Orientation Model of Elite Education and Mass Education

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Abstract: This paper studies the problem of how to orientate the educational mode between elite education and mass education for the universities. Firstly, the major factors which influence on education development level are discussed. Then, an orientation model of educational mode is established based on grey relational analysis method. Finally, the orientation model is applied to orientate the educational mode between elite education and mass education for Central China Normal University and Huanggang Normal University
Key words: Elite education; Mass education; Education orientation; Grey relational analysis

1 Introduction

The educational mode of universities can be divided into two kinds, i.e., elite education and mass education [1-5]. For a university, its educational mode should orientate the format of elite education or mass education? What key aspects should strive to develop to enhance education levels? These problems are very important to study for the decision makers in universities. Aiming at these problems, this paper discusses the major factors which influence on education development level, and establishes an orientation model of educational mode based on the method of grey relational analysis [6-8]. This model provides the decision makers in universities with useful method to orientate the educational mode between elite education and mass education.

2 The Orientation Model

Grey relational analysis is one key theory of grey system theory, and is also the base of grey system analysis, modeling, forecast and decision. Grey relational analysis provides the modeling of complex system with important technical analysis method by establish grey relational analysis method [6-8]. Its ultimate principle is to clear the relevance link degree to multiple factors by comparing multiple data sequences. The geometric shape of two sequences is closer, the grey relational degree is greater. This principle is one of two important principles in the grey system theory.

2.1 Original data processing

To ensure high quality of the modeling and the right results of system analysis, the collected original data must be to make data transformation and processing to eliminate dimension.

Definition 1. Let the original data sequence be $x = (x(1), x(2), \cdots, x(n))$, then the transformation $f(x(k)) = y(k)$, $k = 1, 2, \cdots, n$ is called the data transformation from sequence x to y, where $y = (y(1), y(2), \cdots, y(n))$.

According to the different types of original data, the following data transform forms are usually used in grey modeling.

Transformation of initial value:

$$f(x(k) = \frac{x(k)}{x(1)} = y(k), \ \ x(1) \neq 0$$

Mean transformation:

$$f(x(k) = \frac{x(k)}{\bar{x}} = y(k), \ \ \bar{x} = \frac{1}{n}\sum_{k=1}^{n} x(k)$$

Percentage transformation:

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$$f(x(k)) = \frac{x(k)}{\max\limits_k x(k)} = y(k)$$

Magnification transformation:

$$f(x(k)) = \frac{x(k)}{\min\limits_k x(k)} = y(k), \quad \min\limits_k x(k) \neq 0$$

Normalization transformation:

$$f(x(k)) = \frac{x(k)}{x_0} = y(k),$$

where x_0 is a constant greater than zero.

Maximum transformation:

$$f(x(k)) = \frac{x(k) - \min\limits_k x(k)}{\max\limits_k x(k)} = y(k)$$

Interval threshold transformation:

$$f(x(k)) = \frac{x(k) - \min\limits_k x(k)}{\max\limits_k x(k) - \min\limits_k x(k)} = y(k)$$

Definition 2. Suppose that

$x_1 = (x_1(1), x_1(2), \cdots, x_1(n))$, $x_2 = (x_2(1), x_2(2), \cdots, x_2(n))$, …, $x_m = (x_m(1), x_m(2), \cdots, x_m(n))$,

then $f(x_i(k)) = y_i(k)$ is called the data transformation from sequence x_i to y_i.

The data transform methods with multiple factors and multiple indexes mainly depend on the attribute types. At present the most commonly used types are cost-type and benefit-type.

For the benefit-type index and cost-type index, the data transformation methods in grey relational analysis are given as follows.

$$y_i(k) = \frac{x_i(k) - \min\limits_i x_i(k)}{\max\limits_i x_i(k) - \min\limits_i x_i(k)} \qquad i = 1, 2, \cdots, m$$

$$y_i(k) = \frac{\max\limits_i x_i(k) - x_i(k)}{\max\limits_i x_i(k) - \min\limits_i x_i(k)} \qquad i = 1, 2, \cdots, m$$

2.2 Grey relational degree

Definition 3. Let $X = \{x_0, x_1, \cdots, x_m\}$ be the grey relational factor set, x_0 be the reference sequence, x_i be the compared sequences, $i = 1, 2, \cdots, m$, $x_0(k)$ and $x_i(k)$ are the k-th number of x_0 and x_i respectively, and $x_0 = (x_0(1), x_0(2), \cdots, x_0(n))$, $x_i = (x_i(1), x_i(2), \cdots, x_i(n))$, $i = 1, 2, \cdots, m$. Let $r(x_0(k), x_i(k))$ be a real number, and ω_k is the weight of the k-th number, and satisfies $0 \le \omega_k \le 1$, $\sum\limits_{k=1}^{n} \omega_k = 1$. If

$$r(x_0(k), x_i(k)) = \frac{\Delta_{\min} + \rho \ \Delta_{\max}}{\Delta_{0i}(k) + \rho \ \Delta_{\max}}, \quad r(x_0, x_i) = \sum_{k=1}^{n} \omega_k r(x_0(k), x_i(k))$$

where $\Delta_{0i}(k) = |x_0(k) - x_i(k)|$ is absolute difference, $\Delta_{\min} = \min\limits_i \min\limits_k \Delta_{0i}(k)$ is minimum difference, $\Delta_{\max} = \max\limits_i \max\limits_k \Delta_{0i}(k)$ is maximum difference, ρ is resolution ratio, $\rho \in (0,1)$, and the following conditions are satisfied:

1) Standardability: $0 \le r(x_0, x_i) \le 1$, $r(x_0, x_i) = 0 \Leftrightarrow x_0, x_i \in \varnothing$, $r(x_0, x_i) = 1 \Leftrightarrow x_0 = x_i$;

2) Symplectic symmetry: $x, y \in X$, $\gamma(x, y) = \gamma(y, x) \Leftrightarrow X = \{x, y\}$;

3) Wholeness: $x_j, x_i \in X = \{x_\sigma \mid \sigma = 0, 1, \cdots, n\}$, $n \ge 2$, $r(x_j, x_i) \overset{\text{often}}{\neq} r(x_i, x_j)$;

4) Accessibility:

The value of $|x_0(k) - x_i(k)|$ is smaller, the value of $r(x_0(k), x_i(k))$ is greater.

Then $r(x_0(k), x_i(k))$ is called grey relational coefficient, $r(x_0, x_i)$ is called the grey relational degree between x_0 and x_i.

2.3 The steps of grey relational analysis

In practice, grey relational analysis method includes the following basic steps:

(1) Collect the original data, and determine the reference sequence and compared sequences.

(2) Make the data transformation for the original data sequence.

(3) Calculate the absolute difference.

(4) Calculate the grey relational coefficient.

(5) Calculate the grey relational degree.

(6) Rank order according to the grey relational degree.

(7) Strength analysis according to the grey relational degree.

3 Application Analysis of Orientation Model

In this section, we select Chinese University Rankings of China WangDa over the years, and choose the following six one-class indexes as the key influencing factors which influence on the development level of universities:

X1: Reputation; X2: Academic resources; X3: Academic Achievements;

X4: Students situation; X5: Faculty resources; X6: Materiel resources

Now we use the grey relational analysis method to analyze the influence degree of all key influencing factors which influence on the development level of universities. Then, we can determine the educational mode of a certain university is elite education or mass education according to the results of grey relational analysis.

Firstly, we select the data of Central China Normal University from Chinese University Rankings of China WangDa from 2003 to 2008. All statistical data of above six factors are listed in Table 1.

Table 1 Chinese University Rankings of China WangDa from 2003 to 2008

Year	2003	2004	2005	2007	2008
Ranking	41	34	34	34	38
X1	52.76	54.9	58.5	59.6	62.8
X2	33.35	39.42	39.6	38.1	39.8
X3	33.68	17.05	13.6	17.8	18.3
X4	54.57	54.91	59.4	65.6	72.2
X5	19.28	46.74	43.3	42.8	42.3
X6	32.65	42.85	41.6	57.8	39.8

Table 2 The Processed Data

Year	2003	2004	2005	2007	2008
Ranking	0	1	1	1	0.4286
X1	0	0.2131	0.5717	0.6813	1
X2	0	0.9411	0.9690	0.7364	1
X3	1	0.1718	0	0.2092	0.2341
X4	0	0.0193	0.2740	0.6256	1
X5	0	1	0.8747	0.8565	0.8383
X6	0	0.4056	0.3559	1	0.2843

(1) Let the ranking value of Central China Normal University be the reference sequence $x_0(k), k = 1, 2, \cdots, 5$, and the values of the other six influencing factors be compared sequences $x_i(k), i = 1, 2, \cdots, 6; k = 1, 2, \cdots, 5$. Obviously, the ranking value is a cost-type index, and X_1, X_2,…,X_6

are all benefit-type indexes. To eliminate the influence of dimensional, we use the method of interval threshold transformation to process the original data, the transformed data is denoted as $y_i(k), i=1,2,\cdots,6; k=1,2,\cdots,5$, the detail results are list in Table 2.

(2) Calculate the absolute difference $\Delta_{0i}(k)=\left|y_0(k)-y_i(k)\right|$ according to the data in Table 2, the results are as follows.

$$\Delta_{01}=(0,0.7869,0.4283,0.3187,0.5714);\quad \Delta_{02}=(0,0.0589,0.0310,0.2636,0.5714);$$
$$\Delta_{03}=(1,0.8282,1,0.7908,0.1945);\quad \Delta_{04}=(0,0.9807,0.7260,0.3744,0.5714);$$
$$\Delta_{05}=(0,0,0.1253,0.1435,0.4097);\quad \Delta_{06}=(0,0.5944,0.6441,0,0.1443);$$

So we get $\Delta_{\min}=0$, $\Delta_{\max}=1$.

(3) Calculate the grey relational coefficient.

We set $\rho=0.5$, then

$$r(x_0(k),x_i(k))=\frac{\Delta_{\min}+\rho\ \Delta_{\max}}{\Delta_{0i}(k)+\rho\ \Delta_{\max}}=\frac{0+0.5\times1}{\Delta_{0i}(k)+0.5\times1}=\frac{0.5}{\Delta_{0i}(k)+0.5}$$

Substituting (2) into above computational formula, we have

$$r_{01}=(1,0.3885,0.5386,0.6107,0.4667);\quad r_{02}=(1,0.8946,0.9416,0.6548,0.4667);$$
$$r_{03}=(0.3333,0.3764,0.3333,0.3873,0.7199);\quad r_{04}=(1,0.3377,0.4078,0.5718,0.4667);$$
$$r_{05}=(1,1,0.7997,0.7770,0.5496);\quad r_{06}=(1,0.4569,0.4370,1,0.7761);$$

(4) Calculate the grey relational degree

We set $\omega_1=\omega_2=\omega_3=\omega_4=\omega_5=\frac{1}{5}$, then the grey relational degree between x_0 and x_i are as follows.

$$r(x_0,x_1)=\frac{1}{5}\sum_{k=1}^{5}r_{01}(k)=0.6009;\quad r(x_0,x_2)=\frac{1}{5}\sum_{k=1}^{5}r_{02}(k)=0.7915;$$
$$r(x_0,x_3)=\frac{1}{5}\sum_{k=1}^{5}r_{03}(k)=0.4301;\quad r(x_0,x_4)=\frac{1}{5}\sum_{k=1}^{5}r_{04}(k)=0.5568;$$
$$r(x_0,x_5)=\frac{1}{5}\sum_{k=1}^{5}r_{05}(k)=0.8252;\quad r(x_0,x_6)=\frac{1}{5}\sum_{k=1}^{5}\xi_{06}(k)=0.7340;$$

From this result, we obtain $r(x_0,x_5)>r(x_0,x_2)>r(x_0,x_6)>r(x_0,x_1)>r(x_0,x_4)>r(x_0,x_3)$.

The result shows that the influence degree of key influencing factors which influence on the development level of Central China Normal University from high to low in turn is Faculty resources, Academic resources, Materiel resources, Reputation, Students situation, Academic Achievements.

According to the ranking results of Central China Normal University since 2003, the ranking order of Central China Normal University is in 31 to 41 fluctuations around, and the rank tend is to be stable. The ranking results show that Central China Normal University develops from teaching university turn to research universities. In addition, from the key influencing factors which influence on the development level of Central China Normal University, the contribution of Faculty resources and Academic resources are higher. This is because they vigorously develop teachers (such as vigorously introduce Doctor overseas and Changjiang Scholars), efforts to improve staff and student ratio and senior professional ratio, making good efforts to build Master's degree program and Key national disciplines, national laboratories and national engineering centers and national humanities social sciences research base and so on.

From above analysis, we can conclude that Central China Normal University should go the development road of “elite education”. In addition to maintaining and strengthening faculty

resources, academic resources, material resources and other aspects of development benefits, it should also focus on the school's reputation, the students situation, increase academic achievement in the development efforts, such as the creation of a better research environment to actively increase the SCI, SSCI , EI, CSSCI and other high-level academic achievement, to further improve quality of new students, increase the proportion of graduate students, and actively introduce academicians and renowned academics and so on.

Secondly**,** we select the data of Huanggang Normal University from Chinese University Rankings of China WangDa from 2003 to 2008. All statistical data of above six factors are listed in Table 3. Let the ranking value of Huanggang Normal University be the reference sequence $x_0(k), k = 1, 2, \cdots, 5$, and the values of the other six influencing factors be compared sequences $x_i(k), i = 1, 2, \cdots, 6; k = 1, 2, \cdots, 5$.

According to the same computing method as above example, we set $\omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = \frac{1}{5}$, and the grey relational degree between x_0 and x_i are as follows.

$$r(x_0, x_1) = \frac{1}{5}\sum_{k=1}^{5} r_{01}(k) = 0.7083 ; \quad r(x_0, x_2) = \frac{1}{5}\sum_{k=1}^{5} r_{02}(k) = 0.7083 ;$$

$$r(x_0, x_3) = \frac{1}{5}\sum_{k=1}^{5} r_{03}(k) = 0.6830 ; \quad r(x_0, x_4) = \frac{1}{5}\sum_{k=1}^{5} r_{04}(k) = 0.6612 ;$$

$$r(x_0, x_5) = \frac{1}{5}\sum_{k=1}^{5} r_{05}(k) = 0.4160 ; \quad r(x_0, x_6) = \frac{1}{5}\sum_{k=1}^{5} \xi_{06}(k) = 0.5838 ;$$

So we have

$$r(x_0, x_1) = r(x_0, x_2) > r(x_0, x_3) > r(x_0, x_4) > r(x_0, x_6) > r(x_0, x_5)$$

Table 3 Chinese University Rankings of China WangDa from 2003 to 2008 of Huanggang Normal University

Year	2003	2004	2005	2007	2008
Ranking	487	512	505	511	505
X1	0	0	0	0	0
X2	0	0	0	0	0
X3	6.52	0.78	0.6	0.6	0.6
X4	37.75	37.75	37.8	37.3	39.9
X5	3.99	26.09	19.3	29.4	30.0
X6	9.18	9.96	12.2	18.5	17.1

The result shows that the influence degree of six key influencing factors which influence on the development level of Huanggang Normal University from high to low in turn is reputation, academic resources, academic achievements, students situation, materiel resources, faculty resources.

According to the ranking results of Huanggang Normal University since 2003, the ranking order of Central China Normal University is in 500 fluctuations around, and the rank tend is to be stable. The ranking results show that the comprehensive level of Huanggang Normal University is in low mediate level within the national ordinary universities. In addition, from the key influencing factors which influence on the development level of Huanggang Normal University, the contribution of reputation and academic resources are higher. This is because the scores of reputation and academic resources are all zero. The score results of these two aspects are derived from two basic statuses, i.e., (i) the academicians and Yangtze scholars are scarce. (ii) Huanggang Normal University was upgraded in 1999 from college to undergraduate university. There is no doctorial point, master's degree, national key disciplines, laboratory-scale national engineering centers, national key research base of humanities and social sciences and other advanced platform. In addition, the high level of academic achievement is lack due to lack of senior talent and senior platform. Moreover, Huanggang Normal University is the second batch of the undergraduate university, so the student quality of College Entrance Examination is not high.

Based on the present situation, we can conclude that Huanggang Normal University should go the development road of "mass education". As a young local university, it should adhere to the "local flavor", and actively serve the local economic and social development, train high-quality, high-grade availability, application-oriented talents and promote their development as a power; it should be

people-oriented, and actively introduce and develop top talent, efforts to improve teacher-student ratio and the proportion of senior professional titles, and actively create a good research environment to increase the output of a high level of academic achievement.

4 Conclusions

In this paper, an orientation model of educational mode based on grey relational analysis method is established to orientate the educational mode between elite education and mass education. In this model, the major factors which influence education development level are discussed, and then the advantages and disadvantages of each university can be obtained. This result can provide reasonable reference for one university to orientate the format of elite education or mass education.

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