Make the Optimal Investment Strategy

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Abstract. Nowadays more and more companies choose to invest in schools to increase their influence,which raises the question how to choose a suitable investment school from so many schools. In this paper,we classify the large number of indicators into three main factors, which are economic status, teaching quality and future development. Then an attempt has been made to determine the funded schools by evaluating the factors. In doing so, Principal Component Analysis (PCA) is utilized to analyze the economic status factor and Gray Relational Analysis (GRA) is applied in the evaluation of another two factors. Finally we adopt the Analytic Hierarchy Process (AHP) to get the final comprehensive evaluation result from which we can obtain the Final investment school.

1. Introduction

In recent years, with the rapid development of economy and society, an increasing number of charitable organizations have made significant contribution to science and technology. As a kind of unique social intermediate force, they playing an important role in educational business are worth studying.

2. The Model of Comprehensive ability of the school Evaluation

In order to initially determine the schools from a lot to invest, we first merge the information given in the collected data into 11 indicators after analyzing their properties. After that, we can classify the 11 indicators into three kinds of factors. They are economic status, teaching quality and future development. So for every factor, we set a specific model to evaluate respectively.

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specific model to evaluate respectively.

For the economic status factor, considering there are more indicators, we set a model based on Principal Component Analysis (PCA). We also define an evaluation index named stage burden rate the weight of which can be utilized to determine the indicator of weighting burden rate about every school[2].

In relation to the teaching quality and future development factors, the amount of indicators are relatively less than economic status, so we set a model based on Gray Relational Analysis (GRA) to evaluate.

After getting three different evaluation results, we apply Analytic Hierarchy Process to calculate the final comprehensive evaluation result and by doing so, we can determine the first two hundred schools initially.

2.1 The Model Preprocessing

In the section, we use some symbols for constructing the model as follows.

Table 1. Symbol and Definition

Symbol	Definition
η_i	Stage burden rate of number i
x_i	Teaching quality indicator
y_i	Economic status indicator
z_i	Future development indicator
X_t	Economic evaluation value
s_i	Grey correlation degree

2.2 Data pre-processing

In order to unify evaluation standard, we can make standard 0-1 transformation and it can make every indicators lies between 0 and 1.

For positive indicators, the standardization formula is:

$$b_{ij} = \frac{a_{ij} - a_j^{\min}}{a_j^{\max} - a_j^{\min}}$$

For negative indicators, the standardization formula is:

$$b_{ij} = \frac{a_j^{\max} - a_{ij}}{a_j^{\max} - a_j^{\min}}$$

Where a_{ij} is the data need to be standardized, $a_j^{\min}$ is the minimum data of the indicators in group j, and $a_j^{\max}$ is the maximum data of the indicators in group j. The standardization result is b_{ij}.

2.3 Evaluation Model

There are six economic status indicators of every school. To use less variables to represent the most change in the data, we build the model of principal component analysis.

First, calculate the data after standardization and obtain the coefficient of correlation matrix R. The formula is:

$$r_{ij} = \frac{\sum_{k=1}^{n} b_{ki} \cdot b_{kj}}{t-1}$$

Where r_{ij} is the coefficient of correlation of indicator i and indicator j. b_{ki} and b_{kj} is the data after standardization. t is the total amount of schools.

Next, calculate the eigenvalues and the eigenvectors. λ_i is the eigenvalue of the coefficient of correlation matrix R and $\lambda_1 \geq \lambda_2 \geq \cdots\cdots \geq \lambda_n \geq 0$. The eigenvectors of the matrix are $u_1, u_2 \cdots u_n$, where $u_j = \left[u_{1j}, u_{2j}, \cdots, u_{nj}\right]^{\mathrm{T}}$.

According to that, we can get new values consisted of the eigenvectors as the following formula.

$$y_1 = u_{11} \cdot b_1 + u_{21} \cdot b_2 + \cdots + u_{n1} \cdot b_n$$
$$y_2 = u_{12} \cdot b_1 + u_{22} \cdot b_2 + \cdots + u_{n2} \cdot b_n$$
$$\cdots$$
$$y_n = u_{1n} \cdot b_1 + u_{2n} \cdot b_2 + \cdots + u_{nn} \cdot b_n$$

Where y_1 is the number 1 principal component, y_2 is the number 2 principal component $\cdots$ n is the number of principal components.

Select m principal components, and calculate the rate of contribution of each principal components. The concrete way as follows.

$$p_i = \frac{\lambda_i}{\sum_{k=1}^{m} \lambda_k}$$

Where p_i is the rate of contribution of each principal component.

$$\alpha_m = \frac{\sum_{k=1}^{m} \lambda_k}{\sum_{k=1}^{n} \lambda_k}$$

Where α_m is the accumulated rate of contribution. We select m principal components instead of n previous principal components when α_m=0.85.

Calculate the comprehensive evaluation value of each school.

$$X_t = \sum_{i=1}^{m} p_i y_i$$

Where X_t is the comprehensive evaluation value of each school. p_i is the rate of contribution of each principal components, y_i is the principal component.

Through above calculation, we obtain the comprehensive economic evaluation of each school.

Considering the amount indicators of the teaching quality and future development factors are relatively less than economic status, we set a model based on Gray Relational Analysis as follows

Ensure the reference sequence

We select the optimal data of different factors as the reference sequence.

Ensure the weight of each indicator

Since there are little indicators to be utilized, we can use the average value of them as the weight respectively.

Calculate the grey relational coefficient

$$\zeta_i(k) = \frac{\Delta_{\min} + \rho\Delta_{\max}}{\Delta^{(0)}{}_{ik} + \rho\Delta_{\max}} (i = 1, 2, \ldots t, k = 1, 2, \ldots, m)$$

When the formula is used to calculate the teaching quality, $m = 3$ while the future development, $m = 2$.

Where :

- $\Delta^{(0)}{}_{ik} = \left| x_0(k) - x_i(k) \right|$ is absolute difference.
- $\Delta_{\min} = \min_s \min_t \left| x_0(t) - x_s(t) \right|$ is minimum difference of all indexes data.
- $\Delta_{\max} = \max_s \max_t \left| x_0(t) - x_s(t) \right|$ is maximum difference of all indexes data.
- ρ is resolution ration, $x_0(k)$ is the reference sequence, $x_i(k)$ is the compare sequence, $x_s(k)$ is the compare sequence.

Calculate the grey correlation degree of each school

$$s_i = \sum_{k=1}^{n} w_i \zeta_i(k)$$

Where w_i is the weight of every coefficient, s_i is the grey correlation degree.

We finally get the correlation degree of each school s_i. According to the order of s_i from high to low, we can observe the teaching quality and future development evaluation value of each school respectively.

3 The Results

Through the models based on Principal Component Analysis and Gray Relational Analysis, we can get three different evaluation results about the factors of economic status, teaching quality and future development. To determine the schools initially, we can still apply Analytic Hierarchy Process to calculate the final comprehensive evaluation result. By doing this, we initially determine two hundred schools according to the magnitude of the final result and the top-ten schools are listed in Table 2 by their unit ID.

Table 2. The final comprehensive evaluation result

UNITID	Economic status	Teaching quality	Future development	Final result
173984	0.629	0.675	0.503	0.602
419457	0.600	0.683	0.503	0.595
139074	0.534	0.801	0.442	0.592
459994	0.648	0.728	0.382	0.586
137148	0.574	0.678	0.503	0.585
439057	0.532	0.717	0.503	0.584
105172	0.516	0.805	0.428	0.583
480091	0.526	0.796	0.417	0.580
134149	0.472	0.715	0.546	0.578
443766	0.670	0.661	0.382	0.571

From the above results can be seen that the highest score in school is Code name 134149

References

[1] Davis J R, Morrall J F. Evaluating educational investment[M]. Lexington Books, 1974.

[2] Hansen W L. Total and private rates of return to investment in schooling[J]. The Journal of Political Economy, 1963: 128-140.

[3] Shoukui Si, Xijing Sun. Mathematical modeling algorithm and application[M]. National defence industry press, 2011.