Make the Optimal Investment Strategy
Wang ying dong¹,a
 ¹North China Electric Power University (Bao Ding), Hebei, China
  a743298926@qq.com

Keywords: Optimal Investment Strategy Return-on-Investment (ROI) Principal Component Analysis (PCA) Gray Relational Analysis (GRA)

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.

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.

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\eta_i)</td>
<td>Stage burden rate of number (i)</td>
</tr>
<tr>
<td>(x_i)</td>
<td>Teaching quality indicator</td>
</tr>
<tr>
<td>(y_j)</td>
<td>Economic status indicator</td>
</tr>
<tr>
<td>(z_i)</td>
<td>Future development indicator</td>
</tr>
<tr>
<td>(X_t)</td>
<td>Economic evaluation value</td>
</tr>
<tr>
<td>(s_i)</td>
<td>Grey correlation degree</td>
</tr>
</tbody>
</table>

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:

\[
b_{ij} = \frac{a_{ij} - a_{\text{min}}}{a_{\text{max}} - a_{\text{min}}}\]

For negative indicators, the standardization formula is:

\[
b_{ij} = \frac{a_{\text{max}} - a_{ij}}{a_{\text{max}} - a_{\text{min}}}\]

Where \(a_{ij}\) is the data need to be standardized, \(a_{\text{min}}\) is the minimum data of the indicators in group \(j\), and \(a_{\text{max}}\) 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. \(\lambda_i\) is the eigenvalue of the coefficient of correlation matrix \(R\) and \(\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_n \geq 0\). The eigenvectors of the matrix are \(u_1, u_2, \cdots, u_n\), where \(u_j = [u_{1j}, u_{2j}, \cdots, u_{nj}]^T\).

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

\[
y_1 = u_{11} \cdot b_1 + u_{21} \cdot b_2 + \cdots + u_{n1} \cdot b_n
\]
\[
y_2 = u_{12} \cdot b_1 + u_{22} \cdot b_2 + \cdots + u_{n2} \cdot b_n
\]
\[
\vdots
\]
\[
y_n = u_{1n} \cdot b_1 + u_{2n} \cdot b_2 + \cdots + u_{nn} \cdot b_n
\]
Where \( y_1 \) is the number 1 principal component, \( y_2 \) is the number 2 principal component \( \cdots \) \( y_n \) is the number of principal components.

Select \( m \) principal components, and calculate the rate of contribution of each principal component. 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 \( \alpha_m \) is the accumulated rate of contribution. We select \( m \) principal components instead of \( n \) previous principal components when \( \alpha_m = 0.85 \).

Calculate the comprehensive evaluation value of each school.

\[
X_i = \sum_{j=1}^{m} p_j y_j
\]

Where \( X_i \) is the comprehensive evaluation value of each school, \( p_i \) is the rate of contribution of each principal components, \( y_j \) 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**

\[
\zeta_i(k) = \frac{\Delta_{\min} + \rho \Delta_{\max}}{\Delta_{0\min} + \rho \Delta_{0\max}} (i = 1, 2, \ldots, k = 1, 2, \ldots, m)
\]

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

Where :

- \( \Delta_{0\min} = |x_0(k) - x_i(k)| \) is absolute difference.
- \( \Delta_{\min} = \min_s \min_t |x_0(t) - x_s(t)| \) is minimum difference of all indexes data.
- \( \Delta_{\max} = \max_s \max_t |x_0(t) - x_s(t)| \) is maximum difference of all indexes data.
- \( \rho \) 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**

\[
s_i = \sum_{k=1}^{n} w_k \zeta_i(k)
\]

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

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

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

References