Risk Forecast Model of P2P Network Loan Based on Grey System

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Abstract. This paper studied the problem of risk forecast for the P2P network loan, and established a GM (1,1) grey forecasting model to forecast the risk. In this model, the least square method is used for data fitting, and an empirical analysis is given by using the statistical data in three kinds of companies' comprehensive development index from August to December in 2017. The conclusion can be drawn that the higher the comprehensive development index, the more stable the corresponding P2P company, and also the less risk of the company.

Introduction

Factors that generate the risks come from many aspects. So we use the Information Gain to optimize the evaluation indicators, based on the optimized evaluation indicators, this paper analyzed the 'woe' value to do the risk assessment. Data were collected on the turnover, revenue, popularity, income amount and other nine aspects of three kinds of companies (Paipai-Loan, Renren-Loan, Yiren-loan) from January to July in 2017. Based on the comprehensive evaluation system for P2P network loan, we calculated the comprehensive development index of P2P platforms. According to its comprehensive development index, the GM (1,1) grey forecasting model is established and the least square method is used for data fitting. It comes to the conclusion that the higher the comprehensive development index, the more stable the corresponding P2P company, and also it has less risk.

The Model

The higher the comprehensive development index of P2P companies, the lower the corporate risk. The comprehensive development index of various companies is influenced by the turnover index, revenue index, liquidity index, income index, leverage index, popularity index, dispersion index, transparency index, brand Index and other indexes[1-5]. According to the historical development index, We established GM (1,1) model [5] to predict the future development index, which is also the prediction of risks from various types of companies in the future.

Data collection and processing. We collected the data of various indicators of the P2P platform risks from January to July in the year of 2016 and calculated the company's comprehensive development index, which listed in Table 1..

Table 1. Comprehensive development index of companies

	January	February	March	April	May	June	July
Paipai-Loan	65.18	53.63	66.26	66.40	58.22	65.88	67.92
RenRen-Loan	67.97	64.76	68.98	67.94	67.91	67.74	68.02
YiRen-Loan	69.01	59.06	69.60	69.63	58.51	69.60	70.41

Ratio test and analyses of modeling feasibility. Here comes an assumption that $x^{(0)} = (x^{(0)}(1), x^{(0)}(2), \mathbf{L}, x^{(0)}(n))$, $x^{(0)}(k), x^{(0)}(k-1) \in x^{(0)}$, and $s^{(0)}(k)$ is

$$s^{(0)}(k) = \frac{x^{(0)}(k-1)}{x^{(0)}(k)}$$

When

$$s^{(0)}(k) \in \left(e^{-\frac{2}{n+1}}, e^{\frac{2}{n+1}} \right)$$

The sequence of $x^{(0)}$ can be modeled as GM (1, 1).

And $s^{(0)}(k)$ is

$$n = 7, \quad s^{(0)}(k) \in [0.778800783, \ 1.284025417]$$

After the calculation, the value of $s^{(0)}(k)$ in the risk prediction problem falls within the corresponding interval, and the grey prediction can be done without further data processing so that it can meet the modeling requirements. And it can be modeled directly.

GM (1, 1) modeling. After testing, the results are all within this range, so a grey prediction can be made. For the sake of simplicity and clarity, taking the 5-month risk forecast of Paipai-Loan as an example, the comprehensive development index of Paipai-Loan in the past 7 months is as follows.

$$x^{(0)} = (65.18, 53.63, 66.26, 66.40, 58.22, 65.88, 67.92)$$

To sum it up and we get:

$$x^{(1)} = (65.18, 118.81, 185.07, 251.47, 309.69, 375.57, 443.49)$$

According to the principle of least squares method, the corresponding parameters are obtained as follows.

$$a = -0.027764, u = 56.134152,$$

The GM (1,1) model of Paipai-Loan company risk prediction is as follows.

$$\hat{x}^{(1)}(k+1) = (x^{(0)}(1) - \frac{u}{a})e^{-ak} + \frac{u}{a} \quad (a = -0.027764, u = 56.134152)$$

According to this model, after the relevant calculation, the comprehensive development index of the three P2P companies, namely Paipai-Loan, Renren-Loan and Yiren-Loan, was obtained from August to December with the following results listed in Table 2.

Table 2. The comprehensive development index of company from August to December

Company	August	September	October	November	December
Paipai-Loan	69.41	71.36	73.37	75.43	77.56
Renren-Loan	68.81	69.17	69.54	69.90	70.27
Yiren-Loan	70.80	72.21	73.64	75.11	76.60

From August to October, the data shows that the risk of Renren-Loan is the highest, and the risk of Yiren-Loan is the lowest. Therefore, it is recommended to invest in Yiren-Loan. From November to December, the risk of Renren-Loan is still the highest and the risk of Paipai-Loan is the lowest. Recommended investment is Paipai-Loan.

The Analyses and Testing of model

The test of predictive accuracy. We define the residual that is $q(k)$, the relative error is $e(k)$ and accuracy is p^0. They are as follows:

Residual:

$$q(k) = x^{(0)}(k) - \hat{x}^{(0)}(k)$$

Relative error:

$$e(k) = \frac{q(k)}{x^{(0)}(k)} \times 100\% = \frac{x^{(0)}(k) - \hat{x}^{(0)}(k)}{x^{(0)}(k)} \times 100\%$$

Accuracy:

$$p^0 = (1 - e(avg)) \times 100\%$$

For $e(k)$, the general requirement is $e(k) < 20\%$, and the best result is $e(k) < 10\%$. For p^0, the general requirement is $p^0 > 80\%$, and the best result is $p^0 > 90\%$.

So we get the result of accuracy of risk forecast for Paipai-Loan in the next five months, and use the same method to do the grey model accuracy test for Renren-Loan and Yiren-Loan, the calculation results are shown in Table 3.

Table 3. The accuracy of risk prediction and relative error of three P2P companies

Companies	Month	Value of observation	Value of simulation	Residual	Relative error (%)
Paipai-Loan	1	65.18	65.18	0	0
	2	53.63	58.755645	5.125645	9.557421
	3	66.26	60.409772	-5.850228	-8.8292
	4	66.40	62.110464	-4.289536	-6.460145
	5	58.22	63.859037	5.639037	9.685739
	6	65.88	65.656837	-0.223163	-0.338742
	7	67.92	67.505249	-0.414751	-0.610646
Renren-Loan	1	67.97	67.97	0	0
	2	64,76	66.673072	1.913072	2.954095
	3	68.98	67.024652	-1.955348	-2.834659
	4	67.94	67.378086	-0.561914	-0.827074
	5	67.91	67.733383	-0.176617	-0.260075
	6	67.74	68.090554	0.350554	0.517499
	7	68.02	68.449609	0.429609	0.631592
Yiren-Loan	1	69.01	69.01	0	0
	2	59.06	62.925742	3.865742	6.545449
	3	69.60	64.175066	-5.424934	-7.794445
	4	69.63	65.449194	-4.180806	-6.004317
	5	58.51	66.748619	8.238619	14.080702
	6	69.60	68.073843	-1.526157	-2.192754
	7	70.41	69.425377	-0.984623	-1.398414

Conclusions

In this paper, we established a GM (1,1) grey forecasting model to forecast the risk level of the P2P network loan. According to the accuracy and relative error of the risk prediction of the three types of P2P companies, the average relative error of risk prediction is calculated, and the relative errors of the risk forecast of Paipai-Loan, Renren-Loan and Yiren-Loan are 5.06884186%, 1.14642771% and 5.43086871% respectively. The accuracy is more than 90% and has achieved great prediction standards, so the accuracy of prediction model is very high.

Acknowledgments

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