New Fuzzy Preference Relations and its Application in Group Decision Making

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***Abstract*—**Decision making preferences to certain criteria usually focus on positive degrees without considering the negative degrees. However, in real life situation, evaluation becomes more comprehensive if negative degrees are considered concurrently. Preference is expected to be more effective when considering both positive and negative degrees of preference to evaluate the best selection. Therefore, the aim of this paper is to propose the conflicting bifuzzy preference relations in group decision making by utilization of a novel score function. The conflicting bifuzzy preference relation is obtained by introducing some modifications on intuitionistic fuzzy preference relations. Releasing the intuitionistic condition by taking into account positive and negative degrees simultaneously and utilizing the novel score function are the main modifications to establish the proposed preference model. The proposed model is tested with a numerical example and proved to be simple and practical. The four-step decision model shows the efficiency of obtaining preference in group decision making.

***Keywords*—**Fuzzy preference relations, score function, conflicting bifuzzy, decision making.

I. Introduction

DECISION making can be regarded as a result of mental processes leading to the selection surrounded by a number of alternatives or criteria known as multi – criteria decision making. Every decision making process produces a final selection of the very best selection after considering number of alternatives. Usually decision makers (DMs) may not be able to correctly state his or her preferences for alternatives due to conflicting nature of alternatives such as negative and positive, bad and good and etc. The linguistic value for every conflicting relation is seemed to be complementary. This concept has been well accepted and authorized by Ying Yang's theories. It becomes rotundity when the both side turn into complementary. Ying Yang bipolar logic has been expanding through basic Ying Yang concept. Zhang [19] said that any product can have both good and/or bad aspects. Zadeh [16] assumed that for every non membership degree is equal to one minus membership degree and this makes the fuzzy sets complement. In logical area, membership degree and non-membership degree can be interpreted as positive and negative. Obviously this explains that the contraries relation exists. Atanassov [1] proposed his idea of intuitionistic fuzzy sets which also involve contraries relation. He stated that the degree of membership and non-membership must hold the condition $0 \le \mu_A(x) + \upsilon_A(x) \le 1$, which implies a complementary relation.

One of the limitations with this explanation is that it does not explain how to handle far beyond complementary relation. At this point, we argue the condition after taking into account cases of intuitive judgment where the condition is no longer valid. What will happen if the value of membership and non-membership greater than one? How do we fulfill the condition for instances in a case where $\mu_A(x) = 0.7$ represents the membership degree, and the non-membership is 0.4? This predicament gives us an opportunity to re-define a solution eventually to improve the concept of intuitionistic fuzzy sets. Based on this argument we propose a new concept so called conflicting bifuzzy set (CBFS). A new condition for this concept is proposed by Imran et. al. [7] and details of this concept also be retrieved from Zamali et.al. [17]. This new concept opens a new approach of preference relations in group decision making.

In real life situation, a DM may not be able to accurate express her or his preferences for alternatives due to several reasons. DM may not possess a precise or sufficient level of knowledge of the problem and DM is also unable to discriminate explicitly the degrees to which one alternative are better than others [5]. Thus, it is very suitable to express the DMs preference values with the use of CBFS values rather than complementary relation in IFS. In this paper, we propose a new preference in group decision making based on CBFS. The theoretical development of CBFS and fuzzy preference relations in group decision making based on CBFS will be paid attention. In order to that, the remainder of this paper is organized as follows. Section II briefly explains the definitions of fuzzy sets and its allies in conceptual

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exploration of conflicting bifuzzy preference relations (CBFPR). In Section III, steps in CBFPR in group decision making is proposed. A numerical example to explain the preference is given in Section IV. This paper concludes in Section V.

II. Conceptual Exploration

In this section, some important definitions are reviewed before conflicting bifuzzy preference relations is defined.

Definition 2.1. Fuzzy Sets [16].

Let X be a space of points (object), with a general element of X denoted by x .Therefore, $X = \{x\}$. A fuzzy set (class) A in X is characterized by a membership (characteristic) function $f_A(x)$ which associates with each points in X a real number in the interval $[0,1]$ with the value of $f_A(x)$ at x representing the "grade of membership" of x in A. Thus, the nearer the value of $f_A(x)$ to unity, the higher the grade of membership of x in A. Specifically, a fuzzy set on a classical set X is defined as follows:

$$A = \{(x, \mu_A(x)) \mid x \in X\} \tag{1}$$

Twenty years later, Atanassov (1986) extended this Zadeh' idea by using the concept of dual membership degrees in each of the sets discourse by giving both a degree of membership and a degree of non-membership which are more-or-less independent from one to one other another with the sum of these two grades being not greater than one [3]. This idea, which is a natural generalization of a standard fuzzy set, seems to be useful in modeling many real life situations [8]. It was derived from the capacity of humans to develop membership functions through their own natural intellect and understanding. It also involves contextual and semantic knowledge about an issue, it can also entail linguistic truth values about this knowledge.

Definition 2.3. Intuitionistic Fuzzy Sets [1].

An intuitionistic fuzzy set (IFS) *A* on a universe X is defined as an object of the following form

$$A = \{(x, \mu_A(x), \upsilon_A(x)) \mid x \in X\} \tag{2}$$

where the functions $\mu_A : X \to [0,1]$ define the degree of membership and $\upsilon_A : X \to [0,1]$ the degree of non-membership of the element $x \in X$ in *A*, and for every $x \in X$, $0 \le \mu_A(x) + \upsilon_A(x) \le 1$. Obviously, each ordinary fuzzy set may be written as $\{(x, \mu_A(x), 1 - \upsilon_A(x)) \mid x \in X\}$.

Recently, the necessity has been stressed of taking into consideration a third parameter $\pi_A(x)$, known as the intuitionistic fuzzy index or hesitation degree, which arises due to the lack of knowledge or 'personal error' in calculating the distances between two fuzzy sets [13]. Thus the summation of three degrees, i.e., membership, non-membership, and hesitation degree is 1. It is obvious that $0 \le \pi_A(x) \le 1$, for each $x \in X$. So, with the introduction of hesitation degree, an intuitionistic fuzzy set *A* in *X* may be represented as:

$$A = \{(x, \mu_A(x), \upsilon_A(x), \pi_A(x)) \mid x \in X\} \tag{3}$$

with the condition $\mu_A(x) + \upsilon_A + \pi_A(x) = 1$.

Fuzzy sets and intuitionistic fuzzy sets approach inspired a new idea. Zamali et.al [17] introduced the new theoretical concept so called 'conflicting bifuzzy sets' (CBFS) which is extension from IFS concepts and Ying Yang theory [19].

Definition 2.4 Conflicting Bifuzzy Sets [17].

Let a set X be fixed. A conflicting bifuzzy set A of X is and object has the following form:

$$A = \{< x, \mu_A(x), \upsilon_A(x) > \mid x \in X\} \tag{4}$$

where the functions $\mu_A : X \to [0,1]$ represents the degree of positive x with respect to A and $x \in X \to \mu_A(x) \in [0,1]$, With the new condition $0 < \mu_A(x) + \upsilon_A(x) \le 1 + \xi < 2$ and all $\xi \ge 0$ by replacing the intuitionistic condition and the functions $\upsilon_A : X \to [0,1]$ represent the degree of negative x with respect to A and $x \in X \to \upsilon_A(x) \in [0,1]$.

They also unveil that in bifuzzy sets, there exists conflict between two fuzzy sets. The IFSs have memberships degree and non-membership degree in the range $[0,1]$. The condition is undoubtedly very limited and not true for all time. To ease this problem, the bridle in the range $[0,1]$ should be taken away. If the performance of a candidate is 'good' is 0.7, in reality it does not mean that the 'poor' performance is always 0.3, but it can be more than 0.3 (i.e. 0.35 or more). In real life situation 'good' and 'poor' are not complements each other.

Recently, more and more decision analyses fuzzy preference relations to help decision makers make their decision. One of the fuzzy preference relations is defined as follows.

Definition 2.5. Fuzzy Preference Relations [5].

A preference relation P on the set X is characterized by a function $\mu_P : X \times X \to D$, where D is the domain of representation of preference degrees.

The preference relations can be represented by the $n \times n$ matrix $P = (p_{ij})$ form as $p_{ij} = \mu_p(x_i, x_j)$ for all $i, j = 1,2,...,n$. p_{ij} is construe as the preference degree of the alternative x_i over x_j: $p_{ij} = 0.5$ (indifference), $p_{ij} = 1$ (absolutely preferred), $p_{ij} > 0.5$ (x_i is preferred to x_j). D will be values at the intervals $[0,1]$. One of the classifications of preference relations is fuzzy preference relation. A fuzzy preference relation R on the set X is represented by a complementary matrix $R = (r_{ij})_{n\times n} \subset X \times X$ for all $i, j = 1,2,...,n$.

Szmidt and Kacprzyk [11] generalized the fuzzy preferences relation to the intuitionistic fuzzy preference relation and Xu [15] introduce the concept of intuitionistic preference relation. IPR is the combination from IFS and fuzzy preference relations.

Definition 2.6. [15]. An intuitionistic preference relation B on the set X is represented by a matrix $B = (b_{ij})_{n\times n} \subset X \times X$ with $b_{ij} = \langle (x_i, x_j), \mu(x_i, x_j), \upsilon(x_i, x_j) \rangle$ for all $i, j = 1,2,...,n$.

For convenience, we let $b_{ij} = (\mu_{ij}, \upsilon_{ij})$, for all $i, j = 1,2,...,n$ where b_{ij} is an intuitionistic fuzzy value, composed by the certainty degree μ_{ij} to which x_i is preferred to x_j and certainty degree υ_{ij} to which x_i is non-preferred to x_j, and $\pi_{ij} = 1 - \mu_{ij} - \upsilon_{ij}$ is interpreted as the uncertainty degree to which x_i is preferred to x_j and $\pi_{ij} = 1 - \mu_{ij} - \upsilon_{ij}$ in interpreted as the uncertainty degree to which x_i is preferred to x_j. Moreover μ_{ij}, υ_{ij} satisfy $0 \le \mu_{ij} + \upsilon_{ij} \le 1$, $\mu_{ij} = \upsilon_{ij}$, $\upsilon_{ij} = \mu_{ij}$ and $\mu_{ij} = \upsilon_{ij} = 0.5$

The concept of CBFS and fuzzy preference relations ushered into the proposed conflicting bifuzzy preference relations and defined as follows.

Definition 2.7. Conflicting Bifuzzy Preference Relations.

Let $A = \{a_1, a_2, ..., a_n\}$ be a finite set of alternatives and $B = \{b_1, b_2, ..., b_m\}$ the set of DMs. X is a matrix of conflicting bifuzzy preferences relation whose represented by with $X = (x_{ij})_{n\times n} \subset A \times A$ for all $x_{ij} = \langle (a_i, a_j), \mu(a_i, a_j), \upsilon(a_i, a_j) \rangle$ for all $i, j = 1,2,...,n$ where x_{ij} is a conflicting bifuzzy value, composed by the certainty degree μ_{ij} to which a_i is positively preferred to a_j and certainty degree υ_{ij} to which a_i is negatively preferred to a_j, and $0 < \mu_A(a) + \upsilon_A(a) < 2$, $\mu_{ij} = \upsilon_{ij}$, $\upsilon_{ij} = \mu_{ij}$ and $\mu_{ij} = \upsilon_{ij} = 0.5$. For conflicting bifuzzy, the condition is no more limited to one as to discard the intuitionistic fuzzy set constraints. By this we state that addition value for positive preference and negative preference can be greater than one but cannot more than two.

A conflicting bifuzzy preferences relation P is a bifuzzy subset of $A \times A$ which characterized by the following membership function:

$$\mu_{ij}(A_i, A_j) = \begin{cases} 1, & \text{if } A_i \text{ is positive definitely preferred to } A_j, \\ c \in (0.5,1), & \text{if } A_i \text{ is positive slightly preferred to } A_j, \\ 0.5, & \text{if there is no preference (indifference)}, \\ d \in (0.5,1), & \text{if } A_j \text{ is positive slightly preferred to } A_i, \\ 0, & \text{if } A_j \text{ is positive definitely preferred to } A_i, \end{cases}$$

and

$$\upsilon_{ij}(A_i, A_j) = \begin{cases} 1, & \text{if } A_i \text{ is negative definitely preferred to } A_j, \\ c \in (0.5,1), & \text{if } A_i \text{ is negative slightly preferred to } A_j, \\ 0.5, & \text{if there is no preference (indifference)}, \\ d \in (0.5,1), & \text{if } A_j \text{ is negative slightly preferred to } A_i, \\ 0, & \text{if } A_j \text{ is negativedefinitely preferred to } A_i, \end{cases}$$

The following definition also applies in Conflicting Bifuzzy Preference Relations.

Definition 2.8 If $x_{ij} = (\mu_{ij}, \upsilon_{ij})$ and $x_{kl} = (\mu_{kl}, \upsilon_{kl})$ are two conflicting bifuzzy values, then it satisfies the following conditions:

1. $\bar{x}_{ij} = (\mu_{ij}, \upsilon_{ij})$
2. $x_{ij} + x_{kl} = (\mu_{ij} + \mu_{kl} - \mu_{ij} \cdot \mu_{kl}, \upsilon_{ij} \cdot \upsilon_{kl})$
3. $x_{ij} \cdot x_{kl} = (\mu_{ij} \cdot \mu_{kl}, \upsilon_{ij} + \upsilon_{kl} - \upsilon_{ij} \cdot \upsilon_{kl})$
4. $x_{ij}^{\lambda} = \left(\mu_{ij}^{\lambda}, 1 - (1 - \upsilon_{ij})^{\lambda}\right), \lambda > 0$

In decision making, score function is one of the selective procedures for selection and ranking. This model has been developed by Wang [14] in fuzzy multi – criteria decision making based on vague set which more practical. This novel score function has develop caused by some insignificant of the earlier works by Hong and Choi [6] when incriminate fuzzy data. There are a few reasons that makes Wang [14] modified the score function formula. In certain cases, this earlier function cannot give sufficient information about alternative because they only consider true and false function without taking into account the unknown part.

Definition 2.8. Let $x_{ij} = (\mu_{ij}, \upsilon_{ij})$ be a conflicting bifuzzy preference value. For $\mu_{ij}, \upsilon_{ij} \in 1$, $\mu_{ij} + \upsilon_{ij} < 2$. The novel score function of x_{ij} can be evaluated by the score function S defined as,

$$S(x_{ij}) = \mu_{ij} - \upsilon_{ij} - \frac{1-\mu_{ij}-\upsilon_{ij}}{2}$$
$$= \frac{3\mu_{ij} - \upsilon_{ij} - 1}{2} \quad (5)$$

The greater the value of $S(x_{ij})$, the highest the degree of appropriateness that alternative satisfies some criteria. For example, in case of conflicting bifuzzy values with $\mu = \upsilon = 0.6$, then $S = 0.1$.

In this paper we insert the novel score function to rank and select the decision in conflicting bifuzzy preference relations.

III. Conflicting Bifuzzy Preference Relations Approach to Group Decision Making

Xu [15] developed an approach to group decision making based on intuitionistic preference relations. Also the same author proposed an approach to group decision making based on incomplete intuitionistic preference relations. The intuitionistic fuzzy arithmetic averaging operator and intuitionistic fuzzy weighted arithmetic averaging operator were used to aggregate intuitionistic preference information and the score function. As an extending idea, intuitionistic fuzzy preference relations will be modified to conflicting bifuzzy preferences relation by using the conflicting preference relations data. This decision making focuses on a numbers of decision makers with multi criteria / alternatives.

Following are the steps on how to construct the decision model based on the conflicting bifuzzy preference relations and the novel score function:

Step 1: Let $A = \{a_1, a_2, ..., a_n\}$ be a finite set of alternatives and $B = \{b_1, b_2, ..., b_m\}$ the set of DMs. Let $\omega = \{\omega_1, \omega_2, ..., \omega_m\}$ be the weight vector of DMs. The DM $b_k \in D$ provides his/her conflicting bifuzzy preference for each pair of alternatives, and constructs conflicting bifuzzy preference relations.

Step 2: Use the conflicting bifuzzy fuzzy arithmetic averaging operator [15] to aggregate all $x_{ij}^{(k)}\ (k = 1, 2, ..., n)$ for obtaining the averaged conflicting bifuzzy values of the alternatives x_i over all the other alternatives.

$$x_i^{(k)} = \frac{1}{n}\sum_{j=1}^{n} x_{ij}^{(k)} \ , \ i, j = 1, 2, ..., n \quad (6)$$

Step 3: Use the conflicting bifuzzy weighted arithmetic averaging operator [15] to aggregate all $x_i^{(k)}\ (k = 1, 2, ..., m)$ consequent to m DMs into a collective conflicting bifuzzy values x_i of all the alternative a_i over all the other alternatives.

$$x_i = \sum_{k=1}^{m} \omega_k x_i^{(k)}, \ i, j = 1, 2, ..., n \quad (7)$$

Step 4: Rank all $x_i^{(k)}\ (k = 1, 2, ..., m)$ used the novel score function (Equation 5), and then rank all the alternatives $a_i\ (i = 1, 2, ..., n)$ and select the best one in accordance with the values of $x_i^{(k)}\ (k = 1, 2, ..., m)$.

The different between intuitionistic fuzzy sets and conflicting bifuzzy sets in decision making is at the part where conflicting bifuzzy allowed judgers to assess the degree of preferences in positive as membership degree and negative as non – membership degree and discard the intuitionistic condition.

IV. Numerical Example

This section presents a modification to data from intuitionistic preference relations [15] into conflicting bifuzzy preferences relation. The value of each preference in conflicting bifuzzy could be greater than one but could not be equivalent to two since of some commonsense thoughts to be occurred in reality when both positive and negative membership is unity (see Definition 2.4). Habitually when positive has been evaluated to have high membership, then logically the negative value cannot be also high. For example when value of $\mu_{ij} = 1$, it's not reasonable to evaluate $\upsilon_{ij} = 1$.

But sometimes in certain cases when $\mu_{ij} = \upsilon_{ij}$, its still can be a reasonable value when $\mu_{ij} = \upsilon_{ij} = 0.5$ or $\mu_{ij} = \upsilon_{ij} = 0.6$. In order to change the intuitionistic data to conflicting bifuzzy data, we do some adjustments to the smaller values whether positive or negative membership and construct the conflicting bifuzzy preference relations value. We choose the smaller values with the purpose to release the constraints of IFS.

Xu [15] used practical examples involving the assessment of a set of agroecological regions in Hubei Province, China. We adjusted the results to suit with conflicting bifuzzy numbers. The differences between the original data and the conflicting bifuzzy data are not too obvious except of the data valued greater than one.

In the example, the alternatives are divided into seven, $a_i\ (i = 1, 2, ..., 7)$ with respect to their agroecological regions in Hubei and there are three DMs $b_k\ (k = 1, 2, 3)$ with weight vector, $\omega = (0.5, 0.2.0.3)^T$ has been set up to provide assessment information on $a_i\ (i = 1, 2, ..., 7)$. The DMs

$b_k\left(k=1,2,3\right)$ provide conflicting bifuzzy preferences for each pair alternatives and construct the conflicting bifuzzy preference relations matrix $X^{(k)}=\left(x_{ij}^{(k)}\right)_{7\times 7}$ $\left(x_{ij}^{(k)}=\left(\mu_{ij}^{(k)},\upsilon_{ij}^{(k)}\right),i,j=1,2,...7;k=1,2,3\right)$ as follows, respectively:

$$X^{(1)}=\begin{bmatrix}(0.5,0.5)&(0.5,0.3)&(0.7,0.2)&(0.5,0.4)&(0.6,0.5)&(0.9,0.2)&(0.8,0.2)\\(0.3,0.5)&(0.5,0.5)&(0.6,0.3)&(0.4,0.6)&(0.7,0.2)&(0.8,0.3)&(0.6,0.4)\\(0.2,0.7)&(0.3,0.6)&(0.5,0.5)&(0.4,0.6)&(0.5,0.5)&(0.7,0.2)&(0.7,0.3)\\(0.4,0.5)&(0.6,0.4)&(0.6,0.4)&(0.5,0.5)&(0.6,0.2)&(0.8,0.2)&(0.7,0.4)\\(0.5,0.6)&(0.2,0.7)&(0.5,0.5)&(0.2,0.6)&(0.5,0.5)&(0.5,0.3)&(0.4,0.2)\\(0.2,0.9)&(0.3,0.8)&(0.2,0.7)&(0.2,0.8)&(0.3,0.5)&(0.5,0.5)&(0.4,0.7)\\(0.2,0.8)&(0.4,0.6)&(0.3,0.7)&(0.4,0.7)&(0.2,0.4)&(0.7,0.4)&(0.5,0.5)\end{bmatrix}$$

$$X^{(2)}=\begin{bmatrix}(0.5,0.5)&(0.6,0.2)&(0.8,0.3)&(0.6,0.4)&(0.7,0.3)&(0.8,0.2)&(0.8,0.3)\\(0.2,0.6)&(0.5,0.5)&(0.5,0.2)&(0.4,0.7)&(0.6,0.2)&(0.7,0.3)&(0.6,0.3)\\(0.3,0.8)&(0.2,0.5)&(0.5,0.5)&(0.5,0.6)&(0.4,0.5)&(0.6,0.3)&(0.5,0.2)\\(0.4,0.6)&(0.7,0.4)&(0.6,0.5)&(0.5,0.5)&(0.7,0.4)&(0.8,0.3)&(0.6,0.3)\\(0.3,0.7)&(0.2,0.6)&(0.5,0.4)&(0.4,0.7)&(0.5,0.5)&(0.6,0.3)&(0.4,0.4)\\(0.2,0.8)&(0.3,0.7)&(0.3,0.6)&(0.3,0.8)&(0.3,0.6)&(0.5,0.5)&(0.4,0.6)\\(0.3,0.8)&(0.3,0.6)&(0.2,0.5)&(0.3,0.6)&(0.4,0.4)&(0.6,0.4)&(0.5,0.5)\end{bmatrix}$$

$$X^{(3)}=\begin{bmatrix}(0.5,0.5)&(0.6,0.3)&(0.8,0.2)&(0.7,0.3)&(0.8,0.3)&(0.9,0.2)&(0.7,0.2)\\(0.3,0.6)&(0.5,0.5)&(0.6,0.2)&(0.3,0.7)&(0.6,0.3)&(0.8,0.2)&(0.8,0.3)\\(0.2,0.8)&(0.2,0.6)&(0.5,0.5)&(0.3,0.3)&(0.4,0.4)&(0.9,0.2)&(0.6,0.2)\\(0.3,0.7)&(0.7,0.3)&(0.3,0.3)&(0.5,0.5)&(0.6,0.3)&(0.8,0.2)&(0.7,0.3)\\(0.3,0.8)&(0.3,0.6)&(0.4,0.4)&(0.3,0.6)&(0.5,0.5)&(0.7,0.3)&(0.7,0.4)\\(0.2,0.9)&(0.2,0.8)&(0.2,0.9)&(0.2,0.8)&(0.3,0.7)&(0.5,0.5)&(0.3,0.8)\\(0.2,0.7)&(0.3,0.8)&(0.2,0.6)&(0.3,0.7)&(0.4,0.7)&(0.8,0.3)&(0.5,0.5)\end{bmatrix}$$

According to the above matrices, notice that some values of conflicting bifuzzy preferences are greater than one after adjusting all the smaller value. Then we can continue to compute all the data according to the steps given in the Section V. Use the conflicting bifuzzy fuzzy arithmetic averaging operator (6) to aggregate all $x_{ij}^{(k)}\left(k=1,2,...,n\right)$ for obtaining the averaged conflicting bifuzzy values of the alternatives x_i over all the other alternatives:

For $X^{(1)}$:

$x_1^{(1)}=\left(0.6429,0.3286\right)$, $x_2^{(1)}=\left(0.5571,0.4000\right)$,
$x_3^{(1)}=\left(0.4714,0.4857\right)$, $x_4^{(1)}=\left(0.6000,0.3714\right)$,
$x_5^{(1)}=\left(0.4000,0.4857\right)$, $x_6^{(1)}=\left(0.3000,0.7000\right)$,
$x_7^{(1)}=\left(0.3857,0.5857\right)$.

For $X^{(2)}$:

$x_1^{(2)}=\left(0.6857,0.3143\right)$, $x_2^{(2)}=\left(0.5000,0.4000\right)$,
$x_3^{(2)}=\left(0.4286,0.4857\right)$, $x_4^{(2)}=\left(0.6143,0.4286\right)$,
$x_5^{(2)}=\left(0.4143,0.5143\right)$, $x_6^{(2)}=\left(0.3286,0.6571\right)$,
$x_7^{(2)}=\left(0.3714,0.5429\right)$.

For $X^{(3)}$:

$x_1^{(3)}=\left(0.7143,0.2857\right)$, $x_2^{(3)}=\left(0.5571,0.0571\right)$,
$x_3^{(3)}=\left(0.4428,0.4286\right)$, $x_4^{(3)}=\left(0.5571,0.3714\right)$,
$x_5^{(3)}=\left(0.4571,0.5143\right)$, $x_6^{(3)}=\left(0.2714,0.7714\right)$,
$x_7^{(3)}=\left(0.3857,0.6143\right)$.

Utilize the conflicting bifuzzy weighted arithmetic averaging operator (7) to aggregate all $x_i^{(k)}\left(k=1,2,...,m\right)$ ensuing to m DMs into a collective conflicting bifuzzy values x_i of the entire alternative a_i over all the other alternatives.

$x_1=\left(0.6729,0.3129\right)$, $x_2=\left(0.5457,0.2971\right)$,
$x_3=\left(0.4543,0.4686\right)$, $x_4=\left(0.5900,0.3828\right)$,

$x_5 = (0.4200, 0.5000)$, $x_6 = (0.2971, 0.7128)$, $x_7 = (0.3828, 0.5857)$.

The final step is to derive preference using novel score function. Equation (5) is utilized to obtain preference.

$S(x_1) = 0.3529$, $S(x_2) = 0.1700$, $S(x_3) = -0.0529$, $S(x_4) = 0.1936$, $S(x_5) = -0.1200$, $S(x_6) = -0.4108$, $S(x_7) = -0.2187$

Therefore, $x_1 > x_4 > x_2 > x_3 > x_5 > x_7 > x_6$
and hence, $a_1 \succ a_4 \succ a_2 \succ a_3 \succ a_5 \succ a_7 \succ a_6$.

The notation '$\succ$' indicates one agroecological region is preferred to another.

V. Conclusion

Preference relations delineate a useful tool in expressing DM's preferences over alternatives. In this paper we have critically explored the related concepts prior introducing conflicting bifuzzy preference relations. We also proposed conflicting bifuzzy data and their application in preferences under a novel score function. By considering positive and negative degree concurrently plus with a novel score functions, the new preference was proposed. This approach provides a new perspective in decision making area especially in conflicting decision. The efficiency of using conflicting bifuzzy data is proven with a straight forward computation in a numerical example. They offer a practical, effective and simple way to produce a comprehensive judgment. It is hoped that they could find more potential applications in contrarily relations of fuzzy group decision analysis in the future.

Acknowledgment

The authors would like to acknowledge University Malaysia Terengganu (UMT) for the *fundamental research grant* (Vot: 59114) to support this study.

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