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2014

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Abstract

The rapid rate of China's urbanization in recent years arises greater demand of houses. To ease the housing shortage, Chinese authority has been building or collecting a large amount of public housing. However, as the large-scale construction of public housing has been promoted, an increasing number of people focus their eyes on the equitable distribution of these houses. This paper aims to establish a distribution system of public housing with the research in Huangshi City (a city in central China). We affirm the importance of priority and housing preference of applicant families, on the basis of which we discuss operating principle of the distribution system based on the multi-objective programming, and advance two ways of model solutions as well. At last, we propose an algorithm instance to verify feasibility of the distribution system, and make the comparison between two types of algorithms as well.

Keywords: Public housing, housing preference, distribution system, multi-objective programming

1 INTRODUCTION

During the ongoing urbanization process in China, housing problem has become one of the major social issues we have to face. China's urbanization rate rose from 17.9% in 1978 to 53.7% in 2013(National Bureau of Statistics), and the influx of the rural population arouses larger demand of housing. In addition, housing situation is severe of urban residents. Rising housing prices has weakened the purchasing power of low-income families. Consequently, Chinese authorities devote greater efforts to the implementation of housing indemnification. And an increasing number of people focus their attention on the distribution of public housing as its large-scale construction has been promoted. However, nearly half of public housing are of illegal use or idle in eight provinces and sixteen cities(annual audit report, 2010). Therefore, how to allocate public housing scientifically and rationally seems an urgent problem that calls for prompt solutions.

The large scale of urbanization also promotes the transformation of industrial cities in China, resulting in increasingly prominent housing problems. We choose Huangshi, an old industrial base in central China, as a representative city for our study on distribution system of public housing. The system realizes the automatic matching scientifically by computer algorithms, taking priorities and housing preferences of applicant families into account.

2 LITERATURE REVIEW

Scholars have examined the allocation issues extensively. Some of them studied factors influencing the allocation in public housing, like education attainment, current residence status and family size(Huang & Clark, 2002; Pan, 2004; Li & Li, 2006). Zhang and Rasiah(2014) also summarized the evaluating system of housing allocation that was adopted by H Air-Conditioner Plant. Chen et al. (2014) made a detailed description from housing application of security groups to the housing allocation progress in China. And they emphasized the waiting list and periodic lottery operation when the demand of public housing exceeded the supply.

Problems existing in the allocation process also caused intense discussion between scholars. Fan and Zhang(2014) considered on main problems in public housing management in China including the equitable distribution problem. They point out that housing distribution mainly relies on a random way, which causes new unfairness. On the basis, they also put forward several allocation principles to standardize such progress. Daniel and Hunt(2014) doubted the fairness of the site-and-services scheme of housing allocation in Nigeria. They believed that the allocation processes based on need and demand was an effective way, whose use in developing countries was advocated also(Monk & Grant, 2011).

Most of the previous studies payed more attention on the whole mechanism of housing indemnification, and researches considering about the distribution were scarcely studied from a quantitative way. Therefore, this study is to fill this gap and construct a distribution system which is suitable for China.

3 DISTRIBUTION OF PUBLIC HOUSING

Currently, the distribution methods of public housing widely used in China are “Waiting” and “Luck”. The “Luck” process is full of randomness that rarely considers actual needs of applicants. This is quite unfair for particularly difficult families only relying on their fortune. What’s more, a large number of time, manpower and material resources will be taken in the whole process. To better carry out the housing indemnification, Chinese government has to consider the application of public housing distribution system.

What’s the critical points that should be focused on in the distribution system? That is equity and efficiency. Equity refers to that all applicants should be assigned to houses they satisfied with, but this cannot be achieved in reality. Thus, here we define equity as the priority, which determined by both basic information and application time of applicants. For example, the priority of a disabled applicant will be higher than normal ones as other things being equal. Efficiency has two meanings: effective and fast. Each applicant has his/her own preferences for housing, and they will be more satisfied if more housing attributes matching their preference, which we define as matching degree. And matching degree reflects the effectiveness of the distribution. Moreover, the distribution system implementing with computer algorithm ensures the distribution velocity.

4 OPERATING PRINCIPLE OF THE DISTRIBUTION SYSTEM

4.1 Selecting Matching Indexes

To assign appropriate public housing to the right applicants, selecting suitable matching indexes is a crucial issue. Namely, applicants’ preferences for houses must be considered. Unlike basic information, applicants’ preference information is their demand towards housing attributes. However, more than 100 housing attributes are given in the “Design code for residential buildings in China”, and it is impossible to take all these attributes into account. Fortunately the housing properties most families cared about in China are roughly the same, thus we want to select several attributes most talked about by the applicants.

According to the data collecting from questionnaires distributed to the security groups and interviews with officers in the housing agency of Huangshi City, we summarize six significant matching indexes: location, living area, house rent, floor, surroundings and apartment layout. Table 1 shows the detailed option items of each index.

Indexes	Location	Living Area	House Rent	Floor	Surroundings	Apartment layout
Options	district sub-district community	15m2 above 30m2 above 45m2 above 60m2 above 75m2 above	less than CNY100 less than CNY200 less than CNY300 less than CNY400 less than CNY500	first floor low floor medium floor high floor top floor	living facilities medical facilities education transportation the employment	single room 1 bedroom+ 1 hall 2 bedrooms+ 1 hall 3 bedrooms+ 1 hall

Table 1. Matching indexes and options

4.2 Computing matching degree

Let I with the number of n and J with the number of m denote sets of the security groups and public housing respectively. The elements of above two sets will be $\{I_1, I_2, \cdots; I_i, \cdots; I_n\}$ and $\{J_1, J_2, \cdots; J_j, \cdots; J_m\}$. We also define S as the matching set, whose elements are paired from sets I and J. For example, one possible S set can be represented as $S=\{(I_1, J_5), (I_2, J_1), \cdots; (I_i, J_j), \cdots; (I_n, J_2)\}$. As discussed previously, the matching results are based on the matching degree between applicant families and public housing. Here $S_1(i, j)$, $S_2(i, j)$, $S_3(i, j)$, $S_4(i, j)$, $S_5(i, j)$ and $S_6(i, j)$ are labeled as the matching degree function of location, living area, house rent, floor, surroundings and apartment layout between applicant I_i and house J_j. Similarly, we also define $C^1{}_i$, $C^2{}_i$, $C^3{}_i$, $C^4{}_i$, $C^5{}_i$, $C^6{}_i$ and $H^1{}_j$, $H^2{}_j$, $H^3{}_j$, $H^4{}_j$, $H^5{}_j$, $H^6{}_j$ as the expectation of applicant family I_i and the actual value of public housing J_j for each matching index respectively.

The constraints of above matching attributes can be classified into two types: hard constraint and soft constraint. Usually, the hard constraint is a certain condition that must be satisfied, while the soft constraint is an acceptable condition as long as it is within a given range.

Location is a hard constraint but with three option items. For convenience, we let $C^1{}_{i1}$, $C^1{}_{i2}$, $C^1{}_{i3}$ represent expectations for district, sub-district and community, and $H^1{}_{j1}$, $H^1{}_{j2}$, $H^1{}_{j3}$ are designed to denote the real value for each item. Unlike normal hard constraints, $S_1(i, j)$ equals to the highest score only if the expectations are fully consistent with the actual value. Here we limit the numerical range of the matching degree functions to [-1, 1], and the $S_1(i, j)$ is calculated in formula (1).

$$S_1(\mathrm{i,j}) = \begin{cases} 1, & C_{i1}^1 = H_{j1}^1, C_{i2}^1 = H_{j2}^1, C_{i3}^1 = H_{j3}^1 \\ 0.6, & C_{i1}^1 = H_{j1}^1, C_{i2}^1 = H_{j2}^1, C_{i3}^1 \neq H_{j3}^1 \\ 0.2, & C_{i1}^1 = H_{j1}^1, C_{i2}^1 \neq H_{j2}^1, C_{i3}^1 \neq H_{j3}^1 \\ -1, & C_{i1}^1 \neq H_{j1}^1, C_{i2}^1 \neq H_{j2}^1, C_{i3}^1 \neq H_{j3}^1 \end{cases} \tag{1}$$

Obviously, living area is a soft constraint, and applicant families will be more pleased with the larger area. Let $C^2{}_i$ as the minimum expectation for living area and $H^2{}_j$ as the lower limit of the actual value, which means $C_i^2, H_j^2 \in \{15,30,45,60,75\}$. Following formula (2) shows the $S_2(i, j)$, and max $H^2{}_j$ is the value of the maximum area among all the public housing.

$$S_2(\mathrm{i,j}) = \begin{cases} 1, & \mathrm{H}_j^2 \geq \mathrm{C}_i^2 \text{ and } \max \mathrm{H}_j^2 = \mathrm{C}_i^2 \\ \frac{\mathrm{H}_j^2 - \mathrm{C}_i^2}{\max \mathrm{H}_j^2 - \mathrm{C}_i^2}, & \mathrm{H}_j^2 \geq \mathrm{C}_i^2 \text{ and } \max \mathrm{H}_j^2 > \mathrm{C}_i^2 \\ -1, & \mathrm{H}_j^2 < \mathrm{C}_i^2 \end{cases} \tag{2}$$

In contrast to the housing area, applicants hope the house rent be lower. Despite the lower rent means the relatively poor house, but for the security groups, money is one of things they concerned the most. Thus here we suppose they all choose the rent ceiling they can afford, and there will be an increasing satisfaction with lower rent. Here $\mathrm{C}_i^3, \mathrm{H}_j^3 \in \{15,30,45,60,75\}$, and min $H^3{}_j$ refers to the minimum rental among all the public housing. Formula (3) presents $S_3(i, j)$.

$$S_3(\mathrm{i},\mathrm{j}) = \begin{cases} 1, & \mathrm{H}_j^3 \le \mathrm{C}_i^3 \ and \ \mathrm{C}_i^3 = min\mathrm{H}_j^3 \\ \frac{\mathrm{C}_i^3 - H3_j}{\mathrm{C}_i^3 - min\mathrm{H}_j^3}, & \mathrm{H}_j^3 \le \mathrm{C}_i^3 \ and \ \mathrm{C}_i^3 > min\mathrm{H}_j^3 \\ -1, & \mathrm{H}_j^3 > \mathrm{C}_i^3 \end{cases} \quad (3)$$

Floor can also be regarded as a hard constraint. To standardization, here we design the number 1 as the first floor, and the number 2,3,4,5 are the low floor, medium floor, high floor and top floor respectively. That is to say, $\mathrm{C}_i^4, H_j^4 \in \{1,2,3,4,5\}$. Then the satisfaction will be lower when there are greater differences of floor height between the applicant's expectation and the actual value of the housing. Formula (4) presents calculation rule of S_4 (i, j).

$$S_4(\mathrm{i},\mathrm{j}) = \begin{cases} 1, & \mathrm{C}_i^4 = H_j^4 \\ 0.5, & |\ \mathrm{C}_i^4 - H_j^4| = 1 \\ 0, & |\ \mathrm{C}_i^4 - H_j^4| = 2 \\ -0.5, & |\ \mathrm{C}_i^4 - H_j^4| = 3 \\ -1, & |\ \mathrm{C}_i^4 - H_j^4| = 4 \end{cases} \quad (4)$$

The matching degree of surroundings depends on the actual situation of living facilities, medical facilities, education, transportation and the employment around the house. We score each house on the basis of numbers of each facility within a radius of 3 km to it. And we define H^5_{j1}, H^5_{j2}, H^5_{j3}, H^5_{j4} and H^5_{j5} as the score of each item in the range of [-1, 1]. Applicant's requirements for the surroundings vary from each other, thus each family can choose several options it thinks the most important. Let C^5_{i1}, C^5_{i2}, C^5_{i3}, C^5_{i4} and C^5_{i5} denote whether they select the corresponding surrounding facility. Following formula (5) shows the S_5 (i, j).

$$S_5(\mathrm{i},\mathrm{j}) = \frac{\sum_{k=1}^{5} \mathrm{C}_{ik}^5 * H_{jk}^5}{\sum_{k=1}^{5} \mathrm{C}_{ik}^5}, \quad \mathrm{C}_{i1}^5, \mathrm{C}_{i2}^5, \mathrm{C}_{i3}^5, \mathrm{C}_{i4}^5, \mathrm{C}_{i5}^5 \in \{0,1\} \quad (5)$$

Security groups all want houses with more rooms, but the similarity of their preference to apartment layout will be relatively higher. Moreover, we should assign appropriate houses for applicants who are genuinely in need. As a consequence, here we consider the family structure of applicants as their expectation. According to the related policies of housing indemnification in Huangshi, Table 2 presents the suitable apartment layout for families of some common structures. All the matching pairs are classified into five levels, which are used to calculate the matching degree. S_6 (i, j) is shown in formula (6) as follows.

$$S_6(\mathrm{i},\mathrm{j}) = \begin{cases} 1, & \mathrm{R} = \text{"entirely appropriate"} \\ 0.5, & \mathrm{R} = \text{"appropriate"} \\ 0, & \mathrm{R} = \text{"Just right"} \\ -0.5, & \mathrm{R} = \text{"not suitable"} \\ -1, & \mathrm{R} = \text{"inappropriate"} \end{cases} \quad (6)$$

	H^6_{j1}: single room	**H^6_{j2}:** one bedroom	**H^6_{j3}:** two bedroom	**H^6_{j4}:** three bedroom
C^6_{i1}: single person	entirely appropriate	Inappropriate	Inappropriate	Inappropriate
C^6_{i2}: a couple	Appropriate	entirely appropriate	Inappropriate	Inappropriate
C^6_{i3}: a couple with a child under 10 years old	Appropriate	entirely appropriate	Inappropriate	Inappropriate
C^6_{i4}: a couple with a child over the age of 10	Just right	Appropriate	entirely appropriate	Inappropriate
C^6_{i5}: family with 3 persons	not suitable	Just right	entirely appropriate	Just right
C^6_{i6}: family with more than 3 persons	not suitable	Just right	Appropriate	entirely appropriate

Table 2. Suitable apartment layout for families of some common structures

4.3 Model construction

The ultimate goal of the distribution system is to pair off n applicant families and m public housing, which makes everyone reasonably happy. To achieve this objective, we build a multi-objective model making the maximum sum of the matching degree of all the attributes in this research.

As mentioned before, priority is another significant point apart from matching degree. According to the relevant regulations of housing indemnification in Huangshi City, each applicant family will obtain a score based on the basic information submitted after approval. Let P_i denotes the priority index of the applicant family I_i, the maximum and minimum of which are defined as P_{max} and P_{min} respectively. We also label K_i as the ordinal value of family I_i.

$$K_1, K_2, \cdots, K_i, \cdots, K_n \in \{1, 2, \cdots, i, \cdots, n\}$$
$$K_x \neq K_y, x \neq y, \ \mathrm{x, y} \in \{1, 2, \cdots, i, \cdots, n\}$$

And following formula (7) shows the P_i:

$$P_i = P_{max} - \frac{P_{max} - P_{min}}{n-1}(K_i - 1), \ i = 1,2,\cdots,n \qquad (7)$$

Actually, the distribution of public housing can be simplified as an assignment problem. Here we introduce the variable x_{ij} to show whether Jj matches I_i or not.

$$x_{ij} = \begin{cases} 1, & J_j \text{ matches } I_i \\ 0, & otherwise \end{cases}$$

With the priority index and matching degree discussed previously, we construct the distribution model as follows.

$$\max f^k = \sum_{i=1}^{n} P_i \sum_{j=1}^{m} S_k(i,j) * x_{ij} \qquad (8)$$

$$\text{s.t.} \begin{cases} \sum_{i=1}^{n} x_{ij} \le 1, \quad \mathrm{j = 1,2,\cdots,m} \\ \sum_{j=1}^{m} x_{ij} \le 1, \quad \mathrm{i = 1,2,\cdots,n} \\ x_{ij} = 1 \ or \ 0, \quad \mathrm{i = 1,2,\cdots,n \text{ and } j = 1,2,\cdots,m} \end{cases}$$

As a scarce resource in Huangshi, there is fewer number of public housing than that of applicant families. Each public house can only be assigned to one family, and one family can only obtain a house. Unlike other matching problems such as marriage problem (Gale & Shpaley 1962; MeVitie & Wilson 1971; Roth 1986), we just need to consider the sum of matching degree of applicant families on each attribute in the model. And the matching degree of family with higher priority index is more significant than the lower ones.

A variety of solutions can be used to solve multi-objective problems. Since the ideal solution of each target can be easily obtained, here we try to get the optimal value from the distance between the ideal value and actual value of each target. We label f^{k*} as the ideal solution of each object respectively. Given that all matching attributes are of equal importance for applicant families, then solving above multi-objective model can be transformed into solving following distance D:

$$\min D = \left(\sum_{k=1}^{6} |f^{k*} - f^{k}|^{q}\right)^{\frac{1}{q}} \quad (9)$$

$$1 \leq q \leq \infty$$

The corresponding matching results and distance value will change with the different value of q. In this research, we only discuss cases q=1 and q=2, which are considered as Absolute Distance and Euclidean Distance.

Above distance can be simplified as formula (10) when q=1. It is easy to know that the multi-objective model has been transformed into a linear assignment problem with a single target. And there are lots of algorithms can be used to solve such problems, such as Branch and bound method, cutting-plane method and so on(Hiller & Lieberman 2001). Furthermore, assignment problem can also be converted into the weight matching problem in the bipartite graph(Bondy & Murty 1976; West 2001). Here we think Kuhn-Munkras algorithm, the commonly used method in assignment problems, is suitable for solving problems like formula (10).

$$\max D = \sum_{k=1}^{6} f^{k} \quad (10)$$

In the case of q=2, the objective function can be shown in formula (11) as follows, which is a nonlinear assignment problem obviously.

$$\min D = \left(\sum_{k=1}^{6} |f^{k*} - f^{k}|^{2}\right)^{\frac{1}{2}} \quad (11)$$

And algorithms mentioned above will be no long applicant for this model. Thus, we consider the Genetic algorithm(Chu & Beasley 1997; Gen & Cheng 2000) here, a relatively mature approach for solving nonlinear problems.

5 INSTANCE ANALYSIS

To conduct the distribution process, we collect some real values of public housing and security group from Huangshi in this section. For simplicity, we set P_{max}=3.2 and P_{min}=1. Therefore the priority index of each applicant can be easily obtained. To avoid the complicated names of location in Huangshi, we let α1 to α3, β1 to β3, and γ1 to γ3 take the place of district, sub-district and community respectively. Table 3 presents the attributes value and priority index of each applicant family. And the actual value of matching indexes of public housing is shown in Table 4. On the basis of calculation rules discussed previously and data from table 3 and table 4, we can easily obtain the matching degrees of each index between applicants and houses.

Applicant family	C^1_i	C^2_i	C^3_i	C^4_i	C^5_i	C^6_i	P_i
I_1	C^1_{i1}=α1, C^1_{i2}=β2, C^1_{i3}=γ1	75	300	4	C^5_{i3}, C^5_{i4}, C^5_{i5}=1	C^6_{i6}	3.2
I_2	C^1_{i1}=α2, C^1_{i2}=β1, C^1_{i3}=γ1	60	200	3	C^5_{i1}, C^5_{i4}, C^5_{i5}=1	C^6_{i5}	3.0
I_3	C^1_{i1}=α2, C^1_{i2}=β3, C^1_{i3}=γ2	60	200	3	C^5_{i1}, C^5_{i4} =1	C^6_{i6}	2.8
I_4	C^1_{i1}=α1, C^1_{i2}=β2, C^1_{i3}=γ3	30	200	1	C^5_{i1}, C^5_{i2}, C^5_{i4}=1	C^6_{i2}	2.6
I_5	C^1_{i1}=α3, C^1_{i2}=β1, C^1_{i3}=γ2	15	100	3	C^5_{i1}, C^5_{i3}, C^5_{i4}, C^5_{i5}=1	C^6_{i1}	2.4
I_6	C^1_{i1}=α1, C^1_{i2}=β1, C^1_{i3}=γ3	30	100	5	C^5_{i1}, C^5_{i3}, C^5_{i4}, C^5_{i5}=1	C^6_{i3}	2.2
I_7	C^1_{i1}=α1, C^1_{i2}=β2, C^1_{i3}=γ1	60	300	2	C^5_{i2}, C^5_{i3}, C^5_{i4} =1	C^6_{i4}	2.0
I_8	C^1_{i1}=α3, C^1_{i2}=β3, C^1_{i3}=γ2	45	400	1	C^5_{i1}, C^5_{i2}, C^5_{i3}, C^5_{i4}, C^5_{i5}=1	C^6_{i4}	1.8
I_9	C^1_{i1}=α2, C^1_{i2}=β2, C^1_{i3}=γ1	30	200	4	C^5_{i4}, C^5_{i5}=1	C^6_{i2}	1.6
I_{10}	C^1_{i1}=α2, C^1_{i2}=β1, C^1_{i3}=γ1	30	200	4	C^5_{i5}=1	C^6_{i2}	1.4
I_{11}	C^1_{i1}=α3, C^1_{i2}=β1, C^1_{i3}=γ2	15	100	3	C^5_{i1}, C^5_{i2}, C^5_{i4}, C^5_{i5}=1	C^6_{i1}	1.2
I_{12}	C^1_{i1}=α1, C^1_{i2}=β3, C^1_{i3}=γ3	30	100	1	C^5_{i1}, C^5_{i5}=1	C^6_{i3}	1.0

Table 3. Attributes value and priority indexes of applicant families

Public housing	H^1_j	H^2_j	H^3_j	H^4_j	H^5_j(score of C^5_{i1}, C^5_{i2}, C^5_{i3}, C^5_{i4}, C^5_{i5})	H^6_j
J_1	H^1_{j1}=α2, H^1_{j2}=β2, H^1_{j3}=γ1	30	300	3	0.5, -0.2, 0.4, 0.2, 0.1	H^6_{j2}
J_2	H^1_{j1}=α1, H^1_{j2}=β2, H^1_{j3}=γ1	75	500	4	0.8, 0.6, 0.9, 0.6, 0.2	H^6_{j4}
J_3	H^1_{j1}=α1, H^1_{j2}=β1, H^1_{j3}=γ2	30	300	2	0.3, 0.7, 0.4, 0.6, 0	H^6_{j3}
J_4	H^1_{j1}=α3, H^1_{j2}=β1, H^1_{j3}=γ2	60	200	1	-0.1, 0.3, -0.5, 0.4, 0.6	H^6_{j3}
J_5	H^1_{j1}=α2, H^1_{j2}=β3, H^1_{j3}=γ1	45	300	2	0.3, 0.5, 0.7, -0.2, 0.3	H^6_{j3}
J_6	H^1_{j1}=α1, H^1_{j2}=β1, H^1_{j3}=γ2	45	200	4	0.3, 0.7, 0.4, 0.8, 0	H^6_{j3}
J_7	H^1_{j1}=α3, H^1_{j2}=β3, H^1_{j3}=γ1	75	400	3	-0.4, 0.2, 0, -0.7, 0.6	H^6_{j4}
J_8	H^1_{j1}=α2, H^1_{j2}=β1, H^1_{j3}=γ2	15	100	3	-0.3, 0.8, 1, 0.2, 0.6	H^6_{j1}
J_9	H^1_{j1}=α1, H^1_{j2}=β3, H^1_{j3}=γ2	30	400	5	0.6, 0.6, 0.5, 0.9, -0.2	H^6_{j2}
J_{10}	H^1_{j1}=α1, H^1_{j2}=β1, H^1_{j3}=γ1	30	300	1	0.5, 0.7, 0.4, 1, 0.1	H^6_{j3}
J_{11}	H^1_{j1}=α2, H^1_{j2}=β1, H^1_{j3}=γ2	60	300	4	0.3, 0.5, 0.7, -0.2, 0.3	H^6_{j3}
J_{12}	H^1_{j1}=α3, H^1_{j2}=β3, H^1_{j3}=γ1	45	200	2	-0.4, 0.2, 0, -0.3, 0.6	H^6_{j2}

Table 4. Actual value of matching indexes of public housing

Since there is no unique result when using the genetic algorithm, we let the algorithm continuously run 15 times and choose the optimal one. The ultimate matching results through two cases mentioned above are shown in Table 5,whose distance value are both calculated from formula (11). Table 6 provides the ideal point values of each target when q=2, which are obtained by the Kuhn-Munkras algorithm. Two matching results in Table 6 demonstrate different characteristics of two algorithms. We find out that priority index plays an important role in the case of q=1, and the overall matching degree is just a linear average of each attributes', which may appear inappropriate results like (I_{11}, J_7). However, the matching results under the circumstance of q=2 are much better than ones under q=1 despite it has a larger distance value. Thus, we believe that the case of q=2 is more suitable for the distribution system here.

Matching results	q=1	q=2
S	(I_1, J_2)	(I_1, J_2)
	(I_2, J_{11})	(I_2, J_7)
	(I_3, J_5)	(I_3, J_5)
	(I_4, J_{12})	(I_4, J_9)
	(I_5, J_8)	(I_5, J_3)
	(I_6, J_9)	(I_6, J_6)
	(I_7, J_3)	(I_7, J_4)
	(I_8, J_4)	(I_8, J_{12})
	(I_9, J_1)	(I_9, J_1)
	(I_{10}, J_6)	(I_{10}, J_{11})
	(I_{11}, J_7)	(I_{11}, J_{10})
	(I_{12}, J_{10})	(I_{12}, J_8)
Distance value	17.68	27.83

Table 5. Matching results under two cases

f^{k*}	f^{1*}	f^{2*}	f^{3*}	f^{4*}	f^{5*}	f^{6*}
value	15.68	8.40	-4.40	24.10	13.06	18

Table 6. Ideal point value of each target when q=2

6 CONCLUSION

A distribution system for equitable assignment of public housing was put forward in this article. And its operating principle was focused on here as well. After carrying out the research in Huangshi City, six critical attributes the applicants concerned the most were summed up: location, living area, house rent, floor, surroundings and apartment layout. Then this study designed the calculation rules of matching degree of each attribute between applicants and houses, on the basis of which a multi-objective assignment model was constructed for solving this problem. And its specific solutions were explored in two cases. Finally, the matching results in the instance validated rationality and feasibility of the system. This article tried to find out an effective way for the automatic allocation of public housing. However the operation principle suitable for Huangshi City may not be applicable for other cities in China, which should be considered in the further research.

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