The Application of Analytic Hierarchy Process in The school evaluation and investment

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Keywords: Analytic Hierarchy Process, school evaluation

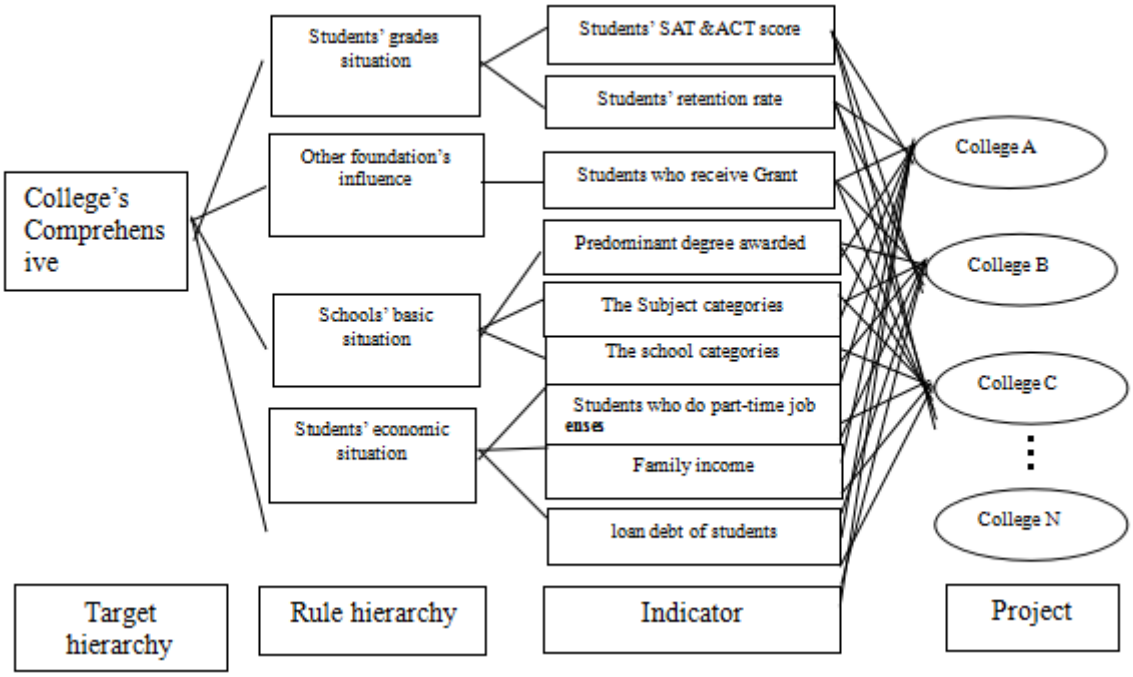
Abstract. We normalize the data we need at the beginning.Then we use analysis hierarchy process to evaluate a college by proposing a comprehensive index which is composed of 4 big factors[1].The comprehensive index is calculated by the accumulation of these indexes according to different weights,and these weights are decided by the comparison matrix.

Introduction

Analytic hierarchy process (AHP) is a decision-making method for multi-index, multi-standard problems[2] . It is particularly suitable in situation where results cannot be got by accurate calculation directly. We divide the university evaluation index into 4 big types :Students' grades situation,Other foundations' influence,School basic situation and Students' economic situation

The Application of Analytic Hierarchy Process

Hierarchical Structure First,we establish Hierarchical structure model.We put decision-making target, considering factors (decision criterion) and decision-making object into the top, the middle and the low layer according to the relationship, then we draw the hierarchical structure picture.
We considered previous study and the analysis of the data.We established an evaluating index system shown in the figure 1 above.In figure 1 above,we divide colleges' comprehensive indexes into 4 parts,this layer is called the rule hierarchy,and the rule hierarchy is composed of several corresponding estimate factors,and it is estimate indexes integrated from factors of the same kind in indicator hierarchy.Indexes in rule hierarchy include:Students' grades situation,Other foundations' influence,School basic situation and Students' economic situation.



Form 1 AHP Hierarchical Structure

(1) We put the the students' grades situation in the first place[3].We evaluate it from two aspects(Students' SAT score and Students' retention rate) from the data,then we give these two aspects different weight(we will give the weight matrix later)so that they can determine the value of the students' grades situation.

(2) Because the we want to avoid investing the same school as the previous organization did,so we put the other foundations' influence in the second place.We use students who receive grant to evaluate it.

(3) We think that schools' basic situation is also an important standard to choose the optimal school.There are three aspects in it:predominant degree awarded,the subject categories and the school categories.The predominant degree awarded reflect the school's educational level.The higher the school's educational level is, the bigger the predominant degree they can award.The subject categories reflect the comprehensiveness of the school.If the school has many different subject,its scale will be more bigger,then they need more investment to support their daily expenses .The school categories is the type of the school,we can judge that if we need to invest this school by analyze it.

(4) It is easy to understand that students' economy situation is one of the important factors.This part includes three aspects:students who do part-time job,family incomes and the loan debt of students.Students who do part-time job may have difficult in money,family incomes clearly shows the students' ability to pay,and the students who have loan debt need more donations than others.

Weight Determination When determining the weight of each level between various factors, if it is only the result of the qualitative analysis, which is often not easy to be accepted, so we plan to use the method consistent matrix method.And its main concept is :

Don't put all the factors together to compare, but to compare them with each other.In order to improve the accuracy,we use the relative scale when comparing so that we can reduce the difficulty to compare the different factors as much as possible.The judgment matrix is shown below.

Form2 Comparison Matrix in Rule Hierarchy

	C1	C2	C3	C4
C1	1	b_{12}	b_{13}	b_{14}
C2	b_{21}	1	b_{23}	b_{24}
C3	b_{31}	b_{32}	1	b_{34}
C4	b_{41}	b_{42}	b_{43}	1

As is shown in the table 1,if $b_{12=}7$,it means C1 is a much more important C2,and the importance degree valuation is shown in the following table.

Form 3 Importance Degree Valuation

SCALE	RELATIVE IMPORTANCE
1	Equally important
3	A little more important
5	More important
7	Much more important
9	Rather more important

Note: 2,4,6,8 is relative importance lying between adjacent scales; $b_{ij} = \frac{1}{b_{ji}}$

Single hierarchical arrangement

The single hierarchical arrangement,the sort of the importance of various factors in this level according to a certain factor from former layer

(1)normalize each column of the matrix, $b_{ij} = \frac{b_{ij}}{\sum_{i=1}^{n} b_{ij}}$

(2)The normalized matrix according to the column, then get the sum according to the row. $\overline{W} = (\overline{W}_1, \overline{W}_2, ..., \overline{W}_n)$

(3)normalize the vector $W_i = \frac{\overline{W}_i}{\sum_{j=1}^{n} \overline{W}_i}$

(4)calculated the maximum eigenvalue $\lambda_{\max} = \sum_{i=1}^{n} \frac{(BW)_i}{nW_i}$

The consistency check of judgment matrix

Consistency refers to the consistency of logical critical thinking .Such as when A is rather more important than c, and b is a little more important than c , apparently a is more important than b[4]. This is the logical consistency, otherwise the critical thinking or judgment will have problems.

$$CI = \frac{\lambda - 4}{3}$$

$$CR = \frac{CI}{RI}$$

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Where CI is consistency index;CR is the consistency check of comparison matrix;RI is average consistency index.

When CR <0.1, the consistency of comparison matrix is acceptable.

When CI=0,A is consistent;The bigger the CI is,the less the consistency is.

The Hierarchy total sorts

The Hierarchy total sorts is a progress which can confirm the weight of all factors' relative importance to the general objective .This progress runs from the top to the bottom.we can get the weights of all the indexes compared to rule hierarchy according to the formula

$$w_j = b_{ij} \times W_i$$

Where w_j is the weight of each indicator compared to the comprehensive ,W_i is the weight of rule hierarchy,b_{ij} is the weight of each indicator compared to the rule hierarchy it belongs to.

Summary

We define a comprehensive index which is composed of four big factors, including students'grade situation, other foundations'influence, schools'basic situation and students'economic situation. Then we divide these four factors into smaller evaluation indexes[5] . The weight of these smaller evaluation indexes is calculated by analytic hierarchy processing(AHP). By AHP ,we can evaluate school and have a certain significance to the invetment for school.Our model can be practically used in different fields to evaluate things from various aspects.

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