

# Credit decision based on BP neural network

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**Abstract:** The BP neural network model is used to predict the credit records of enterprises without credit records, and the training data set is the relevant data of 123 enterprises with credit records in Appendix 1. Then, on the basis of question 1, it is given that the total annual credit is 100 million yuan, so the loan amount allocated to each enterprise can be calculated directly from the total credit amount and the enterprise credit line ratio. Taking the epidemic situation of COVID-19 as a sudden factor, it is also necessary to classify the industries and categories to which the enterprises belong. In quantifying and reflecting the impact of COVID-19 's epidemic situation on enterprises, we first investigated and quantified the data of different degrees of impact of the epidemic on enterprises of various industries and different sizes, and then quantified the data of different degrees into epidemic impact indicators by using fuzzy comprehensive evaluation method. Take the epidemic impact index, credit risk, enterprise type and output amount as indicators to make a fuzzy comprehensive evaluation to determine the comprehensive risk and adjust the credit strategy.

**Keywords:** Fuzzy comprehensive evaluation model, BP neural network model, Optimization model

## 1. Introduction

This paper makes a quantitative analysis on the credit risk of 302 enterprises with unknown credit rating and whether they default or not, and gives the bank's credit strategy to the enterprises when the total annual credit is 100 million yuan. First of all, we still use the five indicators selected by question 1 for quantitative analysis, because the credit rating and default are unknown, so we select the BP neural network algorithm to predict these two indicators; secondly [1], we use the fuzzy evaluation method to establish the credit risk assessment system; finally, when the total annual credit is fixed at 100 million yuan, the credit strategy of the bank to the enterprise is given.

On the basis of the previous increases the sudden factors on the influence of different industries, different types of enterprises, in the case of guarantee bank interest is Russian, sudden factors in COVID - 19 outbreak [2], for example, according to the regulations of the state and enterprise standard of industry classification of industries and enterprises, each enterprise belongs to industry and business category, by collecting large data shows a new outbreak of fuzzy influence, using fuzzy comprehensive evaluation model to determine the sudden factors on the impact factors of the enterprise, and the impact factor as one of the bank credit evaluation index. The fuzzy comprehensive evaluation model is used again [3]. The comprehensive risk of the enterprise in the case of sudden epidemic can be obtained, and the credit adjustment strategy of the bank can be given according to the comprehensive risk.

## 2. Model building

In the prediction of credit records, the Logistic model and the BP neural network model are used respectively. Through the comparison of the predicted data, it is found that the data predicted by the BP neural network model has a higher degree of fit, so the BP neural network model is selected to predict the credit record.

BP neural network model:

Determine the number of nodes in each layer

Input node n: total sales, total income, profit

Output node l: credit rating, default or not

Number of hidden layer nodes m:

$$m = \sqrt{m + l} + \alpha \tag{1}$$

Forward propagation, the activation function used is the Sigmoid function:

$$f(x) = \frac{1}{1 + e^{-ax}} \quad (0 < f(x) < 1) \tag{2}$$

The loss function is used to solve the gap between the real value and the predicted value. the smaller the loss value is, the more accurate the prediction is. The loss function selected for this question is the quadratic cost function.

$$E = \frac{1}{2}(t - y)^2 = \frac{1}{2}(t - f(wx))^2 \tag{3}$$

Update the weight by back propagation and iterate in a loop until the loss function is minimum or the number of iterations reaches the upper limit.

The credit rating and default of the enterprise can be calculated from this. The establishment of credit evaluation index system requires the establishment of fuzzy comprehensive evaluation model, which will not be described again here.

Credit strategy quantifies the index of total annual credit and obtains the specific formula of annual credit allocation.

### 3. Solution and analysis of the model

According to the data of 123 enterprises with credit records, the BP neural network is trained by matlab software, and the BP neural network model is established. Then the data index of the enterprise without credit record is taken as the input node of the model, and the cyclic iterative prediction is carried out. When the hidden layer node is 8 and the number of iterations is 5000, the credit records of some enterprises are as follows:

Table 1: Credit records of 302 enterprises

Number	Credit Rating	Breach of contract	Number	Credit Rating	Breach of contract
E124	86.72765330	104.2455542	E126	56.23401402	85.97796
E125	86.72811663	104.2458957	E199	60.31755014	96.92123
E128	88.36226587	105.4494982	E210	72.88744778	100.2030
E129	89.24633886	106.0999408	E215	68.85266213	98.53663
E130	86.79234998	104.2932375	E233	65.67925580	94.48815
E131	86.89331535	104.3676465	E234	61.42691309	99.46058
E132	87.06593035	104.4948444	E236	60.32551403	96.75007
E133	86.85091014	104.3364523	E241	60.58997608	96.4181
E134	86.99106094	104.486047	E242	60.39598805	96.51005
E135	86.96631982	104.4216188	E245	56.49127913	85.04967

ii determines the credit strategy of the enterprise when the total annual credit is 100 million yuan.

Table 2: Credit Strategy

Number	Whether to lend	Proportion of loan amount to total amount (%)	Interest rate (%)	Term (years)
E124	Yes	237149.1636	0.083255	1
E125	No	0	0	1
E126	Yes	270592.5793	0.076369	1
E128	Yes	380602.3839	0.064657	1
E129	Yes	333727.2225	0.070734	1
E130	Yes	450316.9511	0.055619	1
E131	Yes	400722.8128	0.062049	1
E132	Yes	402789.2352	0.061781	1
E133	Yes	446727.9017	0.056084	1

**4. Influenced by the epidemic**

**4.1 Model building**

1) The impact of COVID-19 epidemic on small and medium-sized enterprises. In the reference, this paper selects the data of the industries of the enterprises given by the coverage topic that are affected by the epidemic, as shown in the following table:

*Table 3: The impact on the industry under the epidemic situation of COVID-19*

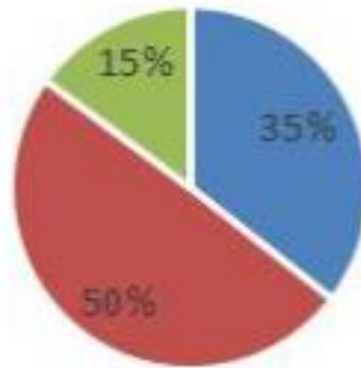
Name	obviously decrease	Decrease	Flat	Increased	obviously increase
Agriculture, forestry, animal husbandry and fisheries	53.2	36.2	8.5	2.1	0
Manufacturing	63.9	29.6	5	1.1	0.5
Construction industry	60.6	31.7	6.7	1	0
Transportation, storage and postal industry	57.1	26.5	16.3	0	0
Information transmission, software and information technology service industry	60.5	27.9	8.1	3.5	0
Retail and wholesale	67.9	27.9	4.2	0	0
Accommodation and meals	95.2	4.8	0	0	0
Financial industry	35.4	52.1	6.3	6.3	0
Leasing and business services	55.6	40	2.2	0	2.2
Scientific research and technical service industry	53.5	37.2	9.3	0	0
Culture, sports and entertainment	71.2	19.2	5.8	3.8	0

From this table, we can see that COVID-19 has a great influence on the accommodation and catering industry, the culture, sports and entertainment industry, and the scientific research and technical service industry. These factors need to be taken into account when formulating credit strategies.

2) Divide the industry and category of the enterprise. The enterprises in Annex 2 are classified according to the National Economic Industry Classification issued by the National Bureau of Statistics, and the categories of enterprises are classified according to the Statistical method for the Classification of large, small, medium and small Enterprises (2017). The partial division results are as follows:

*Table 4: Industry breakdown of 302 enterprises*

Number	Name	Category	Industry
E202	Self-employed E202	Small	Individual
E203	***Construction Engineering Co., Ltd	Small	Building
E204	***Technology Development Co., Ltd.	Middle	Technology
E205	Self-employed E205	Mini	Individual
E206	***Construction Engineering Co., Ltd	Middle	Building
E207	Self-employed E207	Small	Individual
E208	Self-employed E208	Mini	Individual
E209	***Engineering Inspection Co., Ltd.	Middle	Manufacture
E210	***Construction Engineering Co., Ltd.	Small	Building
E211	Self-employed E211	Mini	Individual



*Figure 1: Distribution map of the categories to which the enterprise belongs*

According to figure 1, among the 302 enterprises given in Annex II, small enterprises account for a relatively large proportion, followed by medium-sized enterprises, and micro-enterprises account for

relatively small. The accommodation and catering industries, manufacturing industries and leasing and business industries of these 302 enterprises account for a large proportion. Table 4 shows that small and medium-sized enterprises are greatly affected by the epidemic in the face of a sudden epidemic, and the risks of different industries will also change. Therefore, this paper uses fuzzy comprehensive evaluation method to use Table 4 to calculate the occurrence of COVID-19 epidemic. The precision degree of enterprises in different industries affected by the epidemic, and the influencing factors were obtained. Finally, the impact factor is used as a credit evaluation index to establish a new evaluation index system, calculate the new credit risk, and repeat the steps of question 2 to get the adjusted credit strategy.

#### 4.2 Solution and result analysis

1) Calculate the impact of the epidemic on different industries and different types of enterprises.

Table 5: Impact of epidemic situation on different industries and different types of enterprises

Number	Category	Industry	Risk	Impact factor
E202	Small	Individual	0.1771	0.211046
E203	Small	Building	0.127	0.098242
E204	Middle	Technology	0.1608	0.115924
E205	Mini	Individual	0.1554	0.208548
E206	Middle	Building	0.1573	0.12274
E207	Small	Individual	0.1798	0.226013
E208	Mini	Individual	0.1416	0.204534
E209	Middle	Manufacture	0.1369	0.106615
E210	Small	Building	0.1305	0.101672
E211	Mini	Individual	0.1278	0.177438

2) Update the credit evaluation index system of index selection, take is total output, the risk, the enterprise type, impact factors as evaluation index, the credit evaluation, in according to the establishment of credit risk when the proportion of the loan amount, bank lending quotas of enterprise is 10 ~ 1 million yuan, and according to the proportion of corporate credit amount to calculate the credit amount, the credit amount is beyond bank lending quotas, therefore, to fix the credit amount of each enterprise of ratio, when the enterprise credit lines of more than 1 million yuan, the bank only the lending of 1 million yuan.

#### References

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