Decision making method of University Asset Allocation Based on Deng's grey relational analysis

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Abstract. At present, most of the domestic colleges and universities have been using management information system which records the history and status of all assets in detail to achieve asset management. Mining and analyzing the huge asset data of colleges and universities can better provide scientific basis for university management and decision-making. This paper proposes to use Deng's grey correlation analysis method to analyze the situation of assets replacement in colleges and universities, so as to provide decision support for asset allocation.

1. Introduction
In the 21st century, the rapid development of economy in China promotes the development of higher education. The expansion of university enrollment and school scale increases the number and type of fixed assets in colleges and universities, which generates large pressure on fixed assets management in colleges and universities[1]. University assets are the basis of teaching, scientific research and innovation with high utilization rate and fast update frequency. Some large-scale precision instruments and equipment are an important part of the national budget allocation, with strong professionalism and high operating cost. Therefore, how to allocate university assets efficiently, balance the replacement frequency of university assets, and improve the efficiency of asset utilization are important issues in asset management. The history and current situation of assets recorded in the asset information management system of colleges and universities constitute the dynamic assets database. The data analysis and mining of this database will provide important support for asset allocation decision-making in colleges and universities. Therefore, we should find a scientific and effective data analysis model to analyze the dynamic database of university assets, discover the dynamic law of asset replacement, and establish an efficient asset allocation decision-making system.

2. Construction of asset replacement prediction and analysis system
According to the relevant policies and the actual situation of domestic colleges and universities, the main indicators affecting asset replacement and allocation can be classified into the following indicators:

- asset value which is the original value of purchased or constructed assets;
- the remaining service life of assets which is the difference between the depreciation period of assets and the useful life of assets;
- the utilization rate of assets which is the utilization frequency of daily assets;
the quality of assets which is the user's assets Evaluation value of production and quality. We can use Deng's grey correlation analysis algorithm to mine the relationship between asset replacement and the above indicators.

3. Introduction of grey correlation analysis method
Grey system theory is a kind of system science theory initiated by Professor Deng Julong, a famous scholar. Grey correlation analysis is a description of the interrelation degree of different factors in the same system and the impact of individual independent factor on the system[2-4]. Through the quantitative analysis of the development trend of the dynamic process, this method compares the geometric relations of the statistical data of the time series in the system, and obtains the grey correlation degree between the reference series and the comparison series. The greater the correlation between the reference sequence and the comparison sequence, the closer the development direction and speed to the reference sequence, and the closer the relationship with the reference sequence. The basic idea is to make the original observation number of the evaluation index dimensionless, calculate the correlation coefficient, correlation degree and sort the evaluation index according to the size of the correlation degree.

3.1. Steps of grey relational analysis algorithm

3.1.1. Determine analysis sequence.
The reference sequence which reflects the characteristics of system behavior and the comparison sequence that affects the system behavior is determined. The data sequence that reflects the characteristics of system behavior is called reference sequence. A data sequence composed of factors that affect the behavior of a system is called a comparison sequence.

Set the reference sequence (also known as the parent sequence) be

\[ y = \{y(k) \mid k = 1,2,\ldots,n\} \quad (1) \]

\[ x_i = \{x_i(k) \mid k = 1,2,\ldots,n,i = 1,2,\ldots,m\} \quad (2) \]

3.1.2. Dimensionless variable. Because the data in each factor column of the system may be different due to different dimensions, it is not convenient to compare or to get correct conclusions when comparing. Therefore, the dimensionless data processing is generally needed in the analysis of grey correlation degree.

3.1.3. Calculation of correlation coefficient. Correlation coefficient of \( x_0(k) \) and \( x_i(k) \) is as follows.

\[ \rho_i(k) = \frac{\min_{i} \min_{k} |y(k) - x_i(k)| + \rho \max_{i} \max_{k} |y(k) - x_i(k)|}{\max_{i} \max_{k} |y(k) - x_i(k)|} \quad (3) \]

\( \rho \) is called the discrimination coefficient. The smaller \( \rho \) is, the greater the discrimination is. The value range of rho is generally (0,1) and the specific value may be determined according to the situation. The discrimination is coefficient best set to 0.5.

3.1.4. Calculation of correlation degree. Because the correlation coefficient is the correlation degree value between the comparison series and the reference series at each moment (namely, each point in the curve), it has more than one number, and the information is too scattered to facilitate the overall comparison. Therefore, it is necessary to set the correlation coefficient of each moment (that is, each point in the curve) into a value, namely, to obtain its average value, which can be used as the quantity to represent the degree of correlation between the comparison sequence and the reference sequence. The correlation degree RI formula is as follows:
\[ r_{0i} = \frac{1}{n} \sum_{k=1}^{n} \xi_{0i}(k) \]  

(4)

3.1.5. Order of correlation degree. If \( r_1 < r_2 \), the reference sequence \( y \) is more similar to the comparison sequence \( x_2 \). After the correlation coefficient of \( x_i(k) \) sequence and \( y(k) \) sequence is calculated, the average value of various correlation coefficients is calculated, and the average value \( r_i \) is called the correlation degree of \( y(k) \) and \( x_i(k) \).

4. Grey correlation analysis of asset turnover

4.1. Index quantification

The selected indicators that affect the replacement and allocation of assets are quantified, among which the value of assets and the remaining useful life of assets can be taken as their own values, the asset utilization rate and asset quality are surveyed by questionnaire, and the record of asset users' use frequency and asset quality is collected and recorded by percentage. Asset turnover is recorded in three states: replacement, maintenance, non-maintenance, or replacement using the natural number respectively. Intercept part of the assets in the database to obtain the original data as follows:

| Sequence | Data 1 | Data 2 | Data 3 | Data 4 | Data 5 | Data 6 |
|----------|--------|--------|--------|--------|--------|--------|
| Need repair or replacement | 3      | 3      | 3      | 2      | 3      | 2      |
| Asset prices in use | 4000   | 5500   | 4500   | 5000   | 4400   | 5700   |
| Remaining service life | 1      | 2      | 1      | 3      | 2      | 3      |
| Usage | 0.7    | 0.8    | 0.7    | 0.8    | 0.6    | 0.8    |
| Quality assessment | 0.3    | 0.4    | 0.3    | 0.5    | 0.4    | 0.6    |

4.2. Grey Correlation Analysis

4.2.1. Dimensionless variable.

To calculate the initial value image of the sequence, the process is as follows: select the index in the first column as the benchmark, and divide all subsequent indexes of other assets by the data in the first column.

| Sequence | Data 1 | Data 2 | Data 3 | Data 4 | Data 5 | Data 6 |
|----------|--------|--------|--------|--------|--------|--------|
| 1.00     | 1.00   | 1.00   | 0.67   | 1.00   | 0.67   |
| 1.00     | 1.38   | 1.13   | 1.25   | 1.10   | 1.43   |
| 1.00     | 2.00   | 1.00   | 3.00   | 2.00   | 3.00   |
| 1.00     | 1.14   | 1.00   | 1.14   | 0.86   | 1.14   |
| 1.00     | 1.33   | 1.00   | 1.67   | 1.33   | 2.00   |

4.2.2. Calculate difference sequence. The absolute difference between each indicator and \( x_i \) in the variable value after dimensionless transformation is calculated, and the maximum range value is 2.3333, and the minimum range value is 0.0000.

4.2.3. Calculation of correlation coefficient. Take \( \rho \) as 0.5 and calculate the correlation coefficient as follows:
Table 3. Calculation of correlation coefficient

|       | 1.00 | 0.76 | 0.90 | 0.67 | 0.92 | 0.61 |
|-------|------|------|------|------|------|------|
| 1.00  | 1.00 | 0.54 | 1.00 | 0.33 | 0.54 | 0.33 |
| 1.00  | 0.89 | 1.00 | 1.00 | 0.71 | 0.89 | 0.71 |
| 1.00  | 0.78 | 1.00 | 0.54 | 0.78 | 0.47 |      |
| 1.00  | 0.76 | 0.90 | 0.67 | 0.92 | 0.61 |      |

4.2.4. *Calculation of correlation degree*. By substituting into the correlation degree calculation formula, the correlation degrees of other sequences and sequence 1 are respectively: 0.81, 0.62, 0.87, 0.76.

4.2.5. *Interpretation of result*. According to these results, it can be seen that the asset turnover is greatly influenced by the order of assets respectively using frequency, asset value and asset quality, assets, according to these results, it can be seen on asset turnover situation influential order of assets respectively using frequency, asset value and asset quality, assets remaining useful life.

5. **Conclusion**

A large amount of historical data have been accumulated in the asset management system of colleges and universities. This paper uses Deng’s grey correlation analysis method to find out the factors related to the asset turnover rate and gives the calculation process. By using this method, it is convenient for managers to manage assets scientifically and rationally.

**References**

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