

A Solution to Solve Employment Matching Problem of Graduates Majoring in Information Management and Information System Based on Lingo

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Abstract. The mathematical modeling thought will be applied to employment matching problem of graduates majoring in information management and information system. Taking the highest overall matching degree as the goal, this paper constructs an employment matching model and solves the model with the optimized modeling software: LINGO.

Introduction

Information management and information system (the following referred to as: IMIS) is a practical and innovative subject, which integrates information technology and management science [1]. This specialty aims to enable students to master the knowledge about modern management theories and computer science, grasp the abilities of system analysis and design. IMIS involves many disciplines, including management, computer science, marketing and other aspects, so the graduates have a lot of options when they find jobs [2]. Therefore, the graduates need a two-way choice according to their own situation and requirements of enterprises, while the enterprises also need to choose graduates based on their own requirements.

This paper solves the employment matching problem by using the method of mathematical modeling according to the graduates' employment abilities and recruiting requirements of the enterprises [3]. The method meets the requirements of individual graduate and enterprise in the best possible, and getting the optimal result of overall employment matching degree.

Hypothetical conditions

1. This paper selects 4 factors, such as job salary, work area, development prospect and working pressure as the conditions that enterprises provide and graduates demand, other factors will not be considered;

2. This paper selects 4 factors, such as academic performance, social activities, computer level and scientific research ability as the conditions that graduates provide and enterprises demand, other factors will not be considered;

3. When the conditions that the graduates (enterprises) can provide is lower than the demand of the enterprises (graduates), the matching degree is 0;

4. Both the graduates and the enterprises are not affected by the interference of other human factors or the external environment.

Employment Matching Model

According to the four aspects mentioned above, the paper chooses 10 class graduates, named S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, and according to the current situation of the professional development of IMIS in China, there are 10 mainly kinds of jobs matching with the specialty of IMIS [4] and are shown in table 1.

Table 1 Jobs Matching With the Specialty of IMIS

Symbol	Job Title	Symbol	Job Title
J1	Computer Programmer	J2	Data Analyst
J3	College Counselor	J4	Civil Servant
J5	Marketers	J6	Financer
J7	Human Resource Manager	J8	Product Manager
J9	Institute Researcher	J10	University Teacher

The working conditions that graduates demand and provided by the enterprises include job salary, work area, development prospect and working pressure; the ability indicators that enterprises demand and provided by the graduates include academic performance, social activities, computer level and scientific research ability. In the establishment of the model, the conditions provided by the graduates and enterprises are quantified, range set to 1, 2, 3, 4, 5 points; the higher points the graduates have, the better conditions the graduates can provide, it also applies to enterprises.

According to the actual requirements of the two parties and the applicable conditions of the model, we use the following formula to calculate the matching degree between supply and demand in the recruitment process:

$$S = x + \sum_{t=1}^n 0.5(f(j,t) - m(i,t)), f(j,t) > m(i,t) \quad (1)$$

Where x said basic satisfaction, referring to the numbers of basic conditions of one graduate (enterprise) to meet the requirements of enterprises (graduates), t said the basic conditions or evaluation indexes, $f(j,t)$ said the level of enterprise j in condition t , $m(i,t)$ said the level of graduate i in condition t , i, j said the current matching sides.

The definition of satisfaction can be understood that when one of the basic conditions of one side meet the corresponding requirements of the other side, there are 1 points; when there are t conditions of one side meet the corresponding requirements of the other side, there are t points. Because that when the actual conditions of one side are higher than the expectations of other side, then the degrees of goodwill of other side will be increased, therefore, when the basic conditions of one side are better than the demand of other side, the degree of satisfaction will be increased. The principle of increase is that each higher level (it is divided into 1, 2, 3, 4, 5 levels in the model) will increase by 0.5 points.

In fact, it is not meaningful to consider the graduates' satisfaction and the satisfaction of enterprises individually, the success of the employment matching depends on the common wishes of both labor and capital, so the concept of matching degree is defined to measure the degree of employment matching and is shown in formula (2).

$$match(i, j) = \frac{m(i,t) + f(j,t)}{2} \quad (2)$$

The matching degree is the average value of the satisfaction of both graduates and enterprises. Obviously, the greater the matching degree, the higher the probability of matching success, and vice versa.

Variable X_{ij} ($X_{ij} = 1$ or 0) is introduced as a decision variable to determine whether the graduate S_i is matched to enterprise J_j . if $X_{ij} = 1$, then 1 and 2 match, otherwise it will not match. Then the problem is to determine a matching scheme to meet the requirements of both parties and to make the maximum overall matching degree.

We get the objective function as:

$$\max = \sum_{i=1}^n \sum_{j=1}^n S_{ij} J_{ij} \quad (3)$$

Constraint conditions:

$$\left\{ \begin{array}{l} \sum_{i=1}^n X_{ij} = 1 \\ \sum_{j=1}^n X_{ij} = 1 \quad (4) \\ X_{ij} = 1 \text{ Or } X_{ij} = 0 \end{array} \right.$$

Model solving

Lingo software is used to solve the model. Lingo is a software developed by the LINDO Systems Inc., which is used to solve the optimization problem. Because of the fast speed of implementation, it's easy to analysis and solve mathematical programming problems, it is widely used in mathematics, scientific research and industry [5].

In the following case study, we establish the Lingo model in the Lingo software according to the objective function and constraint conditions. The combination of graduates and enterprises with the highest overall matching degree and value of degree are obtained.

Case study

Assume that the graduates' abilities and their requirements for the enterprises are shown in table 2.

Table 2 Graduates' Abilities and Requirements

Graduates	Abilities				Requirements			
	Academic Performance	Social Activities	Computer Level	Scientific Research	Job Salary	Work Area	Development Prospect	Working Pressure
S1	4	2	4	3	4	3	4	2
S2	3	5	1	2	3	4	4	4
S3	3	2	2	4	3	2	2	5
S4	5	3	2	4	5	4	4	3
S5	2	1	2	1	2	3	2	2
S6	3	3	3	3	2	3	4	3
S7	5	4	1	4	4	3	2	1
S8	2	4	5	3	4	4	3	3
S9	3	2	4	4	4	3	3	2
S10	4	4	3	2	2	4	3	2

Assume that the treatment conditions and requirements of enterprises for the graduates are shown in table 3.

Table 3 Treatment Conditions and Requirements of Enterprises

Jobs	Treatment Conditions				Requirements			
	Job Salary	Work Area	Development Prospect	Working Pressure	Academic Performance	Social Activities	Computer Level	Scientific Research Ability
J1	5	5	3	1	3	1	5	2
J2	4	5	3	2	5	3	3	4
J3	2	3	2	4	4	5	1	3
J4	2	2	2	5	4	4	2	2
J5	3	4	4	2	3	4	2	1
J6	4	4	4	2	4	3	3	3
J7	3	2	2	2	3	4	2	2
J8	4	4	3	3	3	4	3	3
J9	3	3	2	3	5	3	3	5
J10	2	1	2	5	4	2	2	4

According to the formula (1), we can calculate the matching degree between the graduates and the job positions. The graduates' satisfaction are shown in table4 and satisfaction of enterprises are shown in table5.

Table4 Graduates' Satisfaction

	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10
S1	3.5	3	3.5	0	3.5	4.5	0	4	2.5	0
S2	3.5	1.5	0	0	3	3.5	0	2.5	0	0
S3	6	0	0	0	5	5.5	0	5	0	0
S4	2.5	1.5	1.5	2	2	2	0	2	1	2
S5	6	6.5	5	4.5	6	6.5	3.5	6.5	5	4.5
S6	4.5	4	3.5	3	4	4.5	0	4.5	4.5	3
S7	5	4.5	3.5	3	3.5	4.5	1	5	3	3
S8	4	4.5	0	0	3.5	4.5	0	4.5	0	0
S9	4.5	5	3	0	4	5	0	5	2.5	0
S10	2.5	5.5	3	3.5	5	5.5	2.5	5.5	3	3.5

Table5 Satisfaction of Enterprises

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
J1	4.5	5	4.5	6	0	4.5	6.5	5	4.5	5
J2	0	0	0	3	0	2	3.5	3.5	2.5	2.5
J3	4.5	2	3	4.5	0	3	4	4	4	3
J4	4.5	2.5	3	4.5	0	3	4.5	5	4	4.5
J5	5.5	4	4.5	5.5	1	4.5	6.5	5.5	5.5	5.5
J6	3.5	0	0	4	0	3	4.5	4.5	3	3.5
J7	5	3.5	4	5	1	4	5	5	5	5
J8	4	2.5	2.5	3.5	0	3	4.5	4	4	3.5
J9	0	0	0	2	0	2	2.5	3.5	0	2.5
J10	4	0	3	5	0	3	4.5	4.5	4	4.5

We can get the following table6 by calculating the matching degree by using the formula (2).

Table6 Matching Degree

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
J1	4	4	4	3	1.75	4.5	3.25	4.5	3.5	2.5
J2	1.75	0.75	0	1.5	1.5	2.75	1.75	3	1.25	1.25
J3	5.25	1	1.5	2.25	2.5	4.25	2	4.5	2	1.5
J4	3.5	2	2.25	3.25	1	2.5	2.25	3.5	2.5	3.25
J5	5.75	5.25	4.75	5	3.5	5.5	5	6	5.25	5
J6	4	2	1.75	3.5	2	3.75	2.25	4.5	3.75	3.25
J7	5	4	3.75	4	1.75	4.25	3	5	4	4
J8	4	3.5	1.25	1.75	1.75	3.75	2.25	4.25	2	1.75
J9	2.25	2.5	1.5	1	2	3.5	1.25	4.25	1.25	1.25
J10	3.25	2.75	3	4.25	2.5	4.25	3.5	5	3.5	4

In order to calculate the optimal matching degree, we establish the following Lingo model according to the objective function and constraints in Lingo software.

Model:

sets:

stu/S1..S10/;

job/J1..J10/;

link(stu,job):p,x;

endsets

data:

p=4 4 4 3 1.75 4.5 3.25 4.5 3.5 2.5
1.75 0.75 0 1.5 1.5 2.75 1.75 3 1.25 1.25

```

5.25 1 1.5 2.25 2.5 4.25 2 4.5 2 1.5
3.5 2 2.25 3.25 1 2.5 2.25 3.5 2.5 3.25
5.75 5.25 4.75 5 3.5 5.5 5 6 5.25 5
4 2 1.75 3.5 2 3.75 2.25 4.5 3.75 3.25
5 4 3.75 4 1.75 4.25 3 5 4 4
4 3.5 1.25 1.75 1.75 3.75 2.25 4.25 2 1.75
2.25 2.5 1.5 1 2 3.5 1.25 4.25 1.25 1.25
3.25 2.75 3 4.25 2.5 4.25 3.5 5 3.5 4;
enddata
max=@prod(stu(i):@sum(job(j):p(i,j)*x(i,j)));
@for(job(j):@sum(link(i,j):x(i,j))=1);
@for(stu(i):@sum(link(i,j):x(i,j))=1);
@for(link:@bin(x));
End

```

Using Lingo software to solve, the highest overall matching degree is obtained and shown in table 7, and the highest overall matching degree was 33.

Table 7 the Highest Overall Matching Degree

Graduates	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Jobs	J3	J6	J5	J10	J7	J9	J1	J2	J8	J4

Summary

In this paper, we divide the graduates' employment abilities into four items, which are academic performance, social activity, computer level and scientific research ability, the treatment conditions of the enterprises are divided into the job salary, working area, development prospects and work pressure, they basically covers the needs of the graduates and enterprises. In the process of solving the problem, we try to match the individual graduate and enterprise as far as possible, and the overall optimal solution is obtained under this way. Finally, we find a set of optimal solution and complete the matching of the graduates and enterprises.

The model used in this paper is relatively simple, we simplify the recruitment process and extract the most critical part of the recruitment process. Therefore, although the model is relatively simple, we can finish the match basically, it has a certain reference value for the graduates majoring in Information Management and Information System in the job search process.

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