Research on Mathematical Modeling Competition and Ideological and Political Education Based on Analysis and Prediction Algorithm

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Abstract. This paper selects the research of mathematical modeling competition and correlation analysis of ideological and political education based on analysis and prediction algorithm, including corresponding analysis algorithm, time series prediction algorithm, bp neural network prediction algorithm, and grey association analysis algorithm. First of all, when the corresponding analysis method is used, based on the extraction of a large number of ideological and political documents, the indicators of the past three years were obtained, and the four indicators of "teacher system, reform and innovation, cultural integration, and student classroom" were clustered to obtain the status quo and development trend of the four indicators. For the prediction of the future ideological and political education, we used the time-series algorithm and the BP neural network algorithm to derive the number of published articles and the development trends in the ideological and political field in the next two years.Using grey correlation analysis, with "mathematical modeling, politics" as the theme, to all relevant literature retrieval, extract representative 100 articles, to all the factors involved in the article clustering, red elements, traditional culture, classroom atmosphere, personal value, national situation five related factors, analyze the influence of grey correlation, get the results from high to low order: red elements 0.611,0.596, traditional culture, classroom atmosphere 0.594, personal value of 0.593, national situation 0.581, are strong influence factors, so as to prove the rationality of the model.

Keywords: corresponding analysis algorithm, time series prediction algorithm, bp neural network prediction algorithm, gray association analysis algorithm.

1. Introduction

Colleges and universities are the place to train talents for the society. Students in colleges and universities are the most likely to accept advanced cultural concepts, but at the same time, they are also the most vulnerable to be eroded by bad thoughts. With the rise of the western trend, the ideas and life style of most college students have changed, and even negative Marxism-Leninism and skeptical attitude towards socialism, and negative groups and serious individualism. Therefore, ideological and political education in colleges and universities is imminent.

Making full use of the rich teaching resources contained in mathematical modeling is conducive to the formation of a healthy and developing curriculum ideological and political pattern, and promoting the development and implementation of the concept of moral education.

2. Problem analysis

For the analysis of the research status, we took the relevant factors of the research status as the indicators, searched the topics of the papers in the past three years, combined the linked indicators for clustering, and analyzed the clustering results, and summarized the current situation of ideological and political education through the analysis results and visual distribution charts. For the problem of "discuss the research status and development trend of curriculum ideological education concept", we

understand the word "research status", and construct the dual dimension model of "academic activity" and "university execution", and we use the time series algorithm and bp neural network algorithm to quantify the development of this field in the future. In the modeling process, we counted the number of papers published on the public platform of ideological education researchers in recent years to indicate the academic activity in the field of universities and obtained the number of articles published in recent years to indicate the relative execution of the work in this field.

With "mathematical modeling ideology" for retrieval index, to "first-class colleges, vocational colleges and universities, ordinary universities, related BBS, primary and secondary schools" five environmental classification, for 100 mathematical modeling paper title contains ideological elements extraction clustering, using gray association, analyze the influence factor weight size, and the results. At the same time, the relevant cases of each environmental category were extracted to explain the cases.

In order to understand the "ideological and political elements in the mathematical modeling competition", we consulted a lot of literature, and the first thing we thought of was to summarize the correlation between the humanistic background and the ideological and political affairs from the previous competitions. Therefore, we downloaded and sorted out some of the competition questions in the "National College Students Mathematical Modeling Competition" for natural language processing over the years, intending to collect and obtain its main component fields, and found the existence of its ideological and political education elements through observation. Then, we quantified the relationship between colleges and universities by comparing the performance of colleges and universities in ideological and political education activities with the participation of students in the competition.

Combined with the analysis of the current situation of ideological and political education in the first three problems and the extraction of ideological and political indicators in mathematical modeling, it is suggested to increase the development intensity for the elements of slow development, integrate all the results, and improve the suggestions and suggestions for the current ideological and political education.

3. Model establishment and solution

Data collection and collation: All relevant ideological and political documents from 2019 to 2021 were searched under the theme of "Ideological and political education in colleges and universities".

The corresponding analysis method is used to observe the data. Define the teacher system in turn, make reform and innovation, and make cultural integration, and take the students' classroom as factors 1,2,3, and 4, starting from the original matrix A

$$p = \frac{1}{T} A = (p_{ij})_{n \times p} \tag{1}$$

$$T = \sum_{i=1}^{n} \sum_{j=1}^{p} a_{ij} \quad ; \quad p_{ij} = \frac{1}{T} a_{ij} (i = 1, 2, \cdots, n; j = 1, 2 \cdots, p) \tag{2}$$

$$B = (b_{ij})_{n * p}$$

$$b_{ij} = \frac{p_{ij} - p_i * p_j}{\sqrt{p_i * p_j}} = \frac{a_{ij} - a_i * a_j / T}{\sqrt{a_i a_j}}, i = 1, 2 \ldots n, j = 1, 2 \ldots p \tag{3}$$

The corresponding matrix P and the transformed new data B were calculated, as shown in the Table 1.

Table 1. The corresponding matrix P and the transformed new data B were calculated

1	2	3	4	5
0.0061	0.003	-0.032	0.0176	7.36E-17
-0.0064	0.0234	-0.01 80	-0.0036	0
5.58E-04	-0.0238	0.0436	-0.0117	0

According to the above calculated corresponding matrix B, the travel profile distribution matrix using the following formula

$$R = \left[\frac{a_{ij}}{a_{i.}}\right]_{n*p} = \left[\frac{p_{ij}}{p_{i}}\right]_{n*p} = D_r^{-1} p^{def} \tag{4}$$

Table 2. The travel profile distribution matrix

0.1453	0.0861	0.2196	0.5
0.1588	0.0953	0.2018	0.5
0.1288	0.1283	0.1962	0.5

Dimension visualization as shown Figure 1.

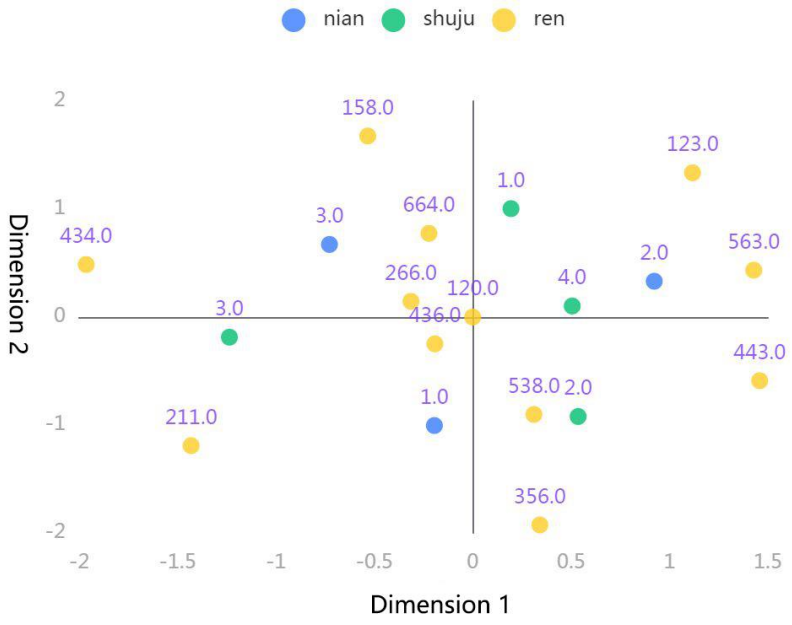


Figure 1. Dimension visualization

Interpretation of result:

According to the figure above, the corresponding value of type 1 data dimension is the largest, indicating that the development momentum of the current teacher system is the most obvious

According to the figure above, the corresponding value of type 2 data dimensions is the smallest, indicating that the development of the current reform and innovation system has a slightly downward trend.

According to the figure above, the corresponding value of type 3 data dimension is around 0, indicating that the development of the current cultural integration system has been relatively stable.

According to the figure above, the corresponding value of the 4-type data dimension is from above 0, indicating that the current cultural integration system has a momentum of development, but it is not obvious.

In predicting the data prediction between 2014 and 2017, we showed a good correlation between the data through observation, and so the bp neural network was used to predict the model.

Usually a multi-layer neural network is composed of L layer neurons, where: layer 1 is called the input layer, the last layer (layer Z) is called the output layer, and the other layers are called the hidden layer (layer 2, layer L-1).

Order the input vector to be:

$$\vec{x} = [x_1 \quad x_2 \quad \cdots \quad x_i \quad \cdots \quad x_m], i = 1, 2, \ldots, m \tag{5}$$

The output vector is:

$$\vec{y} = [y_1 \quad y_2 \quad \cdots \quad y_k \quad \cdots \quad y_n], k = 1, 2, \ldots, n \tag{6}$$

The output of each neuron in the l-hidden layer is:

$$h^{(l)} = [h_1^{(l)} \quad h_2^{(l)} \quad \cdots \quad h_j^{(l)} \quad \cdots \quad h_{sl}^{(l)}],\ j = 1, 2, \ldots, sl \tag{7}$$

Let W be the connection weight between the first neuron in layer l-1 and layer 1; b be the bias of the first neuron in layer 1, then:

$$h_i^{(l)} = f(net_i^{(l)}) \tag{8}$$

$$net_i^{(l)} = \sum_{j=1}^{sl-1} W_{ij}^{(l)} h_j^{(l-1)} + b_i^{(l)} \tag{9}$$

Evaluation metrics through the cross-validation set can constantly adjust the hyperparameters to obtain a reliable and stable model.

MSE (mean square error): the expected value of the difference between forecast and actual value. The smaller the values, the higher the model accuracy.

RMSE (RMSE): it is the square root of the MSE, and the smaller the value is, the higher the model accuracy is.

MAE (average absolute error): the average of absolute error, can reflect the actual situation of predicted value error. The smaller the values, the higher the model accuracy.

MAPE (average absolute percentage error): It is a deformation of the MAE, and it is a percentage value. The smaller the values, the higher the model accuracy.

R^2: Comparing the predicted value to the mean only, the closer to the 1, the higher the accuracy of the model.

For question 2,100 documents related to mathematical modeling courses were first quantitatively collected, the evaluation objects and reference system were determined, and the ideological and political related factors were extracted and clustered.

Determine the evaluation objects and the reference columns. The reference column is $x_0 = \{x_0(k) \mid k = 1, 2, \cdots, n\}$,The comparison number is $x_i = \{x_i(k) \mid k = 1, 2, \cdots, n\}$,i=1,2,⋯,m

$$\xi_i(k) = \frac{\min\limits_s \min\limits_t |x_0(t) - x_s(t)| + \rho \max\limits_s \max\limits_t |x_0(t) - x_s(t)|}{|x_0(k) - x_i(k)| + \rho \max\limits_s \max\limits_t |x_0(t) - x_s(t)|} \tag{10}$$

From the ranking results, in the first dimension of influencing factors in all mathematical modeling courses contain ideological elements, factors influence from large to small for red elements 0.611,0.596 traditional culture, classroom atmosphere 0.594, personal value 0.593, the national situation 0.581, the results show that the extracted factors are involved in mathematical modeling courses ideological elements have strong correlation, to verify the rationality of the model.

According to the gray correlation analysis, in the second dimension, mainly in the research field, the relevant departments attach great importance to ideological and political education in mathematical modeling from high to low, ranking as follows: First-class universities attach the most importance to it, and the following are ordinary universities, vocational universities, related forums, primary and secondary schools.

In the raw data processing process, we used a ——Viterbi algorithm of the hidden Markov model to segment the text and form a coherent set of phrases.

The DP recursive form of the algorithm can be expressed as:

$$\delta t(j) = \max[\delta t - 1(i) \times aij \times bj(ot)] \tag{11}$$

Principal Components Analysis (PCA), also known as principal component analysis, is a method to simplify the data structure by reducing the dimension: how to turn multiple indexes into a few comprehensive indicators, which can reflect most of the information of multiple indicators. The purpose of the PCA is to take several linear combinations from the original multiple variables to retain as much information in the original data as possible.

$$\tilde{\alpha}_{ij} = \frac{\alpha_{ij} - \frac{1}{31}\sum_{i=1}^{31}\alpha_{ij}}{\sqrt{\frac{1}{31}\sum_{i=1}^{31}\left(\alpha_{ij} - \frac{1}{31}\sum_{i=1}^{31}\alpha_{ij}\right)^2}}, j = 1, 2..., 12, \tag{12}$$

It can be clearly seen that in recent years, the theme of the National College Students Mathematical Modeling Competition mainly focuses on people's livelihood and social issues. The words of transportation, medical care, disease, and electricity are very conspicuous, highlighting the positive impact of ideological and political education in mathematical modeling competitions. The author guides college students to pay attention to social facts, understand the latest trends of scientific research, abstract the seemingly serious and difficult social problems in life into mathematical problems to examine and think, and improve the ability of college students to solve practical problems.However, it is arbitrary and subjective to analyze the correlation only from the competition questions and the stem.

Therefore, we expect to analyze problems in a quantitative way to achieve convincing results.

After observing the data, we found that in a large number of mathematical modeling competition questions based on engineering knowledge, we rarely directly explained the ideological and political education statements directly, so we turned to universities with more direct data sources. The relationship between them was assessed by comparing the performance of universities in ideological and political education activities with students' participation in the competition.

We selected schools of different levels as experimental samples, and collected the number of papers in the field of ideological and political education published this year as the original data, in an attempt to estimate the school's recent academic activity of the school in the field of ideological and political education. On the other hand, we used the 2017 data downloaded from the CUMCU (National College Student Mathematical Modeling Competition) website, using the number of teams from each school quantified to assess students' enthusiasm for participating in the competition.

Finally, we get a mathematical model that can better evaluate the relationship between ideological and political education and mathematical module competition. By analyzing the correlation and visualization, we can see the influence relationship between the two more intuitively. As shown Figure 2.

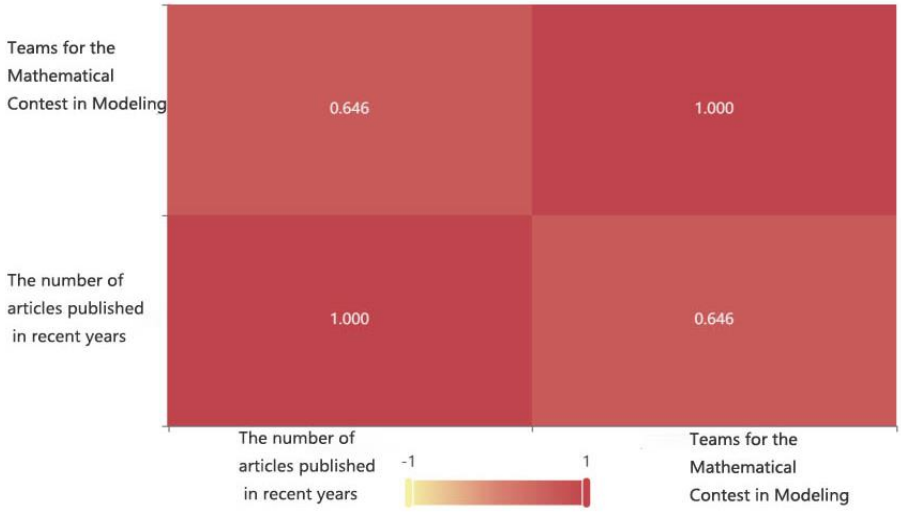


Figure 2. The influence relationship between the two more intuitively

The above figure shows that the form of the heat map shows the value of the correlation coefficient, mainly through the color depth to indicate the size of the value. We can easily see that there is a strong correlation between the two.

Schools should keep good for education materials, including education, especially the official website of ideological articles, it is not difficult to find that the more top school for historical literature management more clear and rigorous, historical documents not only recorded the development history of the academic institutions, but also reflects the background of an academic organization atmosphere, should pay more attention to the retention of historical materials.

4. Conclusion

Extracting factors and indicators from a large number of authoritative documents is both authoritative and persuasive. With the increase of the number of documents, the representativeness gradually strengthens.A large number of factors are clustered and divided into four to five representative categories, which not only eliminates the redundant indicators, but also is extremely representative. Judge the future development trend of ideological and political education by prediction and analysis. The bp neural network is used to improve the model generalization ability and fault tolerance ability, and give it a strong non-linear mapping ability, so as to improve the accuracy and adaptabilityAnalysis analysis should be susceptible to adverse effects of extreme values. Less data volume and unstable performance. Improvement of the model: First of all, due to the limitation of time and other conditions, more sufficient data quantity cannot be obtained for model training. In the next step, more relevant data can be collected and invested in the training and analysis of the model, so as to further improve the accuracy of the model. Secondly, the generalization ability of the model can be improved by expanding the data dimension. Data sources can also be expanded, such as extracting related factors in mathematical modeling courses, or expanding data sources in the ideological and political syllabus, to improve the reliability of data.

References

[1] Yan Liang, Ma Jinzhu. Discussion on the Value of Hot Social Hot Issues in Ideological and Political Education in Universities [J]. Journal of Changchun University of Science and Technology: Social Science Edition, 2011,24 (7): 2.

[2] Tian Chuanxin. The Practical Education Mode and Its Value of Ideological and political Education in Colleges and Universities under the Vision of Great Ideological and Political Education [J]. Journal of Zhejiang Shuren University (Humanities and Social Sciences edition), 2013.

[3] Ying Xingren, Zeng Nan. BP neural network memory fuzzy rule [J]. Journal of Automation, 1991.

[4] Sun Xiaodong, Jiao Yue, Hu Jinsong. Decision-making method based on grey correlation degree and ideal solution [J]. Chinese Management Science, 2005,13 (4): 6.

[5] Cui Jie, Dang Yaoguo, Liu Shifeng. Improved method for solving index weights based on gray correlation degree [J]. China Management Science, 2008,16 (5): 5.

[6] Sun Cai, Song Yantao. Theoretical discussion of the grey correlation degree [J]. World Geology, 2000,19 (3): 6.

[7] Lin Haiming. Improvement and application of the factor analysis model [J]. Mathematical Statistics and Management, 2009 (6): 15.