

MCDM FOR CHOOSING A BEST ALTERNATIVE APPLYING AHP

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Abstract: In the present day scenario choosing the Best College for the students plays a vital role in their Career perspective. This paper aims at giving an application of Analytic Hierarchy process (AHP), using Multi Criteria Decision Making method to find out the best alternative for choosing best college by taking the subjective parameters into consideration. In this paper we have chosen six criteria and three alternatives. Based on experts ranking/evaluation of these criteria's weights of the alternative should be calculated. The alternative holding first rank will be considered as the most preferred alternative.

Keywords: AHP, Multi Criteria Decision Making, Priorities.

1. Introduction: The Analytic Hierarchy Process (AHP) was first developed by Professor Thomas L. Saaty in the 1970's and since that time has received wide application in a variety of areas. Thomas.L.Saaty [7,8] has explained about Decision Making, Hierarchies and Multiple objectives. Donegan H.A and Dodd F.J [2] explained the details on the Saaty's Random Indexes. Methodologies such as neural networks, machine learning, rough sets, fuzzy sets and MCDA[9] are considered by researchers both at the theoretical and at practical levels. At the practical level, researchers focus on the use of classification or sorting methodologies to analyze the real-world problems and provide decision support, or on the investigation of the performance of different methodologies using real-world data. MCDM is used in the field of Engineering [1],[3],[5], Data mining [10], Architecture Analysis [6] and Project Management [4]

2. Preliminaries [7],[8]:

Definition 2.1: Let $A = [a_{ij}]$ be a square matrix of order n . Suppose there exists a non-zero (at least one entry is non-zero) column vector and a scalar λ such that $AX = \lambda X$. Then λ is called an eigen value of the matrix A and X is called the eigen vector corresponding to the eigen value λ .

Definition 2.2: Corresponding to each Eigen value λ there corresponds non-zero vector X which satisfies the equation $(A - \lambda I)X = 0$. The non-zero vectors X are called characteristic vectors or eigenvectors.

Definition 2.3: Let $A = (a_{ij})$ be a $n \times n$ positive reciprocal matrix. A is said to be consistent (in Saaty's sense) provided that $a_{ij}a_{jk} = a_{ik}$ for all $i, j, k = 1, \dots, n$.

The matrix $A = (a_{ij})$, $a_{ij} = w_i / w_j$, $i, j = 1, \dots, n$, has positive entries everywhere and satisfies the reciprocal property $a_{ji} = 1 / a_{ij}$. Any matrix with this property is called a reciprocal matrix.

In addition, A is consistent because the $a_{jk} = a_{ik} / a_{ij}$, $i, j, k = 1, \dots, n$.

3. The methodology of the AHP : The methodology of the AHP can be explained in following steps:
Alternatives of the best college are as follows:

Step 1: The problem is decomposed into a hierarchy of goal, criteria, sub-criteria and Alternatives.

Step 2: Data are collected from experts or decision-makers corresponding to the hierarchical structure, in the pair wise comparison of alternatives on a qualitative scale as described below. Experts can rate the comparison as equal importance, moderately important, strongly important, very strongly important and extremely important

Step 3: The pair wise comparisons of various criteria generated at step 2 are organized into a square matrix.

Step 4: The principal eigen value and the corresponding normalized right eigenvector of the comparison matrix give the relative importance of the various criteria being compared.

Step 5: The consistency of the matrix of order n is evaluated.

Step 6: The rating of each alternative is multiplied by the weights of the sub-criteria and aggregated to get local ratings with respect to each criterion.

4. Decision making using Analytic Hierarchy Process and Evaluation of Alternatives -Selecting Best College:

Step 1: Define the problem and determine the kind of knowledge sought

Goal - To choose the Best College

Six criteria Academics, Fees, Location, Extra Curricular, Reputation and Size were identified for choosing the Best College and the alternatives are College 1, College 2 and College 3. Based on the above data a pair wise comparison has been made using Analytic hierarchical ranking as in table using AHP to determine the best college.

C- Criteria for the colleges are as follows:

C_1 - Academics

C_2 - Fees

C_3 - Location

C_4 - Extra Curricular

C_5 - Reputation

C_6 - Size

A_1 - College 1

A₂ – College 2
 A₃ – College 3

I. Table of Relative scores

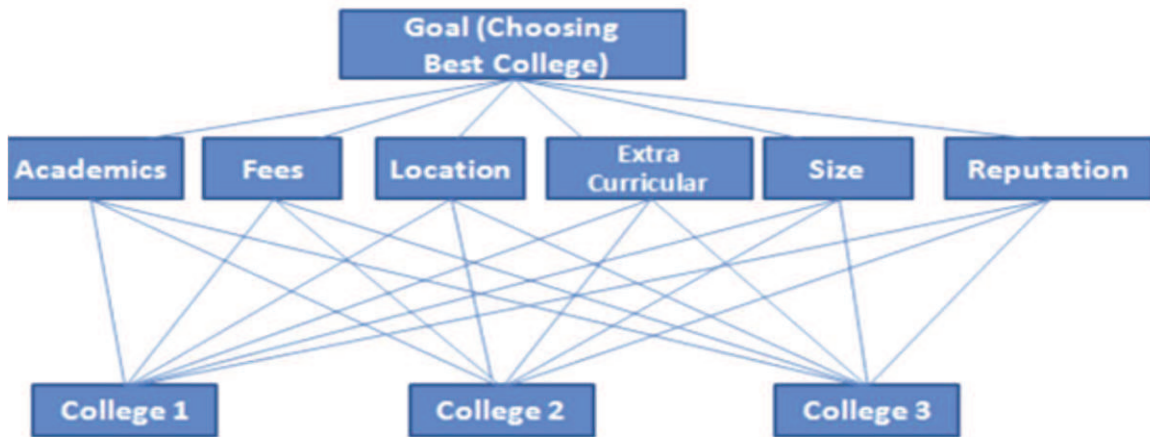
Criteria	Interpretation
Academics	Rank hold by the Institution
Fees	Tuition fee Structure
Location	Nearness to Home
Extra Curricular	Importance given to Sports and other activities
Reputation	Academic, Balanced Academic
Size	Students count

a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives) represented in Fig. 4.2

Step 3: Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weighed values and obtain its overall or global priority. Continue this process of weighing and adding until the final priorities of the alternatives in the bottom most level are obtained.

Step 2: Structure the decision hierarchy from the top with the goal of the decision, then the objectives from

Fig 4.1 Decision Hierarchy of best college



II. Pairwise comparison matrix for level 1:

Focus	Academics	Fees	Location	Extra Curricular	Reputation	Size	Priority vector
Academics	1	1	2	5	1	2	0.225
Fees	1	1	1	5	3	3	0.259
Location	1/2	1	1	5	1	3	0.188
Extra Curricular	1/5	1/5	1/5	1	1/5	1/6	0.036
Reputation	1	1/3	1	5	1	4	0.192
Size	1/2	1/3	1/3	6	1/4	1	0.100
$\lambda \text{ max} = 6.516, CI = 0.103, CR = 0.083$							

III a). Comparison matrices and local priorities

Academics	A1	A2	A3	Priority vector
A1	1	3	5	0.633
A2	1/3	1	3	0.260
A3	1/5	1/3	1	0.106
$\lambda_{max} = 3.055, CI = 0.027, CR = 0.047$				
Fees	A1	A2	A3	Priority vector
A1	1	5	7	0.738
A2	1/5	1	2	0.168
A3	1/7	1/2	1	0.094
$\lambda_{max} = 3.024, CI = 0.012, CR = 0.021$				
Location	A1	A2	A3	Priority vector
A1	1	1	5	0.480
A2	1	1	3	0.405
A3	1/5	1/3	1	0.115
$\lambda_{max} = 3.035, CI = 0.017, CR = 0.030$				

III b). Comparison matrices and local priorities

Extra Curricular	A1	A2	A3	Priority vector
A1	1	3	4	0.623
A2	1/3	1	2	0.239
A3	1/4	1/2	1	0.137
$\lambda_{max} = 3.025, CI = 0.012, CR = 0.021$				
Reputation	A1	A2	A3	Priority vector
A1	1	1	5	0.435
A2	1	1	7	0.487
A3	1/5	1/7	1	0.078
$\lambda_{max} = 3.016, CI = 0.008, CR = 0.014$				
Size	A1	A2	A3	Priority vector
A1	1	1	4	0.423
A2	1	1	6	0.484
A3	1/4	1/6	1	0.093
$\lambda_{max} = 3.023, CI = 0.011, CR = 0.020$				

IV. Pairwise comparison of alternatives according to the criterion

Criteria	Academics	Fees	Location	Extra Curricular	Reputation	Size	Priority vector
		0.225	0.259	0.188	0.036	0.192	
A ₁	0.633	0.738	0.480	0.623	0.435	0.423	0.572
A ₂	0.260	0.168	0.405	0.239	0.487	0.484	0.329
A ₃	0.106	0.094	0.115	0.137	0.078	0.093	0.099

Step 4: Finding the ranks of the Alternatives based on their corresponding weights

V. Weights and Ranks of Alternatives

Alternatives	Weights of Alternatives	Ranks of Alternatives
A ₁	0.572	1
A ₂	0.329	2
A ₃	0.099	3

Analytic hierarchy Process, as this uses qualitative opinions. Based on the results from Table V we get the results that College A₁ is the best choice, followed by the college A₂ as the second choice and the worst choice is A₃. The Fuzzy AHP method could be applied to the above and the results could be compared. This can be used in various comparative studies such as in consumer products, automobiles etc.

Conclusion and Scope : The above problem of choosing the Best College is an application of

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