

Retraction

Retracted: Prediction of College Students' Employment Rate Based on Gray System

Scientific Programming

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets 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 own 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] H. Yao and M. Dahlan Hj. A. Malek, "Prediction of College Students' Employment Rate Based on Gray System," *Scientific Programming*, vol. 2021, Article ID 4182011, 7 pages, 2021.

Research Article

Prediction of College Students' Employment Rate Based on Gray System

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College students' employment is affected by many factors such as economy and policy, which makes the prediction error of college students' employment rate large. In order to solve this problem, a prediction method of college students' employment rate based on the gray system is designed. Firstly, it analyzes the current research status of college students' employment rate prediction, finds out the causes of errors, then collects the historical data of college students' employment rate, fits the change characteristics of college students' employment rate through the gray system, and establishes the prediction model of college students' employment rate. Finally, the simulation test is realized by using the employment rate data of college students. The results show that the gray system can reflect the change characteristics of college students' employment rate and obtain high-precision college students' employment rate prediction results. The prediction error is less than that of other college students' employment rate prediction methods. We achieved an average accuracy of 95.22% as compared to 92.3% and 87.7% of other proposed systems. The prediction results can provide some reference information for the university employment management department.

1. Introduction

College students' employment plays an important role in the stability of the country and society, and college students' employment rate prediction can help universities as well as education management departments to understand the changing trend of college students' employment and formulate corresponding college students' employment rate measures, so college students' employment rate prediction has become a hot issue in college students' management research [1–3]. For the problem of college students' employment rate prediction, many scholars have conducted in-depth analysis and research and put forward some methods for college students' employment rate prediction. Initially, college employment rate prediction adopts an expert system to establish an expert knowledge base for college employment rate prediction by analyzing the characteristics of college employment rate changes by some experts in the field and estimate and predict the college employment rate at a

certain time in the future, but the working process of this method is complicated; the effect of college employment rate prediction is closely related to the knowledge richness of the expert base, and the result of college employment rate prediction has certain blindness [4, 5].

Subsequently, the methods of college students' employment rate prediction based on statistical theory emerged, which model and predict the change characteristics of the college students' employment rate through the methods in statistics [6, 7], such as multiple regression analysis. The parameters of the multiple regression analysis model are estimated based on the historical data of college students' employment rate, but because multiple regression analysis assumes a linear variation characteristic of college students' employment rate, while the actual college students' employment rate is influenced by the economy of a region, the employment policies of the country and city, and college students' own psychological factors, which has a strong nonlinear variation characteristic, so the multiple regression

analysis of the prediction accuracy of college students' employment rate is low, and the prediction error of the college students' employment rate is large [8]. With the development of modern statistics and nonlinear theory, the method of college students' employment rate prediction based on neural network appears. The neural network has better nonlinear fitting ability to predict the trend of college students' employment rate and obtains better college students' employment rate prediction results than multiple regression analysis. However, due to the complex structure of neural networks and the large amount of historical data required for the college employment rate, the prediction results are prone to "overfitting," which increases the actual cost of college employment rate prediction [9, 10].

Aiming at the current problem of large error of college student employment rate prediction, this paper proposes a method of college student employment rate prediction based on the gray system. Firstly, we collect the historical data of college students' employment rate; then, we fit the change characteristics of the college students' employment rate through the gray system and establish the college students' employment rate prediction model, and finally, we realize the simulation test using the college students' employment rate data and analyze the effectiveness and superiority of the method.

2. Related Works

At present, as domestic higher education is gradually moving from elite education to mass education, the employment of college students has become the focus of research in the field of education and also a topic of concern for the whole society [1–3]. Among them, the employment rate of college graduates has become the most intuitive tool for higher education consumers and society to judge the employment situation of college students and also a yardstick to judge the quality and level of education of a college [4–6]. In this situation, how to effectively estimate the student employment rate has become a major problem in the field of education, and the student employment rate estimation optimization model can analyze the historical initial employment data of graduates and estimate the future student employment rate, based on which the student employment rate estimation optimization model is formed as a fundamental way to solve the above problem, which has attracted the attention of many experts and scholars. Since the student employment rate estimation optimization model has a wide scope for development, it has also become a focal topic of research in the field and has received widespread attention, and many good methods have also emerged [7].

Literature [8] proposed a model for estimating the student employment rate based on C4.5 categories. The method classifies students' basic information and test scores of each subject and selects their decision attributes to extract the developmental relationship between students' employment and test scores, based on which an estimation model of the students' employment rate is formed. The model is relatively simple, but suffers from the problem of large estimation limitations. Zhu et al. [9] proposed a

model for estimating the student employment rate based on Cramer's law. This model introduces Cramer's law into the process of estimating the student employment rate and forms a student employment rate estimation model. The method is robust, but it is difficult to extract the eigenvectors of the academic being estimated when the current model is used to estimate the student employment rate, and there is a problem of large error in the estimation of the student employment rate. Wang et al. [10] proposed a model for estimating the student employment rate based on cluster analysis. The model forms a database based on the employment status and related information of college graduates in previous years, obtains the influence of various factors on student employment, and forms an estimation model of the student employment rate. The estimation accuracy of this method is high, but there are problems that the calculation is too tedious and time-consuming. Li and Yang [11] have proposed a forecast technique of graduates' employment on the basis of short-term memory (LSTM) recurrent neural network. The paper also discusses network structure design, network training, and forecast process implementation algorithm.

To address the above problems, an estimation model of the student employment rate based on big data analysis is proposed. The simulation results show that the proposed model provides an effective theoretical basis for adjusting college students' employment policies and measures.

3. Analysis of the Principle of Student Employment Rate Estimation

In the process of forming a student employment rate estimation model, historical student employment data are first obtained. A sample of students' employment is given and classified, and the data features of students to be predicted are extracted. The features are converted into feature vectors, the distance between students to be predicted and the full sample is calculated, and a student employment rate estimation model is formed. The specific steps are described in detail below.

Suppose R represents the sample data set, \mathfrak{R} represents the expected amount of information for employment estimation, K_I represents the historical student employment data, and $?$ represents the sample data for student employment; the sample data for student employment estimation are classified using

$$g(y) = \frac{(R \times \vartheta)^\beta}{(K_I \cdot Y)_b} \times \mathfrak{R}, \quad (1)$$

where β represents the classification function of student employment samples, b represents the different types of student sample data, and \mathfrak{R} represents the set of student employment data training samples.

Suppose that S_i represents the extracted data features of the students to be predicted, $D(i, t)$ and $k(i, t)$ represent different types of data feature vectors, and the distance between the students to be predicted and the full sample is calculated using

$$\omega[d, k] = \frac{\sqrt{D(i, t) + k(i, t)}}{C_i \otimes X} g(y), \quad (2)$$

where C_i represents any category of the student employment sample and X represents an unknown student employment sample.

Assuming that the employment status vector of students is represented by F_U , an estimation model of the student employment rate is formed using

$$Q_{sa} = \frac{F_U}{\omega[d, k]} \oplus g(y). \quad (3)$$

However, the traditional method cannot analyze historical graduate employment data and suffers from the problem of large errors in student employment rate estimation. A model for estimating the student employment rate based on big data analysis is proposed.

4. Gray System

Some scholars proposed a gray system based on the gray theory, assuming that the research object has a certain gray color, analyzing it according to the current information known about the object, establishing a corresponding mathematical model, and then analyzing and quantifying the association between the factors of the object according to the model to get a model that can describe the change characteristics of the object [12]. In this section, we will discuss a common model of the gray system.

4.1. Model GM (1, 1). The most commonly used model of the gray system is GM (1, 1), so in this paper, we choose GM (1, 1) to model and predict the employment rate of college students, and the working steps of GM (1, 1) are as follows:

- (1) Let the sequence of historical data of the study subjects be

$$X^{(0)} = \{x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(n-1), x^{(0)}(n)\}$$

and perform an accumulation operation to obtain a new data sequence of

$$X^{(1)} = \{x^{(1)}(1), x^{(1)}(2), \dots, x^{(1)}(n-1), x^{(1)}(n)\}, \text{ where}$$

$$x^{(1)}(k) = \sum_{m=1}^k x^{(0)}(m), k = 1, 2, \dots, n. \quad (4)$$

- (2) Modeling the new data $x^{(1)}$, the prediction equation of the gray system is obtained as

$$\frac{dX^{(1)}}{dt} + aX^{(1)} = u, \quad (5)$$

where a denotes the development system and u denotes the amount of gray action.

- (3) Let the estimated value of the parameter u be, which can be obtained according to the least squares (LS) method $\hat{u} = (B^T B)^{-1} B^T Y$, where

$$B = \begin{bmatrix} -\frac{1}{2}(x^{(1)}(1) + x^{(1)}(2)) & 1 \\ -\frac{1}{2}(x^{(1)}(2) + x^{(1)}(3)) & 1 \\ \vdots & \vdots \\ -\frac{1}{2}(x^{(1)}(n-1) + x^{(1)}(n)) & 1 \end{bmatrix}, \quad (6)$$

$$Y = \begin{bmatrix} x^{(0)}(2) \\ x^{(0)}(3) \\ \vdots \\ x^{(0)}(n) \end{bmatrix}.$$

- (4) After obtaining the values of the parameters a and u , the solution of equation is obtained:

$$\hat{x}^{(1)}(k+1) = \left(x^{(0)}(1) - \frac{u}{a}\right)e^{-ak} + \frac{u}{a}, \quad (7)$$

$$\hat{x}^{(0)}(k+1) = \hat{x}^{(1)}(k+1) - \hat{x}^{(1)}(k).$$

4.2. Residual Correction of Prediction Results. Usually, the prediction accuracy of GM (1, 1) is difficult to meet the requirements of practical applications, and the residuals of the prediction results need to be corrected [13]. Let the residuals between the actual and predicted values be $\varepsilon^{(0)} = (\varepsilon(1), \varepsilon(2), \dots, \varepsilon(k), \varepsilon(n))$; taking the tail of the residual gives $\varepsilon^{(0)} = (\varepsilon(k_0), \varepsilon(k_0+1), \dots, \varepsilon(n))$, the corresponding first-order cumulative sequence is

$$\varepsilon^{(1)} = (\varepsilon(k_1), \varepsilon(k_1+1), \dots, \varepsilon(n)). \quad (8)$$

The solution of GM(1,1) is

$$\varepsilon^{(1)}(k+1) = \left(\varepsilon(k_0) - \frac{u_\varepsilon}{a_\varepsilon}\right)\exp[-a_\varepsilon(k - k_0)] + \frac{u_\varepsilon}{a_\varepsilon}. \quad (9)$$

The tail simulation sequence of the residual sequence is

$$\varepsilon(k+1) = (-a_\varepsilon)\left(\varepsilon(k_0) - \frac{u_\varepsilon}{a_\varepsilon}\right)\exp[-a_\varepsilon(k - k_0)]. \quad (10)$$

According to $\hat{x}^{(0)}(k+1) = \hat{x}^{(1)}(k+1) - \hat{x}^{(1)}(k)$, we can obtain

$$\hat{x}^{(0)}(k+1) = (-a)\left(x^{(0)}(1) - \frac{u}{a}\right)\exp(-ak). \quad (11)$$

The residual correction time response is calculated as

$$\hat{x}^{(0)}(k+1) = \begin{cases} -a\left(x^{(0)}(1) - \frac{u}{a}\right)\exp(-ak), k < k_0 \\ -a\left(x^{(0)}(1) - \frac{u}{a}\right)\exp(-ak) \pm a_\varepsilon\left(\varepsilon(k_0) - \frac{u_\varepsilon}{a_\varepsilon}\right)e^{-a_\varepsilon(k-k_0)}, k \geq k_0 \end{cases} \quad (12)$$

This gives the final prediction of the research problem.

5. Prediction of Employment Rate Based on Gray System

The steps for predicting the employment rate of college students based on the gray system are as follows:

- (1) Collecting historical data of the college students' employment rate of a university in recent years and eliminating some wrong data through experts to ensure the validity of the data.
- (2) Using equation (12) to process the original college student employment rate data to obtain better college student employment rate prediction results,

$$x' = \frac{(x - x_{\min})}{(x_{\max} - x_{\min})}. \quad (13)$$

- (3) Using GM (1, 1) in the gray system to model the employment rate data of college students and getting the prediction results of college students' employment rate.
- (4) Correcting the residuals of college employment rate prediction results to improve the accuracy of college employment rate prediction.
- (5) Adopting equation (13) to process the predicted results of the college employment rate to obtain the actual predicted results of the college employment rate:

$$x = x'(x_{\max} - x_{\min}) + x_{\min}. \quad (14)$$

In summary, the prediction process of the college students' employment rate based on the gray system is shown in Figure 1.

6. Testing the Predictive Performance

6.1. Historical Data on the Employment Rate of College Students. The employment data of graduates of a university for 20 consecutive years are selected for the study. Figure 2 shows the data we collected. The employment rate is only about 81% for the first few years, and it increases as we go up. It reaches almost 99% at the 20th year showing that the employment rate of graduates has been increasing historically with the passage of time.

6.2. Single-Step Prediction Results of the College Student Employment Rate. The gray system is used to model and predict the college students' employment rate data in Figure 2, and the obtained one-step prediction results of the college students' employment rate are shown in Figure 3. From Figure 3, it can be found that the gray system can describe the change trend of the college students' employment rate, and the deviation between the expected value of the college students' employment rate and the predicted value of the gray system is very little, which can obtain the prediction result of the college students' employment rate with small error and high accuracy.

6.3. Results of Multistep Prediction of the College Student Employment Rate. Since the one-step prediction result of college students can only reflect the change trend of college students' employment in the next year, which is not conducive to the formulation of long-term college students' employment management measures by colleges and universities, it is necessary to make multistep prediction of the college students' employment rate and adopt the rolling method to realize the 4-step prediction of the college students' employment rate, and the 4-step prediction result of the college students' employment rate obtained is shown in Figure 4.

From Figure 4, it can be seen that the multistep prediction effect of the gray system for college students is obviously worse than the one-step prediction result, and the prediction error of the college students' employment rate becomes larger, but the gray system can still accurately portray the change trend of the college students' employment rate, and the prediction accuracy can meet the practical application requirements of the college students' employment rate.

6.4. Comparison with Other Methods for Predicting the Employment Rate. In order to test how advance is the gray system, BP neural network and multiple regression analysis are selected for the comparison experiment of college students' employment rate prediction, and their one-step and multistep prediction accuracies are counted, and the statistical results obtained are shown in Table 1. Analyzing the statistical results of Table 1, we can find

- (1) Multiple regression analysis has the lowest prediction accuracy of the college student employment rate, which indicates that its prediction error of the

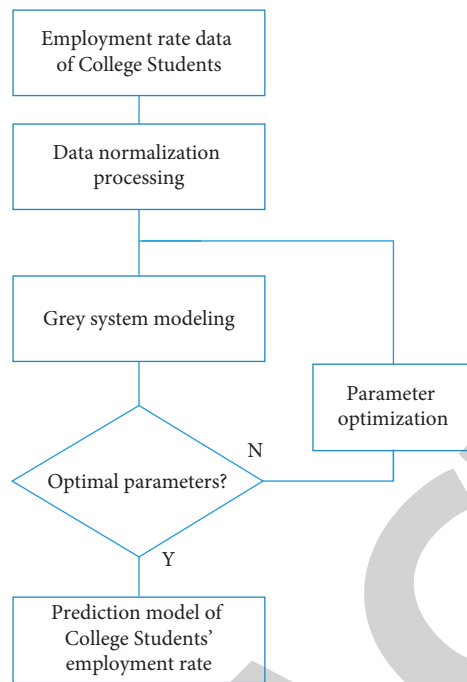


FIGURE 1: Prediction process of the college students' employment rate based on the gray system.

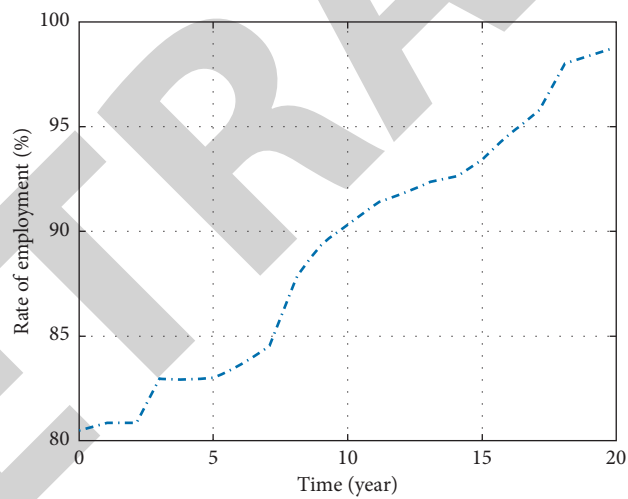


FIGURE 2: Employment data of graduates of a university for 20 years.

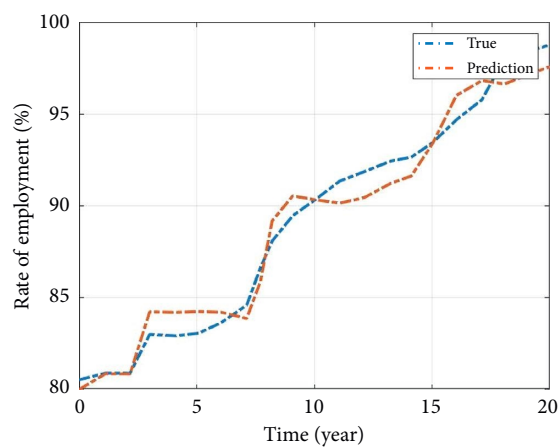


FIGURE 3: One-step prediction results of the college students' employment rate.

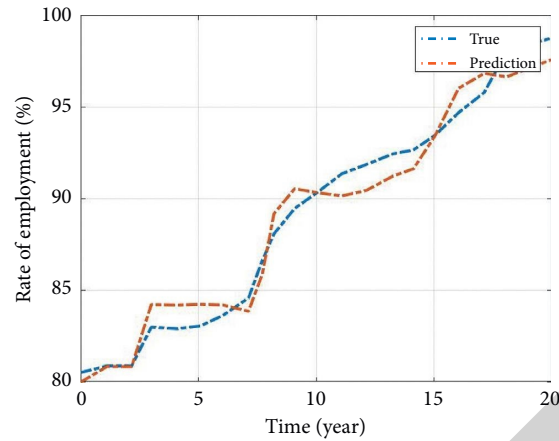


FIGURE 4: Multistep prediction results of the college students' employment rate.

TABLE 1: Comparison of the prediction accuracy of the college students' employment rate with other methods.

Method	One-step prediction accuracy	Multistep prediction accuracy
Multiple regression analysis	90.35	85.12
BP neural network	94.37	90.28
Our method	96.38	94.07

college student employment rate is the largest, which is mainly due to the fact that multiple regression analysis is a linear analysis method, which cannot describe the nonlinear variation characteristics of the college student employment rate, resulting in the poor prediction effect of the college student employment rate.

- (2) Compared with multiple regression analysis, the prediction accuracy of the college student employment rate of BP neural network has been improved, and the prediction error of the college student employment rate has been effectively reduced, which is mainly due to the fact that BP neural network is a nonlinear analysis method, which can build a college student employment rate prediction model with better overall prediction performance.
- (3) Compared with multiple regression analysis and BP neural network, the prediction result of the college employment rate of the gray system is better, whether it is one-step prediction or multistep college employment rate prediction result with higher accuracy, which is mainly because the gray system not only overcomes the defects of nonlinear modeling ability of multiple regression analysis but also solves the shortcomings of BP neural network which is easy to "overfit." This is because the gray system not only overcomes the shortcomings of multiple regression analysis but also solves the shortcomings of BP neural network, which is prone to "overfitting." Comparison of the prediction accuracy of the college students' employment rate with other methods is shown in Table 1.

7. Conclusions

In order to overcome the current problem of large error in college students' employment rate prediction, the method of college students' employment rate prediction based on the gray system is proposed. According to the nonlinear change characteristics of the college employment rate, the original data are normalized and the historical data of college employment rate are mined by the GM(1, 1) model in the gray system to find the change trend of the college employment rate and obtain the high accuracy college employment rate prediction results. Whether it is single-step prediction or multistep prediction result, the prediction error of the college students' employment rate in this paper is lower than other current methods of college students' employment rate prediction, the prediction effect of the college students' employment rate has been improved significantly, and the prediction result can provide valuable reference opinions for relevant departments [14–18].

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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