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Multi-objective Optimal Model of Two-sided Matching

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Abstract
Based on the interval neutrosophic numbers, a new multi-objective optimal model of two-sided matching is researched. Through integrating interval neutrosophic information of each subject, the relative closeness degree of uncertainty evaluation information and positive and negative ideal is calculated by the approximate method, which can be expected as the satisfaction of the matching subjects. According to these, a multi-objective optimal model of two-sided matching is constructed, and applied to the leisure industry technology demand and supply. Finally a numerical example is given to illustrate the feasibility and validity of the proposed method.

Key words: Two-sided Matching, Interval Neutrosophic Number, Leisure Industry.

1. INTRODUCTION

After China's economy has entered a new normal condition, the innovation of technology has become the key driving force to cultivate new economic growth points. As a sunrise industry, leisure industry is very vigour, and basically forms a development pattern with the socialist market economy which has become a dynamic force for China's market economy. The development of leisure industry cannot leave the innovation of technology, the mutual integration and penetrations are very important for the development of leisure industry.

The so-called leisure industry science and technology innovation refers to technology innovation in various forms part of leisure industry or apply the new technology into leisure industry chain, which considers all resource as basis and technology innovation as dominance. Specifically, a series of frontier science and some science technologies such as cognitive science, cloud computing technology, the virtual space technology, digital switching technology, monitoring technology, and simulation technology, are used into leisure industry. In the finding and matching process, the most important tool is the leisure industry technology trading. It is an effective means which can realize the technology transfer between supply and demand subjects.

With the wide application of Internet technology, traditional technology trading activities gradually shift to the Internet platform, and online technology suppliers and demanders increased rapidly, internet technology market has a fast development, such as China zhejiang online technology market, and online technology trading service system "YeePay" etc. It is not hard to find that the rapid development of Internet technology market in China brings the unprecedented development opportunities for leisure industry in technology trading, but also all of above faces a lot of problems such as technology trading contract rate is not high and information overloading. Under the condition, how to effectively realize the two-sided matching for leisure industry technology demand and supply has become the problem to be solved during the sport industry technology market rapid developing on-line.

The definition of Two-sided matching was put forward firstly by professor Rothw from Harvard University (1986). The theory was applied to medical treatment, education, and marriage etc. in early days. In recent years, lots of two-sided matching problems in real life caused the scholars' widespread concern, such as buying and selling goods in electronic intermediary(Zadeh,1965), second-hand housing transactions matching problem(Torra, 2010), the staff/job seekers and job matching problem (Qian et al.,2013), I-T service supply and demand two-sided matching problem(Zhu B, etc..,2012), venture capitalists and venture enterprises matching problem(Ye J. ,2014)and so on. Le et al. has given a solution of two-sided matching decision problem based on uncertain preference sequence information. This method considered the satisfaction degree of the matching body and intermediary interests demand based on which a multi-objective optimization model is constructed. Abdulkadiroglu used mechanism design methods to research school selection problem. Chen et al. developed a bilateral micro matching framework for matching problem of heterogeneous workers and production machine. Baccara investigated teachers and office matching problem with network externalities.

For leisure industry technology trading, the technology trading can be succeed depends on whether the leisure industry technology suppliers and needs can achieve satisfaction, which is two-sided matching decision making problem. However in reality because of people's judgments are vague and decision environment is complex, it is very difficult to depict the both sides satisfaction using accurate numbers, so the information is vague. Therefore, Zadeh proposed vague set theory in 1965, and he expressed vague information by membership function. Since then, Atanassov proposed the intuitionistic vague set based on vague set by increasing non-membership function. In 1999, professor Smarandache proposed the neutrosophic set on the basis of intuitionistic vague set, which described the vague nature of the real world more exquisitely. So for leisure industry in technology trading which evaluation index is interval neutrosophic numbers, the satisfaction function of leisure industry technology supply and demand subjects is defined. A multi-objective optimal model of two-sided matching is constructed, thus the decision method for implementing the match between leisure industry technology suppliers and technology demanders is put forward. Finally a numerical example is given to illustrate the feasibility and validity of the proposed method. These have theoretical and practical significance to the technology trading market of leisure industry in our country, especially the online technology market carrying out intelligent matching and intelligent recommendation services.

In the process of the leisure industry trade supply and demand two-sided matching, there are three decision-making subjects: leisure industry technology suppliers, leisure industry technology demanders and leisure industry technology trading intermediary (trading platform). The leisure industry technology demanders provided expectation information for the leisure industry technology suppliers to leisure industry technology trading intermediary. The agency objectively offers the actual information to leisure industry technology suppliers. Otherwise the leisure industry technology supplier provided expectation information for the leisure industry technology demanders to leisure industry technology trading intermediary. The agency objectively offers the actual information to leisure industry technology demanders. The leisure industry technology trading agency makes the deal according to the two-sided expected and actual evaluation information until the two-sided achieve satisfaction.

2. TWO-SIDE DECISION-MAKING MODAL BASED ON INTERVAL NEUTROSOPHIC SETS AND APPLICATION

The first we give the definitions about the neutrosophic sets and interval neutrosophic sets.

2.1 Neutrosophic Sets

From philosophical point of view, Smarandache originally presented the concept of a neutrosophic set A in a universal set X.

Definition 1 Let X be a universe of discourse, for any $x \in X$, the set $A = \{x(T_A(x), I_A(x),\ F_A(x)) \mid x \in X\}$ is called a neutrosophic set, which is characterized independently by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$ and a falsity-membership function $F_A(x)$. The functions $T_A(x)$, $I_A(x)$ and $F_A(x)$ in X are real standard or nonstandard subsets $]0^0, 1^+[$, such that $T_A(x): X \to [0,1]$, $I_A(x): X \to [0,1]$ and $F_A(x): X \to [0,1]$. Then, the sum of $T_A(x)$, $I_A(x)$ and $F_A(x)$ satisfies the condition $0^- \le T_A(x) + I_A(x) + F_A(x) \le 3^+$.

Obviously, it is difficult to apply the neutrosophic set to practical problems. To easily apply it in science and engineering fields, Wang et al. [8] introduced the concept of a single-valued neutrosophic set as a subclass of the neutrosophic set and gave the following definition.

Definition 2 Let X be a universe of discourse, for any $x \in X$, the set $A = \{x(T_A(x), I_A(x),\ F_A(x)) \mid x \in X\}$ is called a trapezoidal neutrosophic set, which is characterized independently by a truth-membership function $T_A(x)$,an indeterminacy-membership function $I_A(x)$ and a falsity-membership function $F_A(x)$. The functions $T_A(x)$, $I_A(x)$ and $F_A(x)$ in X are real standard or nonstandard subsets $[0,1]$, and the sum of $T_A(x)$, $I_A(x)$ and $F_A(x)$ satisfies the condition $0^- \le \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \le 3^+$.

For convenience, the interval neutrosophic number are denoted by $x = ([T^L, T^U], [I^L, I^U],\ [F^L, F^U])$, where $[T^L, T^U] \subseteq [0,1], [I^L, I^U] \subseteq [0,1], [F^L, F^U] \subseteq [0,1]$ and $0^- \le \sup[T^L, T^U] +\ \sup[I^L, I^U] + \sup[F^L, F^U] \le 3^+$.

Scoring function and accuracy function are two very important indicators in the interval neutrosophic numbers sorting method. For an interval neutrosophic set, the truth-membership value is bigger, and the interval neutrosophic set is bigger; the indeterminacy-membership value is smaller, and the interval neutrosophic set is bigger; similarly the falsity-membership value is smaller, and the interval neutrosophic set is bigger. So the scoring function of the interval neutrosophic number is defined as the following:

Definition 3 Let $x = ([T^L, T^U], [I^L, I^U], [F^L, F^U])$ be an interval neutrosophic number, the scoring function of x can be defined by

$$S(x) = \frac{T^L + T^U}{2} + 1 - \frac{I^L + I^U}{2} + 1 - \frac{F^L + F^U}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Definition 4 Let $x=([T^L,T^U],[I^L,I^U],[F^L,F^U])$ be an interval neutrosophic number, the accuracy function of x can be defined by

$$H(x)=\frac{T^L+T^U}{2}+1-\frac{I^L+I^U}{2}+\frac{F^L+F^U}{2}.$$

Definition 5 Let $x=([T_1^L,T_1^U],[I_1^L,I_1^U],[F_1^L,F_1^U])$ and $y=([T_2^L,T_2^U],[I_2^L,I_2^U],[F_2^L,F_2^U])$ be two interval neutrosophic numbers, the scoring function and accuracy function of x and y are $S(x),H(x)$ and $S(y),H(y)$, so

(1)If $S(x)>S(y)$, then $x>y$;

(2)If $S(x)=S(y)$ and $H(x)>H(y)$, then $x>y$;

(3)If $S(x)=S(y)$ and $H(x)=H(y)$, then $x=y$.

2.2 Problem Description

In the process of the leisure industry trade supply and demand two-sided matching, there are three decision-making subjects: leisure industry technology suppliers, leisure industry technology demanders and leisure industry technology trading intermediary (trading platform). The leisure industry technology demanders provided expectation information for the leisure industry technology suppliers to leisure industry technology trading intermediary. The agency objectively offers the actual information to leisure industry technology suppliers. Otherwise the leisure industry technology supplier provided expectation information for the leisure industry technology demanders to leisure industry technology trading intermediary. The agency objectively offers the actual information to leisure industry technology demanders. The leisure industry technology trading agency makes the deal according to the two-sided expected and actual evaluation information until the two-sided achieve satisfaction.

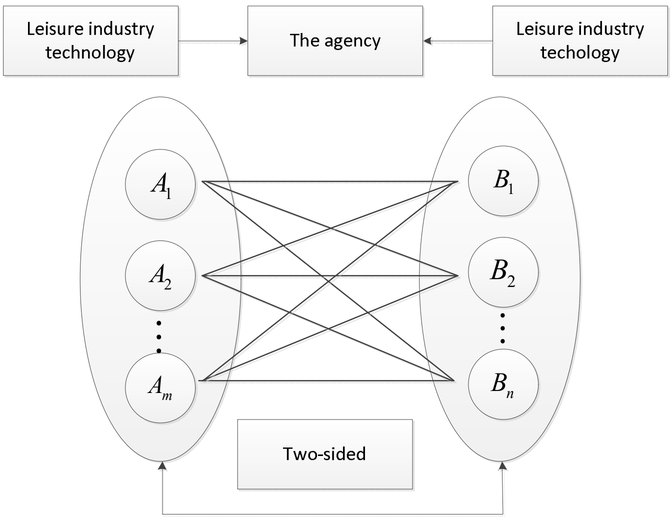

Figure 1. Leisure industry technology demander and supplier two-sided matching

Suppose the leisure industry technology demand alternatives $A=\{A_1,A_2,\cdots,A_m\}$, and they consider the index alternatives is $C=\{C_1,C_2,\cdots,C_g\}$ when offering the evaluation information. The weighted vectors of index are $W=(\omega_1,\omega_2,\cdots,\omega_g)^T$, $0\le\omega_i\le1,\sum_{i=1}^{g}\omega_i=1$. The leisure industry technology supply alternatives $B=\{B_1,B_2,\cdots,B_n\}$ and they consider the index alternatives is $Y=\{Y_1,Y_2,\cdots,Y_h\}$ when offering the evaluation information. The weighted vectors of index are $V=(v_1,v_2,\cdots,v_h)^T$, $0\le v_i\le1,\sum_{i=1}^{h}v_i=1$.

Because of the uncertainty of the leisure industry technology market and the complexity of objective things, the evaluation values of the technology trading supply and demand two sides about each index are fuzzy and uncertain. In order to better describe the quantitative indicators, here we adopt interval neutrosophic fuzzy number to express. The interval neutrosophic fuzzy number evaluation matrix of subject A_i to subject B_j about

C_k is $\tilde{A}_B^k = (\tilde{a}_{ij}^k)_{n\times m}$, where $\tilde{a}_{ij}^k = ([T_{\tilde{a}_{ij}^k}{}^L, T_{\tilde{a}_{ij}^k}{}^U], [I_{\tilde{a}_{ij}^k}{}^L, I_{\tilde{a}_{ij}^k}{}^U], [F_{\tilde{a}_{ij}^k}{}^L, F_{\tilde{a}_{ij}^k}{}^U])$. The interval neutrosophic fuzzy number evaluation matrix of subject B_i to subject A_j is $\tilde{B}_A^f = (\tilde{b}_{ij}^f)_{n\times m}$, where $\tilde{b}_{ij}^f = ([T_{\tilde{b}_{ij}^f}{}^L, T_{\tilde{b}_{ij}^f}{}^U], [I_{\tilde{b}_{ij}^f}{}^L, I_{\tilde{b}_{ij}^f}{}^U],$ $[F_{\tilde{b}_{ij}^f}{}^L, F_{\tilde{b}_{ij}^f}{}^U])$.

To eliminate the influence of different physical dimension to the decision result, first we need to normalize the index value of the evaluation information. According to the method of Li, the normalized matrix is recorded as $\tilde{A}_B'^k = (\tilde{a}_{ij}'^k)_{n\times m}$.

When the evaluation indexes are efficiency indexes, the formula is

$$\tilde{a}_{ij}'^k = \frac{\tilde{a}_{ij}^k}{\max\{\tilde{a}_{ij}^k\}} \qquad (2)$$

When the evaluation indexes are cost indexes, the formula is

$$\tilde{a}_{ij}'^k = \frac{\min\{\tilde{a}_{ij}^k\}}{\tilde{a}_{ij}^k} \qquad (3)$$

The comprehensive evaluation interval neutrosophic numbers of subject A_i to B_j is

$$\tilde{a}_{ij} = \sum_{k=1}^{h} \omega_k \tilde{a}_{ij}'^k, i = 1, 2, \cdots, m; j = 1, 2 \cdots, n \qquad (4)$$

The comprehensive evaluation interval neutrosophic numbers of subject B_j to A_i is

$$\tilde{b}_{ij} = \sum_{f=1}^{g} v_k \tilde{b}_{ij}'^f, i = 1, 2, \cdots, m; j = 1, 2 \cdots, n. \qquad (5)$$

According to the formulas (4) and (5), we integrated the interval neutrosophic numbers and get the comprehensive evaluation interval neutrosophic numbers $\tilde{a}_{ij}$, $\tilde{b}_{ij}$. The comprehensive evaluation interval neutrosophic numbers matrix of subjects A to B is stall remarked $\tilde{A}_B = (\tilde{a}_{ij})_{n\times m}$, and the comprehensive evaluation interval neutrosophic numbers matrix of subjects B to A is stall remarked $\tilde{B}_A = (\tilde{b}_{ij})_{n\times m}$.

2.3 The satisfaction degree of matching subjects

Let the positive and negative ideal interval neutrosophic numbers of subject A to B are

$$\tilde{a}_{ij}^+ = ([T_{\tilde{a}_{ij}}{}^{L+}, T_{\tilde{a}_{ij}}{}^{U+}], [I_{\tilde{a}_{ij}}{}^{L+}, I_{\tilde{a}_{ij}}{}^{U+}], [F_{\tilde{a}_{ij}}{}^{L+}, F_{\tilde{a}_{ij}}{}^{U+}]),$$

$$\tilde{a}_{ij}^- = ([T_{\tilde{a}_{ij}}{}^{L-}, T_{\tilde{a}_{ij}}{}^{U-}], [I_{\tilde{a}_{ij}}{}^{L-}, I_{\tilde{a}_{ij}}{}^{U-}], [F_{\tilde{a}_{ij}}{}^{L-}, F_{\tilde{a}_{ij}}{}^{U-}]). \qquad (6)$$

Let the positive and negative ideal interval neutrosophic numbers of subject B to A are

$$\tilde{b}_{ij}^+ = ([T_{\tilde{b}_{ij}}{}^{L+}, T_{\tilde{b}_{ij}}{}^{U+}], [I_{\tilde{b}_{ij}}{}^{L+}, I_{\tilde{b}_{ij}}{}^{U+}], [F_{\tilde{b}_{ij}}{}^{L+}, F_{\tilde{b}_{ij}}{}^{U+}]),$$

$$\tilde{b}_{ij}^- = ([T_{\tilde{b}_{ij}}{}^{L-}, T_{\tilde{b}_{ij}}{}^{U-}], [I_{\tilde{b}_{ij}}{}^{L-}, I_{\tilde{b}_{ij}}{}^{U-}], [F_{\tilde{b}_{ij}}{}^{L-}, F_{\tilde{b}_{ij}}{}^{U-}]). \qquad (7)$$

Using the TOPSIS method, we calculate respectively the distances between each matching subject's comprehensive evaluation value and their positive and negative ideal interval neutrosophic numbers, they are

$$d_{\tilde{a}_{ij}}^+ = \frac{1}{2}\sqrt{(T_{\tilde{a}_{ij}}^L - T_{\tilde{a}_{ij}}^{L+})^2 + (T_{\tilde{a}_{ij}}^U - T_{\tilde{a}_{ij}}^{U+})^2 + (I_{\tilde{a}_{ij}}^L - I_{\tilde{a}_{ij}}^{L+})^2 + (I_{\tilde{a}_{ij}}^U - I_{\tilde{a}_{ij}}^{U+})^2 + (F_{\tilde{a}_{ij}}^L - F_{\tilde{a}_{ij}}^{L+})^2 + (F_{\tilde{a}_{ij}}^U - F_{\tilde{a}_{ij}}^{U+})^2},$$

$$d_{\tilde{a}_{ij}}^- = \frac{1}{2}\sqrt{(T_{\tilde{a}_{ij}}^L - T_{\tilde{a}_{ij}}^{L-})^2 + (T_{\tilde{a}_{ij}}^U - T_{\tilde{a}_{ij}}^{U-})^2 + (I_{\tilde{a}_{ij}}^L - I_{\tilde{a}_{ij}}^{L-})^2 + (I_{\tilde{a}_{ij}}^U - I_{\tilde{a}_{ij}}^{U-})^2 + (F_{\tilde{a}_{ij}}^L - F_{\tilde{a}_{ij}}^{L-})^2 + (F_{\tilde{a}_{ij}}^U - F_{\tilde{a}_{ij}}^{U-})^2},$$

$$d_{\tilde{b}_{ij}}^+ = \frac{1}{2}\sqrt{(T_{\tilde{b}_{ij}}^L - T_{\tilde{b}_{ij}}^{L+})^2 + (T_{\tilde{b}_{ij}}^U - T_{\tilde{b}_{ij}}^{U+})^2 + (I_{\tilde{b}_{ij}}^L - I_{\tilde{b}_{ij}}^{L+})^2 + (I_{\tilde{b}_{ij}}^U - I_{\tilde{b}_{ij}}^{U+})^2 + (F_{\tilde{b}_{ij}}^L - F_{\tilde{b}_{ij}}^{L+})^2 + (F_{\tilde{b}_{ij}}^U - F_{\tilde{b}_{ij}}^{U+})^2},$$

$$d_{\tilde{b}_{ij}}^{-} = \frac{1}{2}\sqrt{(T_{\tilde{b}_{ij}}^{L} - T_{\tilde{b}_{ij}}^{L-})^2 + (T_{\tilde{b}_{ij}}^{U} - T_{\tilde{b}_{ij}}^{U-})^2 + (I_{\tilde{b}_{ij}}^{L} - I_{\tilde{b}_{ij}}^{L-})^2 + (I_{\tilde{b}_{ij}}^{U} - I_{\tilde{b}_{ij}}^{U-})^2 + (F_{\tilde{b}_{ij}}^{L} - F_{\tilde{b}_{ij}}^{L-})^2 + (F_{\tilde{b}_{ij}}^{U} - F_{\tilde{b}_{ij}}^{U-})^2} .$$

Calculate the relative closeness degree of each subject comprehensive evaluation interval neutrosophic numbers,

$$\mu_{\tilde{a}_{ij}} = \frac{d_{\tilde{a}_{ij}}^{-}}{d_{\tilde{a}_{ij}}^{-} + d_{\tilde{a}_{ij}}^{+}}, \quad \mu_{\tilde{b}_{ij}} = \frac{d_{\tilde{b}_{ij}}^{-}}{d_{\tilde{b}_{ij}}^{-} + d_{\tilde{b}_{ij}}^{+}} \quad \text{.......................... (8)}$$

Obviously relatively closeness degree value $\mu_{\tilde{a}_{ij}}$ is bigger, the satisfaction of subject A_i to B_j is higher; relatively closeness degree value $\mu_{\tilde{b}_{ij}}$ is bigger, the satisfaction of subject B_j to A_i is higher. So the value $\mu_{\tilde{a}_{ij}}$ can be as the satisfaction degree of A_i to B_j, and the value $\mu_{\tilde{a}_{ij}}$ can be as the satisfaction degree of A_i to B_j. The satisfaction degree matrixes of subject A and B are $A_B = (\mu_{\tilde{a}_{ij}})$, $B_A = (\mu_{\tilde{b}_{ij}})$.

2.4 Matching decision modal

Based on the two-sided matching satisfaction matrixes $A_B = (\mu_{\tilde{a}_{ij}})$, $B_A = (\mu_{\tilde{b}_{ij}})$, the optimization model is constructed by considering the main body satisfaction maximization and consistency:

$$\max Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\left(\lambda\left(\frac{\mu_{\tilde{a}_{ij}} + \mu_{\tilde{b}_{ij}}}{2}\right) + (1-\lambda)\sqrt{\mu_{\tilde{a}_{ij}}\mu_{\tilde{b}_{ij}}}\right)x_{ij} \quad \text{..........................}$$

$$s.t \sum_{j=1}^{n} x_{ij} \le 1$$

$$\sum_{i=1}^{m} x_{ij} \le 1 \quad \text{.......................... (9)}$$

where, x_{ij} is the variable of 0-1. When $x_{ij} = 1$, it said subject A_i to B_j matching; when $x_{ij} = 0$, it said subject A_i to B_j non-matching. $\lambda (0 \le \lambda \le 1)$ is called the adjust the parameter, which value is determined by decision maker considering to the actual matching problem. When $\lambda = 0$, it emphasizes the consistency of both subjects satisfaction; when $\lambda = 1$, it emphasizes the complementary of both subjects satisfaction. Using the software LINGO 11.0, we can calculate the optimal modal and obtain the matching result.

2.5 Matching decision step

In conclusion, this paper puts forward the method of two-sided matching decision model for leisure industry technical demand and supply based on interval neutrosophic sets. The decision steps are as follows:

Step 1: Standardize the interval neutrosophic numbers information which the leisure industry technology demand and supply subjects provide, and integrate the comprehensive evaluation information.

Step 2: Determine the positive and negative ideal of supply and demand two-sided matching, subjects and calculate the distance between each subjects interval neutrosophic information and positive and negative ideal $d_{\tilde{a}_{ij}}^{-}$, $d_{\tilde{a}_{ij}}^{+}$, $d_{\tilde{b}_{ij}}^{-}$, $d_{\tilde{b}_{ij}}^{+}$. Then get the matching subjects distance matrixes.

Step3: Calculate the relative degree of matching subjects comprehensive evaluation information (satisfaction degree), and get two-sided matching satisfaction matrix $A_B = (\mu_{\tilde{a}_{ij}})$, $B_A = (\mu_{\tilde{b}_{ij}})$.

Step4: For the given adjust parameter λ, the optimization model is constructed according to the satisfaction matrixes A_B, B_A. Then obtain the result of the two-sided matching.

3. SIMULATIOM

A leisure industry technical trading intermediary mainly engages in technology transferring businesses, such as ports equipment, new materials. According to the information of technology supply and demand subjects, leisure industry technology agency matches the two-sided. The agency receives technology needs information of 5 companies $A = \{A_1, A_2, A_3, A_4 A_5\}$, and technology transferring information of 6 sports science research institutes $B = \{B_1, B_2, B_3, B_4, B_5, B_6\}$. The company evaluates the technology transferring information of sports science research institutes mainly considering the four indexes, namely technical practicability C_1, market demand C_2, technical maturity C_3, the expected economic benefits C_4. The weight vector is $W=(0.2,0.3,0.25,0.25)^T$, which is determined by experts' judgment. The sports science research institute evaluates the companies mainly considering the five indexes: entrepreneurship Y_1 , annual number of enterprises Y_2 , the technology transferring income Y_3 , enterprise scientific research ability Y_4 , enterprise scale Y_5 . The weight vector is $V=(0.15,0.15,0.1,0.3,0.3)^T$, which is determined by experts judgment.

Table 1. The evaluation information of the sports companies to sports technology institutes

	C1	C2	C3	C4
A1	([0.22,0.31], [0.15,0.55], [0.23,0.54]) ……..	([0.12,0.37], [0.17,0.58], [0.4,0.56]) …….	([0.13,0.53], [0.11,0.67], [0.20,0.36]) ……..	([0.22,0.31], [0.15,0.55], [0.23,0.54]) …….
A2	([0.25,0.41], [0.15,0.45], [0.23,0.44]) …….	([0.33,0.53], [0.11,0.47], [0.20,0.36]) ……..	([0.23,0.45], [0.18,0.56], [0.21,0.37]) …….	([0.28,0.34], [0.43,0.61], [0.11,0.23]) ……..
A3	([0.26,0.37], [0.23,0.53], [0.22,0.40]) …….	([0.12,0.37], [0.17,0.58], [0.4,0.56]) …….	([0.06,0.21], [0.49,0.66], [0.28,0.30]) …….	([0.11,0.24], [0.57,0.75], [0.14,0.19]) …….
A4	([0.30,0.48], [0.07,0.61], [0.09,0.45]) …….	([0.12,0.37], [0.17,0.58], [0.4,0.56]) …….	([0.13,0.53], [0.11,0.67], [0.20,0.36]) …….	([0.22,0.31], [0.15,0.55], [0.23,0.54]) …….
A5	([0.21,0.35], [0.36,0.68], [0.11,0.29]) ……	([0.16,0.25], [0.56,0.70], [0.14,0.19]) ……	([0.39,0.46], [0.37,0.60], [0.10,0.17]) …….	([0.28,0.34], [0.43,0.61], [0.21,0.37]) …….

Table 2. The evaluation information of sports technology institutes to the sports companies

	Y1	Y2	Y3	Y4	Y4
B1	([0.21,0.41], [0.14,0.35], [0.42,0.49]) ……..	([0.19,0.26], [0.26,0.56], [0.27,0.46]) …….	([0.13,0.53], [0.11,0.67], [0.20,0.36]) ……..	([0.22,0.31], [0.15,0.55], [0.23,0.54]) …….	([0.22,0.31], [0.15,0.55], [0.23,0.54]) …….
B2	([0.25,0.41], [0.15,0.45], [0.23,0.44]) …….	([0.12,0.28], [0.37,0.60], [0.22,0.29]) ……..	([0.19,0.36], [0.12,0.56], [0.37,0.45]) …….	([0.34,0.49], [0.23,0.52], [0.15,0.25]) ……..	([0.12,0.37], [0.18,0.53], [0.21,0.46]) ……
B3	([0.22,0.37], [0.12,0.63], [0.25,0.43]) …….	([0.12,0.37], [0.17,0.58], [0.4,0.56]) …….	([0.06,0.21], [0.49,0.66], [0.28,0.30]) …….	([0.15,0.24], [0.37,0.74], [0.14,0.19]) …….	([0.24,0.35], [0.42,0.47], [0.11,0.52]) …….
B4	([0.32,0.48], [0.14,0.58], [0.21,0.41]) …….	([0.12,0.37], [0.23,0.58], [0.31,0.56]) …….	([0.13,0.53], [0.11,0.67], [0.20,0.36]) …….	([0.25,0.42], [0.17,0.67], [0.13,0.52]) …….	([0.23,0.32], [0.14,0.34], [0.33,0.52]) …….
B5	([0.21,0.35], [0.36,0.68], [0.11,0.29]) ……	([0.16,0.25], [0.45,0.67], [0.13,0.32]) ……	([0.39,0.46], [0.37,0.60], [0.21,0.34]) …….	([0.28,0.34], [0.43,0.61], [0.19,0.37]) …….	([0.21,0.32], [0.25,0.47], [0.32,0.42]) …….

Using the formula to standardize the comprehensive multi-index evaluation information of leisure industry technology demand and supply and build the positive and negative ideal value of each index. Based on these, calculate the distance between each value and positive and negative ideal value. So we get leisure industry technology demand and supply satisfaction matrix $\Gamma_A = (\alpha_{ij})_{5\times 6}$. Five leisure industry technology demand subjects and six technology supply subjects can produce 30 combination and 30 technology supply and demand combination satisfaction matrix $\Gamma_{(A,B)} = [(\alpha_{ij}, \beta_{ij})]_{5\times 6}$.

$$\Gamma_{(A,B)} \begin{pmatrix} (0.44,0.67) & (0.33,048) & (0.35,0.82) & (0.52,0.75) & (0.31,0.49) & (0.37,0.50) \\ (0.28,0.66) & (0.51,0.55) & (0.43,0.48) & (0.57,0.77) & (0.62,0.70) & (0.38,0.43) \\ (0.30,0.88) & (0.63,0.73) & (0.39,0.58) & (0.39,0.68) & (0.55,0.84) & (0.27,0.57) \\ (0.61,0.46) & (0.41,0.31) & (0.73,0.75) & (0.39,0.60) & (0.61,0.56) & (0.30,0.81) \\ (0.29,0.56) & (0.32,0.51) & (0.50,0.72) & (0.65,0.72) & (0.31,0.61) & (0.30,0.70) \end{pmatrix}$$

According to leisure industry technology supply and demand satisfaction matrix and the consistency of two-sided satisfaction, the value of adjust parameter is considered as $\lambda = 0$. By the software LINGO 11.0, we calculate the modal and get the results $x_{32} = 1,\ x_{43} = 1,\ x_{54} = 1,\ x_{52} = 1$. Therefore, the best matching results are A1 matching to B4, A2 matching to B5, A3 matching to B2, A4 matching to B3, B6 non-matching. From the matching results, both sides of leisure industry technology demand and supply give higher satisfaction evaluation, in accordance with the actual situation which the agency provides matching service.

4. CONCLUSIONS

In the leisure industry technology intermediary service, due to the uncertainty of supply and demand both sides judgment, this paper uses interval neutrosophic numbers to describe the decision-making information of subjects for more convenience. On this basis, through integrating interval neutrosophic information of each subjects, the relative closeness degree of uncertainty evaluation information and positive and negative ideal is calculated by the approximate method, which can be expected as the satisfaction of the matching subjects. Thus, the optimization model of comprehensive consideration of matching subjects maximization and consistency. The matching result is got by solving the modal. At last, a simulation example is given to illustrate the feasibility and validity of the method. Considering the characteristics of the leisure industry technology product, the two-sided matching modal of this paper has theoretical and practical significance for both sides of leisure industry technology suppliers and demanders.

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