

Selecting Visualization Alternative Based on Fuzzy Multiple Attribute Lattice Order Decision Making Method

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Abstract

This research develops a fuzzy multiple attribute lattice decision making (FMALDM) model with preference information on alternatives based on lattice theory, which is used for selecting a suitable visualization alternative for tourism. The information on attribute weights is unknown and the attribute values are trapezoidal fuzzy numbers. The definition of the deviation degree of trapezoidal fuzzy number is given. A formula based on deviation degree for deriving attribute weights is presented, then the comprehensive weight is given combined with the subjective weight. According to the center of the trapezoidal fuzzy number, the order of all programs is given based on calculating the distance sum from the center of the attribute values of various programs to the optimal solution. The method can sufficiently utilize the normalized fuzzy evaluation information and meets the requirements of decision-maker, and can also be performed on the computer easily. Finally, combined with the case of enterprises in the choice of strategic alliance, a numerical example is given to show the feasibility and effectiveness of the proposed method.

Key words: *tourism; FMALDM; trapezoidal fuzzy number; deviation degree; lattice theory*

1 Introduction

In recent years tourism is gaining more and more popularity among civilians. In many areas of science, studying phenomena often involve exploring data from acquisitions or numerical simulations and observing their changes over time. Thus interactive scientific visualization¹ becomes an important tool for scientists in tourism to help the studying phenomenon understanding. However, how to choose a suitable scientific visualization alternative when opting for an appropriate tourism is a difficult task. This problem, which involves much uncertainty² and should consider many factors, is a typical fuzzy multiple attribute decision making problem³.

The method of fuzzy multiple attribute lattice order⁴ decision making is a synergetic combination of fuzzy set theory and lattice theory⁵⁻⁶. In this paper, we evaluate the visualization alternatives through the model of fuzzy multiple attribute latter order decision making by ranking the visualization alternatives so as to offer the traveler a reasonable

suggestion.

2 Preliminaries

Definition 1 [2] For a trapezoidal number $\tilde{a} = (a, b, c, d)$, its membership function is given by

$$f_{\tilde{a}}(x) = \begin{cases} f_{\tilde{a}}^L(x) & x \in [a, b) \\ 1 & x \in [b, c] \\ f_{\tilde{a}}^R(x) & x \in (c, d] \\ 0 & \text{otherwise} \end{cases}$$

where $f_{\tilde{a}}^L(x) = (x-a)/(b-a)$, $f_{\tilde{a}}^R(x) = (x-d)/(c-d)$. The center point (x, y) for a trapezoidal number $\tilde{a} = (a, b, c, d)$ is defined as:

$$x = \frac{1}{3} \left[a + b + c + d - \frac{dc - ab}{(d+c) - (a+b)} \right] \quad y = \frac{1}{3} \left[1 + \frac{c-b}{(d+c) - (a+b)} \right] \quad (1)$$

Definition 2 Let $\tilde{a}_1 = (a_1, b_1, c_1, d_1)$ and $\tilde{a}_2 = (a_2, b_2, c_2, d_2)$ be two trapezoidal numbers, provide a preference rule as follows:

$$\tilde{a}_1 \geq \tilde{a}_2 \Leftrightarrow a_1 \geq a_2, b_1 \geq b_2, c_1 \geq c_2, d_1 \geq d_2 \quad (2)$$

Definition 3 Let $\tilde{r} = (r_1, r_2, r_3, r_4)$ and $\tilde{s} = (s_1, s_2, s_3, s_4)$ be two trapezoidal numbers,

$C_1 = (r_x, r_y)$ and $C_2 = (s_x, s_y)$ be the center points of \tilde{r} and \tilde{s} respectively, define

$$\|\tilde{r} - \tilde{s}\| = \sqrt{(r_x - s_x)^2 + (r_y - s_y)^2}.$$

we call $D(\tilde{r}, \tilde{s}) = \|\tilde{r} - \tilde{s}\|$ the deviation degree of \tilde{r} and \tilde{s} . Especially, if $s_1 = s_2$ and $s_3 = s_4$,

then \tilde{s} is an interval number and its center point is $C_2 = (\frac{s_1 + s_3}{2}, \frac{1}{2})$, so

$$D(\tilde{r}, \tilde{s}) = \|\tilde{r} - \tilde{s}\| = \sqrt{(r_x - \frac{s_1 + s_3}{2})^2 + (r_y - \frac{1}{2})^2}. \text{ Obviously, the smaller the value of } D(\tilde{r}, \tilde{s}),$$

the closer \tilde{r} is to \tilde{s} .

3 The solution approach

Suppose that there exists an alternative set $X = \{X_1, X_2, \dots, X_n\}$, from which the best alternative

has to be selected. Denote the set of all attributes by $G = \{G_1, G_2, \dots, G_m\}$. In general, there are

benefit attributes and cost attributes in multiple attribute decision making problems. Assume $\omega = (\omega_1, \omega_2, \dots, \omega_m)^T$ is the weight vector of attributes, such that $\sum_{j=1}^m \omega_j = 1, \omega_j \geq 0$, and ω_j denotes the weight of attribute G_j .

Suppose that $A = (\tilde{a}_{ij})_{n \times m}$ is the trapezoidal decision matrix, where $\tilde{a}_{ij} = (a_{1ij}, a_{2ij}, a_{3ij}, a_{4ij})$ represents the performance of the alternative X_i with respect to the attribute G_j .

Provide a preference rule by using Eq. (2):

$$X_a < X_b \Leftrightarrow \begin{cases} \tilde{a}_{aj} < \tilde{a}_{bj} & G_j \in \text{benefit attribute} \\ \tilde{a}_{aj} > \tilde{a}_{bj} & G_j \in \text{cost attribute} \end{cases} \quad (3)$$

where $a, b = 1, 2, \dots, n$; $j = 1, 2, \dots, m$.

If X can form the finite lattice according to Eq. (3), then the top element is the most desirable alternative, if not, making fuzzy positive ideal alternative and negative ideal visualization alternative as virtual alternatives, which are respectively viewed as top element and bottom element, constructing a lattice.

$$A^+ = \{(p_1, q_1, r_1, s_1)(p_2, q_2, r_2, s_2) \cdots (p_m, q_m, r_m, s_m)\}$$

$$A^- = \{(p'_1, q'_1, r'_1, s'_1)(p'_2, q'_2, r'_2, s'_2) \cdots (p'_m, q'_m, r'_m, s'_m)\}$$

where

$$(p_j, q_j, r_j, s_j) = \begin{cases} (\max_{1 \leq i \leq n} a_{1ij}, \max_{1 \leq i \leq n} a_{2ij}, \max_{1 \leq i \leq n} a_{3ij}, \max_{1 \leq i \leq n} a_{4ij}) \\ G_j \in \text{benefit attribute} \\ (\min_{1 \leq i \leq n} a_{1ij}, \min_{1 \leq i \leq n} a_{2ij}, \min_{1 \leq i \leq n} a_{3ij}, \min_{1 \leq i \leq n} a_{4ij}) \\ G_j \in \text{cost benefit} \end{cases}$$

$$(p'_j, q'_j, r'_j, s'_j) = \begin{cases} (\min_{1 \leq i \leq n} a_{1ij}, \min_{1 \leq i \leq n} a_{2ij}, \min_{1 \leq i \leq n} a_{3ij}, \min_{1 \leq i \leq n} a_{4ij}) \\ G_j \in \text{benefit attribute} \\ (\max_{1 \leq i \leq n} a_{1ij}, \max_{1 \leq i \leq n} a_{2ij}, \max_{1 \leq i \leq n} a_{3ij}, \max_{1 \leq i \leq n} a_{4ij}) \\ G_j \in \text{cost benefit} \end{cases}$$

Let A^- and A^+ be respectively top element and bottom element and draw the Hasse diagram based on the relation of alternatives.

Step 1. Suppose the alternatives in the layer nearest to A^+ are S_1, S_2, \dots, S_k and the evaluation

matrix is $B = (\tilde{b}_{ij})_{k \times m}$, where $\tilde{b}_{ij} = (b_{1ij}, b_{2ij}, b_{3ij}, b_{4ij})$ represents the performance of the alternative S_i ($i = 1, 2, \dots, k$) with respect to the attribute G_j ($j = 1, 2, \dots, m$).

Since the attributes are generally incommensurate, the decision matrix needs to be normalized so as to transform the various attribute values into comparable values.

Step 2. For the convenience of calculation and extension, the following two functions are used to calculate the degree of membership.

For benefit attribute:

$$\tilde{r}_{ij} = (\frac{b_{1ij}}{\max_i b_{4ij}}, \frac{b_{2ij}}{\max_i b_{3ij}}, \frac{b_{3ij}}{\max_i b_{2ij}} \wedge 1, \frac{b_{4ij}}{\max_i b_{1ij}} \wedge 1) \quad (4)$$

For cost attribute:

$$\tilde{r}_{ij} = (\frac{\min_i b_{1ij}}{b_{4ij}}, \frac{\min_i b_{2ij}}{b_{3ij}}, \frac{\min_i b_{3ij}}{b_{2ij}} \wedge 1, \frac{\min_i b_{4ij}}{b_{1ij}} \wedge 1) \quad (5)$$

So we get the normalized decision matrix $R = (\tilde{r}_{ij})_{k \times m}$.

Step 3. Decide the weight vector of attributes:

The decision method of subjective weight vector mainly depends on the experience of experts. We can rank the attributes according to the importance of attribute and decide the subjective weight vector by using Filev and Yager's method⁷

$$\bar{\omega}_1 = \alpha, \bar{\omega}_2 = \alpha(1-\alpha), \bar{\omega}_3 = \alpha(1-\alpha)^2, \dots, \bar{\omega}_{n-1} = \alpha(1-\alpha)^{n-2}, \bar{\omega}_m = (1-\alpha)^{m-1} \quad (6)$$

where $\alpha \in [0, 1]$, the weights of attributes can be respected as:

$$\bar{\omega}_i = \begin{cases} \alpha, & i = 1 \\ \bar{\omega}_{i-1}(1-\bar{\omega}_1), & i = 2, \dots, m-1 \\ \bar{\omega}_{i-1}(1-\bar{\omega}_1)/\bar{\omega}_1, & i = m \end{cases} \quad (7)$$

Due to some limits, there are some differences between the subjective preference and the objective preference. So the choice of objective weight vector can consider this difference, which should be as small as possible. Suppose the subjective preference to S_i ($i = 1, 2, \dots, k$) given

by decision makers is P_i , where $P_i \in [u_i, v_i]$, construct the multiple objet model:

$$\min\{(D_1(\omega'), D_2(\omega'), \dots, D_k(\omega'))\}$$

$$\begin{aligned} s, t \quad & \sum_{j=1}^m \omega'_j = 1 \\ & \omega'_j \geq 0 \end{aligned}$$

where

$$\begin{aligned} D_i(\omega) &= \sum_{j=1}^m (\omega'_j D(\tilde{r}_{ij}, \tilde{P}_i))^2 \\ &= \sum_{j=1}^m (\|\tilde{r}_{ij} - \tilde{P}_i\| \omega'_j)^2 \\ &= \sum_{j=1}^m (\omega'_j)^2 [(r_{ij}^x - \frac{u_i + v_i}{2})^2 + (r_{ij}^y - \frac{1}{2})^2] \end{aligned}$$

which represents the difference between the subjective preference and the objective preference of alternative S_i ($i=1,2,\dots,k$). Let (r_{ij}^x, r_{ij}^y) be the center point of \tilde{r}_{ij} and ω'_j be the weight of G_j . Construct the multiple objective optimization models as follows:

$$\begin{aligned} \min H(\omega') &= \sum_{i=1}^k [D_i(\omega')]^2 \\ s, t \quad &\sum_{j=1}^m \omega'_j = 1 \\ &\omega'_j \geq 0 \end{aligned}$$

Construct the Lagrange function:

$$L(\omega', \lambda) = \sum_{i=1}^k \sum_{j=1}^m [\omega'_j D(\tilde{r}_{ij}, \tilde{P}_i)]^2 + 2\lambda (\sum_{j=1}^m \omega'_j - 1)$$

suppose

$$\frac{\partial L}{\partial \omega'_j} = 0, \quad \frac{\partial L}{\partial \lambda} = 0 \quad (j=1,2,\dots,m)$$

then

$$\begin{cases} \sum_{i=1}^k \omega'_j D^2(\tilde{r}_{ij}, \tilde{P}_i) + \lambda = 0 \\ \sum_{j=1}^m \omega'_j = 1 \quad (\omega'_j \geq 0) \end{cases}$$

so

$$\begin{cases} \omega'_j = -\frac{\lambda}{\sum_{i=1}^k \omega'_j D^2(\tilde{r}_{ij}, \tilde{P}_i)} \\ \sum_{j=1}^m \omega'_j = 1 \quad (\omega'_j \geq 0) \end{cases}$$

we get

$$\omega'_j = \frac{\frac{1}{\sum_{i=1}^k D^2(\tilde{r}_{ij}, \tilde{P}_i)}}{\sum_{j=1}^m \frac{1}{\sum_{i=1}^k D^2(\tilde{r}_{ij}, \tilde{P}_i)}} \quad (j=1,\dots,m) \quad (8)$$

we get the optimal solution $\omega^* = (\omega'_1, \omega'_2, \dots, \omega'_m)^T$, that is the objective attribute vector.

Then, calculate the comprehended weight vector:

$$\omega = \beta \bar{\omega} + (1-\beta)\omega' = \beta(\bar{\omega}_1, \bar{\omega}_2, \dots, \bar{\omega}_m)^T + (1-\beta)(\omega'_1, \omega'_2, \dots, \omega'_m)^T = (\omega_1, \omega_2, \dots, \omega_m)^T \quad (9)$$

where β is the preference to the subjective weight vector.

Step 4. Construct the weighted normalized fuzzy decision matrix $C = (\tilde{r}_{ij})_{k \times m}$, where

$$\tilde{c}_{ij} = (c_{1ij}, c_{2ij}, c_{3ij}, c_{4ij}) = (\omega_j r_{1ij}, \omega_j r_{2ij}, \omega_j r_{3ij}, \omega_j r_{4ij}) \quad (10)$$

Calculate the fuzzy positive ideal solution:

$$\tilde{c}^+ = (\tilde{c}_1^+, \tilde{c}_2^+, \dots, \tilde{c}_m^+) \quad (11)$$

where $\tilde{c}_j^+ = (c_{1j}^+, c_{2j}^+, c_{3j}^+, c_{4j}^+) = (\max_i(c_{1ij}), \max_i(c_{2ij}), \max_i(c_{3ij}), \max_i(c_{4ij}))$

Construct the trapezoidal fuzzy decision matrix based on the definition of positive ideal point:

$$C' = \begin{pmatrix} \tilde{c}_{11} & \tilde{c}_{12} & \dots & \tilde{c}_{1m} \\ \tilde{c}_{21} & \tilde{c}_{22} & \dots & \tilde{c}_{2m} \\ \dots & \dots & \dots & \dots \\ \tilde{c}_{k1} & \tilde{c}_{k2} & \dots & \tilde{c}_{km} \\ \tilde{c}_1^+ & \tilde{c}_2^+ & \dots & \tilde{c}_m^+ \end{pmatrix} \quad (12)$$

C' is called the unilateral augmented decision matrix.

Step 5. Let $D_i = \sum_{j=1}^m \|\tilde{c}_{ij} - \tilde{c}_j^+\|$ ($i = 1, 2, \dots, k$) be the similar degree between S_i and the positive alternative, then the smaller D_i , the better S_i .

4 The establishment of the evaluation

Whether the visualization alternative is good or not can be described by a group of attributes. In the course of these attributes, there are so many fuzzy phenomena that the attribute values can not be found exactly, so the evaluation of these attributes is always confirmed by means of grade. Meanwhile, people's cognition and evaluation about attribute are restricted by lots of factors, the result of grade is generally fuzzy, so adopting the fuzzy comprehensive evaluation is an effective way.

Let $\{X_1, X_2, \dots, X_7\}$ be a discrete set of feasible alternatives, $G = \{G_1, G_2, \dots, G_6\}$ be the set of attributes, and the decision matrix be $A = (\tilde{a}_{ij})_{7 \times 6}$:

$$A = \begin{pmatrix} (0.7, 0.72, 0.75, 0.8) & (0.5, 0.58, 0.6, 0.63) & (0.5, 0.62, 0.62, 0.73) \\ (0.6, 0.62, 0.65, 0.67) & (0.5, 0.52, 0.6, 0.63) & (0.7, 0.72, 0.82, 0.9) \\ (0.7, 0.73, 0.78, 0.79) & (0.5, 0.52, 0.61, 0.63) & (0.6, 0.72, 0.82, 0.83) \\ (0.61, 0.63, 0.66, 0.68) & (0.4, 0.45, 0.6, 0.63) & (0.7, 0.72, 0.86, 0.9) \\ (0.72, 0.75, 0.77, 0.8) & (0.7, 0.72, 0.8, 0.83) & (0.7, 0.72, 0.82, 0.83) \\ (0.54, 0.57, 0.59, 0.61) & (0.4, 0.46, 0.5, 0.56) & (0.7, 0.75, 0.9, 0.92) \\ (0.6, 0.63, 0.69, 0.71) & (0.5, 0.52, 0.7, 0.74) & (0.4, 0.45, 0.5, 0.53) \end{pmatrix}$$

$$\begin{pmatrix} (0.5, 0.5, 0.64, 0.72) & (0.2, 0.21, 0.22, 0.23) & (0.09, 0.1, 0.14, 0.17) \\ (0.5, 0.5, 0.54, 0.6) & (0.2, 0.205, 0.21, 0.212) & (0.09, 0.09, 0.098, 0.1) \\ (0.8, 0.85, 0.9, 0.92) & (0.206, 0.208, 0.21, 0.213) & (0.1, 0.1, 0.15, 0.2) \\ (0.6, 0.65, 0.7, 0.7) & (0.176, 0.178, 0.18, 0.181) & (0.095, 0.099, 0.15, 0.18) \\ (0.7, 0.7, 0.74, 0.8) & (0.196, 0.199, 0.20, 0.202) & (0.1, 0.16, 0.18, 0.2) \\ (0.4, 0.5, 0.54, 0.62) & (0.18, 0.185, 0.189, 0.19) & (0.1, 0.12, 0.13, 0.13) \\ (0.44, 0.5, 0.66, 0.7) & (0.18, 0.186, 0.189, 0.19) & (0.12, 0.18, 0.21, 0.22) \end{pmatrix}$$

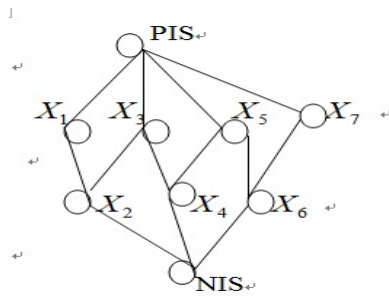


Fig1.

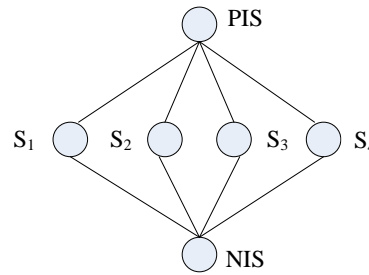


Fig2.

Consider the relationship among these schemes in order to draw the Hasse figure, then chose the better alternatives are S_1, S_2, S_3, S_4 , which is shown in figure1 and figure2.

Construct the new decision matrix $B = (\tilde{b}_{ij})_{4 \times 6}$:

$$B = \begin{pmatrix} (0.7, 0.72, 0.75, 0.8) & (0.5, 0.58, 0.6, 0.63) & (0.5, 0.62, 0.62, 0.73) \\ (0.7, 0.73, 0.78, 0.79) & (0.5, 0.52, 0.61, 0.63) & (0.6, 0.72, 0.82, 0.83) \\ (0.72, 0.75, 0.77, 0.8) & (0.7, 0.72, 0.8, 0.83) & (0.7, 0.72, 0.82, 0.83) \\ (0.6, 0.63, 0.69, 0.71) & (0.5, 0.52, 0.7, 0.74) & (0.4, 0.45, 0.5, 0.53) \end{pmatrix}$$

$$\begin{pmatrix} (0.5, 0.5, 0.64, 0.72) & (0.2, 0.21, 0.22, 0.23) & (0.09, 0.1, 0.14, 0.17) \\ (0.8, 0.85, 0.9, 0.92) & (0.206, 0.208, 0.21, 0.213) & (0.1, 0.1, 0.15, 0.2) \\ (0.7, 0.7, 0.74, 0.8) & (0.196, 0.199, 0.20, 0.202) & (0.1, 0.16, 0.18, 0.2) \\ (0.44, 0.5, 0.66, 0.7) & (0.18, 0.186, 0.189, 0.19) & (0.12, 0.18, 0.21, 0.22) \end{pmatrix}$$

Normalized the matrix B according to Eqs. (4) and (5) as follows:

$$R = \begin{pmatrix} (0.875, 0.923, 1.000, 1.00) & (0.602, 0.725, 0.822, 0.900) & (0.548, 0.726, 0.806, 1.000) \\ (0.875, 0.936, 1.000, 1.000) & (0.602, 0.650, 0.836, 0.900) & (0.482, 0.549, 0.694, 0.883) \\ (0.900, 0.936, 1.000, 1.000) & (0.843, 1.000, 1.000, 1.000) & (0.482, 0.563, 0.694, 0.757) \\ (0.750, 0.808, 0.920, 0.986) & (0.602, 0.650, 0.875, 0.892) & (0.755, 0.900, 1.000, 1.000) \\ (0.543, 0.555, 0.753, 0.900) & (0.870, 0.955, 1.000, 1.000) & (0.409, 0.476, 0.777, 1.000) \\ (0.870, 0.944, 1.000, 1.000) & (0.896, 0.945, 1.000, 1.000) & (0.455, 0.476, 0.833, 1.000) \\ (0.761, 0.777, 0.871, 1.000) & (0.852, 0.905, 0.952, 0.981) & (0.455, 0.762, 1.000, 1.000) \\ (0.478, 0.555, 0.776, 0.875) & (0.783, 0.845, 0.900, 0.922) & (0.545, 0.857, 1.000, 1.000) \end{pmatrix}$$

Suppose $\alpha = 0.3$, by using Eqs. (6) and (7), we can get the subject weight vector as follows:

$$\bar{\omega} = (\bar{\omega}_1, \bar{\omega}_2, \dots, \bar{\omega}_6)^T = (0.3, 0.21, 0.147, 0.1029, 0.072, 0.05)^T$$

Suppose the subject preference given by decision makers are as follows:

$$P_1 = (0, 3, 0.5), \quad P_2 = (0, 5, 0.6), \quad P_3 = (0.3, 0.4), \quad P_4 = (0.4, 0.6),$$

we get the deviation degree matrix based on definition 3 as follows:

$$D(\tilde{r}_j, \tilde{P}) = \begin{pmatrix} 0.5499 & 0.3701 & 0.3888 & 0.2949 & 0.5587 & 0.2751 \\ 0.4047 & 0.2010 & 0.1323 & 0.4064 & 0.4122 & 0.1476 \\ 0.6094 & 0.6205 & 0.2798 & 0.5116 & 0.5769 & 0.4490 \\ 0.3710 & 0.2553 & 0.3165 & 0.1780 & 0.3682 & 0.3480 \end{pmatrix}$$

Calculate the subject weight vector by using Eq. (8):

$$\omega' = (\omega'_1, \omega'_2, \dots, \omega'_6)^T = (0.094, 0.158, 0.268, 0.168, 0.097, 0.218)^T$$

Suppose $\beta = 0.4$, we get the comprehensive weight vector by using Eq. (9):

$$\omega = (\omega_1, \omega_2, \dots, \omega_6)^T = (0.1582, 0.1784, 0.217, 0.159, 0.1246, 0.164)^T$$

Construct the augmented and weighted decision C' by using Eqs. (10) -(12):

$$C' = \begin{pmatrix} (0.1384, 0.1460, 0.1582, 0.1582) & (0.1074, 0.1293, 0.1466, 0.1506) & (0.1189, 0.1575, 0.1749, 0.217) \\ (0.1384, 0.1481, 0.1582, 0.1582) & (0.1074, 0.1160, 0.1491, 0.156) & (0.1046, 0.1191, 0.1506, 0.1916) \\ (0.1424, 0.1481, 0.1582, 0.1582) & (0.1504, 0.1784, 0.1784, 0.1784) & (0.1046, 0.1221, 0.1506, 0.1643) \\ (0.1187, 0.1278, 0.1455, 0.1560) & (0.1074, 0.1160, 0.1561, 0.1591) & (0.1638, 0.1953, 0.217, 0.217) \\ (0.1424, 0.1481, 0.1582, 0.1582) & (0.1504, 0.1784, 0.1784, 0.1784) & (0.1638, 0.1953, 0.217, 0.217) \\ (0.0863, 0.0882, 0.1197, 0.1431) & (0.1084, 0.119, 0.1246, 0.1246) & (0.067, 0.0781, 0.1274, 0.164) \\ (0.1383, 0.1501, 0.159, 0.159) & (0.1116, 0.1177, 0.1246, 0.1246) & (0.0746, 0.0781, 0.1366, 0.164) \\ (0.121, 0.1235, 0.1385, 0.159) & (0.1062, 0.1128, 0.1186, 0.1222) & (0.0746, 0.1250, 0.164, 0.1640) \\ (0.076, 0.0882, 0.1234, 0.1391) & (0.0976, 0.1053, 0.1121, 0.1149) & (0.0894, 0.1405, 0.164, 0.164) \\ (0.1383, 0.1501, 0.159, 0.159) & (0.1116, 0.119, 0.1246, 0.1246) & (0.0894, 0.1405, 0.164, 0.164) \end{pmatrix}$$

Then construct the center matrix Q by using equation Eq. (1):

$$Q = \begin{pmatrix} (0.1500, 0.4604) & (0.1328, 0.4278) & (0.1673, 0.3835) & (0.1098, 0.4522) & (0.1187, 0.4190) & (0.1137, 0.4652) \\ (0.1505, 0.4459) & (0.1321, 0.4684) & (0.1425, 0.4219) & (0.1512, 0.4336) & (0.1195, 0.4489) & (0.1130, 0.4692) \\ (0.1516, 0.4633) & (0.1691, 0.3333) & (0.1353, 0.4410) & (0.1362, 0.4277) & (0.1148, 0.4220) & (0.1303, 0.4346) \\ (0.1370, 0.4406) & (0.1346, 0.4789) & (0.1972, 0.4299) & (0.1068, 0.4527) & (0.1073, 0.4274) & (0.1373, 0.4132) \\ (0.1516, 0.4633) & (0.1691, 0.3333) & (0.1972, 0.4299) & (0.1068, 0.4336) & (0.1197, 0.4337) & (0.1373, 0.4132) \end{pmatrix}$$

Calculate the value of D_i as follows:

$$D_1 = 0.2778 \quad D_2 = 0.2890 \quad D_3 = 0.1142 \quad D_4 = 0.2389$$

Obviously, the best alternative is S_3 , that is X_7 .

5 Conclusion

There are many types of visualization alternatives faced by the traveler, so it is hard to see which one is better. In order to deal with this problem, visualization alternative evaluations should be done to help the traveler to decide on the better option for tourism. In this paper, a new fuzzy multiple attribute decision method is given to evaluate visualization alternatives. Compared to traditional way of assessment, the new selection model proposed by this article is less liable to fault and more feasible to practice. This method can not only be used to solve visualization alternatives selection problem, but also be used to deal with select problems of many similar issues.

Acknowledgements

The National Natural Science Foundation Project of China (No. 61203285)

The Province Department of Science Soft Science Project in Sichuan (2016ZR0095)

The province major projects of high level research team of social science in Sichuan (Sichuan letter [2015] no.17-5)

The Project of Chengdu University of Information Technology (CRF201508, CRF201615, CRFKYTZ201644)

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