

Each Investment Leads to Its Repayment

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Abstract. Our basic model has two parts, to divide the data set according to different classes by K-mean Clustering Analysis, and to find the optimal strategy by using eclectic fuzzy decision-making model. In the extended model, we discuss the return on investment and define the return on investment (ROI) for a charitable organization such as the Goodgrant Foundation. Considering the progress of students during the college and analyzing the data for five years, the result of the optimal strategy is obtained.

The 7383 colleges are divided into 6 clusters by using the K-mean Clustering Analysis method. Moreover, we analyze the values of the relative parameters and find the colleges of the fourth type are optimal. The result of cluster analysis shows that the number of the universities more likely to be donated is 1309.

Next, considering the five major elements that impact the optimal strategy and using eclectic fuzzy decision-making method, the top 50 colleges that will be donated is obtained.

Finally, considering that the progress the students make in the college might impact the optimal strategy, the enrollment achievement is taken into account. After considering the enrollment achievement, it turns out that the ranking of the universities changed greatly. Meanwhile, when different weight is attached to the five elements, the result also changes.

Introduction

Endowment fund of universities such as the Goodgrant Foundation play an important role in the higher education system. The purpose of the funds is to provide ongoing financial support to higher education [1]. For producing a strong positive effect on student performance, the investment strategies should be attached importance by the manager of the Foundation organization.

Shortage of funds for universities' development is not only difficult to meet the needs of universities' continued development, and funding issues has become a bottleneck restricting to universities. Therefore, the foundation is of importance to the universities short of funds. As a charitable organization, the Goodgrant Foundation is prepared to donate a total amount of \$100,000,000 each year to appropriate universities since 2016. However, the foundation wants to avoid repeated investment in order to make the investment more meaningful.

To provide an optimal investment strategy, there are many elements to be taken into account. Still, we need to find out schools to be invested, the amount of investment for each school and the time duration of investing. In rush for higher returns, the return-on-investment also needs considering.

Model Overview

The model can be divided into two parts: to divide the data set according to different classes by k-mean clustering analysis, and to find the optimal strategy by using eclectic fuzzy decision-making model.

By using the K-mean Clustering Analysis [6] method, 1309 universities that are more appropriate can be screened. The amount of data thus becomes significantly smaller.

Next, we consider four major elements that impact the investment strategy. Depending on the reality, the relationship is created between the major elements and the data collected. To examine

the question of optimal investment strategies for university endowment funds, one must of course address the issue of the objective function by which optimality is to be measured [4]. Using eclectic fuzzy decision-making model, the relationship between the optimal strategy and the five major elements can be obtained. Then, the result of the universities selected can be given.

Solutions to the Requirement

Categorize the 7383 colleges into six types and choose 1309 colleges that are more appropriate.

Using K-mean Clustering Analysis method, we categorize the 7383 colleges into six clusters under the assumption that the main bases for classification are the completion rate, the income of students after graduation, the repayment and the index of cash monitoring. The foundation does not want to invest into the colleges on Heightened Cash Monitoring 2. Analyzing the data in the **Tab 1**, the forth cluster is chosen as the group of universities that are more likely to be invested into. The number of the colleges is 1309. Still, the indexes of cash monitoring of the 1309 colleges all equal to 0, which means that these universities all make good use of private funding.

Tab 1.

The result of the cluster analysis

factor	cluster					
	1	2	3	4	5	6
cmprate	0.3014	0.6947	0.1101	0.6854	0.7742	0.1294
earning	0.1227	0.0741	0.0955	0.1437	0.1010	0.1022
earn-rate	0.5880	0.3878	0.4822	0.6619	0.4614	0.4991
hcm2	0	0	0	0	1	1
rpy	0.7101	0.5035	0.5041	0.8474	0.5725	0.5637

Tab2.

The number of universities in each cluster

classification	number of universities
1	1414
2	2436
3	2159
4	1309
5	36
6	29
valid	7383
missing	0

Identify the schools and the investment amount per school.

At first, we take into account five major elements impacting the investment strategies. For the indexes of cash monitoring of the 1309 universities all equal to 0, the “use of private funding” is neglected. Thus, there remains four major elements to be further analyzed. The “repeated investment” is represented by the percentage of undergraduates who receive a Pell Grant. In the basic model, we suppose the “student performance” is only related to the completion rate and income of students after graduation.

Considering that the data given in the question is abundant, data filtering is necessary.

In the basic model, the same weight is endowed with different key factors. That is to say, the four major elements each weighs 25%. In the same category, each element is also regarded as equally important, except in the subsidized situation of university. Pell Grants accounting for 60% and federal loans accounting for 40% when constituting the standard.

According to the processed data, the values of the four elements of the 1309 universities are

obtained. Suppose the weight of each factor is 25%, the result of the top 50 colleges is as follows.

Tab 8. Top 50 colleges and corresponding investment amount

Priority	Unit ID	University Names	Amount/Million dollar
1	191287	The International Culinary Center	0.245243
2	191311	Gemological Institute of America-New York	0.090193
3	114947	Gemological Institute of America-Carlsbad	0.087735
4	217493	Rhode Island School of Design	0.886146
5	199847	Wake Forest University	2.113872
6	192712	Manhattan School of Music	0.164807
7	211440	Carnegie Mellon University	2.50965
8	441229	West Coast Ultrasound Institute	0.292181
9	122931	Santa Clara University	2.303882
10	167057	The New England Conservatory of Music	0.174339
11	211291	Bucknell University	1.484873
12	231624	College of William and Mary	2.634534
13	198516	Elon University	2.362189
14	193900	New York University	9.337876
15	216597	Villanova University	2.882495
16	129242	Fairfield University	1.559657
17	179867	Washington University in St Louis	2.870304
18	164988	Boston University	6.89353
19	161208	The Landing School	0.03473
20	164580	Babson College	0.880853
21	112260	Claremont McKenna College	0.547012
22	237057	Whitman College	0.633535
23	168421	Worcester Polytechnic Institute	1.660583
24	164924	Boston College	3.914472
25	179159	Saint Louis University	3.291654
26	116846	American Jewish University	0.044993
27	131496	Georgetown University	2.98893
28	168148	Tufts University	2.117226
29	217402	Providence College	1.63133
30	147767	Northwestern University	3.639362
31	152318	Rose-Hulman Institute of Technology	0.885972
32	160977	Bates College	0.732268
33	131469	George Washington University	4.135235
34	131159	American University	2.789441
35	215770	Saint Joseph's University	2.149676
36	130590	Trinity College	0.913718
37	163046	Loyola University Maryland	1.61915
38	228875	Texas Christian University	3.501547
39	194824	Rensselaer Polytechnic Institute	2.189449
40	214175	Muhlenberg College	0.959246
41	166009	Hallmark Institute of Photography	0.028065
42	130794	Yale University	2.202284
43	135726	University of Miami	4.565406
44	234207	Washington and Lee University	0.748769
45	197708	Yeshiva University	1.169192
46	216287	Swarthmore College	0.616972
47	213543	Lehigh University	1.984143

48	167358	Northeastern University	5.341436
49	164739	Bentley University	1.686764
50	165662	Emerson College	1.50308

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