Comprehensive Evaluation of Working Environment Based on Grey Clustering

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Keywords: Recruitment, Employment, Entropy weight method, Grey clustering assessment, Recommendations

Abstract: Employment and job hunting are an eternal topic. Each person has to take on certain responsibilities as being a member of society. Throughout the continuous development of society from the past decade, it is way more difficult now than before for current undergraduates to find a suitable job. In reality, many college graduates feel that the employment situation is severe, and finding a job is not easy. A large part of the reason for this psychology is that the high-end talents in various positions are now saturated, and people are anxious about finding a suitable job. Therefore, if you encounter some difficulties in the process of job hunting, you must put yourself in the right frame of mind and treat them objectively. We take the selection order of four companies as an example. Firstly, we analyze the influence of job search factors. In order to better help contemporary college students find a suitable job, we use the entropy method to analyze the degree of influence of five factors, including academic qualifications, attitude, professional evaluation, practical experience, and expression ability, on the job search for candidates. We hope candidates be able to focus on the aspects that the company values and work hard on the corresponding aspects to help them find their favorite jobs. Then, we build a comprehensive evaluation model of the working environment. We utilize the grey cluster evaluation method to study the impact of five aspects, including benefits, working conditions, labor intensity, promotion opportunities, and further study opportunities on applicants' selection of companies. And a selection order of the four companies is given in the end.

1. Introduction

Nowadays, it is difficult to find a good job only with a diploma. With the significant acceleration of economic globalization, companies have gradually realized that academic qualifications cannot determine a person's value to the company. Except for academic qualifications, the factors that affect the recruitment of employees include attitude, professional evaluation, practical experience, and expression skills. These factors together determine the overall quality of an applicant. Only applicants with sufficiently high comprehensive ability can find the best job. Besides, during job hunting, applicants never merely consider the pros and cons of the companies through one aspect. They often think about the benefits, working conditions, labor intensity, promotion opportunities, and further study opportunities that the companies can provide to choose a suitable company. This topic will be studied from two perspectives. Firstly, the degree of influence of the five factors including education, attitude, professional evaluation, practical experience, and expression ability on the job search of candidates. Secondly, which aspects of the companies are more important to candidates when looking for a job.

Firstly, we use the entropy method to analyze the five factors (educational background, attitude, professional evaluation, practical experience, expression ability) that affect the job applicants to obtain the weight of each influencing factor, and different weights correspond to the importance of each factor,

There are many advantages that using the entropy method to solve this problem: 1) The relevant influence between the evaluation indicators can be eliminated; 2) The workload of indicator selection can be reduced; 3) When there are many rating indicators, most information can be

  DOI: 10.25236/edssr.2020.032

reserved too. A few comprehensive indicators are used to replace the original indicators for analysis; 4) In the comprehensive evaluation function, the weight of each principal component is its contribution rate which reflects that the principal component contains the original data. The proportion of the total amount of information is objective and reasonable to determine the weight in this way. some defects of determining the weight in some evaluation methods can be avoided.

Secondly, we use the grey cluster evaluation method to study the impact of five aspects including benefits, working conditions, labor intensity, promotion opportunities, and further study opportunities on recruiters when they choose companies. Through a series of calculations, we can get the results of 4 companies. The scoring coefficient is used to obtain the candidate's ranking of the 4 companies when choosing a job.

The evaluation of each company is subjective. It may be easy for people with a wide range of knowledge to search and organize data, but for people with a narrow range of knowledge, searching and organizing data can be tricky. So its evaluation will vary significantly. In view of this, we use the grey cluster evaluation model to comprehensively consider the evaluation results of various factors for each company, which is comprehensive and referential, unlike a single-sided evaluation. The weight of each factor in the model is mainly given subjectively based on the actual background, and there may be personal preferences. In practice, it can be adjusted appropriately according to the focus without affecting the overall effect.

Finally, based on the research results from the above two perspectives, we can put forward some reasonable and effective suggestions to the recruits during the job search to help them find their favorite jobs.

2. Analysis of the Influence of Job Search Factors

According to the analysis of the problem, the factors affecting the job search include academic qualifications, attitude, professional evaluation, practical experience, and expression ability. The degree of influence of these factors is different. Naturally, we adopt the entropy method to the problem is modeled [7-15], and the given data is analyzed to obtain the order of the degree of influence of each factor.

2.1 The Basic Principle of Entropy Weight Method

Entropy can be used to measure the uncertainty of information. Assuming that the probability of each state in a system is recorded as $(i = 1, 2, \cdots, m)$, then the information entropy of the system can be expressed as:

$$entropy = -\sum_{i=1}^{m} p_i * \log_2(p_i) \tag{1}$$

We can see from Formula (1) that if the entropy of an indicator is greater, its corresponding probability will be smaller, and the amount of information contained in the indicator will be greater, and the description of the data will be corresponding. The more obvious it is, the greater its corresponding weight should is [8].

The entropy weight method is a method for assigning weight to each indicator by analyzing multiple indicators. In the process of use, the entropy weight method assigns weights according to the variability of each indicator. The stronger the indicator variability, the more obvious the indicator's description of the data, so we assign a greater weight to the indicator.

The entropy method has strong objectivity and can be applied to any problem of determining weight in theory. It is often used in questionnaire surveys and user preference indicators. In this paper, we use the entropy method to calculate the weight of each indicator [9, 10].

2.2 Steps of Algorithm

For a sample, we can use multiple indicators to evaluate it. In the evaluation process, the relative importance of these indicators to the sample is different. We can obtain a more reasonable

evaluation of the sample by calculating the importance of these indicators and integrating the amount of information provided by these indicators [11, 12].

Suppose we have n samples and m evaluation indicators, which x_{ij} represents the j-th indicator of the i-th sample, we can get the following data matrix

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdots & \cdots & \ddots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \tag{2}$$

Firstly, we need to standardize these indicators: non-quantitative processing of features, and standardization of various indicators into a unified system. The standardized matrix X' is as follows:

$$X' = \begin{bmatrix} x'_{11} & x'_{12} & \cdots & x'_{1m} \\ x'_{21} & x'_{22} & \cdots & x'_{2m} \\ \cdots & \cdots & \ddots & \cdots \\ x'_{n1} & x'_{n2} & \cdots & x'_{nm} \end{bmatrix} \tag{3}$$

Secondly, we need to calculate the information entropy redundancy of each indicator: for an indicator, if its specificity is relatively strong, then the indicator is considered to have a greater effect on the overall evaluation. Therefore, the weight we assign to this indicator is relatively large, and vice versa. The information entropy redundancy calculation formula is as follows:

$$E_j = -In(n)^{-1} \sum_{i=1}^{n} p_{ij} * In(p_{ij}) \tag{4}$$

where $p_{ij} = \dfrac{x'_{ij}}{\sum_{i=1}^{n} x'_{ij}}$,when $p_{ij} = 0$, $p_{ij} * In(p_{ij}) = 0$.

We obtain the entropy of each column feature, and the weight is the standardized result of the information entropy redundancy [13, 14]:

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j} = \frac{1 - e_j}{m - \sum_{j=1}^{m} e_j} \tag{5}$$

Where $d_j = 1 - e_j$ represents the information utility value of the j-th indicator. e_j is the element in E_j, d_j represents the entropy value of the j-th indicator, and w_j is the weight of the j-th indicator.

3. Comprehensive Evaluation Model of Working Environment

According to the problem analysis, we use the grey cluster evaluation method [16-25] to study the impact of five aspects of welfare, working conditions, labor intensity, promotion opportunities, and further study opportunities on recruiters when they choose companies. The series calculated the score coefficients of the 4 companies, so as to get the candidate's ranking of the 4 companies when making job selection.

As the name implies, grey is an indeterminate state between black and white. The black state refers to the ignorance of the system, and the white state refers to the knowledge of everything in the system. So the grey state refers to the state where part of the information in the system is known, and the other part of the information is unknown. The uncertainty and incompleteness of information are the basic characteristics of the grey system. We can eliminate the uncertainty and incompleteness of the information in the system by analyzing and mining the known information. According to the basic characteristics of the grey system, we can extend its concept [17-18].

3.1 Whitening Weight Function

For a grey system, we use grey numbers to describe it in many cases. The grey number refers to the number whose value range is only known, but the specific value is not known. Grey numbers correspond to true numbers. For example, we know that a person's height is between 1.7-1.8 meters. Because we don't know the specific value, this is a grey number. Then through actual measurement, we know that this person's height is 1.75 meters, which is an exact value, so it is a true number. Grey numbers can be divided into three types according to their values: 1) Grey numbers with only lower bounds; 2) Grey numbers with upper bounds only; 3) Interval grey numbers with both upper and lower bounds known. Here we choose the interval grey number and use the whitening weight function to describe the interval grey number [17]. For the system, we want to build, suppose we have n objects to be evaluated and m evaluation indicators. For each evaluation indicator, we can divide it into s levels, that is, s grey classes, which can be expressed as:

$$[a_1, a_2], \cdots, [a_{k-1}, a_k], \cdots, [a_{s-1}, a_s], [a_s, a_{s+1}] \tag{6}$$

When $\lambda_k = {(a_k + a_{k+1})}/{2}$, $f_j^k(x)$ is the whitening weight function, we can use the following formula to describe it [19]:

$$f_j^k(x) = \begin{cases} \dfrac{x - a_{k-1}}{\lambda_k - a_{k-1}}, & x \in [a_{k-1}, \lambda_k]; \\ \dfrac{a_{k+2} - x}{a_{k+2} - \lambda_k}, & x \in [\lambda_k, a_{k+2},]. \end{cases} \tag{7}$$

3.2 Grey Cluster Decision Evaluation Process

In this paper, we evaluate the working environment of the company and the attractiveness of the company to the candidate through the method of grey clustering decision assessment [20]. Assuming that we have n objects to be evaluated and m evaluation indicators, our evaluation process for grey clustering decision-making is:

Step 1: Establish an evaluation system for the evaluation system, including the m evaluation indicators we need to use. We use V to denote the evaluation system, which can be expressed as:

$$V = (v_1, v_1, \cdots, v_m). \tag{8}$$

Step 2: Next, we use n samples and m evaluation indicators to establish a data matrix X. We also call the sample measurement matrix.

Step 3: Then, according to the actual situation, we divide the evaluation indicators into s grey categories, that is, s levels, which are expressed as:

$$S = (s_1, s_1, \cdots, s_s). \tag{9}$$

At this point, we will get a whitening weight function $f_j^k(x)$.

Step 4: For the evaluation system, since it contains multiple evaluation indicators, each evaluation indicator describes the data in the evaluation system to a different degree, so we use the entropy weight method to assign a weight to each indicator. The final weights of each indicator are as follows:

$$W = (w_1, w_1, \cdots, w_j). \tag{10}$$

Step 5: We can get the decision coefficient σ_i^k of k by calculating $\sigma_i^k = \sum_j^n f_j^k(x_{ij}) w_j$,

correspondingly, the decision coefficient matrix $\sum = (\sigma_i^k)_{m \times s}$ can be calculated as follows:

$$\sum = (\sigma_i^k)_{m \times s} = \begin{bmatrix} \sigma_1^1 & \sigma_1^2 & \cdots & \sigma_1^s \\ \sigma_2^1 & \sigma_2^2 & \cdots & \sigma_2^s \\ \cdots & \cdots & \ddots & \cdots \\ \sigma_m^1 & \sigma_m^2 & \cdots & \sigma_m^s \end{bmatrix}. \tag{11}$$

Step 6: Unitize the decision coefficient matrix with the following formula:

$$\sigma_i^k = \frac{\sigma_i^k}{\sum_{k=1}^{s} \sigma_i^k}. \tag{12}$$

Step 7: Sort and make decisions based on the unitized decision coefficient matrix.

4. Case Solving and Analysis

This section uses the methods proposed in Sections 2 and 3 to carry out an example analysis of simulated cases. It then ranks the degree of influence of the recruits on the job search in descending order, and analyzes that the candidates pay more attention to the company when looking for a job In which respects, according to the model. The candidates will rank the choices of the 4 companies.

4.1 Data

Case analysis of the method proposed in this paper, the specific simulation data are as follows. Table 1 shows the various ratings of candidates. Table 2 shows the basic situation of companies. The average scores of each factor are shown in Table 3.

Table 1 Various Ratings Of Candidates.

Applicants	Education	Attitude	Professional assessment	Practical experience	Expression ability	Whether the application is successful
Applicant 1	B	A	B	C	B	YES
Applicant 2	C	A	A	A	A	YES
Applicant 3	B	A	A	B	B	YES
Applicant 4	A	A	B	C	B	YES
Applicant 5	A	A	A	B	A	YES
Applicant 6	A	C	B	B	B	NO
Applicant 7	B	B	C	C	C	NO
Applicant 8	A	A	C	B	C	NO
Applicant 9	B	B	C	B	B	NO
Applicant 10	C	A	C	C	B	NO
Applicant 11	C	A	B	A	B	YES
Applicant 12	B	A	A	A	B	YES
Applicant 13	A	A	C	C	C	NO
Applicant 14	A	B	B	B	C	NO
Applicant 15	C	B	B	A	B	NO
Applicant 16	A	A	B	C	B	YES
Applicant 17	C	A	A	A	A	YES
Applicant 18	A	A	C	C	B	NO
Applicant 19	B	A	B	C	A	YES
Applicant 20	A	B	C	B	C	NO

Table 2 Basic Situation Of the Companies.

Company	Benefits and benefits	Working conditions	Labor intensity	Promotion opportunities	Further study opportunities
Company 1	Middle	Good	Middle	Less	Many

Company 2	Middle	Bad	Middle	Many	Less
Company 3	Good	Middle	Big	Middle	Middle
Company 4	Good	Good	Big	Many	Middle

Table 3 Average Score Of Each Factor.

Factors	Benefits and benefits	Working conditions	Labor intensity	Promotion opportunities	Further study opportunities
Average score	9	7	7	8	6

4.2 Results of Analysis of the Influence of Job Search Factors

For the given data (see Table 2), we first preprocess it. Since the given data is non-quantitative, we will quantize it. Specifically, replace A with 2, B with 1, C with 0, “Yes” with 2, and “No” with 0. The scores of the candidates are shown in the following table:

Table 4 Scores of Digital Candidates.

Applicants	Education Attitude	Professional assessment	Practical experience	Expression ability	Whether the application is successful	
Applicant 1	1	2	1	0	1	2
Applicant 2	0	2	2	2	2	2
Applicant 3	1	2	2	1	1	2
Applicant 4	2	2	1	0	1	2
Applicant 5	2	2	2	1	2	2
Applicant 6	2	0	1	1	1	0
Applicant 7	1	1	0	0	0	0
Applicant 8	2	2	0	1	0	0
Applicant 9	1	1	0	1	1	0
Applicant 10	0	2	0	0	1	0
Applicant 11	0	2	1	2	1	2
Applicant 12	1	2	2	2	1	2
Applicant 13	2	2	0	0	0	0
Applicant 14	2	1	1	1	0	0
Applicant 15	0	1	1	2	1	0
Applicant 16	2	2	1	0	1	2
Applicant 17	0	2	2	2	2	2
Applicant 18	2	2	0	0	1	0
Applicant 19	1	2	1	0	2	2
Applicant 20	2	1	0	1	0	0

Then, analyze the data in Table 4 through the entropy method to obtain the weight of each indicator, which corresponds to the question, that is (education, attitude, professional evaluation, practical experience, expression ability) 5 factors corresponding to the impact of the hired on finding a job degree. The weights of the five factors obtained are shown in the following table:

Table 5 the Degree Of Influence of 5 Factors on the Job Search.

Factors	Benefits and benefits	Working conditions	Labor intensity	Promotion opportunities	Further study opportunities
Indicator Weight	0.184576	0.047765	0.268188	0.31183	0.187641

From the results in Table 6, we can see that during the job search period, the various influencing factors correspond to the degree of influence of the recruits on the job search in descending order: practical experience>professional evaluation>expressive ability>education>attitude. Practical experience and professional evaluation may be the more important aspects of recruitment units, and the degree of influence of academic qualifications is not the highest. This further shows that in

today's society, no matter how high a degree is, it cannot ensure a satisfying job. The era of job hunting with diplomas and academic qualifications has passed. Academic qualifications represent your past, while independent thinking influences the talents of others through words and deeds. Unique core competitiveness represents future development.

4.3 Results of Comprehensive Evaluation Model of Working Environment

Similar to question 1, for the data in Table 2, we first preprocess it. Since the given data is non-quantitative, we will quantize it. Specifically, replace "excellent" with 2, "medium" with 1, "bad" with 0, "more" with 2, "less" with 1, and "big" with 2. The basic situation of quantitative recruitment units is shown in the following table:

Table 6 Basic Situation Of Companies.

Company	Benefits and benefits	Working conditions	Labor intensity	Promotion opportunities	Further study opportunities
Company 1	1	2	1	0	2
Company 2	1	0	1	2	0
Company 3	2	1	2	1	1
Company 4	2	2	2	2	1

According to Table 7, we can know the impact of five aspects of benefits, working conditions, labor intensity, promotion opportunities, and further study opportunities on recruiters when they choose recruiters [21]. We standardize them to obtain the corresponding weights as shown in the following table.

Table 7 Weight Distribution Of Each Factor.

Factors	Benefits and benefits	Working conditions	Labor intensity	Promotion opportunities	Further study opportunities
Indicator weight	0.2432	0.1892	0.1892	0.2162	0.1622

According to the grey clustering evaluation process, we can get the data matrix A as follows:

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

Using the grey clustering model for evaluation, we can get the decision coefficient matrix of 4 companies as:

$$\Sigma=\begin{bmatrix}0.0702&0&0.0631&0.1261\\0.0702&0&0.0721&0.1441\\0.2840&0.0134&0.2921&0.1403\\0.14882&0.0134&0.4272&0.4106\end{bmatrix}$$

Then, through formula (29), we normalize the obtained decision coefficient matrix to obtain the company decision coefficient matrix as:

$$\Sigma'=\begin{bmatrix}0.2705&0&0.2432&0.4863\\0.2450&0&0.2517&0.5033\\0.3891&0.0183&0.4002&0.1923\\0.1488&0.0134&0.4272&0.4106\end{bmatrix}$$

Using the grey adjustment coefficient, we can see the evaluation scores of the 4 companies in Table 8.

Table 8 Evaluation Scores Of 4 Companies.

Company	Company 1	Company 2	Company 3	Company 4
Evaluation score	0.2594	0.2864	0.7297	1.0000

It can be concluded from Table 9 that the candidate's order of selection of the 4 companies from largest to smallest is: Company 4>Company 3>Company 2>Company 1. This result is more in line with our subjective feeling, because company 4 is better in all aspects, especially the benefits and

promotion opportunities that applicants are more concerned about. In contrast, company 1 is not good enough in terms of benefits and promotion opportunities that the applicants value more.

5. Conclusions

Using the entropy method to the analysis of the influence of job search factors, we can get that in the first question: during the job hunting period, the influence of each influencing factor on the job hunting of the job applicant is in descending order: practical experience > professional evaluation > Expression ability > Education > Attitude. Practical experience and professional evaluation may be the more important aspects of recruitment companies, and the degree of influence of academic qualifications is not the highest. This further shows that in today's society, no matter how high a degree is, it cannot guarantee good food and clothing when looking for a job. The era of job hunting with diplomas and academic qualifications has passed. Academic qualifications represent your past, while independent thinking influences the talents of others through words and deeds. Unique core competitiveness represents future development.

Using the grey cluster evaluation model to model a comprehensive evaluation model of the working environment, we can draw the following conclusion: the candidate's choice of the 4 companies in descending order is: company 4 > company 3 > company 2 > company 1. This result is more in line with our subjective feelings, because company 4 is better in all aspects, especially the benefits and promotion opportunities that applicants are more concerned about. On the contrary, company 1 is not good enough in terms of benefits and promotion opportunities that the applicants value more.

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