

Comparison of Two Fuzzy Binary Contrast Decisions

Xiaolei Li^{1†}

School of Science, China University of Geosciences, Beijing, 100083, China

[†]Email: 2582496662@qq.com

Abstract

Fuzzy binary contrast decision includes fuzzy similarity priority ratio decision and fuzzy relative comparison decision. The purpose is to sort the research objects. In this paper, two methods are used to establish the fuzzy priority ratio matrix and the fuzzy related matrix respectively. Then the elements in the two fuzzy matrices are sorted by the method of removing the infimum, and the sorting results are consistent. The conclusion can be extended to the general situation that the domain of the n elements.

Keywords: Fuzzy Binary Contrast Decision; Fuzzy Similarity Priority Ratio Decision; Fuzzy Relative Comparison Decision

1 INTRODUCTION

Decision making is an activity that is ubiquitous in people's life and work, and is the process of choosing the best solution to solve problems that are currently occurring or may occur in the future. The purpose of fuzzy decision is to sort the objects in the domain, or to select a satisfactory solution from the domain in some way. The binary comparison decision is a comparison of the two objects, and finally the priority relationship of the objects in the domain is sorted. Previous studies have known that under the condition of the domain including two objects, the sorting results of fuzzy similarity priority ratio decision and fuzzy relative comparison decision is consistent. Whether the results are consistent when the domain is more than binary is discussed in this paper.

2 INTRODUCTION OF FUZZY BINARY COMPARISON DECISION

2.1 The Basic Knowledge of Fuzzy Binary Comparison Decision

1) Binary Comparative Level

Set the domain of $U = \{x_1, x_2, \dots, x_n\}$, for a pair of elements (x_i, x_j) , if $(f_j(x_i), f_i(x_j))$ satisfying the condition $0 \leq f_j(x_i) \leq 1$, $0 \leq f_i(x_j) \leq 1$, in the comparison of x_i and x_j , the degree of certain characteristics in x_i is $f_j(x_i)$ while the degree of the same characteristic in x_j is $f_i(x_j)$. In this situation, $(f_j(x_i), f_i(x_j))$ is referred to as a binary relative comparative level of x_i and x_j to this characteristic.

2) Binary Relative Comparative Matrix

$$\Phi = \begin{pmatrix} 1 & f_2(x_1) & f_3(x_1) & \cdots & f_n(x_1) \\ f_1(x_2) & 1 & f_3(x_2) & \cdots & f_n(x_2) \\ f_1(x_3) & f_2(x_3) & \ddots & \ddots & \ddots \\ \vdots & \vdots & \ddots & 1 & f_n(x_{n-1}) \\ f_1(x_n) & f_2(x_n) & \cdots & f_{n-1}(x_n) & 1 \end{pmatrix} \quad (1)$$

3) Fuzzy Priority Relationship

r_{ij} represent the superior degree of x_i than x_j relative to A (A is a fuzzy set based on a definite domain U), also

is called preference ratio of x_i to x_j . The r_{ij} need to satisfy

$$\begin{cases} r_{ii} = 0, 0 \leq r_{ij} \leq 1 (i \neq j) \\ r_{ij} + r_{ji} = 1. \end{cases}, \quad (2)$$

$r_{ii} = 0$ means that there is no advantage when x_i is compared with x_i . The matrix $R = (r_{ij})_{n \times n}$ composed of r_{ij} is named fuzzy priority relation matrix.

2.2 Relevant Concepts of Fuzzy Similarity Priority Ratio Decision

Supposing $(f_j(x_i), f_i(x_j))$ is binary comparative level and making

$$\begin{cases} r_{ij} = \frac{f_j(x_i)}{f_j(x_i) + f_i(x_j)} \\ r_{ji} = \frac{f_i(x_j)}{f_j(x_i) + f_i(x_j)} \end{cases}, \quad (3)$$

so $r_{ii} = 0.5$ and $r_{ij} + r_{ji} = 1$, r_{ij} is fuzzy similarity priority ratio and $R = (r_{ij})_{n \times n}$ is fuzzy similarity priority ratio matrix. $r_{ii} = 0.5$ represents that the own has the same priority as itself.

2.3 Relevant Concepts of Fuzzy Relative Comparison Decision

1) Fuzzy Relative Comparison Function

Supposing domain $U = \{x_1, x_2, \dots, x_n\}$ and $(f_j(x_i), f_i(x_j))$ is binary comparative level, the fuzzy relative comparison function is named as follows:

$$f(x_i | x_j) = \frac{f_j(x_i)}{f_i(x_j) \vee f_j(x_i)}. \quad (4)$$

Under this definition, $f(x_i | x_j) \in [0, 1]$ $f(x_i | x_j) = \begin{cases} 1 & , f_j(x_i) > f_i(x_j) \\ \frac{f_j(x_i)}{f_i(x_j)} & , f_j(x_i) \leq f_i(x_j) \end{cases}$, $f(x_i | x_i) = 1$.

2) Fuzzy Related Matrix

Supposing domain $U = \{x_1, x_2, \dots, x_n\}$, $r_{ij} = f(x_i | x_j)$, the matrix $R = (r_{ij})_{n \times n}$ with r_{ij} as the elements is named fuzzy related matrix.

$$R = \begin{pmatrix} 1 & f(x_1 | x_2) & \cdots & f(x_1 | x_n) \\ f(x_2 | x_1) & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & f(x_{n-1} | x_n) \\ f(x_n | x_1) & \cdots & f(x_n | x_{n-1}) & 1 \end{pmatrix} \quad (5)$$

3 COMPARISON OF FUZZY SIMILARITY PRIORITY RATIO DECISION AND FUZZY RELATIVE COMPARISON DECISION

There is the comparison of two methods when the domain is ternary, quaternary and more.

3.1 The Domain is Ternary

$U = \{x_1, x_2, x_3\}$, supposing $f_1(x_2) \geq f_2(x_1)$, $f_1(x_3) \geq f_3(x_1)$, $f_2(x_3) \geq f_3(x_2)$, fuzzy related matrix is as follows:

$$R_3 = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2)} & \frac{f_3(x_1)}{f_1(x_3)} \\ 1 & 0.5 & \frac{f_3(x_2)}{f_2(x_3)} \\ 1 & 1 & 0.5 \end{pmatrix} \quad (6)$$

Supposing $\frac{f_2(x_1)}{f_1(x_2)} \leq \frac{f_3(x_1)}{f_1(x_3)} \leq \frac{f_3(x_2)}{f_2(x_3)}$, using the method of taking the infimum from each line except the diagonal elements, the sorting result of the fuzzy relative comparison decision method is x_3, x_2, x_1 .

Fuzzy priority ratio matrix is as follows:

$$R'_3 = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} & \frac{f_3(x_1)}{f_1(x_3) + f_3(x_1)} \\ \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)} & 0.5 & \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)} \\ \frac{f_1(x_3)}{f_1(x_3) + f_3(x_1)} & \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)} & 0.5 \end{pmatrix} \quad (7)$$

The first line,

$$\frac{f_2(x_1)}{f_1(x_2)} \leq \frac{f_3(x_1)}{f_1(x_3)} \Rightarrow 1 + \frac{f_1(x_2)}{f_2(x_1)} \geq 1 + \frac{f_1(x_3)}{f_3(x_1)} \Rightarrow \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \leq \frac{f_3(x_1)}{f_1(x_3) + f_3(x_1)},$$

the second line,

$$1 + \frac{f_2(x_1)}{f_1(x_2)} \leq 1 + \frac{f_3(x_2)}{f_2(x_3)} \leq 1 + \frac{f_2(x_3)}{f_3(x_2)} \Rightarrow \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)} \geq \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)},$$

the third line,

$$1 + \frac{f_3(x_1)}{f_1(x_3)} \leq 1 + \frac{f_3(x_2)}{f_2(x_3)} \Rightarrow \frac{f_1(x_3)}{f_1(x_3) + f_3(x_1)} \geq \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)},$$

so the infimum of each line except the diagonal elements is $\frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)}, \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)}, \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)}$. Because of $1 + \frac{f_1(x_2)}{f_2(x_1)} \geq 1 + \frac{f_2(x_3)}{f_3(x_2)} \geq 1 + \frac{f_3(x_2)}{f_2(x_3)}$, the

infimum sorting result is $\frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \leq \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)} \leq \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)}$. So x_3 is the first superior

object. Removing the third row and column of R'_3 to get

$$R_3^{(1)} = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \\ \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)} & 0.5 \end{pmatrix}, \quad (8)$$

the situation is the same as the binary, so x_2 is the second superior object, the last sorting result is x_3, x_2, x_1 . It

can be seen that the sorting results of the two methods are consistent.

Other situations of the magnitude and the ratio relationship between $f_j(x_i)$ and $f_i(x_j)$, the result can be inferred by

the same method and step. For example, the supposing is changed to $f_1(x_2) \leq f_2(x_1)$, $f_1(x_3) \geq f_3(x_1)$,

$f_2(x_3) \geq f_3(x_2)$, $\frac{f_1(x_2)}{f_2(x_1)} \leq \frac{f_3(x_1)}{f_1(x_3)} \leq \frac{f_3(x_2)}{f_2(x_3)}$, the results obtained by both methods are x_3, x_1, x_2 . That means

exchanging x_1 and x_2 in domain, the analysis process is the same. It is suitable for the domain is quaternary and more.

3.2 The Domain is Quaternary

$U = \{x_1, x_2, x_3, x_4\}$, supposing $f_1(x_2) \geq f_2(x_1)$, $f_1(x_3) \geq f_3(x_1)$, $f_1(x_4) \geq f_4(x_1)$, $f_2(x_3) \geq f_3(x_2)$, $f_2(x_4) \geq f_4(x_2)$, $f_3(x_4) \geq f_4(x_3)$, fuzzy related matrix is as follows:

$$R_4 = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2)} & \frac{f_3(x_1)}{f_1(x_3)} & \frac{f_4(x_1)}{f_1(x_4)} \\ 1 & 0.5 & \frac{f_3(x_2)}{f_2(x_3)} & \frac{f_4(x_2)}{f_2(x_4)} \\ 1 & 1 & 0.5 & \frac{f_4(x_3)}{f_3(x_4)} \\ 1 & 1 & 1 & 0.5 \end{pmatrix} \quad (9)$$

Supposing $\frac{f_2(x_1)}{f_1(x_2)} \leq \frac{f_3(x_1)}{f_1(x_3)} \leq \frac{f_4(x_1)}{f_1(x_4)} \leq \frac{f_3(x_2)}{f_2(x_3)} \leq \frac{f_4(x_2)}{f_2(x_4)} \leq \frac{f_4(x_3)}{f_3(x_4)}$, using the method of taking the infimum from each line except the diagonal elements, the sorting result of the fuzzy relative comparison decision method is x_4, x_3, x_2, x_1 .

Fuzzy priority ratio matrix is as follows:

$$R'_4 = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} & \frac{f_3(x_1)}{f_1(x_3) + f_3(x_1)} & \frac{f_4(x_1)}{f_1(x_4) + f_4(x_1)} \\ \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)} & 0.5 & \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)} & \frac{f_4(x_2)}{f_2(x_4) + f_4(x_2)} \\ \frac{f_1(x_3)}{f_1(x_3) + f_3(x_1)} & \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)} & 0.5 & \frac{f_4(x_3)}{f_3(x_4) + f_4(x_3)} \\ \frac{f_1(x_4)}{f_1(x_4) + f_4(x_1)} & \frac{f_2(x_4)}{f_2(x_4) + f_4(x_2)} & \frac{f_3(x_4)}{f_3(x_4) + f_4(x_3)} & 0.5 \end{pmatrix} \quad (10)$$

The first line,

$$1 + \frac{f_1(x_2)}{f_2(x_1)} \geq 1 + \frac{f_1(x_3)}{f_3(x_1)} \geq 1 + \frac{f_1(x_4)}{f_4(x_1)} \Rightarrow \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \leq \frac{f_3(x_1)}{f_1(x_3) + f_3(x_1)} \leq \frac{f_4(x_1)}{f_1(x_4) + f_4(x_1)},$$

The second line,

$$1 + \frac{f_2(x_1)}{f_1(x_2)} \leq 1 + \frac{f_2(x_4)}{f_4(x_2)} \leq 1 + \frac{f_2(x_3)}{f_3(x_2)} \Rightarrow \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)} \geq \frac{f_4(x_2)}{f_2(x_4) + f_4(x_2)} \geq \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)},$$

The third line,

$$1 + \frac{f_3(x_1)}{f_1(x_3)} \leq 1 + \frac{f_3(x_2)}{f_2(x_3)} \leq 1 + \frac{f_3(x_4)}{f_4(x_3)} \Rightarrow \frac{f_1(x_3)}{f_1(x_3) + f_3(x_1)} \geq \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)} \geq \frac{f_4(x_3)}{f_3(x_4) + f_4(x_3)},$$

The fourth line,

$$1 + \frac{f_4(x_1)}{f_1(x_4)} \leq 1 + \frac{f_4(x_2)}{f_2(x_4)} \leq 1 + \frac{f_4(x_3)}{f_3(x_4)} \Rightarrow \frac{f_1(x_4)}{f_1(x_4) + f_4(x_1)} \geq \frac{f_2(x_4)}{f_2(x_4) + f_4(x_2)} \geq \frac{f_3(x_4)}{f_3(x_4) + f_4(x_3)},$$

so the infimum of each line except the diagonal elements is

$$\frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)}, \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)}, \frac{f_4(x_3)}{f_3(x_4) + f_4(x_3)}, \frac{f_3(x_4)}{f_3(x_4) + f_4(x_3)}.$$

Because of $1 + \frac{f_1(x_2)}{f_2(x_1)} \geq 1 + \frac{f_2(x_3)}{f_3(x_2)} \geq 1 + \frac{f_3(x_4)}{f_4(x_3)} \geq 1 + \frac{f_4(x_3)}{f_3(x_4)}$, the infimum sorting result is

$$\frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \leq \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)} \leq \frac{f_4(x_3)}{f_3(x_4) + f_4(x_3)} \leq \frac{f_3(x_4)}{f_3(x_4) + f_4(x_3)}.$$

So x_4 is the first superior object.

Removing the fourth row and column of R_4' to get R_3' , the sorting result of R_3' is x_3, x_2, x_1 . So the sorting result of the fuzzy similarity priority ratio decision method is x_4, x_3, x_2, x_1 . The result is same as fuzzy relative comparison decision.

3.3 The Domain Contains n objects

$U = \{x_1, x_2, \dots, x_n\}$, supposing $f_1(x_2) \geq f_2(x_1), f_1(x_3) \geq f_3(x_1), \dots, f_1(x_n) \geq f_n(x_1), f_2(x_3) \geq f_3(x_2), f_2(x_4) \geq f_4(x_2), \dots, f_{n-1}(x_n) \geq f_n(x_{n-1})$, fuzzy related matrix is as follows:

$$R_n = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2)} & \frac{f_3(x_1)}{f_1(x_3)} & \dots & \frac{f_n(x_1)}{f_1(x_n)} \\ & 1 & 0.5 & \frac{f_3(x_2)}{f_2(x_3)} & \dots & \frac{f_n(x_2)}{f_2(x_n)} \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 1 & 1 & \dots & 0.5 & \frac{f_n(x_{n-1})}{f_{n-1}(x_n)} \\ 1 & 1 & \dots & 1 & 0.5 \end{pmatrix} \quad (11)$$

Supposing $\frac{f_2(x_1)}{f_1(x_2)} \leq \dots \leq \frac{f_n(x_1)}{f_1(x_n)} \leq \frac{f_3(x_2)}{f_2(x_3)} \leq \frac{f_4(x_2)}{f_2(x_4)} \leq \dots \leq \frac{f_n(x_{n-2})}{f_{n-2}(x_n)} \leq \frac{f_n(x_{n-1})}{f_{n-1}(x_n)}$, using the method of taking the infimum from each line except the diagonal elements, the sorting result of the fuzzy relative comparison decision method is $x_n, x_{n-1}, \dots, x_2, x_1$.

Fuzzy priority ratio matrix is as follows:

$$R_n' = \begin{pmatrix} 0.5 & \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} & \dots & \frac{f_n(x_1)}{f_1(x_n) + f_n(x_1)} \\ \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)} & 0.5 & \dots & \frac{f_n(x_2)}{f_2(x_n) + f_n(x_2)} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{f_1(x_n)}{f_1(x_n) + f_n(x_1)} & \frac{f_2(x_n)}{f_2(x_n) + f_n(x_2)} & \dots & 0.5 \end{pmatrix} \quad (12)$$

The first line,

$$1 + \frac{f_1(x_2)}{f_2(x_1)} \geq 1 + \frac{f_1(x_3)}{f_3(x_1)} \geq \dots \geq 1 + \frac{f_1(x_n)}{f_n(x_1)} \Rightarrow \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \leq \frac{f_3(x_1)}{f_1(x_3) + f_3(x_1)} \leq \dots \leq \frac{f_n(x_1)}{f_1(x_n) + f_n(x_1)},$$

so the infimum is $\frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)}$.

the second line,

$$1 + \frac{f_2(x_3)}{f_3(x_2)} \geq 1 + \frac{f_2(x_4)}{f_4(x_2)} \geq \dots \geq 1 + \frac{f_2(x_n)}{f_n(x_2)} \geq 1 + 1 \geq 1 + \frac{f_2(x_1)}{f_1(x_2)} \Rightarrow$$

$$\frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)} \leq \frac{f_4(x_2)}{f_2(x_4) + f_4(x_2)} \leq \dots \leq \frac{f_n(x_2)}{f_2(x_n) + f_n(x_2)} \leq \frac{1}{2} \leq \frac{f_1(x_2)}{f_1(x_2) + f_2(x_1)},$$

so the infimum is $\frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)}$.

the third line,

$$1 + \frac{f_3(x_4)}{f_4(x_3)} \geq \dots \geq 1 + \frac{f_3(x_n)}{f_n(x_3)} \geq 1 + 1 \geq 1 + \frac{f_3(x_2)}{f_2(x_3)} \geq 1 + \frac{f_3(x_1)}{f_1(x_3)} \Rightarrow$$

$$\frac{f_4(x_3)}{f_3(x_4) + f_4(x_3)} \leq \dots \leq \frac{f_n(x_3)}{f_3(x_n) + f_n(x_3)} \leq \frac{1}{2} \leq \frac{f_2(x_3)}{f_2(x_3) + f_3(x_2)} \leq \frac{f_1(x_3)}{f_1(x_3) + f_3(x_1)},$$

so the infimum is $\frac{f_4(x_3)}{f_3(x_4) + f_4(x_3)}$.

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the (n-2)th line,

$$1 + \frac{f_{n-2}(x_{n-1})}{f_{n-1}(x_{n-2})} \geq 1 + \frac{f_{n-2}(x_n)}{f_n(x_{n-2})} \geq 1 + 1 \geq \dots \geq 1 + \frac{f_{n-2}(x_2)}{f_2(x_{n-2})} \geq 1 + \frac{f_{n-2}(x_1)}{f_1(x_{n-2})} \Rightarrow$$

$$\frac{f_{n-1}(x_{n-2})}{f_{n-2}(x_{n-1}) + f_{n-1}(x_{n-2})} \leq \frac{f_n(x_{n-2})}{f_{n-2}(x_n) + f_n(x_{n-2})} \leq \frac{1}{2} \leq \dots \leq \frac{f_1(x_{n-2})}{f_1(x_{n-2}) + f_{n-2}(x_1)},$$

so the infimum is $\frac{f_{n-1}(x_{n-2})}{f_{n-2}(x_{n-1}) + f_{n-1}(x_{n-2})}$.

the (n-1)th line,

$$1 + \frac{f_{n-1}(x_n)}{f_n(x_{n-1})} \geq 1 + 1 \geq 1 + \frac{f_{n-1}(x_{n-2})}{f_{n-2}(x_{n-1})} \geq \dots \geq 1 + \frac{f_{n-1}(x_1)}{f_1(x_{n-1})} \Rightarrow$$

$$\frac{f_n(x_{n-1})}{f_{n-1}(x_n) + f_n(x_{n-1})} \leq \frac{1}{2} \leq \frac{f_{n-1}(x_{n-2})}{f_{n-2}(x_{n-1}) + f_{n-1}(x_{n-2})} \leq \dots \leq \frac{f_1(x_{n-1})}{f_1(x_{n-1}) + f_{n-1}(x_1)},$$

so the infimum is $\frac{f_n(x_{n-1})}{f_{n-1}(x_n) + f_n(x_{n-1})}$.

the nth line,

$$1 + \frac{f_n(x_{n-1})}{f_{n-1}(x_n)} \geq 1 + \frac{f_n(x_{n-2})}{f_{n-2}(x_n)} \geq \dots \geq 1 + \frac{f_n(x_2)}{f_2(x_n)} \geq 1 + \frac{f_n(x_1)}{f_1(x_n)} \Rightarrow$$

$$\frac{f_{n-1}(x_n)}{f_{n-1}(x_n) + f_n(x_{n-1})} \leq \frac{f_{n-2}(x_n)}{f_{n-2}(x_n) + f_n(x_{n-2})} \leq \dots \leq \frac{f_2(x_n)}{f_2(x_n) + f_n(x_2)} \leq \frac{f_1(x_n)}{f_1(x_n) + f_n(x_1)},$$

so the infimum is $\frac{f_{n-1}(x_n)}{f_{n-1}(x_n) + f_n(x_{n-1})}$.

After taking the reciprocal of the infimum of each line,

$$1 + \frac{f_1(x_2)}{f_2(x_1)} \geq 1 + \frac{f_2(x_3)}{f_3(x_2)} \geq \dots \geq 1 + \frac{f_{n-2}(x_{n-1})}{f_{n-1}(x_{n-2})} \geq 1 + \frac{f_{n-1}(x_n)}{f_n(x_{n-1})} \geq 1 + \frac{f_n(x_{n-1})}{f_{n-1}(x_n)},$$

$$\text{so } \frac{f_2(x_1)}{f_1(x_2) + f_2(x_1)} \leq \frac{f_3(x_2)}{f_2(x_3) + f_3(x_2)} \leq \dots \leq \frac{f_n(x_{n-1})}{f_{n-1}(x_n) + f_n(x_{n-1})} \leq \frac{f_{n-1}(x_n)}{f_{n-1}(x_n) + f_n(x_{n-1})},$$

which means x_n is the first superior object. Removing the n th row and column of R'_n to get R'_{n-1} , so $x_{n-1}, x_{n-2}, \dots, x_1$ is the second, third, ... n th superior object in turn, which can be inferred by the same method and step. It can be seen that the sorting results of the two methods are consistent.

4 CONCLUSIONS

In summary, the fuzzy similarity priority ratio decision and the fuzzy relative comparison decision are consistent in the sorting results. This conclusion is general, that is, it is suitable for the domain of arbitrary elements. This is just a comparison of the two methods in the binary comparison decision. From this we can think of whether the binary comparison decision has the same sorting results of other decision methods. If the answer is positive, other methods can be used as a check of the binary comparison decision; if not, two or more methods can be compared to find out the reason and difference. All of these issues require further study.

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AUTHORS



¹**Xiaolei Li**, borned in 1994, master student in China University of Geosciences, Beijing, major in mathematics, research direction is application statistics. She was graduated from Hebei University of Science and Technology with a bachelor's degree in 2017. Email:2582496662@qq.com