A Win-Win Investment Strategy Based on CW-TOPSIS

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Abstract. Our goal is a model to determine an optimal investment strategy. First of all, data preprocessing is significantly indispensable for a kind of data insight problem. Cluster analysis is such a kind of algorithm for preprocessing data. We classify the factors as five groups, and each group has the similar nature (Fig.2,3). We choose five most important factors for future analysis.

For determining an optimal investment strategy, we start our first model by re-build the AHP. We list the optimal candidates list of 2170 schools and give the amount per school (Table.3).By evaluating the AHP, we find that the AHP depends too much on subjective weight, and ignore the objective factors. On the contrary, a method named entropy depends mostly on objective weight. So we combine AHP and entropy together and we get the Composite weights-TOPSIS, where TOPSIS is an algorithm for getting a 1-N optimized candidate list of school (Table.7).

1. Introduction

We are discussing the problem basing on the problem C in 2016MCM. The Goodgrant Foundation is a charitable organization that wants to help improve educational performance of undergraduates attending colleges and universities in the United States. To do this, the foundation intends to donate a total of $100,000,000 (US100 million) to an appropriate group of schools per year, for five years, starting July 2016. In doing so, they do not want to duplicate the investments and focus of other large grant organizations such as the Gates Foundation and Lumina Foundation. To develop a model to determine an optimal investment strategy that identifies the schools and the investment amount per school, we should analyze the specific problems.

We face four mainly problems as listed:

- Seek out the colleges and universities record, which is representative.
- The model we make should be suitable for any kind of similar order and any time.

2. Data Preprocessing

We ignored 807 schools, which are lack of data. Therefore, there are still 2170 potential candidate schools. We will analysis the investment strategy based on these 2170 schools.

Microsoft Excel is powerfulsoftware, and we solved the problem by using the INDEX and the MATCH function.

Table 1 shows the result of data preprocessing. *We replaced the "PrivacySuppressed" and "NULL" with the average value.*

Table 1. The result of Data Preprocessing

N	INSTNM	PREDDEG	…	gt_25k_p6
1	California State University-Bakersfield	3		0.650056601
2	University of California-Berkeley	3		0.735725939
3	California Christian College	3		***PrivacySuppressed***
4	California Maritime Academy	3		0.765550256
⋮				
2169	Alaska Christian College	1		***NULL***
2170	Stella and Charles Guttman Community	0		***NULL***

3. Cluster analysis for selecting the major factors

We analyzed the factors and selected 9 factors we considered useful based on our assumption. Then, we chose the Group Average, a kind of Robert Tryonclustering.

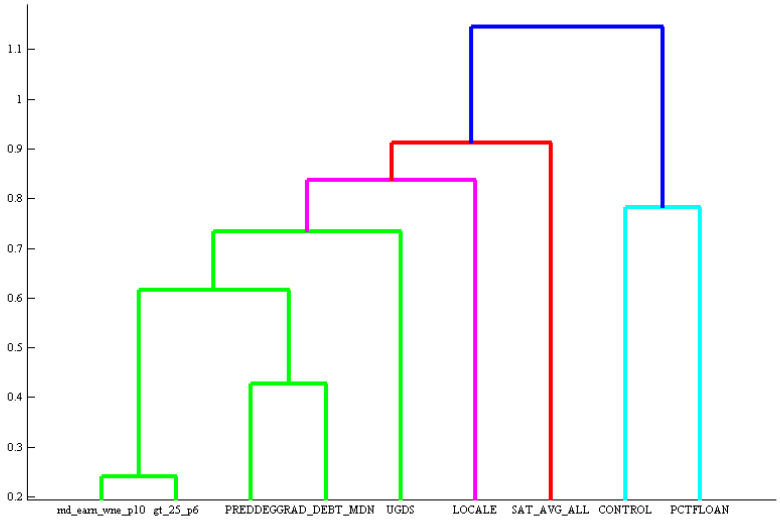


Figure 1 shows the result of clustering analysis. The 9 main factors are divided into five classes:

4. Display of cluster analysis result

Choose one factor from every class, and then get the five most important factors. These five factors are: md_earn_wne_p10, CONTROL, LOCALE, SAT_AVG_ALL and PCTFLOAN. *This is a result of statistic, represents the useful, meaningful, representative of our data*.

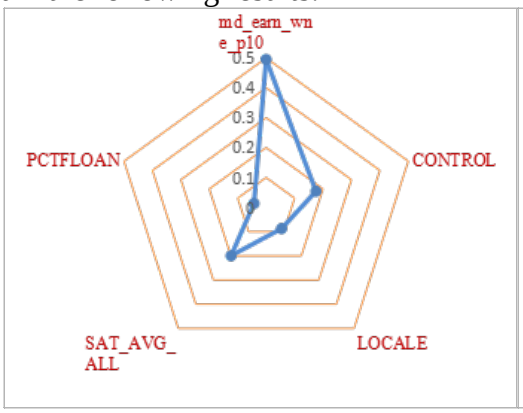
Figure 2 clearly shows the result of *Cluster analysis* result. It includes 12 factors concerned. Red means important, yellow means less important, blue means unimportant.

114 factors turn out to be 13 and only five of them are the most important factors. Then, we start our modeling base on the five factors and 2170 schools.

5. The Composite Weight-TOPSIS (CW-TOPSIS) model（1）（ 2）

5.1 Result and analysis

We obtain the following results:



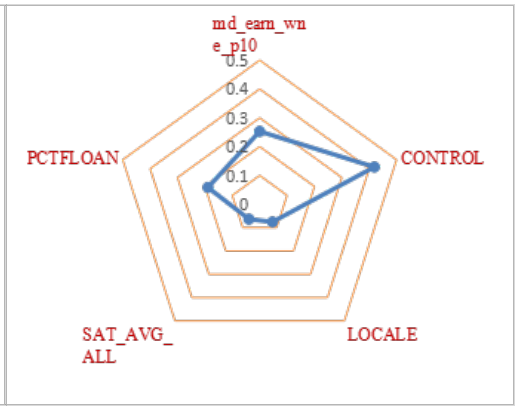


Figure 3.The weight by AHP.(3) **Figure 4**.The weight by entropy

Now, we give the value of β, and the table below is an investment strategy when $\beta = 0.5$.

Table 2. An optimal investment strategy based on CW-TOPSIS

N	INSTNM	STABBR	Score	Money
1	Albany College	NY	0.8867	$137,962
2	MCPHS University	MA	0.8447	$131,427
3	St Louis College	MO	0.8387	$130,485
4	United States Merchant Marine Academy	NY	0.7414	$115,350
5	Harvard University	MA	0.7252	$112,831
6	Babson College	MA	0.6848	$106,539
7	Massachusetts Institute of Technology	MA	0.6711	$104,41

8	Stevens Institute of Technology	NJ	0.6635	9 $103,230
⋮				
2167	Mesalands Community College	NM	0.1052	$16,372
2168	Commonwealth Technical Institute	PA	0.0922	$14,348
2169	CBD College	CA	0.0877	$13,651
2170	Wright Career College	KS	0.0821	$12,776

6. Conclusion

Table 2 shows the investment strategy based on CW-TOPSIS, is part of the 1 to 2170 optimized and prioritized candidate's list of schools we are recommending for. Here come the following conclusions:

- Schools which are famous not always get a better score and receive more money from the Goodgrand Foundation.
- The students who make more money after graduation will lead a higher score of their schools.
- All schools in the candidate list will get the money, but the amount per school is different. And the strategy is more reasonable compare to the old one.

We found that the AHP method exist some weakness. The AHP is a representative of calculating subjective weight, which ignores the objective factors. The Entropy is a representative of calculating objective weight. It depends on objective numerical indicators, but ignores the relevant experts experience and subjective judgment. So we introduced the preference factor β to combine them together. Composite Weight-TOPSIS (CWTOPSIS) is the Strengths of our model.

Above all, CW-TOPSIS is more objective, this is the optimal investment strategy we choose to calculate the RIO.

Reference

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