Application of Employment to College Students Based on AHP Virtual Platform

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Abstract—**The paper proposed an application method on college student employment using the AHP virtual platform. The application method is a simple, flexible and practical multi criterion decision method. It has been proved by experiment that the results obtained from using the Analytic Hierarchy Process analyzing multiple factors on college students employment agreed with actual data. The method is easily applicable and can provide useful information on college student employment for those who are interested.**

Keywords: AHP, Consistency Check, Comparative Matrix, Weight vectors.

I. INTRODUCTION

Analytic Hierarchy Process (AHP) is a simple, flexible and practical multi criterion decision-making method proposed by American operational researcher T.L.Saaty in 70s. Based on AHP virtual platform, one can apply analytical hierarchy process to perform college student employment analysis. The purpose of the method is to provide an objective and systematic way of analyzing the problem for students and others who are interested.

II. AHP VIRTUAL PLATFROM

The Analytic Hierarchy Process is basically the same as the way of thinking for one to solve a complicated decision problem.

A. Steps of Applying the AHP Method

The basic steps are:

Step1: Divide the problem into three layers, define the top one to be the target layer; the bottom to be the solution layer; the middle layer to be the criterion layer. The relationship between each layer is presented by lines connecting them.

Step2: Compare the weight of each criterion on the target, the weight of each plan on its corresponding criterion. The weights are commonly fixed in a way of thinking. AHP will give an algorithm to evaluate these weights.

Step3: Synthesis the two weights mentioned in step 2, and find the final weight of each criterion to the target. AHP will give an algorithm of calculation.

Step4: Make the decision based on the weights of each criterion to the target.

B. Comparative Weight Vector and Comparative Pair Matrix

Assume there are n factors $c_1, c_2, \cdots, c_n$ in one layer to be compared with some factor O in the upper layer. Let's say there are five criteria, pick 2 random factor c_i and c_j, use a_{ij} to present the ratio of effects of c_i and c_j cast on O. All the comparative results can form a comparative pair matrix:

$$A = (a_{ij})_{n \times n}, a_{ij} > 0, a_{ji} = \frac{1}{a_{ij}} \qquad (1)$$

From the characters of a_{ij} given in formula (1), A is a straight reciprocal matrix, and $a_{ii} = 1$. We use $c_1, c_2, \cdots, c_5$ to denote the 5 criteria. Using the comparative method we have the matrix (C_5^2 compares were made):

$$A = \begin{pmatrix} 1 & 1/2 & 4 & 3 & 3 \\ 2 & 1 & 7 & 5 & 5 \\ 1/4 & 1/7 & 1 & 1/2 & 1/3 \\ 1/3 & 1/5 & 2 & 1 & 1 \\ 1/3 & 1/5 & 3 & 1 & 1 \end{pmatrix} \qquad (2)$$

From the matrix A given in formula (2), since the ratio of c_1 and c_2 is $1:2$, and the ratio of c_1 and c_3 is $4:1$, then by the mathematic nature, the ratio of c_2 and c_3 should be $8:1$, other than $7:1$. This shows that results of each compare are inconsistent with each other. However, n factors will need $\frac{n(n-1)}{2}$ compares. Now, we denote $a_{ij} = w_i / w_j$ in the new matrix. We'll have

$$A = \begin{pmatrix} \dfrac{w_1}{w_1} & \dfrac{w_1}{w_2} & \cdots & \dfrac{w_1}{w_n} \\ \dfrac{w_2}{w_1} & \dfrac{w_2}{w_2} & \cdots & \dfrac{w_2}{w_n} \\ \cdots & \cdots & \cdots & \cdots \\ \dfrac{w_n}{w_1} & \dfrac{w_n}{w_2} & \cdots & \dfrac{w_n}{w_n} \end{pmatrix} \qquad (3)$$

Obviously, these compares are consistent with each other, the weight of n factors to the object can be denoted by $w = (w_1, w_2, \cdots, w_n)^T$. Obviously, we have $\sum_{i=1}^{n} w_i = 1$. Clearly, in the matrix A shown in formula (3), each row vector differs from w in only one ratio element.

Generally, if a straight reciprocal matrix satisfies:
$$a_{ij} \cdot a_{jk} = a_{ik}, \ i, j, k = 1, 2, \cdots, n. \qquad (4)$$

Then we call it a consistent matrix. Apparently, matrix A is a consistent matrix.

If the matrix we got from comparing the weight of factors is a consistent matrix, like matrix A, it's natural to take the normalized eigenvector of eigenvalue n to present the weights on object O from multiple factors $c_1, c_2, \cdots, c_n$, which is then called weight vector. If the matrix is not a consistent matrix, but the inconsistency is within a tolerant range (the definition of the tolerant range will be given later), Saaty, et al. suggests that one should take the normalized eigenvector of the largest eigenvalue of A as the weight vector, which is denoted as w, i.e. w satisfies:
$$Aw = \lambda w. \qquad (5)$$

The method introduced is the eigenvalue method for finding the weight of comparative matrix.

C. Comparative Standard

When comparing the effect of two different factors c_i and c_j on some object O in the top layer, we need to figure out a standard to measure a_{ij}. Satty, et al. proposed a 1-9 standard, i.e. the value of a_{ij} is chosen between integers 1,2,3,4.. 9, which is shown in table 1.

TABLE 1 MEANING OF a_{ij} IN THE 1—9 STANDARD

Standard a_{ij}	Meaning
1	c_i and c_j has the same effect
3	Effect of c_j is slightly higher
5	Effect of c_j is mildly higher
7	Effect of c_j is significantly higher
9	Effect of c_j is absolutely higher
2, 4, 6, 8	Effect of c_i is between its adjacent level higher than c_j
$1, \frac{1}{2}, \cdots, \frac{1}{9}$	The ratio of effeteness of c_j and c_i is reversely related as the value above

Currently in Analytical Hierarchy Process applications, most people would use the 1-9 standards.

D. Consistency Check on Comparative Pair Matrix

Comparative Pair Matrix are generally not consistent matrix, but as mentioned previously, such matrix will need a consistent check to make sure the inconsistency of such matrix is within the tolerant rage. We'll discuss how to define the range in this section.

We'll use the value of $\lambda - n$ to measure the inconsistency of matrix A. Saaty et al. defines:
$$CI = \frac{\lambda - n}{n - 1} \qquad (6)$$

as the consistency indicator. When $CI = 0$, A is consistent matrix. However, the value of CI needn't to grow with the value of A. Therefore, Saaty introduced another indicator RI to be the Random Indicator, which is shown in table 2.

TABLE 2 VALUE FOR THE RANDOM INDICATOR

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

For those matrix which has a value of n greater than 3, we'll take ratio of the consistency indicator value and the corresponding random indicator value. We name the factor the Consistency Ratio, CR. When the inconsistency of matrix A is out of tolerant. We'll then use the eigenvector corresponding to its maximum eigenvalue as the weight vector. Otherwise, one should repeat the comparison in order to adjust the matrix A.

The check on matrix A using equation (6) and (7) and table 2 is called the consistency check.
$$CR = \frac{CI}{RI} < 0.1 \qquad (7)$$

III. THE APPLICATION OF AHP ON COLLEGE STUDENT EMPLOYMENT

Since different job emphasize on different aspects, the indicator weight also differs from job to job. A precise, reasonable weight could help employees focusing on the completion of evaluating the important and complicated indicators. It may also help the employee to view the job in a more objective point of view. Here's an example of using the AHP method to analyze a college student employment problem. First we'll use the AHP method to build a comparative pair matrix, then do the consistency check and give a reasonable solution to the problem.
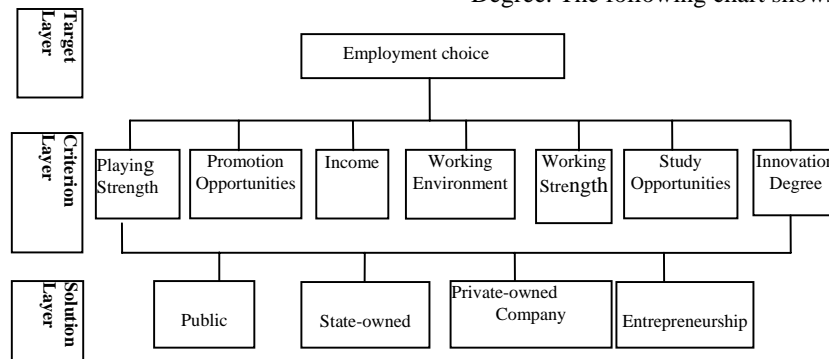
A. Setup of the Factor Evaluating System

Use the AHP method to analyze the trend of employment of a specific occupation. Accordingly, we'll build up a 3-layer model, including the target layer, criterion layer, and the solution layer.

The criterion layer is the students' basic needs to the employment unit, which is relatively defined. Different occupation will have different requirements. According to investigation on the subject, we have the following 7 different criteria: 1. Playing Strength, 2.Promotion Opportunities 3.Income 4.Working Environment 4.Working Strength 5. Study Opportunities 6.Innovation Degree. The following chart shows:

B. Building the Comparative Pair Matrix, computing the weight and Consistency Check

The results are shown in the following matrixes and table 3.

$$A = \begin{bmatrix} 1 & 1/4 & 1/4 & 1/3 & 2 & 1 & 1 \\ 4 & 1 & 1 & 2 & 6 & 4 & 4 \\ 5 & 1 & 1 & 2 & 6 & 4 & 4 \\ 3 & 1/2 & 1/2 & 1 & 5 & 3 & 3 \\ 1/2 & 1/6 & 1/6 & 1/5 & 1 & 1/2 & 1/2 \\ 1 & 1/4 & 1/4 & 1/3 & 2 & 1 & 1 \\ 1 & 1/4 & 1/4 & 1/3 & 2 & 1 & 1 \end{bmatrix}$$

$$B_1 = \begin{bmatrix} 1 & 1/2 & 2 & 1/2 \\ 2 & 1 & 4 & 1 \\ 1/2 & 1/4 & 1 & 1/4 \\ 2 & 1 & 4 & 1 \end{bmatrix} \quad B_2 = \begin{bmatrix} 1 & 2 & 2 & 4 \\ 1/2 & 1 & 1 & 2 \\ 1/2 & 1 & 1 & 2 \\ 1/4 & 1/2 & 1/2 & 1 \end{bmatrix} \quad B_3 = \begin{bmatrix} 1 & 1 & 1/4 & 1/4 \\ 1 & 1 & 1/4 & 1/4 \\ 4 & 4 & 1 & 1 \\ 4 & 4 & 1 & 1 \end{bmatrix}$$

$$B_4 = \begin{bmatrix} 1 & 1/2 & 1/2 & 1/4 \\ 2 & 1 & 1 & 1/2 \\ 2 & 1 & 1 & 1/2 \\ 4 & 2 & 2 & 1 \end{bmatrix} \quad B_5 = \begin{bmatrix} 1 & 1/5 & 1/2 & 1 \\ 5 & 1 & 3 & 3 \\ 2 & 1/3 & 1 & 2 \\ 1 & 1/3 & 1/2 & 1 \end{bmatrix} \quad B_6 = \begin{bmatrix} 1 & 1/5 & 1/3 & 1/2 \\ 5 & 1 & 2 & 4 \\ 3 & 1/2 & 1 & 2 \\ 2 & 1/4 & 1/2 & 1 \end{bmatrix} \quad B_7 = \begin{bmatrix} 1 & 7 & 9 & 7 \\ 1/7 & 1 & 5 & 3 \\ 1/9 & 1/5 & 1 & 1/5 \\ 1/7 & 1/3 & 5 & 5 \end{bmatrix}$$

TABLE 3

k	1	2	3	4	5	6	7
ϖ_{k1}	0.182	0.444	0.100	0.111	0.221	0.116	0.679
ϖ_{k2}	0.364	0.222	0.100	0.222	0.101	0.532	0.179
ϖ_{k3}	0.091	0.222	0.400	0.222	0.432	0.221	0.038
ϖ_{k4}	0.364	0.111	0.400	0.444	0.255	0.131	0.104

$\lambda_{\max}$	4.000	4.000	4.000	4.000	4.012	4.049	4.058
CI_k	0	0	0	0	0.007	0.016	0.019
RI_k	0	0	0	0	0.008	0.018	0.022

The weight to the target of matrix B_1 is 0.252. The weight to the target of matrix B_2 is 0.211. The weight to the target of matrix B_3 is 0.316. The weight to the target of matrix B_4 is 0.291.All in all, the weight vector of the criterion layer the target is{0.252, 0.211, 0.316, 0.291}.Since

CR =0.00275＜0.1, one consistency check is needed.

IV. CONCLUSIONS

By applying the AHP virtual platform method to college student employment, we can understand the result straightforwardly. This is a simple, low-cost method and it can provide useful information and improve efficiency for those who are interested.

ACKNOWLEDGEMENTS

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