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Evaluation and improvement of the higher education system

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Abstract: *For any country, the higher education system not only plays an industrial role, but also sends a large number of talents to the country's development. This article is based on this, establishing an evaluation model of the higher education system and formulating an improvement policy. Question one requires us to establish a system that can assess the health of any country's higher education system. We select the gross enrollment rate, the proportion of people receiving higher education, the proportion of higher education expenditure in fiscal expenditure, and the proportion of international students to measure the health of the higher education system. Because each indicator has different impacts, that is, the weight is different, we first use the analytic hierarchy process to calculate the weight of each indicator, then use the TOPSIS method to build an evaluation model, combine the weights, calculate the scores of each country, and determine their health status in turn. Question two requires us to apply the model. We chose the data of the United States, Germany, Japan, Australia, and China to analyze and calculate the score. Since China has the lowest score, we selected China as our improvement target. Finally, we summarized the advantages and disadvantages of this model, and the model can be improved through the disadvantages.*

Keywords: *The analytic hierarchy process, TOPSIS, Time-Series Analysis*

1. Introduction & Backgrounds

For a country, having a healthy and sustainable higher education system not only has industrial value, but also cultivates more talented citizens for the development of the country. Therefore, it is possible to understand and understand a country’s higher education system. On this basis, it is very important to grasp the development direction of the higher education system. This question requires us to develop a model to measure and evaluate the national higher education system to solve the following problems:

1) Apply the model to several countries and analyze, select a country with room for improvement, and develop a blueprint for improvement for this country.

2) Use the model to measure the health of the current system and propose a sustainable development model. According to the model, it proposes a targeted policy and time implementation table, and demonstrates the effectiveness, impact and difficulty of the policy.

2. Assumptions

- Assume that indicators other than the selected indicators will not have an impact on the higher education system.
- It is assumed that the results of the forecasting model can be fully reflected in the implementation of the policy, without being affected by other factors.

3. Model Development

3.1 Establishment of health evaluation modeltype your subhead

3.1.1 Model building

(1) Analytic Hierarchy Process

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First of all, the analytic hierarchy process was adopted. This was proposed by Professor Sadie of the University of Pittsburgh, an American operations researcher, in the early 1970s. It combines qualitative and quantitative factors, hierarchizes various factors, and targets various levels of the comparison of related factors provides a quantitative basis for analyzing the status quo of things and predicting the development of things. It is a practical and effective multi-objective decision-making method that expresses and processes human subjective judgments in a quantitative form. The basic idea is: the evaluator decomposes complex issues into several levels and several factors, and performs simple judgments and calculations among the various elements at the same level to obtain comprehensive evaluation indicators for different programs. The key to this process is the division of levels, the determination of weights and the combination of rules. [1]

(2) Analytic hierarchy process calculation

1) Establish a hierarchical structure model

a) Target level: establish a higher education system

b) Standard level: gross enrollment rate, proportion of people receiving higher education, proportion of higher education expenditure in fiscal expenditure, proportion of international students

c) Scheme level: higher education

2) Calculating index weight

Since we finally use the TOPSIS method to establish the evaluation model, only the index weights need to be calculated using the analytic hierarchy process.

a) In order to compare each standard, or each scheme under a certain standard, to obtain the relative weight, we introduce the relative importance scale.

b) Construct a judgment matrix

We use the criteria of the criteria level to compare two by one, look up relevant information, and get the judgment matrix as Table 1:

Table 1: The judgment matrix

	Gross enrolment ratio	Outbound mobility ratio	Government expenditure on education ratio	Percentage of population with tertiary schooling
Gross enrolment ratio	1	7	5	3
Outbound mobility ratio	1/7	1	1/3	1/5
Government expenditure on education ratio	1/5	3	1	1/3
Percentage of population with tertiary schooling	1/3	5	3	1

c) Consistency inspection

Step 1: Calculate the consistency index CI

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

Step 2: Find the corresponding average random consistency index RI

Note: In actual application, n rarely exceeds 10. If the number of indicators is more than 10, consider establishing a secondary indicator system, or use the fuzzy comprehensive evaluation model that we will learn in the future.

Step 3: Calculate the consistency ratio CR

$$CR = \frac{CI}{RI}$$

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If CR<0.1, the consistency of the judgment matrix can be considered acceptable; otherwise, the judgment matrix needs to be revised.

d) Use eigenvalue method to find weight

$$k[\frac{1}{a_{11}}, \frac{1}{a_{12}}, \cdots, \frac{1}{a_{1n}}]^T \ (k \neq 0)$$

The consensus matrix has an eigenvalue n, and the other eigenvalues are all 0. We know that when the eigenvalue is n, the corresponding eigenvector is just:

This eigenvector is just the first column of the consistent matrix.

If the consistency of our judgment matrix is acceptable, then we can imitate the method of finding the weight of the consistency matrix.

The first step: Find the maximum eigenvalue of matrix A and its corresponding eigenvector.

The second step: normalize the calculated feature vector to get our weight.

According to the above steps, we use the program to get CR=0.0438136. At this time CR<0.1, the judgment matrix B has satisfactory consistency, and then use the eigenvalue to find the weight coefficient, as shown in the following Figure 1:

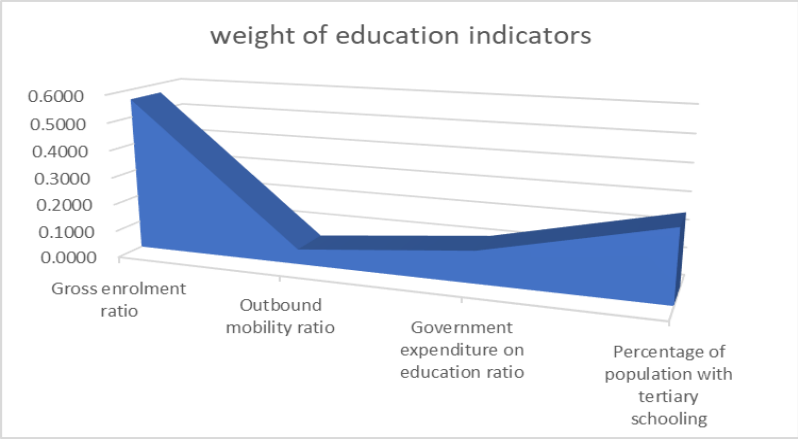

Figure 1: The weight of the consistency matrix

(3) TOPSIS method

TOPSIS method is usually a commonly used method in system engineering for system engineering with limited solution multi-objective conditional attribute system decision analysis. This method is widely used in how to effectively solve the system decision problem of multi-objective condition attribute. [2]

3.1.2 Model Solution

According to the above model, we can select the gross enrollment rate of the same country or different countries in different years, the proportion of people receiving higher education, the proportion of higher education expenditure in fiscal expenditure, and the data of the proportion of international students. Among them, the gross enrollment rate is subject to higher education. The proportion of the education population and the proportion of international students are very large indicators, and there is no need for positive treatment. The proportion of higher education expenditure in fiscal expenditure is an interval index, which needs to be treated positively. After the processing is completed, standardization and normalization and weight calculation can be performed. Because the changes are not done instantaneously, in order to better reflect the changes, we select China's 1990, 1995, 2000, 2005, 2010, 2015 data as examples to verify this model. We calculate the score of China's higher education system, as shown in Figure 2:

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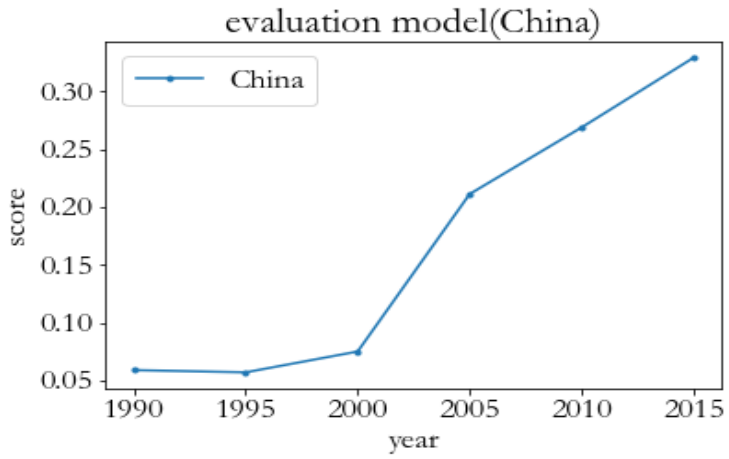

Figure 2: Evaluation model of China

3.2 Application of the model

In order to better promote and verify the model established by TOPSIS, we select the same data from China, the United States, Germany, Japan and Australia to work together! Combined with the weight table, the scores of each country in each year are Obtained and plotted as a chart:

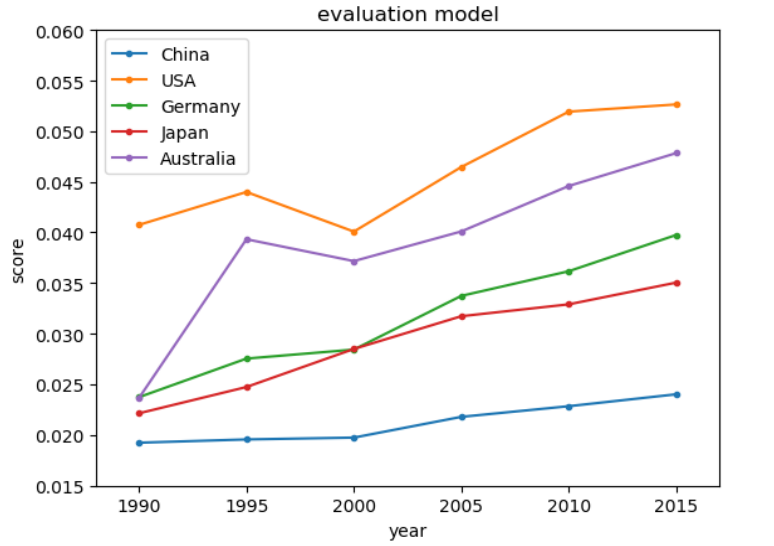

Figure 3: Evaluation model of the five countries

From the Figure 3, we can see that the overall higher education scores of all countries are showing an increasing trend, and continue to rise to. Among them, the United States scores the highest, and Germany, Japan and Australia are at a relatively high level. Although China has improved, it is still at a low level.

In summary, according to the evaluation, we choose China as the country that needs to improve the higher education system.

4. Conclusion

The healthy and sustainable development of the higher education system is of vital importance to any country, and even determines the future of a country. It is also vital to establish a reasonable evaluation system to evaluate the higher education system. This article is just what we continue to discuss and think about how to build models and how to improve the higher education system.

The analytic hierarchy process is used to evaluate the weight, the TOPSIS method is adopted to establish an evaluation model, and the time series method is adopted to establish a forecast model, which

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provides our plan for the evaluation of the higher education system.

At the same time, we also realize that there are some shortcomings in the model that can be improved, such as subjectivity and other issues. In order to reduce the shortcomings as much as possible, we will further discuss this issue in depth later.

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