Evaluation system of ideological of college students based on improved grey relational algorithm

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Abstract. Grey relational algorithm is a branch of grey system theory, which seeks the numerical relationship between each subsystem through the analysis of the correlation degree of each subsystem. This algorithm can provide a quantifiable measure of the development and change of a system, which is very suitable for dynamic process analysis. This paper takes the college students’ course performance indicators and extracurricular learning indicators in the second semester of the third year of the university and the second semester of the fourth year of the university as the analysis factors, improves the grey correlation algorithm and establishes the corresponding evaluation model of the ideological status of college students, and collects the indicators of 400 students’ Information for model fitting. Experimental verification shows that the average relative errors of the model are 3.78% and 3.26 respectively, which proves that the model has high accuracy and is very suitable for dynamic evaluation of college students’ ideological status.

1. Introduction
According to data released by the Ministry of Education on May 12, 2020, the number of college graduates in 2020 is as high as 8.74 million, accounting for about 10% of the population of the same age, and it is still increasing year by year. As high-end talents in the future society, college graduates are particularly important to strengthen Ideological. It has always been a complex and dynamic system, and college students are the cornerstone of the future society. Therefore, the use of systematic and scientific methods to assess their current ideological status is conducive to dynamically grasping the development of Ideological for students’ academic work. And the future social construction provides the correct value protection [1].

The correct evaluation of the ideological status of each college student in each time period requires a scientific and effective calculation model, while the current classic model is the factor analysis and evaluation method.

In the past, the basic methods of factor analysis and evaluation were mainly statistical methods, such as regression analysis, but most of them were only suitable for linear ones with few factors, and it was difficult to deal with non-linear ones. In 1995, Tan Xuerui, Deng Julong and others put forward the grey relational analysis theory, which takes into account the various drawbacks and deficiencies of regression analysis methods, adopts the method of correlation analysis for systematic analysis, and has the ability to use "less data" modeling to find the law of realization. Good characteristics, and correlation coefficient calculated by applying medical case modeling: r1=0.7010, r2=0.06594,r3=0.8398, This is in line with the physiological characteristics of normal people to prove the effectiveness of the algorithm [2]. In 2016, Li Xiaogang, Zheng Yang and others applied the gray
correlation analysis method for the analysis of the influencing factors of the production of glutenite reservoirs, and concluded that the gray correlation analysis method has the value of promotion through the experimental results [3]. In 2020, Meng Xiaoke and Xu Shanshan used the grey relational analysis algorithm to model the evaluation model of the employment quality of college students in order to improve the evaluation effect of the employment quality of college students. The evaluation accuracy of the designed model is about 93%, but the evaluation accuracy of the current classic model is lower than 90% [4].

However, these methods use traditional grey correlation algorithms to evaluate with fixed indicators. The ideological status of college students will fluctuate and change with the received information, and human beings are physiologically forgetful of information.

Therefore, this paper uses some strategies to improve the gray correlation algorithm to make this algorithm capable of dynamic evaluation over time, and then collect relevant evaluation index information, and use the improved gray correlation algorithm to establish the evaluation model of the ideological status of college students. Via fitting and predicting the ideological state of the country, the validity of the model is proved through experiments and the experimental results are analyzed.

2. Principle

2.1. Basic principle of grey correlation analysis

Grey Relation Analysis (GRA) is a method of multi-factor statistical analysis. In a gray system, the degree of gray correlation is used to describe the strength, size and order of the relationship between factors, the data sequence of the thing being judged as the reference data sequence, and the data sequence matrix of each influencing factor as the control data matrix, and then calculate Compare the correlation between the data sequence of each factor in the data matrix and the reference data column. As a quantitative measurement of the relationship between each factor and the thing being evaluated, the basic idea is to determine whether the relationship is close by determining the geometrical similarity between the reference data column and several comparison data columns, which reflects the relationship between the curves. Degree of relevance.

2.2. The calculation steps of grey correlation analysis

(1) Determine the evaluation index system according to the evaluation purpose and collect evaluation data. Suppose n data series form the following matrix (see formula 1).

\[
(X'_1, X'_2, ..., X'_n) = \begin{bmatrix}
    x'_1(1) & x'_1(2) & ... & x'_1(n) \\
    x'_2(1) & x'_2(2) & ... & x'_2(n) \\
    ... & ... & ... & ...
    x'_i(m) & x'_i(m) & ... & x'_i(m) \\
\end{bmatrix}, i = 1, 2, ..., n
\]

The m in formula 1 is the number of indicators.

(2) Determine the reference data column. The reference data column should be an ideal comparison standard. The reference data column can be constituted by the optimal value (or worst value) of each index, or other reference values can be selected according to the evaluation purpose (see formula 2).

\[
X'_0 = (x'_0(1), x'_0(2), ..., x'_0(m))
\]

(3) The data indicators are dimensionless, and the dimensionless data forms the following sequence:
(\(X_0, X_1, \ldots, X_m\)) = \begin{bmatrix}
x_0(1) & x_1(1) & \cdots & x_n(1) \\
x_0(2) & x_1(2) & \cdots & x_n(2) \\
\vdots & \vdots & \ddots & \vdots \\
x_0(m) & x_1(m) & \cdots & x_n(m)
\end{bmatrix}

Commonly used dimensionless methods are: averaging method (see formula 4), initial value method (see formula 5)

\[
x_i(k) = \frac{x_i'(k)}{\sum_{i=1}^{m} x_i'(k)}
\]

(4) Calculate the absolute difference between the index sequence (comparison sequence) of each evaluated object and the corresponding element of the reference sequence one by one (see formula 6)

\[|x_0(k) - x_i(k)| \quad k = 1, 2, \ldots, m; i = 1, 2, \ldots, n\]

(6) Calculate the correlation coefficient. Calculate the correlation coefficient between each comparison sequence and the corresponding element of the reference sequence by formula 8.

\[
\zeta(k) = \frac{\min_{i=1}^{n} \max_{k=1}^{m} |x_0(k) - x_i(k)| + \rho \cdot \max_{i=1}^{n} \max_{k=1}^{m} |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \cdot \max_{i=1}^{n} \max_{k=1}^{m} |x_0(k) - x_i(k)|}
\]

(8) According to the correlation order of each observation object, a comprehensive evaluation result is obtained.

In formula 8, \(\rho\) is the resolution coefficient, which is taken in the range of (0, 1). If \(\rho\) is smaller, the difference between the correlation coefficients is greater, and the discrimination ability is stronger. Usually, \(\rho\) is 0.5.
2.3. Improvement plan
As the ideological status of college students changes with time, many of the indicators collected this time appear gradually over time, and human thinking has a certain degree of forgetfulness and plasticity, and is susceptible to external factors. Therefore, it can be considered that the longer it is for college students to study a certain course, the smaller the impact on the student’s ideological status evaluation score. Taking the number of semesters away from the study as the unit value, all students’ scores for this course will show convergence (See formula 10).

\[
\text{mean} = \sum_{k} x_i(k) \\
\begin{cases} 
    x_i(k)' = x_i(k) + (x_i(k) - \text{mean}) \times \frac{1}{e}, & x_i(k) < \text{mean} \\
    x_i(k)' = x_i(k) - (x_i(k) - \text{mean}) \times \frac{1}{e}, & x_i(k) > \text{mean}
\end{cases}
\]

(10)

Where \( k \) is the label corresponding to each student, \( k=1,2,...,m \), and \( i \) is the label corresponding to a certain indicator. After learning a certain course, once every semester, formula 10 is executed to update the index score of the course.

3. Data research and collection
In order to better evaluate the ideological status of college students, the selection of corresponding evaluation indicators must be scientific, objective and representative. The selection of evaluation indicators directly affects the effectiveness and fairness of the evaluation results, and the evaluation results have a greater impact on college students. At the same time, because the ideological status of college students changes with time, the evaluation indicators need to be dynamic Changing characteristics.

Since the ideological status is difficult to express intuitively, most indicators can only be selected from schemes with measurement significance. From the beginning of the freshman year, college students will offer at least one ideological course every semester: "Ideological and Moral Cultivation and Legal Foundation", "Mental Health Education for College Students", "Basic Principles of Marxism", "Outline of Modern Chinese History", "Situation and Policy", "Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics", and because the courses are offered semester-by-semester, the results of these courses can be regarded as a dynamic indicator. Among them, "Situation and Policy" is It will be opened every semester. The learning points for learning a powerful country and the number of views of the video of the youth study can also be accumulated through continuous learning of thoughts. They also have dynamic characteristics and can be used as a reference indicator. Finally, since the counselor is concerned about the daily life of the college students in his class and is responsible for the party’s membership, he undoubtedly has a better understanding of the student’s ideological status. Therefore, the counselor’s score on each student’s ideological status can be regarded as the student’s ideological status. The final score. See Table 1 for detailed evaluation indicators.

| The first level of Evaluation indexes | Serial number | The second level of Evaluation indexes |
|--------------------------------------|-------------|--------------------------------------|
| X1                                   | Ideological and Moral Cultivation and Legal Foundation |
| X2                                   | Mental Health Education for College Students |
| X3                                   | Basic Principles of Marxism |
| X4                                   | Outline of Modern Chinese History |
Table 1, cont

| Learning indicators for ideological courses |   |
|------------------------------------------|--|
| X5 | Summary of Mao Zedong Thought and Lu Lun System of Socialism with Chinese Characteristics |
| X6 | Situation and policy (first semester of the first year of university) |
| X7 | Situation and policy (the next semester of the first year of university) |
| X8 | Situation and policy (first semester of the second year of the university) |
| X9 | Situation and policy (the second semester of the second year of the university) |
| X10 | Situation and policy (first semester of the third year of the university) |
| X11 | Situation and policy (the second semester of the third year of the university) |
| X12 | Situation and policy (first semester of the fourth year of university) |
| X13 | Situation and policy (the second semester of the fourth year of the university) |

| Indicators for extracurricular ideological learning |   |
|-------------------------------------------------|--|
| X14 | Accumulated points for learning a strong country |
| X15 | Youth University Study Cumulative Views |

| Final ideological evaluation |   |
|------------------------------|--|
| Y1                           | Counselor’s score for the next semester of the third year of the university |
| Y2                           | Counselor’s score for the next semester of the fourth year of the university |

For each indicator, the actual score or integral of the indicator is taken as the actual score of the indicator. Randomly investigate the information of 400 senior students in a certain department, and get the data in Table 2.

Table 2. Indicator data collected through a random survey of 400 college students.

| X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | X9 | X10 | X11 | X12 | X13 | X14 | X15 | Y1 | Y2 |
|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|----|----|
| 75 | 83 | 85 | 88 | 84 | 95 | 90 | 90 | 95 | 89  | 97  | 89  | 83  | 9300| 27 | 90 | 94 |
| 75 | 84 | 85 | 68 | 74 | 90 | 90 | 85 | 75 | 85  | 80  | 74  | 82  | 8400| 15 | 86 | 89 |
| 82 | 72 | 81 | 72 | 74 | 90 | 85 | 84 | 80 | 92  | 92  | 94  | 98  | 8900| 23 | 83 | 85 |
| 93 | 93 | 81 | 92 | 83 | 81 | 71 | 61 | 82 | 72  | 73  | 93  | 89  | 5200| 8  | 80 | 90 |
| 83 | 72 | 62 | 61 | 83 | 62 | 81 | 82 | 73 | 92  | 72  | 72  | 82  | 7300| 15 | 85 | 78 |
| 83 | 72 | 71 | 63 | 53 | 82 | 81 | 72 | 63 | 73  | 93  | 83  | 83  | 0   | 20 | 74 | 69 |
|    |    |    |    |    |    |    |    |    |     |     |     |     | 2000| 3  | 67 | 74 |
|    |    |    |    |    |    |    |    |    |     |     |     |     | 2100| 15 | 60 | 62 |
4. Experimental results and analysis

Since the cumulative number of views and accumulated points for studying strong nations in the second book of the junior year cannot be obtained, this experiment still uses the two index values of the second book of the senior year as the index value of the second book of the junior year. According to the data in Table 2 and the calculation steps of formulas 1 to 10, the correlation between each index and the evaluation of ideological status is obtained (see Table 3).

**Table 3.** Correlation coefficients between the indicators of the third and fourth grades of college and the ideological status of college students.

| Index | X1  | X2  | X3  | X4  | X5  | X6  | X7  | X8  | X9  | X10 | X11 | X12 | X13 | X14 | X15 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| The correlation coefficient of the third year of University | 0.6 | 0.6 | 0.7 | 0.8 | 0.9 | 0.3 | 0.4 | 0.4 | 0.5 | 0.6 | --- | --- | 0.8 | 0.9 | 21 |
| The correlation coefficient of the fourth grade in University | 0.6 | 0.6 | 0.6 | 0.8 | 0.9 | 0.2 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 | 0.9 | 0.9 | 18 |

From the comparison in Figure 1, it can be seen that as time progresses, the overall correlation coefficients of the indicators of the fourth volume are slightly lower than that of the second volume of the junior year, and the correlation coefficients of the indicators of the first semester of the study subjects are generally lower. The lower, and the lower the index correlation coefficient is generally higher, in line with the expected effect that the improvement strategy needs to achieve.
Figure 1. Radar chart comparing the correlation coefficients of indicators between juniors and seniors.

Table 4. The predicted and true values of ideological status scores based on the improved grey relational analysis algorithm.

| Items                        | Predicted value (the second semester of the third year of University) | Real value (the second semester of the third year of University) | Predicted value (the second semester of the fourth year) | Real value (the second semester of the fourth year) |
|------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------|
| Evaluation of College Students’ Ideological status | 93                                                                      | 90                                                              | 93                                                      | 94                                                |
|                              | 84                                                                      | 86                                                              | 88                                                      | 89                                                |
|                              | 82                                                                      | 83                                                              | 90                                                      | 85                                                |
|                              | 81                                                                      | 80                                                              | 89                                                      | 90                                                |
|                              | 83                                                                      | 85                                                              | 77                                                      | 78                                                |
|                              | 72                                                                      | 74                                                              | 71                                                      | 69                                                |
|                              |                                                                        | ...                                                             |                                                          |                                                   |
|                              | 81                                                                      | 83                                                              | 82                                                      | 83                                                |
|                              | 69                                                                      | 67                                                              | 71                                                      | 74                                                |
|                              | 65                                                                      | 60                                                              | 59                                                      | 62                                                |
| Average relative error (%)   | 3.78%                                                                   |                                                                |                                                          | 3.26%                                             |

Figure 2 is drawn by comparing the predicted data in Table 4 with the real data. It can be seen intuitively from Figure 2 that the true value curve and the predicted value curve in (a) and (b) fit well, which is consistent with the average relative error obtained from the experimental results. And the ideological status of college students is generally around 80 points, indicating that the ideological status of college students is good, but compared with the grades of the juniors, the grades of the seniors are slightly lower. It is speculated that this is caused by only the situation and policy courses in the seniors. And other courses have forgotten part.
Figure 2. (a) The true value (the second semester of the third year of university) and the predicted value (the second semester of the third year of college); (b) the true value (the second semester of the fourth year of college) and the predicted value (the second semester of the fourth year of college) Contrast curve.

5. Conclusions
Ideological, as an indispensable and important link of college student education, plays an important role in college students’ academic and future career development. Especially in the current epidemic situation, students are faced with school closures and online classes, and are often more prone to problems in the ideological status. Therefore, it is especially important to correctly evaluate the ideological status of college students through external indicators scientifically and effectively. By collecting easy-to-obtain college student curriculum and extracurricular dynamic index information, this model can be used to correctly and dynamically evaluate the current ideological status of each student. The average relative error of the model is only about 3.5%, which fully proves the effectiveness of the model. Schools can grasp student information in a timely manner, and conduct correct guidance and ideological construction for students.

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