

Retraction

Retracted: Rural Financial Decision Support System Based on Database and Genetic Algorithm

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] J. Yu and H. Cui, "Rural Financial Decision Support System Based on Database and Genetic Algorithm," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 9662953, 14 pages, 2022.

Research Article

Rural Financial Decision Support System Based on Database and Genetic Algorithm

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With the development of society and economy, the rural financial institution system mainly includes cooperatives and political and commercial rural financial institutions, and they are supplemented by agricultural insurance, guarantee, securities and other nonfinancial organizations to improve their own functions. Rural credit cooperatives have higher investment and operation risks than other financial institutions. New-type rural financial institutions are more sensitive to the market environment, asset quality and profitability, and risk-taking ability. Internal and external risks continue to accumulate, and their potential is low. These risks pose serious obstacles to the development and growth of financial institutions such as rural banks and microfinance companies, and pose major challenges to the security and stability of rural areas and agriculture. Using database and genetic algorithm to study rural credit risk, profitability, and liquidity, in order to track the impact of each explanatory variable in the system on the explained variable, the impulse response function is used to analyze the impact of nonperforming loan ratio on asset profitability. The data are all close to 0, indicating that the influence between the two is more obvious. The intelligent decision-making system support system evaluates the market risk, credit risk, liquidity risk, and risk management and risk acceptance of rural financial institutions and explores effective countermeasures for their sustainable development.

1. Introduction

With the continuous development of industrialization and informatization, a series of related policies that are beneficial to farmers have been introduced one after another, which shows the strong support of the state for agriculture. Agriculture plays an immeasurable role in the development of the national economy with its special status. What is more important is the reform and improvement of the financial system. Due to the lack of rural finance itself, the capital recovery rate is low, and the rural financial risks are also deepening, so the rural financial market theory came into being. And it is committed to excavating and giving play to the important role of the rural financial system in the rural financial market and consolidating the status of the rural financial system.

It is of practical significance to improve the risk prevention and control ability of rural financial institutions in China to evaluate the rural financial risk through the database and the optimal algorithm of the genetic algorithm. It has a great impetus to the continuous improvement of China's rural financial market. This provides reference for risk prevention and control of other financial institutions and provides scientific and reasonable countermeasures and suggestions for relevant regulatory authorities such as the government. The risk status of cooperative rural financial institutions puts forward corresponding countermeasures and suggestions, so that relevant institutions can develop rural finance in a more targeted manner, promote the rational allocation and use of rural resources, and further improve the risk assessment and service quality of rural financial institutions.

2. Related Work

With the rapid development of the financial industry, great progress has been made in the legal construction of China's financial sector, but the development of rural finance is lagging behind compared with urban areas. Dawid and Kopel discuss the use of genetic algorithms (GA) to model the learning behavior of groups of adaptive and bounded rational agents interacting in economic systems. They present simulations with different encoding schemes and explain the rather surprising differences between results for different settings by employing the mathematical theory of GAs with state-dependent fitness functions [1]. Gong et al. proposed an ensemble-based genetic algorithm to solve these problems efficiently. They define a set-based Pareto dominance relation to modify the fast nondominated sorting method in NSGA-II. Numerical results demonstrate the superiority of the method and show that a compromise between convergence and uncertainty approximate frontiers can be generated [2]. Hossein et al. propose a medical image encryption method based on a hybrid model of a modified genetic algorithm (MGA) and a coupled grid. Both the experimental results and computer simulations show that the proposed method including the hybrid algorithm not only has excellent encryption performance, but is also resistant to various typical attacks [3]. Jose and Carlos developed a new method to detect road anomalies (i.e., speed bumps). The method utilizes gyroscopes, accelerometers, and GPS sensors installed in the car. They then use a cross-validation strategy and genetic algorithms, to find logical models that accurately detect road anomalies. This method has the potential of quasi-real-time detection of speed bumps and can be used to construct real-time ground monitoring systems [4]. Khalifa et al. proposed a new method for computing fuzzy metrics related to Choquet integrals in the context of multimodal biometric data fusion. The method they proposed is based on genetic algorithm. It has been validated in two databases: the first basis is related to composite score and the second basis is related to facial, fingerprint, and palm print biometrics. The obtained results demonstrate the robustness of the proposed method [5]. In order to improve the rejection characteristics of the analyzed DGS, Barbosa and Da use a genetic algorithm to optimize its parameters. The experimental results show that optimizing the hexagonal DGS can improve the thenSn11n parameters of the fundamental mode, while suppressing or further attenuating the higher-order modes. Such results are particularly important once DGS is applied to the antenna's self-immunity to harmonic radiation by avoiding the use of filter circuits [6]. Jin et al. proposed a tracking algorithm based on quantum genetic algorithm. Among them, the global optimization ability of quantum genetic algorithm is used. Under the framework of quantum genetic algorithm, the position of the pixel is taken as the individual in the population, and the scale-invariant feature transformation and color feature are taken as the target model [7]. Zheng and Xie research shows that the income gap between urban and rural residents has a significant positive correlation in space, and increasing rural credit input and promoting agricultural

revitalization can effectively alleviate the urban-rural income gap [8]. Tang et al. developed a knowledge-based financial statement fraud detection system based on financial statement detection ontology and detection rules extracted from the C4.5 decision tree algorithm. They detect financial statement fraudulent activities and uncover tacit knowledge by leveraging SWRL rules and Pellet inference engine in domain ontology [9]. These studies are instructive to a certain extent, but the studies are too single and can be further improved.

3. Decision Support System Based on Database and Genetic Algorithm

3.1. Definition of Genetic Algorithm (GA). Genetic algorithm is a standard-based algorithm. The design concept is based on choosing the natural way of living the most comfortable life, and retaining and inheriting the best chromosomes and culling the poor ones to ensure that every inheritance is optimal. Genetic algorithm is an optimization search algorithm based on the evolution theory of survival of the fittest, natural selection, survival of the fittest, and species genetics. The basic idea is to continuously evolve the solution of the problem to obtain the optimal solution that meets the requirements.

Genetic algorithm has a certain possibility of mutation [10]. This mutation is to maintain the principle of diversity and avoid repeated search for the optimal solution, resulting in a local optimal solution. The parameters involved in genetic algorithm design mainly include population size, crossover rate, mutation rate, and evolutionary algebra. In addition, when selecting a specific operator, it is sometimes involved in selecting parameters related to the operator. The genetic algorithm is specifically expressed as follows, and the problem to be solved is set to be $\max f(x)$, $x \in D$. If the optimization problem is to find the minimum value of the objective function, it should be transformed into the problem of finding the maximum value of the objective function, that is,

$$\max f(x) = \max (-f(x)). \quad (1)$$

If the optimization problem finally needs to determine the nonnegative maximum value of the objective function, the individual fitness function value $F(x)$ is transformed into the corresponding objective function value $F(x) = f(x)$.

Finding the maximum value of problem $f(x)$: if the solution corresponding to individual x is x , then the fitness of individual X can be expressed as:

$$\text{Fit}(X) = \begin{cases} -C_{\min} + f(x), & f(x) > C_{\min} \\ 0, & \text{other} \end{cases} \quad (2)$$

$$\text{或 Fit}(x) = \frac{1}{C_{\max} - f(x)} \quad (3)$$

Similarly, to find the minimum value of $f(x)$, the fitness of individual X can be expressed as

$$\text{Fit}(X) = \begin{cases} C_{\max} - f(x), & f(x) < C_{\min} \\ 0, & \text{other} \end{cases} \quad (4)$$

or

$$\text{Fit}(x) = \frac{1}{-C_{\min} + f(x)}. \quad (5)$$

The probability that any individual i_x in the group is selected to be inherited to the next generation is $T(i_x)$:

$$T(i_x) = \frac{\text{Fit}(i_x)}{\sum_{y=1}^n \text{Fit}(i_y)}, \quad x = 1, 2, 3, \dots, n. \quad (6)$$

The main frame of the pair is declared, and attached to the normal tracking algorithm, various genetic algorithms first create a solution for the population [11]. Each population is called a chromosome, and generations of evolution have come up with a controversial solution to the optimization problem. The most suitable chromosome in the population represents the optimal solution or optimal solution. The general structure of the genetic algorithm is shown in Figure 1.

The random search method of genetic algorithm, its algorithm flow is shown in Figure 2.

3.2. Database-Based Genetic Algorithm. A database model is a multidimensional form of data that directly affects high-level tools and OLAP requirement engines [12]. In a multidimensional data model, some of the data are quantitative values such as sales, investments, and income. These quantities depend on the set of “dimensions” that provide context for quantitative values. Therefore, multidimensional type information is a quantized value stored in a multidimensional space [13]. Its structure is shown in Figure 3.

Based on the information entropy theory in information theory, for a given dataset D , take it as a training sample set of class-labeled tuples. Let the class tag attribute have m unequal values, and divide it into m different classes C_x ($x = 1, 2, 3, \dots, m$). The set of tuples corresponding to class C_x in the data partition D is denoted as $C_{x,i}$, $|D|$ represents the number of tuples in D , and $|C_{x,i}|$ represents the number of tuples in $C_{x,i}$. To classify the tuples in the data partition D , the desired information is required:

$$\text{Info}(D) = - \sum_{x=1}^m P_x \log_2(P_x). \quad (7)$$

Therefore, the information entropy obtained by calculating attribute A is:

$$\text{Info}_I(D) = - \sum_{y=1}^B \frac{|D_y|}{|D|} \times \text{Info}(D_y). \quad (8)$$

The corresponding information formula obtained from the expected information and the information entropy value is:

$$\text{Gain}(I) = \text{Info}(D) - \text{Info}_I(D). \quad (9)$$

Assuming that attribute I has B unequal values $\{a_1, a_2, a_3, \dots, a_B\}$, attribute I can be used to divide D into B different subsets $\{D_1, D_2, D_3, \dots, D_B\}$, where D_y represents the samples in D that have value a_y on I . Next, take the value of attribute I as the reference standard to divide the training sample set, then its initial information amount is:

$$\text{SplitInfo}_I(D) = - \sum_{y=1}^B \frac{|D_y|}{|D|} \times \log_2 \left(\frac{|D_y|}{|D|} \right). \quad (10)$$

The quotient of the information gain and the initial amount of information is defined as the information gain rate:

$$\text{GainRatio}(I) = \frac{\text{Gain}(I)}{\text{SplitInfo}_I(I)}. \quad (11)$$

Considering the complexity of the classification rule set, its fitness function is defined as:

$$f(x) = w_1 * x_1 \frac{\text{Gain}(I)}{w_2 * x_2 + w_3 * x_3}. \quad (12)$$

w_1, w_2, w_3 represent the impact factors of x_1, x_2, x_3 , respectively, $w_1 + w_2 + w_3 = 1$ and $0 \leq w_1, w_2, w_3 \leq 1$.

Denoting the fitness value of individual i as f_x , then the probability of individual i being selected for replication is defined as q_x :

$$q_x = \frac{f_x}{\sum_{y=1}^n f_y}, \quad x = 1, 2, \dots, n. \quad (13)$$

According to the order of the individuals, the cumulative probability is calculated by selecting the probability p_x

$$p_x = \sum_{y=1}^x q_y, \text{ and } q_x = p_x - p_{x-1}. \quad (14)$$

Randomly generate n numbers nr , if $p_{x-1} < r_n < p_x$, choose i_x , and a new generation group containing n individuals will be obtained after selection. The genetic algorithm uses information gain to judge the degree of feature importance. The greater the information gain, the greater the degree of importance, but the result is often inaccurate when calculating the information gain of a feature with a large number of categories. The classification rules generated by the C4.5 algorithm are easy to understand and have a high accuracy rate. The basic flow of the genetic algorithm based on C4.5 is shown in Figure 4.

In recent years, the combination of decision support systems and big data has been widely used. With the in-depth development of artificial intelligence, big data, cloud computing, and other technologies, the self-learning and adaptive decision-making systems of high-tech machines are also developing rapidly [14]. C4.5 is a kind of decision tree algorithm, and the genetic algorithm is the optimal solution. As a classification algorithm, the goal of decision tree

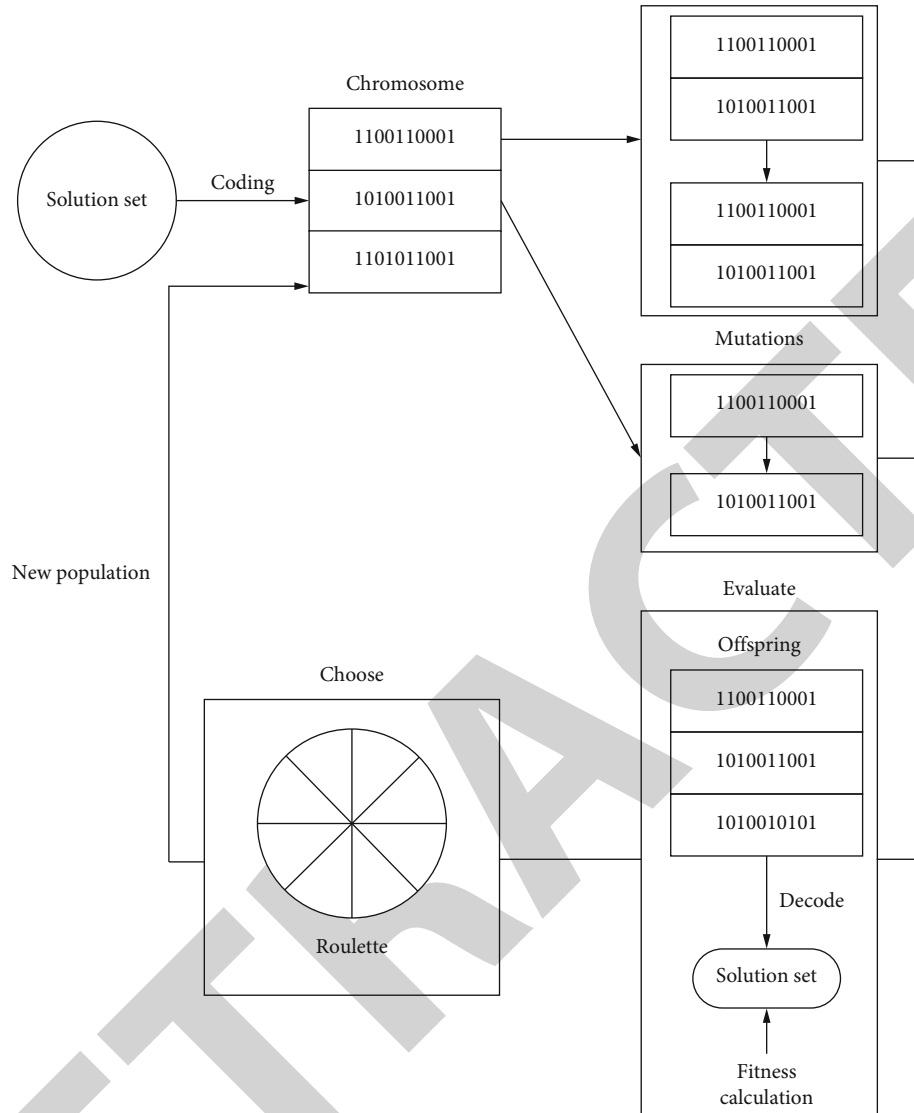


FIGURE 1: General framework of genetic algorithm.

algorithm is to divide n samples with p -dimensional features into c categories, one is a method, and the other is an algorithm, and the levels are different.

3.3. Rural Finance. Rural financial theories are mainly divided into three schools: agricultural credit subsidy theory, rural financial market theory, and incomplete market theory [15]. This emphasizes the important role of the market in the evolution of rural financial theory, and the neoclassical development of the economy is reflected in the evolutionary trajectory of the traditional agricultural credit subsidy theory based on state support. With the development of the times, the theory of rural financial market continues to develop and improve. The rural financial market theory of imperfect competition unifies the roles of the government and the market, and believes that the most important problem in rural financial development today is information asymmetry [16]. The government needs to adopt an indirect control mechanism to establish standards for the scope of supervi-

sion, so that both parties in financial market transactions can fully understand each other's information, especially the information communication between rural financial institutions and borrowers. Only if this problem is alleviated and resolved, financial institutions will be able to control the systemic risks existing in the rural financial system more easily.

There are current situation, problems, and causes of risk control in rural financial institutions in China. In recent years, new financial institutions in rural areas of China have continued to deepen reforms and have made important progress. The scale of capital supply of rural financial institutions has continued to expand, and financial service products have become increasingly rich [17]. The theory of rural financial market mainly expounds that the government can only exist as an important promoter of rural financial development. To develop rural finance, the rural financial market must be developed. The imperfect rural financial system and excessive regulation make rural financial risks continue to deepen. Although the current efforts to support rural finance

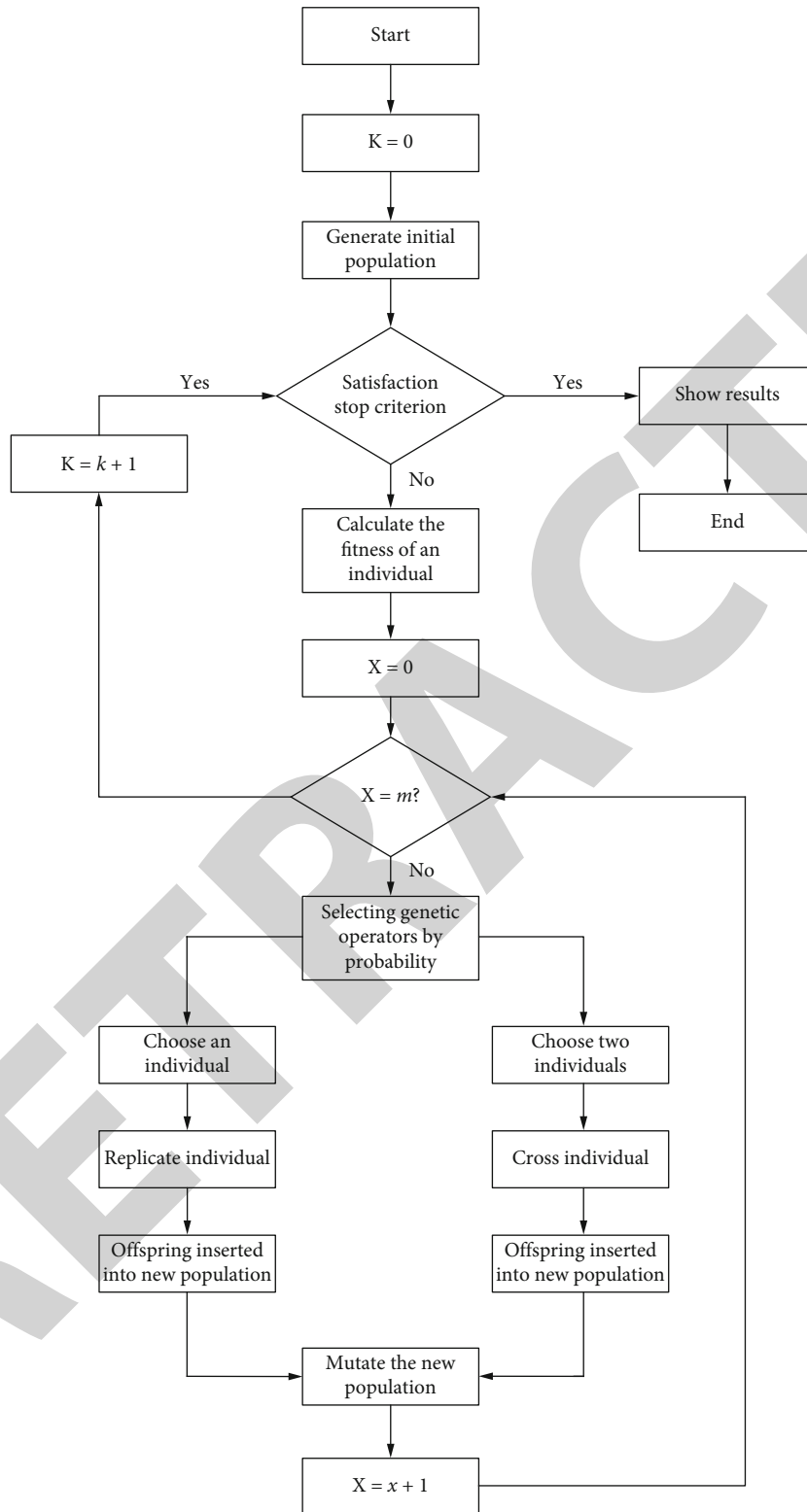


FIGURE 2: The computational flow of the genetic algorithm.

are also increasing, there are still some unoptimistic risks in rural financial institutions. Its nonperforming loan ratio is higher than that of state-owned commercial banks, and its liquidity risk and profitability risk are prominent. Therefore, it is necessary to dig deeper into the specific causes of these

risks. Table 1 shows the development of major rural financial institutions.

In terms of the number of institutions, China has a total of rural credit cooperatives, including rural commercial bankers and rural cooperative bankers. As can be seen from

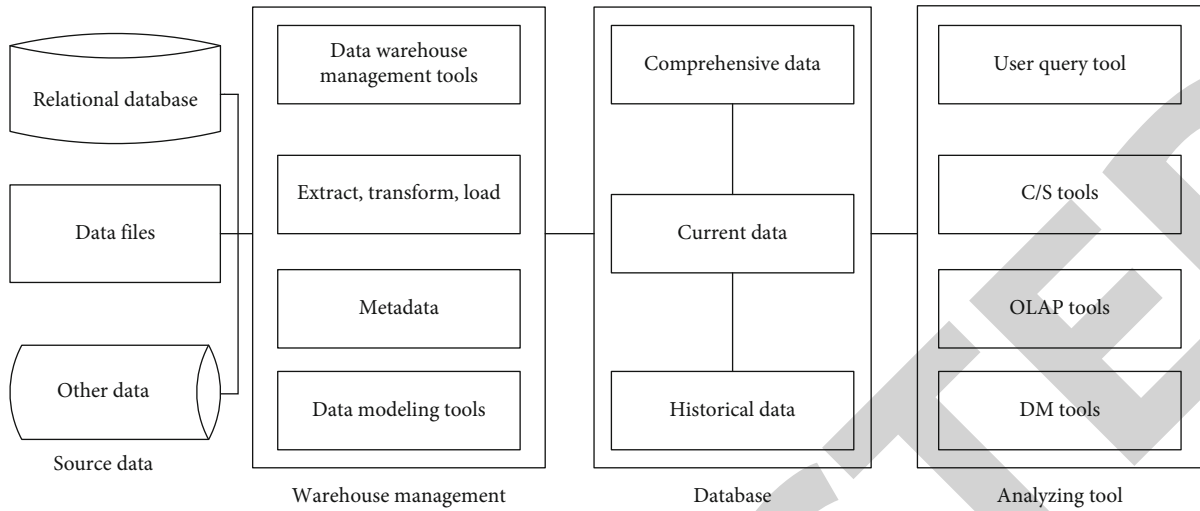


FIGURE 3: Database structure diagram.

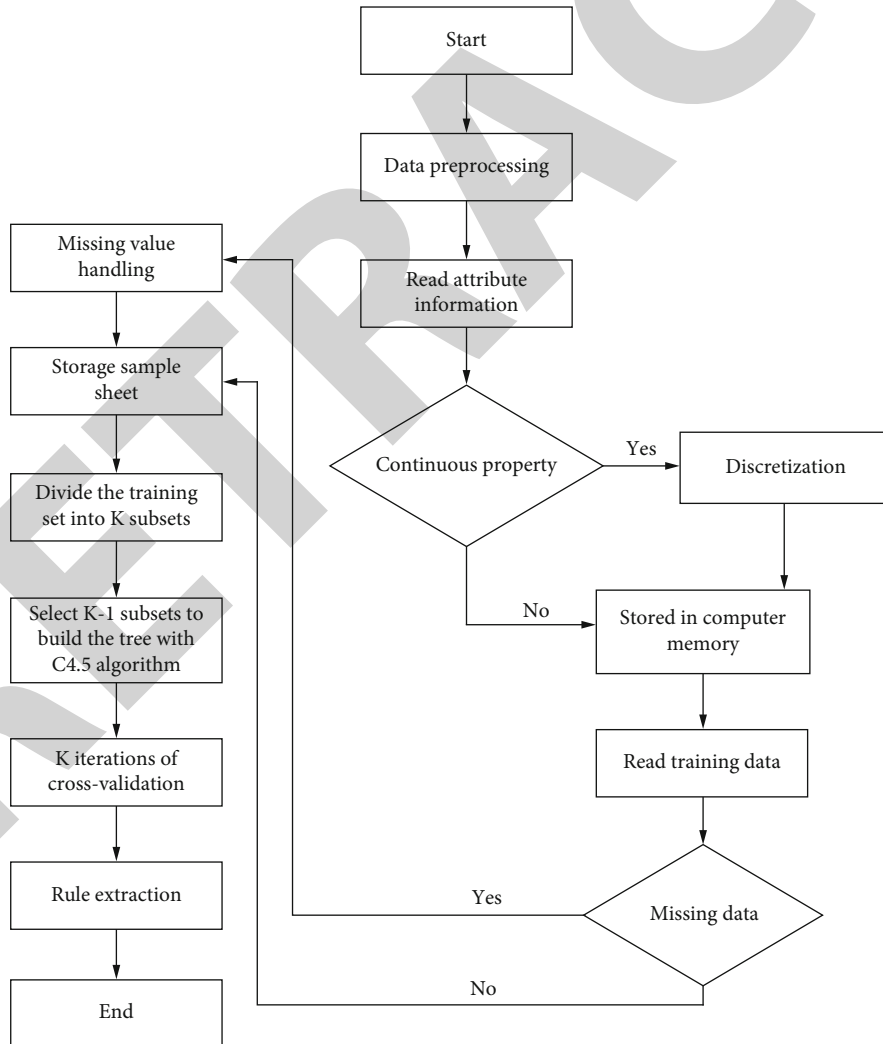


FIGURE 4: Basic flow chart based on C4.5 genetic algorithm.

Figure 5, the absolute scale of deposits and loans of rural credit cooperatives has increased year by year, and their deposits have significantly contributed to loans.

At this stage, the development of RCCs has strong sustainable development ability, and the future development potential has been greatly improved [18]. From the perspective of China's rural credit cooperatives' nonperforming loan ratio, capital adequacy ratio and profitability, and the level of rural financial services, there has been great progress.

3.3.1. New Rural Financial Institutions. The supply of financial resources relies on the principle of supplying the west from the east, and in the process of serving rural finance, the principle of using the city to drive the countryside is adopted. Under the guidance of these principles, rural financial institutions have improved their agricultural support and service quality and provided a better development model for the formation of a rural financial system with Chinese characteristics. In terms of institutional size, Figure 6 depicts the trend chart of the asset size of major rural financial institutions in 2019 [19]. Among them, the assets of rural cooperative banks have grown relatively steadily, while the assets of rural commercial banks have grown rapidly.

Table 2 illustrates the profitability of the three major rural financial institutions in the past four years by comparing the rate of return on assets and the rate of return on capital. Among them, the return on assets of rural commercial banks has increased by a total of 1% from year to year, which is 1% higher than that of rural cooperative banks [20].

On the one hand, the low comparative efficiency of agriculture has brought about low returns on rural financial capital, and at the same time, the cost of providing financial services in rural areas is high, which makes rural areas coexist with high-efficiency deposit absorption and low-efficiency loan issuance. Rural financial institutions face market risks, liquidity risks, credit risks, and operational risks, which restrict the development of rural financial institutions in China. On the other hand, a large part of rural areas still have the phenomenon of capital outflow to varying degrees [21]. Third, the actual operating environment faced by rural financial institutions does not match the supporting policies related to rural finance.

3.3.2. Credit Risk of Rural Financial Institutions. In recent years, new types of financial institutions in China's rural areas have continuously deepened their reforms and made important progress, and the scale of capital supply to rural financial institutions has continued to expand. Although China's rural financial institutions have achieved obvious results in the reform in recent years, there are still some deep-seated problems from the perspective of financial support for "agriculture, rural areas, and farmers". In the context of market economic reform, financial risk performance tends to be diversified [22]. Financial risk is defined as the possibility of loss of financial capital due to the existence of a series of financial system uncertainties in the process of financial transaction activities, including real capital and virtual capital. The reverse change of risk and return is a major feature of rural financial institutions. Due to the single asset

business structure, the nonperforming asset ratio is relatively high. The credit risk problem faced by rural financial institutions is relatively prominent, and the interest rate level of rural financial institutions is in a declining trend, which eventually leads to excessive capital investment but low capital return. This is the most fundamental reason for the reverse movement of risk and return.

At present, credit risk is still the most important risk faced by rural financial institutions. Nonperforming loans will not only have a great negative impact on the entire economic system, but also bring a great operational burden to financial entities. Judging from the current situation in China, the quality of nonperforming credit assets of rural financial institutions is low. At the end of 2018, the nonperforming loan ratio of rural financial institutions in China's county areas was higher than that of large commercial banks, reaching an average of 18.9%, 3 percentage points higher than that. It shows that the credit risk of rural financial development is more prominent, and the security and stability of its operation are greatly affected [23]. Since 2019, the asset quality of rural financial institutions has been effectively improved. The nonperforming loan ratio of rural financial institutions in China has basically reached the standard limited by the Basel Accord, but there is still a big gap with other large- and medium-sized commercial banks. For rural commercial banks, their profits mainly come from the interest difference between deposits and loans, and this part of the income accounts for 90% of the total income. From the current situation, the loan quality is worrying. In addition, it faces a high nonperforming loan ratio compared to other state-owned banks. It is worth noting that under China's policy, the Agricultural Development Bank is also plagued by excessive nonperforming loans, and its ratio is higher than the two policy banks, China Development Bank and China Export-Import Bank. Table 3 compares the agricultural nonperforming loans of rural credit cooperatives, rural commercial banks, rural cooperative banks, and village and township banks. It can be seen that the scale of nonperforming loans of rural credit cooperatives and agricultural cooperative banks has decreased significantly compared with the previous year, and the ratio of nonperforming loans has also decreased to a certain extent. However, the nonperforming loan ratio of village banks and rural commercial banks has increased significantly [24].

It can be seen from Table 3 that the nonperforming loan ratios of rural credit cooperatives, rural commercial banks, and village banks are compared. It can be found that the nonperforming loan ratio of rural credit cooperatives is significantly higher than that of the other three banks, and rural financial institutions face greater credit risks.

3.3.3. Increased Liquidity Risk of Rural Financial Institutions. Liquidity risk has a relatively large impact on the operating conditions of China's rural financial institutions and belongs to a relatively prominent type of risk [25]. An important reason for the existence of liquidity risk in banks is that due to the mismatch between the supply and demand of funds, these demands become liquidity demands, and risks will occur when the liquidity demands cannot be realized. In

TABLE 1: Number of employees in rural financial institutions.

Institution name	2019		2020	
	Number of institutions	Number of employees	Number of institutions	Number of employees
Rural credit cooperatives	189	56740	215	70115
Rural commercial bank	98	46831	132	53670
Village bank	176	8970	195	99
Total	463	112541	542	1233884

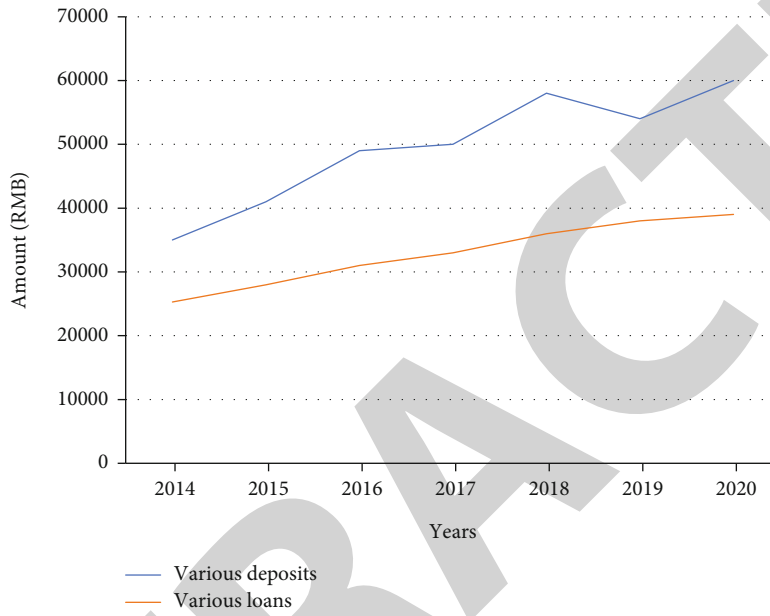


FIGURE 5: Rural credit cooperative loan trend chart.

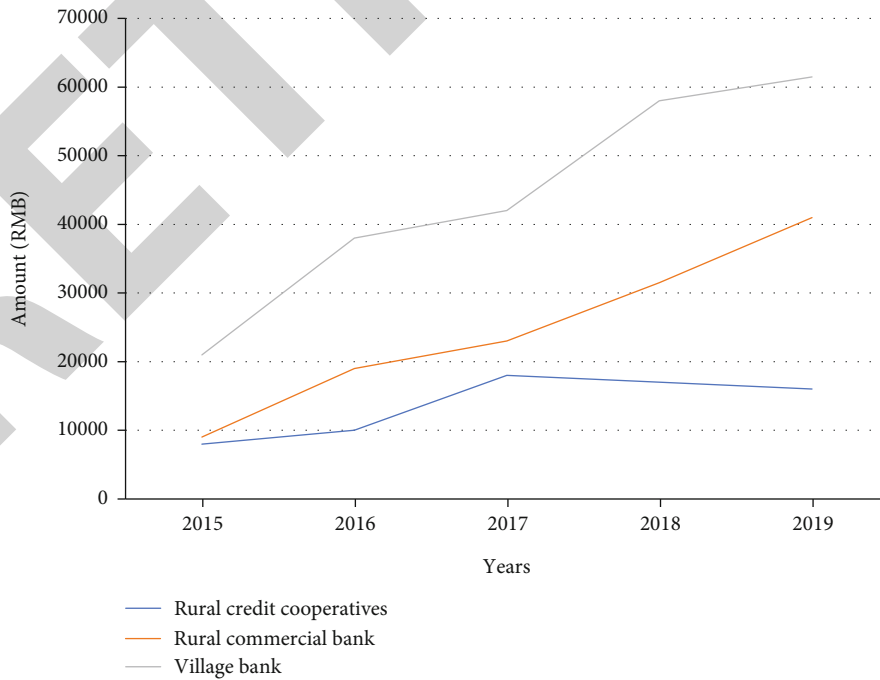


FIGURE 6: Asset scale trend chart of major agricultural financial institutions.

TABLE 2: Profitability of major agricultural financial institutions (2016–2019).

Institution name	Project	2016	2017	2018	2019
Rural credit cooperatives	Balance sheet	0.65%	0.89%	1.42%	1.56%
	Capital income statement	15.63%	14.52%	13.55%	15.36%
Rural commercial bank	Balance sheet	1.08%	1.07%	1.32%	1.45%
	Capital income statement	16.44%	16.98%	17.45%	16.98%
Village bank	Balance sheet	0.42%	0.42%	0.45%	0.76%
	Capital income statement	9.97%	10.87%	9.32%	15.93%

TABLE 3: Agriculture-related NPL ratio of major rural financial institutions in 2019 (100 million yuan).

Institutions Projects institutions	Agricultural nonperforming rate			
	Balance	Ratio		
	This period	Year-on-year growth	This period	A year-on-year increase of percentage points
Rural credit cooperatives	2450	-8.9	7.9	-1.4
Rural commercial bank	396	78.9	2.6	0.21
Village bank	13	198.5	0.32	0.2

recent years, affected by macroeconomic fluctuations, there are still many serious problems lurking in the operation of rural financial institutions. Insufficient capital adequacy ratio and low return on assets have caused the quality of their loans to decline to a certain extent, or even insufficient to offset debts. In this regard, the relevant departments have introduced a series of measures to prevent and control liquidity risks, but the profitability of rural financial institutions is still worrying. Its high operating cost is an indisputable fact, which makes rural financial institutions very prone to losses.

In other words, the problems exposed at present have affected the liquidity, safety, and efficiency of financial institutions. Specifically, from the analysis of the liquidity index, the proportion of demand deposits in rural credit cooperatives has risen to 55.49%, an increase of 1.89 percentage points from 2019. At the same time, the proportion of medium- and long-term loans increased to 57.9%, an increase of nearly 5 percentage points. It can be seen that the short-term asset inflow and the long-term asset outflow form a prominent contradiction [26]. From the analysis of the safety index, the proportion of overdue loans, sluggish loans, and bad debt loans of all rural financial institutions showed a significant increase. It is not difficult to find that the risk of bad debts within an institution is gradually increasing. From the perspective of the benefit index, the after-tax asset profit rate of rural credit cooperatives dropped from 0.79% in 2018 to 0.86% at the end of 2019.

4. Application and Realization of Intelligent Decision Support System

This is mainly through the idea of genetic algorithm and the application of genetic algorithm to improve the performance of the decision support system and design and implement a decision support system integrated in the management information system combined with the actual. The problem

that needs to be solved most in the development of rural finance at present is the problem of information asymmetry. The government needs to adopt an indirect control mechanism to establish a standard for the scope of supervision, so that both parties in the financial market can fully understand each other's information. In particular, the problem of information communication between rural financial institutions and borrowers, only if this problem is alleviated and resolved, financial institutions will be able to control the systemic risks existing in the rural financial system more easily. The application of genetic algorithm in decision support system is developing in a more profound direction. Combining it with other people's intelligent technology will be an important application form in the future. This application is of great significance for improving the efficiency of decision support systems and assisting decision-makers to make scientific and rational decisions.

4.1. Intelligent Decision Support System. Intelligent decision support system is a system composed of database, analytical processing, and data mining. They take a large amount of data in the data warehouse as the object, provide multidimensional data analysis information through analysis and processing, and jointly assist decision-making for practical decision-making problems [27]. This is mainly through the idea of genetic algorithm and the application of genetic algorithm to improve the performance of the decision support system and design and implement a decision support system integrated in the management information system combined with the actual. The structure diagram of this intelligent decision support system is shown in Figure 7.

The intelligent architecture mainly consists of three modules, data mining, database, and analytical processing, which complement each other [28–31]. In addition to pushing fixed decision-making information to the management, the intelligent architecture can also drill underground and mine information in a self-service manner to assist in

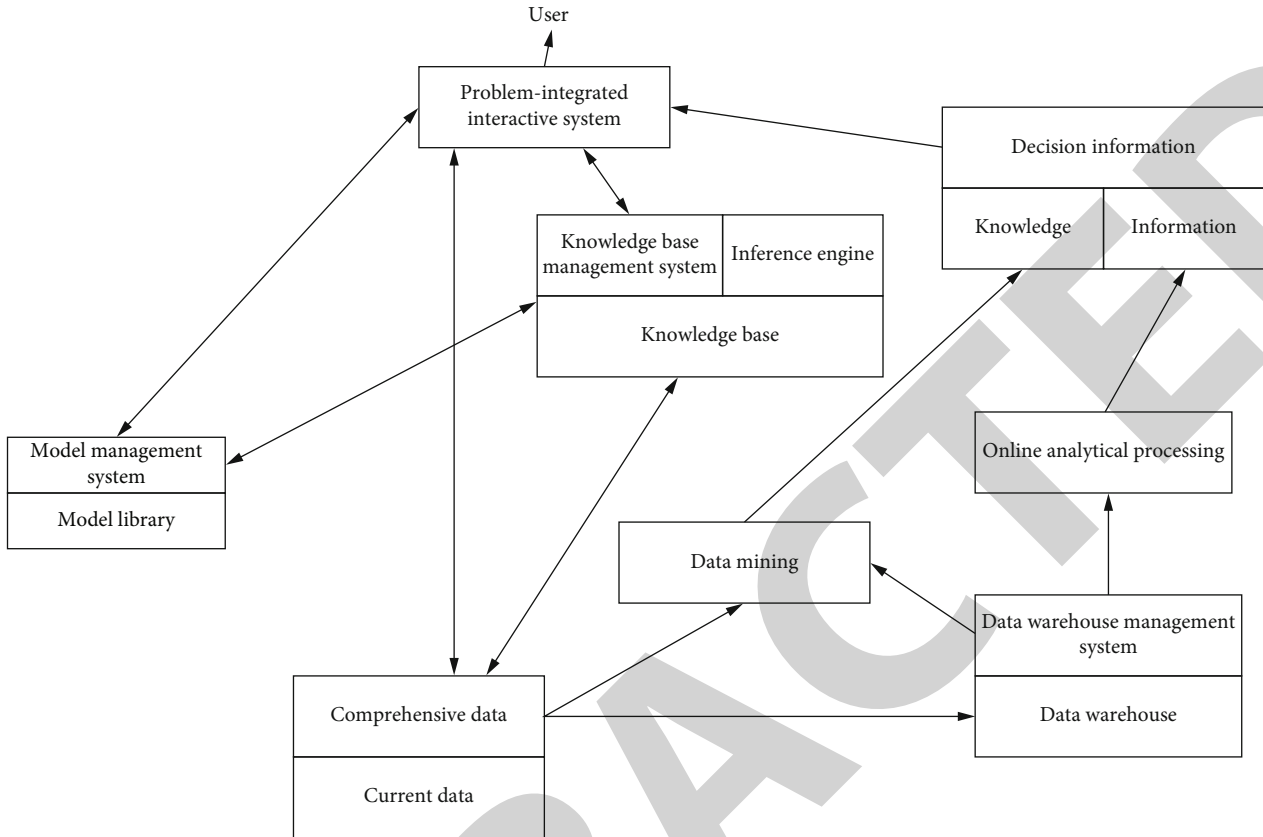


FIGURE 7: Structure diagram of comprehensive decision support system.

decision-making. In the future system design, self-service information services can be further enriched.

4.2. Rural Financial Decision Support. It mainly starts with the composition, development status, and risk characteristics of rural financial institutions, describes and analyzes according to relevant statistical data, and has an intuitive understanding of the overall development of rural financial institutions. And it focuses on the cooperative financial institutions dominated by rural credit cooperatives and the new rural financial institutions led by village and town banks in detail. The main problem faced by rural financial institutions is risk, which is manifested in credit risk, liquidity risk, etc. The reasons for these risks are mainly the external environmental factors and internal control factors of rural financial institutions.

4.2.1. Model Design. The model design adopts vector autoregression, and the model analyzes the influence of the lag terms of the four groups of time series on the variables. Second, a Granger test is performed to verify the hypothesis that there is an influence relationship. Thirdly, the impulse response function is used to describe the impact effect of each explanatory variable in the model on the explained variable. Finally, the cointegration test is used to verify whether there is a long-term equilibrium relationship between the variables.

4.2.2. The Unit Root Test. Unit root test refers to a method of comparing the estimation results of a market risk measurement method or model with the actual profit and loss to test the accuracy and reliability of the measurement method or model and adjust and improve the measurement method or model accordingly.

Before carrying out the test, firstly adopt the method to test the unit root of these five variables at the 5% confidence level. The test results are shown in Table 4.

The test results show that the original sequence value is less than the critical value at the 5% significant level, which is a first-order difference stationary sequence, thus determining the stationarity of the time series, and VAR can perform model testing and cointegration analysis on it.

4.2.3. Mean Spillover Effect Test. Test results of the models of capital adequacy ratio (CAR), return on assets (ROE), provision coverage ratio (PCR), agricultural loan ratio (RAL), and nonperforming loan ratio (BLR). In the VAR model, the lag order is 1 according to the SIC criterion.

From the perspective of the impact of the nonperforming loan ratio (BLR) on itself, the effect is not significant, but the impact on the capital adequacy ratio is more significant. It can be said that the two influence each other, and it is significant at a lag of 5%.

4.2.4. Granger Causality Test and Result Analysis. Granger causality test is a method to test the causal relationship

TABLE 4: ADF inspection results.

Variable	BLR	CAR	ROE	PCR	RAL
Original series ADF value	0.0078	0.3121	0.8923	0.3892	0.9351
Difference ADF value	0.0613	0.0591	0.0041	0.0015	0.009
5% confidence level critical value	-2.6934	-2.6754	-2.6994	-2.6384	-2.6894
Conclusion	First-order difference stationary series	First-order difference stationary series	First-order difference stationary series	First-order difference stationary series	First-order difference stationary series

TABLE 5: Granger causality test.

Variable	Lags	1	
BLR and ROE	RROE does not Granger cause RBLR	0.0613	0.0892
BLR and ROE	RROE does not Granger cause RBLR	0.0613	0.0892
BLR and ROE	RROE does not Granger cause RBLR	0.0613	0.0892
BLR and ROE	RROE does not Granger cause RBLR	0.0613	0.0892

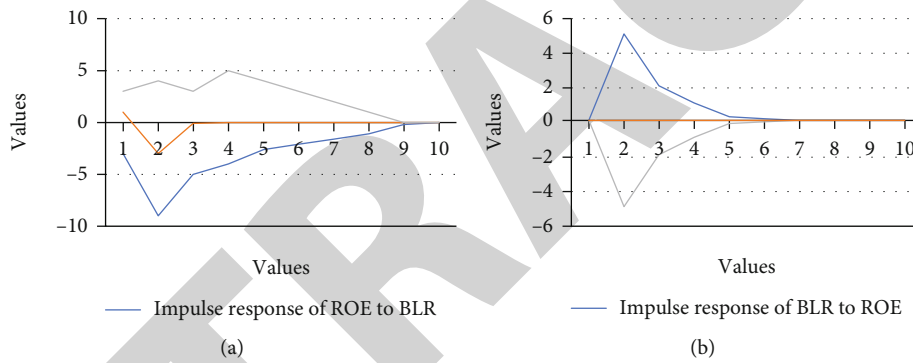


FIGURE 8: Impulse response plot between ROE and BLR.

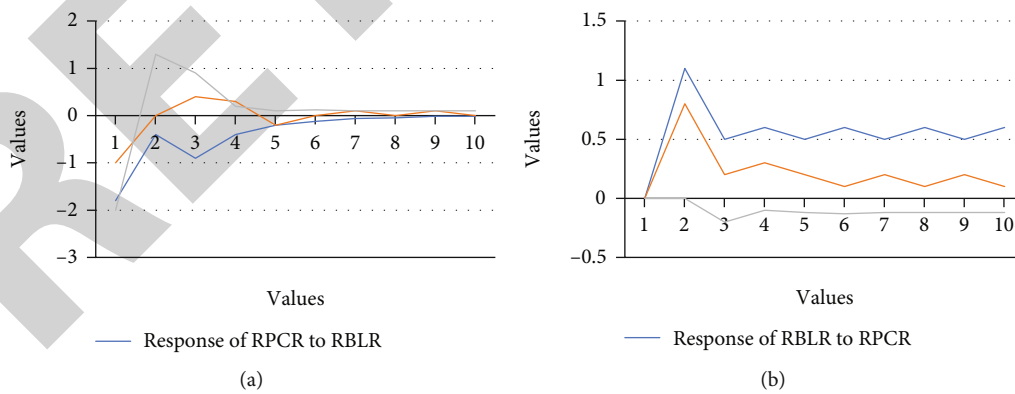


FIGURE 9: Impulse plot between provision coverage ratio and nonperforming loan ratio.

between variables; if a variable is affected by the lag of other variables, it has Granger causality.

Same as above, both CAR and RAL are Granger causes of BLR changes. Therefore, according to the analysis in Table 5, there is a Granger causality between the return on

assets (ROE), provision coverage ratio (PCR), capital adequacy ratio (CAR), agricultural loan ratio (RAL), and nonperforming loan ratio (BLR).

In order to track the impact effect of each explanatory variable in the system on the explained variable, the impulse

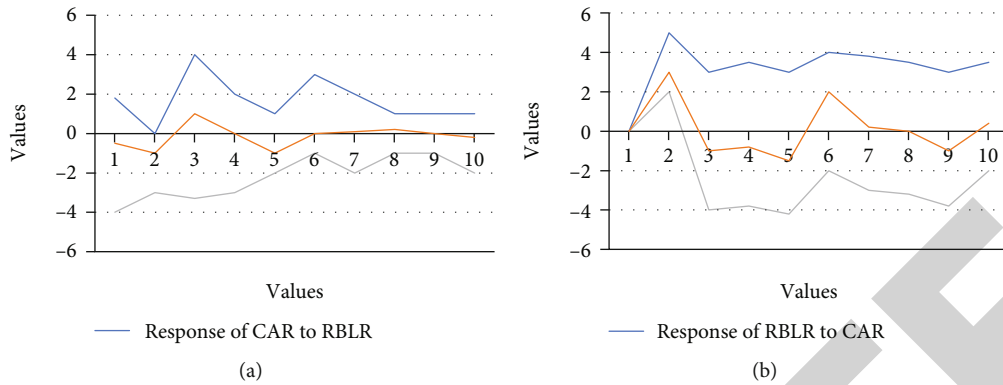


FIGURE 10: Impulse plot between capital adequacy ratio and nonperforming loan ratio.

response function is used for analysis. There are four explanatory variables, and the following three figures explain the impulse response function of each factor to the NPL ratio.

It can be seen from Figure 8(a) that in the first half of the first period, the asset return rate has a positive impact on the NPL ratio, and the response of the NPL ratio is positive, and in the second half of the first period, the response is negative. And after the second period, the impact reached the maximum value, and after the fourth period, the impact of the rate of return on assets gradually tended to zero. As shown in Figure 8(b), the impact of NPL ratio on asset profitability is not significant and will tend to zero in the third period.

It can be seen from Figure 9(a) that in periods 1-2, the provision coverage ratio has a negative impact on the NPL ratio, and the response of the NPL ratio is negative, and in the second half of the second period, the response is positive. And after the third period, the impact gradually tends to be zero. As shown in Figure 9(b), the impact of the NPL ratio on the return on assets is always positive.

The pulse results between the capital adequacy ratio and the nonperforming loan ratio are shown in Figure 10. Therefore, countermeasures and suggestions can be made for the prevention and control of risks of rural financial institutions from macro- and micro aspects. Establishing and improving its risk early warning mechanism can enable rural financial institutions to effectively reduce their nonperforming loan ratio and other risk factors and improve the risk management level and risk prevention and control ability of rural financial institutions.

5. Discussion

An important means for rural financial institutions to avoid credit risks is to improve their own profitability and competitiveness. On the whole, rural finance needs to further improve the credit environment and strengthen the risk supervision of rural finance. Locally speaking, it is still necessary to improve its own operating capacity and profitability, and carry out risk prevention and control according to specific measures such as the risk margin system, guarantee system, risk loss, and related information and data.

The capital adequacy ratio of rural financial institutions affects their nonperforming loans. Raising the capital ade-

quacy ratio undoubtedly plays an important role in reducing rural credit risks and improving their risk resistance, and it is also a very effective method. In the specific operation, rural financial institutions are required to take appropriate methods to carry out credit rating of borrowers and reasonably price financial assets. It is also required to be able to predict risks in advance, provide risk managers with a good decision-making reference, and design a complete set of plans for the establishment of a scientific financial risk management system.

6. Conclusion

The rural financial decision support system is a system created by the combination of decision support system and artificial intelligence technology. Traditional decision support systems use different model sources and knowledge sources than new decision support systems. The latter uses information sources for information and education in decision-making, in order to provide decision-makers with more comprehensive, broader, and more effective decision-making information and knowledge and to handle the relationship between risk minimization and insurance maximization. The rural financial decision support system adopts the method of combining database and genetic algorithm. From the perspective of the financial system and financial institutions, issues such as liquidity measurement, liquidity risk and savings timing early warning, liquidity saving tools, and liquidity saving channels are regularly studied. In the process of writing off nonperforming loans, higher-level external financial intermediaries can be used to guarantee the risks of credit assets, so as to prevent and control the risks of rural financial institutions.

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The authors state that this article has no conflict of interest.

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