

Research on Health Model of higher Education system based on Fuzzy Comprehensive Evaluation

Shaoxin Lei, Minfei Hu, Rui Peng

School of economics and management, Southwest University of science and technology, Mianyang, Sichuan, 621000

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Abstract: Higher education system is an important part of a country's education. This paper discusses a series of problems in the higher education system. In this paper, a health grade evaluation model of higher education is established by using two-level fuzzy comprehensive evaluation model and analytic hierarchy process (AHP), and the health grades of different countries are given. Then, on the basis of the traditional grey GM model, an improved metabolic GM algorithm is proposed, and the sustainable evaluation model of higher education system is established. Then, the model is analyzed by selecting the United States, China and Japan, and the corresponding health grade of higher education system is given to verify the accuracy of the model.

1. Introduction

In today's education system, the higher education system is an important part of the national higher education system [1]. It not only has its own industrial value, but also has the value of providing well-trained people for the national economy. Looking at the world, the education system of each country has its own advantages and disadvantages. In the current era, countries need to consider the advantages and disadvantages of their own education systems before they can make improvements and think about what can be done better [2].

Based on the above situation, this paper establishes the evaluation model of university health system to evaluate the advantages and disadvantages of their own education system, and then gives the optimization direction [3].

2. Model preparation of health evaluation system in Higher Education

The fuzzy comprehensive evaluation model can just make a clear grade for the evaluation target, so as to carry out quantitative analysis. When selecting evaluation indicators, we consider selecting indicators from two perspectives: the state's input in higher education and the output of higher education to society and the country [4] [5].

Based on these two criteria, we have selected six indicators: ① The Ratio of Higher Education Expenditure to GDP ② The Gross Enrollment Rate of Students in Higher Education Schools ③ The Ratio of Teachers to Students in Higher Education Schools, and ④ The Employment Rate of Graduates ⑤ The Proportion of the World's Top 100 Universities ⑥ The Number of Papers

Published by the Country in SCI Each Year.

Because the number of indicators is greater than 5, we have constructed a Secondary Fuzzy Synthetic Evaluation Model.

3. Establishment of the higher education health grade evaluation model

3.1 Determine the factor set and comment set.

1) Construction factor set Based on the analysis, we construct the second set of registration factors as the above six indicators, denoted as:

$$U = \{u_1, u_2, u_3, u_4, u_5, u_6\} \quad (1)$$

After classifying them, construct the first-level factor set:

$$U = \{U_1, U_2\} \quad (2)$$

Among them, U : the first factor set, U_i : the second factor set.

3.2 Build a comment collection

Divide the health level of a country's higher education system into: excellent, good, and poor:

$$V(v_1, v_2, v_3) \quad (3)$$

3.3 Calculate the corresponding weight

In order to calculate the corresponding weight of each indicator, the analytic hierarchy process is used to solve the weight and establish a judgment matrix

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (4)$$

3.4 Consistency Test of the Judgment Matrix

1) Calculate the consistency index: $CI = \frac{\lambda a_{\max} - n}{n - 1}$

2) Find the corresponding average random Consistency Test Index RI . If the value of n is larger than 10, in actual modeling, consider establishing a second-level factor set system, but for this article, if the value of n is small, the first-level can be established Factor set system.

3) Calculate the consistency ratio: $CR = \frac{CI}{RI}$

If the consistency ratio CR meets the test conditions, that is $CR < 0.1$, the consistency of the judgment matrix can be considered acceptable, and the next step can be performed.

3.5 Use three methods to normalize the weights

In order to ensure the robustness of the results, this paper adopts the three methods of Analytic

Hierarchy Process (AHP) to calculate the weights, and then calculates the scores of the three programs according to the weight matrix obtained, and calculates the average weight.

1) Arithmetic average method: $\omega_i = \frac{1}{n} \sum_{j=1}^n \frac{a_{ij}}{\sum_{k=1}^n a_{kj}} (i=1,2,\dots,n)$

2) Geometric mean: $\omega_i = \frac{\left(\prod_{j=1}^n a_{ij}\right)^{\frac{1}{n}}}{\sum_{k=1}^n \left(\prod_{j=1}^n a_{kj}\right)^{\frac{1}{n}}}$

3) Eigenvalue weighting: $k \left[\frac{1}{a_{i1}}, \frac{1}{a_{i2}}, \dots, \frac{1}{a_{in}} \right]^T (k \neq 0, i=1,2,\dots,n)$

Then calculated weight.

3.6 Determination of fuzzy matrix and comprehensive evaluation

Evaluate the second factor set $U_i = \{u_1^{(i)}, u_2^{(i)}, \dots, u_{n_i}^{(i)}\}$ to obtain the fuzzy comprehensive judgment matrix of each index.

Perform matrix synthesis operations: $B_i = A_i \cdot R_i (i=1,2,\dots,k)$

Then comprehensively judge the first factor set, if the weight $A = \{a_1, a_2, \dots, a_k\}$, then $R = \begin{bmatrix} B_1 \\ B_2 \\ \vdots \\ B_k \end{bmatrix}$.

Fuzzy vector set: $B = [B_1, B_2, \dots, B_m]$, if $B_k = \max\{[B_1, B_2, \dots, B_m]\}$, the evaluation object belongs to this level B_k

4. Establishment of the higher education health grade evaluation model

4.1 Establishment of improved gray model

Construct a metabolic $GM(1,1)$ model based on the traditional $GM(1,1)$ model

Set the original data series $x^{(0)} = (x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(p))$, The model built with this sequence can be called full data $GM(1,1)$. When $\forall k_0 > 1$, the established model was called partial data. Then let $x^{(0)}(p+1)$ be the latest information and put it in $X^{(0)}$. The model built with $X^{(0)} = (x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(p), x^{(0)}(p+1))$ is called the new information GM(1,1) model. Insert the latest information $x^{(0)}(p+1)$, and remove the oldest information $x^{(0)}(1)$, the model with $X^{(0)} = (x^{(0)}(2), \dots, x^{(0)}(p), x^{(0)}(p+1))$ is called the MDGM(1,1) model.

4.2 Model solution

The selected China, Japan, and the United States as evaluation indicators.

A1 is the judgment matrix composed of HEE, CER, and TSR

A2 is the judgment matrix composed of ECS, PPC, and PTW

A3 is the judgment matrix composed of Input and Output

$$A1 = \begin{bmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/2 \\ 1/2 & 2 & 1 \end{bmatrix} \quad A2 = \begin{bmatrix} 1 & 2 & 5 \\ 1/2 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix} \quad A3 = \begin{bmatrix} 1 & 1/3 \\ 3 & 31 \end{bmatrix}$$

A1 is 0.0088 to meet the consistency

A2 is 0.0036 to meet the consistency

A3 is a second-order matrix to meet the consistency

Then, the second level factor sets of three countries are solved at one time to construct the fuzzy comprehensive evaluation moment and the first level comprehensive evaluation factors. The fuzzy comprehensive evaluation of three countries and factor set is shown here.

Table 1: The fuzzy comprehensive judgment matrix of the first-level factor set of higher education in China, Japan, and the United States

Country	USA			CHINA			JAPAN		
Grade	E	G	P	E	G	P	E	G	P
First-grade factor set									
Input	0.79	0.19	0.02	0.19	0.59	0.22	0.36	0.63	0.01
Output	0.57	0.37	0.06	0.46	0.41	0.13	0.44	0.46	0.1

Table 2: The final comprehensive evaluation results of the health level of higher education in China, Japan, and the United States

Country	B1	B2	B3
USA	0.625	0.325	0.05
CHINA	0.3925	0.455	0.1525
JAPAN	0.42	0.5025	0.0775

The health indicators of higher education in the United States, China and Japan are excellent, good, and good (B1 corresponds to excellent, B2 corresponds to good, and B3 corresponds to poor). However, analyzing the data of the two B1, B2, and B3 shows that the probability of Japan in the health level B3 is lower than that of China, and the probability in the health level B1 and B2 is higher than that of China, indicating that China's higher education system is worse than Japan's which needs improvement.

5. Conclusion

Based on the fuzzy comprehensive evaluation model, the evaluation model of health and sustainable development of higher education is obtained by using analytic hierarchy process and metabolic discrete grey prediction model. The health indicators of higher education in the United States, China and Japan were excellent, good and good respectively (B1 for excellent, B2 for good and B3 for poor). However, the data analysis of B1, B2 and B3 shows that the probability of Japan being in health level B3 is lower than that of China, and the probability of being in health level B1 and B2 is higher than that of China, which indicates that China's higher education system is worse than that of Japan and needs to be improved.

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