Model for Determination of Candidate Schools

Yulan Shen

[1]School of North China Electric Power University, Baoding 071000, China;

2351545956@qq.com

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Abstract. The Goodgrant Foundation is devoted to the educational performance of undergraduates attending colleges. A series of realistic, sensible, and useful mathematical model are established to determine the optimal investment strategy of the Goodgrant Foundation.

In order to determine the candidate list of schools and time duration, a comprehensive evaluation model based on TOPSIS Method is established. To avoid the investments and focus of other large grant organizations such as the Gates Foundation, we use product integrated weighting method. According to the evaluation results, the length of time duration is divided into 4 categories: Five years, Four years, Three years and Two years.

Introduction

Education is the focus of the charitable foundation investment. Since the United States has a large number of universities which show different characteristics. Therefore, a reasonable allocation and investment of funds is the focus of Foundations.

The optimal investment strategy first needs to determine 1 to N optimized and prioritized candidate list of schools. Given the College Scorecard Data[1], but some of the data sets are meaningless, so we first screen the candidate schools.

In order to sort the funds utilization potential of different candidate schools, we plan to build the comprehensive evaluation model based on TOPSIS Method[2], regard the potential for effective use of private funding as the evaluation object and select a series of evaluation indexes. And determine the objective weight of each index by Entropy Value Method, then, give a reasonable sort of candidate schools according the evaluation results.

Evaluation indexes of the potential for effective use of funds

Given a large number of variables and data sets, taking into account the academic degree, Admission scores, family net price and other factors have a greater impact on the students' performance, we select the following 7 indexes: Degree, Pell Grant, Average Debt, Average Wages, Family Net Price, Admission Scores, High Wage Ratio.

Among them, the admission scores is made up of the SAT scores and ACT scores, and the others can be obtained directly from the table.

The level of the degree and admission scores reflect the utilization of funds; average wage and high wage ratio reflect the feedback effects; family net price, average debt and Pell grants reflect students' need for funds; Pell grants reflect the allocation of funds.

Analyze the data and Screen the candidate schools

Three excel tables are given in the title: IPEDS UID for Potential Candidate Schools, it contains the basic information of 2,977 candidate schools; Most Recent Cohorts Data (Scorecard Elements), it contains the detailed information of 7,804 candidate schools; College Scorecard Data Dictionary, it contains detailed description of variables.

Since some of the data sets which affect the potential for effective use of private funding are meaningless, we have to screen the potential candidate schools. We first match the 2,977 schools in Table 2 with the 7,804 schools in Table 1, and screen out 2,936 potential candidate schools with detailed

information.

Then, according to the admission scores, we eliminate the school lack of admission scores, and 1,204 schools were screened out. Finally, we screen 1,165 potential candidate schools based on the wages and average debt.

Evaluation Model of candidate schools based on TOPSIS

Step 1: Determine the weight coefficient of each index[3]

(1)The objective weight w_{1j} is determined by entropy method

Since the influence degree of the academic degree, admission scores, wages, average debt, family net price, Pell Grant on the potential for effective use of funds is different, we use the Entropy Method to determine the objective weight coefficient.

Where, in addition to the family net price is a negative index, others are positive indexes, that is, the greater of the weight coefficient, the better it is.

(2)The subjective weight w_{2j} is determined by AHP

The Gates foundation mainly aims at helping the minority students and students with poor family economic conditions to get the education.

In order not to duplicate the investments and focus of other large grant organizations such as the Gates Foundation, we do not consider the racial discrimination, and reduce the weight of Pell Grant subjectively

(3)The final weight w_j

$$w_j = \frac{w_{1j} \bullet w_{2j}}{\sum_{j=1}^{m} w_{1j} \bullet w_{2j}} \qquad (1)$$

The answers are described as follows:

Table1:The final weight coefficient w_j

Degree	Family net price	Admission scores	Pell Grant	Average wage	High wage ratio	Average debt
0.0147	0.0891	0.4598	0.1798	0.1629	0.0215	0.0722

Step 2: Calculation of comprehensive evaluation index value by TOPSIS

In order to analyze the fund utilization potential of different schools, we calculate the close degree of the index values and the ideal values of all the candidate schools, so as to make a reasonable sort of school.

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First, determine the positive and negative ideal solution ($x_1^*, x_2^*, \cdots, x_m^*$). In this model, regard the optimal value and the difference value of each index attribute in all candidate schools as the positive and negative ideal solutions.

Then, calculate the distance between each index value to the positive or negative ideal solution:

$$d(x_{ij}, x_j^*) = (x_{ij} - x_j^*)^2$$

Where: $x_{ij} \in [0,1] (i = 1, 2 \cdots n; j = 1, 2 \cdots m; n = 1165, m = 7)$ is the j evaluation index of i candidate school.

Finally, constructing a comprehensive evaluation function:

$$y_i = \sum_{j=1}^{m} d(x_{ij}, x_j^*) = \sum_{j=1}^{m} w_j (x_{ij} - x_j^*)^2, i = 1, 2 \cdots n \qquad (2)$$

Where, w_j is the weight coefficient of each index; y_i reflect the difference between the index value and the ideal value of the Candidate School i.

Solving

As is shown in Table 4-3, the weight coefficient has been determined. According to the known data and formula two, the comprehensive evaluation values of the indexes of the 1165 candidate schools are calculated, and finally 14 optimized candidate list of schools are screened out as follows:

Table 4-4: The Comprehensive evaluation value of Candidate Schools

UNITID	Degree	Family net price	Admission scores	Pell Grant	Average wage	High wage ratio	Average debt	Sort
179265	4				111600	0.922	17500	1
177214	3	23726	79.57	0.9259	32200	0.532	23500	2
156295	3	1776	77.00	0.8293	34400	0.467	5750	3
166683	3	21816	105.57	0.1825	91600	0.873	13645	4
166027	3	14049	105.48	0.1016	87200	0.876	6000	5
166656	3	34345	76.10	0.3009	116400	0.927	25000	6
243744	3	15713	102.81	0.1596	80900	0.868	12224	7
188526	3	29630	83.90	0.2215	110600	0.912	25000	8
190150	3	22672	103.05	0.2154	72900	0.823	19435	9
110680	3	14421	88.76	0.4274	59600	0.710	19266	10
115409	3	24311	104.62	0.1314	78600	0.818	25696	11
186131	3	8413	104.19	0.1218	75100	0.755	6810	12
110635	3	13769	94.29	0.3237	62700	0.736	14667	13

Table 4-5: The detailed information of Candidate Schools

UNITID	Candidate Schools
179265	St Louis College of Pharmacy
177214	Drury University
156295	Berea College
166683	Massachusetts Institute of Technology
166027	Harvard University
166656	MCPHS University
243744	Stanford University
188526	Albany College of Pharmacy and Health Sciences
190150	Columbia University in the City of New York
110680	University of California-San Diego
115409	Harvey Mudd College
186131	Princeton University
110635	University of California-Berkeley

Based on the evaluation values of each indexes, 13 candidate schools can clearly produce a better impact on students' performance

Summary

It can be seen, the effect of using TOPSIS to the school rankings screening is very good. The schools chosen are a lot of well-known universities or universities with black or special ethnic groups, in line with our expectations. Using the combination of subjective and objective weight determination method, is also an improvement of this method and highlights.

References

[1] The College Scorecard Data http://collegescorecard.ed.gov

[2] Si Shou-kui, Sun Xi-jing. Mathematical modeling algorithm and application.

[3] Wang Hui, Chen Li, Chen Ken, man Qing Xue Liang Qing. The multi index comprehensive evaluation method and the weight coefficient [J]. Academic Journal of Guangdong College of pharmacy, 2007,05:583-589.