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Employment Competitiveness of College Students Based on Improved AHP

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ABSTRACT

The evaluation of college students' employment competitiveness has always been a concern of education, which is of great significance to promote the development of education and promote reform in education. The evaluation of college students' employment competitiveness is also a typical multi-level and multi-factor comprehensive evaluation problem, this paper proposes an improved AHP algorithm, by using the three-scale method to construct the optimal transfer matrix and high accuracy of the judgment matrix, to avoid the consistency check of judgment matrix and adjustment. The improved AHP can reduce the amount of calculation and ensure the correctness of the conclusion, make the index weight more reasonable and real, and provide the scientific basis for evaluation decision.

Keywords: employment competitiveness, improved AHP, three-scale method, optimal transfer matrix, fuzzy comprehensive evaluation

INTRODUCTION

Employment competitiveness, the international labor organization's expression for it is the ability of individuals to acquire and maintain work, progress in their work, and respond to changes in their working lives. The American education and employment commission (DFEE) defines employment competitiveness as the ability to acquire and maintain work and to realize its potential through full employment in the labor market. The research on the employment competitiveness of college students has always been the concern of government, college and enterprise, which is of great significance to how to educate, choose and employ college students. The scientific evaluation of college students' employment competitiveness can be used to reform the education, provide the career guidance for government and college.

AHP (Analytical Hierarchy Process) is a combination of qualitative and quantitative analysis of multiple criteria decision method, by the famous American operational research specialist T.L. Satty etc put forward in the 1970 s, is widely used in the social, economic, management, and other areas of the evaluation. As a result of the artificial judgment subjective and unilateral, AHP as the weight method and consistency inspection standards have been gradually inadequate: Satty 1-9 scale method is used to construct comparison matrix more likely to appear unreasonable results; Consistency check for judgment matrix is complex and indispensable.

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State of the literature

- There are many research perspectives, and the subjects of evaluation are diverse and difficult to unify
- There are too many employment competitiveness evaluation index systems which is difficult to choose
- The traditional AHP evaluation method has shortcomings, that is, the judgment matrix needs manual adjustment.

Contribution of this paper to the literature

- In view of the shortcomings of the traditional AHP, this paper uses the three-scale method and the optimal transfer matrix to construct the judgment matrix, which avoids the consistency check of the judgment matrix. Through comparative analysis, improved AHP is scientific and effective. And the paper uses the improved AHP to analyze the employment competitiveness of College students. In order to improve the employment competitiveness of college students, colleges should strengthen college students' professional skills education, strengthen quality education, and so on.

Based on the above problems, this paper introduces the three-scale method to construct the judgment matrix, which can better overcome the influence of the ambiguity of subjective judgment to the decision-making. With the concept of optimal transfer matrix to a more accurate judgment matrix, avoid the consistency check of judgment matrix and adjustment, and combining with the fuzzy comprehensive evaluation method, constructs based on improved AHP employment competitiveness comprehensive evaluation model.

LITERATURES REVIEWING

According to the research content of literatures, the research can be divided into two categories, namely, the concept and index system of employment competitiveness, and the evaluation method of employment competitiveness. The concept of employment competitiveness is defined: Harvey (1995) believed that employment competitiveness refers to the ability of employees to have the skills that the labor market and employers need and find attractive. Mel Fugate (2004) & Liu (2017) believed that employment competitiveness refers to the ability of individuals to identify and realize professional opportunities within and outside the organization during their occupation. Ke Yu etc. (2004) believed that employment competitiveness is the expression of the college graduates in the job market, is the ability of graduates more than its competitors to meet the demand of society and employer.

Employment competitiveness is divided into five categories, including sixteen skills, by the United States institute of training and development, which are basic competencies, communication skills, adaptability, group effectiveness, and impact capability. Scholars at home and abroad establish the evaluation index system about college students' employment competitiveness, more representative models include, USEM model of Yorke, M.& Knight, P. T (2004), Pool,L. D.& Sewell, P (2007), simple and practical model of the 3S - Aareer - EDGE. Ke Yu (2004) put forward the basic structure diagram of the evaluation system for the employment competitiveness of college graduates, and divided the index of graduates' employment competitiveness evaluation system into two categories: display and analysis indicators. Hong Ying and Wu Jianhao (2011) used questionnaire method to build employment competitiveness evaluation system of college graduates, and point out that basic condition, work ability, moral character, potential, career orientation, are the influence factors of employment competitiveness. Wang Qikai etc. (2012) & Gao et al. (2017) constructed the evaluation system of college students' employment competitiveness through questionnaire survey, mainly including subjective employment competitiveness and objective employment competitiveness. Guan Liguo and Wang Ying (2016) believed that school, family, individuals, and professional competence, basic skills and scientific research ability were the main factors that influence the employment competitiveness of college students.

Zhang Jiangong etc. (2012) from the social perspective, with the background, knowledge structure, basic ability and moral quality of the four factors, established the evaluation index of College Students' employment competitiveness, and comprehensive evaluated using the AHP. Xiang Zhuoyuan and Ding Ke (2009) used fuzzy

AHP model from the professional construction, knowledge and skills acquisition, the personal traits of construction employment competitiveness evaluation index, and deeply analyzed college students' employment competitiveness from the two perspectives of graduates and employment guidance. By regression analysis, Yang Chunhua and Yang Ling (2009) investigated the employment status of college graduates in a large scale, and analyzes the school factors and own factors that affect the employment competitiveness of College Students. Li Zhengwei etc. (2010) & Mi et al. (2016) from the four dimensions of social relations background, academic achievement, employment attitude and practical ability, made quantitative analysis on the influencing factors of College Students' employment competitiveness by using the Logistic model. Huang Yan etc. (2014) studied of the current situation of college graduates employment competitiveness, through mathematical modeling from the employment quality competitiveness, employment quality competitiveness, employment competitiveness and built social capital competitiveness evaluation system. Liu li (2011), using three-scale transform comparative matrix, Quan Hongzheng (2016), using triangular fuzzy analytic hierarchy process, to improve the AHP, better overcame the fuzziness of subjective judgment to the effects of decisions.

IMPROVED AHP ALGORITHM AND PRINCIPLE

The Question

The AHP method's primary problem is to determining the weights of the factors which was constructed by judgment matrix; the difficulty is the consistency checking of judgment matrix is too complex. When inconsistent, the judgment matrix should be rebuilt. Improved AHP reflected in the method of constructing judgment matrix is more simple, and do not need to check the consistency of judgments matrix. Specific ideas: with a more intuitive three scale method to construct the comparison matrix, convert it to a judgment matrix with the characteristics of AHP, then calculate the optimal transfer matrix of the judgment matrix, and finally calculate the feature vector composed by maximum characteristic quasi optimal consistent matrix value, then obtains the weight value of each influence factor, at the same time, make sure that the judgment matrix is naturally satisfied with consistency requirements, and avoiding the consistency test and adjustment.

Establish Judgment Matrix

1) To construct comparison matrix

The three-scale method is adopted to compare the importance of each factor, to constructing the corresponding comparative judgment matrix A_{ij}. With "0", "1", "2" three values express "not important", "the same important" and "more important" fuzzy concept. A_{ij} stands for the value of i element compared to the importance of the j element, and has A_{ii} = 1.

2) To construct judgment matrix

According to the comparison matrix A, calculate the importance of various factors sorting index r_i, that is $r_i = \sum_{i=1}^{n} A_i$.Take $r_{\max} = \max\{r_i\}$, which represents the largest sort index corresponding elements; Take $r_{\min} = \min\{r_i\}$ as the index minimum order corresponding elements; Take $k_m = r_{\max}/r_{\min}$ as $r_{\max}$ when compared with $r_{\min}$ according to given the importance of a certain scale. Finally, the judgment matrix B_{ij} is constructed so that the elements of the b_{ij} satisfy the following conditions:

$$b_{ij} = \begin{cases} \dfrac{r_i - r_j}{r_{max} - r_{min}}(k_m - 1) + 1, & r_i \geq r_j \\ \left[\dfrac{r_i - r_j}{r_{max} - r_{min}}(k_m - 1) + 1\right]^{-1}, & r_i \leq r_j \end{cases}$$

Calculate the Quasi Optimal Consistent Matrix B'

According to the judgment matrix B, calculate the corresponding anti-symmetric matrix and the corresponding optimal transfer matrix. Finally, the optimal consistent matrix is derived by judgment matrix.

1) The transfer matrix of anti-symmetric C

Set A $= (a_{ij})$, B $= [b_{ij}]$, C $= [c_{ij}] \in \mathbb{R}_{m\times n}$ for real matrix

Definition 1: if the $a_{ij} = 1 / a_{ji}$, then A is reciprocal matrix; if $b_{ij} = -b_{ji}$, then B is anti-symmetric matrix.

Definition 2: if A is reciprocal matrix, and $a_{ij} = a_{ik}/a_{jk}$, then A is consistent, if B is anti-symmetric matrix, and $b_{ij} = b_{ik} - B_{jk}$, then B is transferable. Obviously, the above judgment matrix B is reciprocal and consistent. if $c_{ij} = \log b_{ij}$ (i, j = 1, 2, ..., n), then C is anti-symmetric matrix, and is transferable.

2) The optimal transfer matrix D

Definition 3: if any transfer matrix D, make the $\sum_{i=1}^{n}\sum_{j=1}^{n}(d_{ij} - c_{ij})^2$ is the smallest, the optimal transfer matrix is D to C.

Theorem 1: if C is anti-symmetric matrix, the optimal transfer matrix of C is D which has $d_{ij} = \frac{1}{n}\sum_{k=1}^{n}(c_{ik} - c_{jk})$.

3) The optimal consistent matrix B′

Theorem 2: if B is reciprocal matrix, and make C $= \log$ B, and D is the optimal transfer matrix of C, then B′ $=$ 10 D is a quasi-optimal transfer matrix of B, and it is the optimal consistent matrix. By the knowable, matrix B′ is the quasi optimal consistent matrix of B, and it is optimal. Therefore, B′ can be directly calculated without consistency checking.

The Calculation of Weight

In order to simplify the calculation, approximate root method is one of the solutions. The steps are as follows: first calculated $M_i = \prod_{j=1}^{n} b_{ij}\ (i = 1,2,\ldots,n)$, and then calculate root$\overline{W_i} = \sqrt[n]{M_i}$, finally, the vector normalization treatment of $\overline{W} = (\overline{W_1}, \overline{W_2}, \ldots \overline{W_n})^{\mathrm{T}}$ has $W_i = \frac{\overline{W_i}}{\sum_{i=1}^{n}\overline{W_i}}$, and the vector $W = (W_1, W_2, \ldots, W_n)^T$ is the answer of weight vector.

THE APPLICATION OF IMPROVED AHP

Firstly, the employment evaluation index system is established, and the improved AHP method is used to determine the weights of each index, and then the fuzzy comprehensive evaluation method is used to carry out comprehensive evaluation. Finally, the total evaluation results are calculated.

To Determine the Employability Evaluation Factor Set and Evaluation Set

Through theoretical research, the methods of investigation and research, determine the comprehensive evaluation index system, establish a hierarchy model which is shown in **Figure 1**, at the highest level as the goal layer, middle layer as the criterion layer, bottom layer as index layer, the evaluation factor set U = (U_1, U_2, U_3, U_4), among them, the U_1 = (U_{11} U_{12}, U_{13}, U_{14}), U_2 = (U_{21}, U_{22}, U_{23}), U_3 = (U_{31}, U_{32}, U_{33}, U_{34}), U_4 = (U_{41}, U_{42},U_{43}, U_{44}). The evaluation criteria that affect employability are divided into 5 grades, set V = {excellent, good, medium, acceptable, bad}, set the corresponding scores as S = (1, 0.8, 0.6, 0.4, 0.2), then F = B * S^{T}.

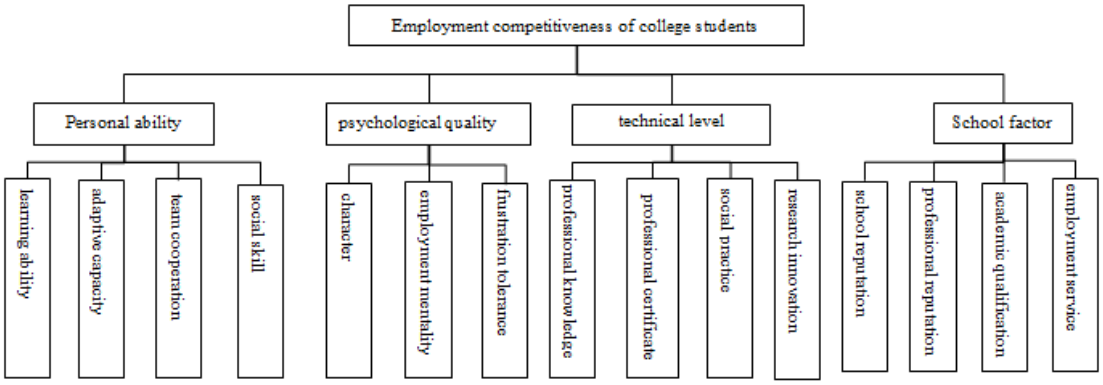

Figure 1. Index system of college students' employment competitiveness

The Improved AHP Method to Determine the Weight of Indexes

In order to determine the weights of the criteria layer as an example, according to the improved AHP method, compared with the three-scale of the two factors important degree, establish the comparison matrix A ij, calculate the importance ranking index $r_{\max} = 6$, $r_{\min} = 1$, construct the judgment matrix B_{ij}, calculate transfer matrix C_{ij}, optimal transfer matrix D_{ij} ,and quasi uniformly consistent matrix B_{ij}'. The results are as follows:

$$A = \begin{bmatrix} 1 & 2 & 1 & 2 \\ 0 & 1 & 0 & 2 \\ 1 & 2 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} 1 & 4 & 1 & 6 \\ 1/4 & 1 & 1/4 & 3 \\ 1 & 4 & 1 & 6 \\ 1/6 & 1/3 & 1/6 & 1 \end{bmatrix}$$

$$C = \begin{bmatrix} 0 & 0.602 & 0 & 0.778 \\ -0.602 & 0 & -0.602 & 0.477 \\ 0 & 0.602 & 0 & 0.778 \\ -0.778 & -0.477 & -0.778 & 0 \end{bmatrix}$$

$$D = \begin{bmatrix} 0 & 0.527 & 0 & 0.853 \\ -0.527 & 0 & -0.527 & 0.327 \\ 0 & 0.527 & 0 & 0.853 \\ -0.853 & -0.327 & -0.853 & 0 \end{bmatrix}$$

$$B' = \begin{bmatrix} 1 & 3.365 & 1 & 7.129 \\ 0.297 & 1 & 0.297 & 2.123 \\ 1 & 3.365 & 1 & 7.127 \\ 0.140 & 0.471 & 0.140 & 1 \end{bmatrix}$$

Finally, the eigenvectors of the quasi optimal consistent matrix are obtained and normalized, the weight vector W= (0.411, 0.121, 0.411, 0.057)

Using the same method to calculate out the weight of each factor in the index layer, get the weight vector:

W_1 = (0.585, 0.18, 0.055, 0.18),

W_2= (0.260, 0.105, 0.634),

W_3 = (0.585, 0.18, 0.055, 0.18),

W_4 = (0.080, 0.574, 0.269, 0.080).

Fuzzy Comprehensive Evaluation

Take a student's employment competitiveness evaluation as an example, invite20 personnel from the student's employment guidance department, job units and experts grade the each membership degree according to the evaluation index. Calculate average of each index, thus, the fuzzy relation matrix R is obtained.

Evaluation from the layer below, then gradually move up, R_i by lower level evaluation of single factor evaluation matrix, get the first-level evaluation vector $B_i = W_i * R_i$, and then each B_i as a factor, get second-level evaluation vector: $B = A * R$.

(1) Do a comprehensive evaluation to the second-level indexes

By the evaluation is obtained from index layer to the criterion of fuzzy evaluation matrix $R_k, k = (1, 2, 3, 4)$, and

$$B_1 = W_1 * R_1 = (0.585, 0.18, 0.055, 0.18) * \begin{bmatrix} 0.5 & 0.25 & 0.15 & 0.05 & 0 \\ 0.45 & 0.4 & 0.10 & 0.05 & 0 \\ 0.6 & 0.2 & 0.15 & 0.05 & 0 \\ 0.4 & 0.45 & 0.10 & 0.05 & 0 \end{bmatrix}$$

$$B_1 = (0.497, 0.310, 0.132, 0.079, 0)$$

The corresponding assessment level is given a certain score, "personal ability" scores for F_1: $F_1 = B_1 * S^T$ = (0. 497, 0. 310, 0.132, 0.079, 0) * (1, 0. 8, 0. 6, 0. 4, 0. 2)^T = 0. 856.

The same calculation:

B_2 = (0.442, 0.307, 0.124, 0.089, 0.037)

B_3 = (0.362, 0.433, 0.120, 0.053, 0.032)

B_4 = (0.527, 0.275, 0.108, 0.068, 0.025)

(2) For primary index comprehensive evaluation

According to the above calculated weight of the criteria layer and the single factor fuzzy judgment matrix, carry out the second-level fuzzy evaluation.

$$B = W * R = (0.411, 0.121, 0.411, 0.057) * \begin{bmatrix} 0.479 & 0.310 & 0.132 & 0.079 & 0 \\ 0.442 & 0.307 & 0.124 & 0.089 & 0.037 \\ 0.362 & 0.433 & 0.120 & 0.053 & 0.032 \\ 0.527 & 0.275 & 0.108 & 0.068 & 0.025 \end{bmatrix}$$

$$B = (0.351, 0.318, 0.221, 0.090, 0.020)$$

The corresponding scores as follows = B * S^T = (0.429, 0.358, 0.125, 0.069, 0.019) * [1, 0.8, 0. 6, 0.4, 0.2]^T = 0.822.The employment competitiveness of the students is a "good" level.

EXPERIMENTAL ANALYSE

Compare the Result

In order to verify the improved AHP method is reasonable and more efficient, here also use the standard AHP to calculate the evaluation system of the index of all levels which are as follows:

W = (0. 389, 0.167, 0.389, 0.056),

Table 1 is for the use of the above two methods to calculate weight of the primary index evaluation system of employment and the sorting result table.

Table 1. Calculate result of two methods

Indicators	Improved AHP	Order	AHP	Ordering
Personal Ability	0.411	1	0.389	1
Psychological Diathesis	0.121	3	0.167	3
Professional Technical	0.411	2	0.389	2
School Factors	0.057	4	0.057	4

From **Table 1**, the weight of each index in the analysis shows that, this article use the improved AHP method and standard of the AHP method to calculate the weights of sorting results are basically identical, weight value is also close , so the weight calculation method of this paper is reliable and effective.

Compare the Process

Compared with the standard of the AHP method, in this paper, the improved AHP method basically has the following advantages:

(1) Using the three-scale method to construct judgment matrix instead of 1-9 scaling method, reduce the difficulty of experts' judgment, Simpler and more accurate.

(2) Avoid the standard AHP complex consistency checking procedure, making the computation process simpler; at the same time, avoid the adjustment work when the judgment matrix is inconsistent, and make the result more reasonable.

CONCLUSION AND RECOMMENDATION

In view of the deficiency of the ordinary AHP, this paper puts forward an improved AHP method to calculate the weights of the indexes and the improved AHP is scientific and simple. The evaluation method can also be easily extended to other areas of evaluation.

In order to improve the employment competitiveness of college students, colleges should first, strengthen college students' professional skills education, improve professional ability, strengthen the research, social practice, science and technology competition; second, strengthen quality education, improve learning ability, teamwork ability and adaptability; third, improve the psychological quality, strengthening frustration education, regular employment mentality.

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