating, and according to the law that the lower the score, the lower the credit risk, the total profit, profit margin and invoice rejection rate of these enterprises are obtained. Using the cluster analysis method and using the Spss software, the strength of the enterprise is classified into three grades, A, B, and C, and the corresponding points are assigned. According to the comprehensive score of enterprise reputation and strength, quantify the credit risk of enterprises. In addition, a Z-score model was established, and Python was used to integrate the data to obtain input and output tax rates and profit margins. Using Spss to use these data to use cluster analysis method to obtain the strength rating of enterprises, reflecting the solvency and business ability of each enterprise, and giving the bank's credit strategy for these enterprises when the total annual

credit is 100 million yuan. Finally, the main factor of customer churn rate is analyzed and combined with Mpai linear regression, the relationship between customer churn rate and annual interest rate is obtained, and the Z-score model is used to obtain the grades of 302 enterprises, so as to reasonably divide the grades of enterprises and adjust credit strategies.

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