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DECISION MAKING IN INTERVAL VALUED INTUITIONISTIC FUZZY CONTEXT

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Abstract

The notion of Intuitionistic Fuzzy Set(IFS for short) theory by Atanassov strikes a paradigm shift in solving decision making problems. Ranking of IFS and Interval Valued Intuitionistic Fuzzy Set (IVIFS for short) is very often required in single person as well as multiperson decision making. In this paper I propose a multicriteria-multiperson decision making based on IVIFS. The proposed model is illustrated by a numerical example. (Goods and Service Tax) will bring a change in the existing sales tax system.

Keywords: *Intuitionistic Fuzzy Sets(IFSs), Interval valued Intuitionistic Fuzzy sets (IVIFSs), accuracy function, novel accuracy function.*

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$\pi_A(x)$ = 1-$\mu_A(x)$ -$v_A(x)$ = [1 $-\mu_{AU}(x)$ $-v_{AU}(x)$,1 $-\mu_{AL}(x)$ $-v_{AL}(x)$] We can denote the set of all the IVIFS in X by IVIFS(X).

Definition 2.3 [2]. Let A, B ∈ IVIFS(X). A subset relation is defined by $A \subseteq B \Leftrightarrow \mu_{AL}(x) \leq \mu_{BL}(x), \mu_{AU}(x) \leq \mu_{BU}(x)$ and $v_{AL}(x) \geq v_{BL}(x), v_{AU}(x) \geq v_{BU}(x)$, ∀ x ∈ X

Definition 2.4 [2]. Two IVIFSs A and B are equal iff $A \subset B$ and $B \subset A$

3.. New score function

Definition 3.1. Let A= ([a, b], [c, d]) be an interval valued intuitionistic fuzzy value obtained by definiton 2.6 for an alternative A, then the score function S of A based on the hesitancy degree is defined by S(A)=(a+b+ab-cd)/2

Theorem 3.1. For any two comparable interval valued intuitionistic fuzzy sets A and B , if A ⊆ B, then S(A) ≤ S(B)

Proof. Let A=[a_1,b_1], [c_1,d_1] and B=[a_2,b_2], [c_2,d_2] be two interval valued intuitionistic fuzzy sets such that A ⊆ B, then by applying definition
3.1, $S(B) - S(A) = (a_2 - a_1) + (b_2 - b_1) + (a_2b_2 - a_1b_1) + (c_1d_1 - c_2d_2) \geq 0$.
There fore $S(B) \geq S(A)$

Ranking of the alternatives by new score function

For the following comparable alternatives A_1 and A_2 with interval valued intuitionistic fuzzy values given by A_1 = ([.25, .35], [.4, .5]), A_2 = ([.3, .4], [.2, .3])and for the incomparable alternatives B_1, B_2 with interval valued intuitionistic fuzzy values given by B_1 = ([.4, .5], [.15, .25]), B_2 = ([.35, .55], [.1, .3] we can easily see that even though L(A)successfully ranked the alternatives it is difficult to handle. By applying definition 3.1 for the comparable alternatives, A_1,A_2 and for the incomparable alternatives, B_1,B_2, we can easily show that A_2 is better than A_1 and B_2 is better than B_1. It indicates the proposed method ranks all comparable as well as incomparable IVIFs correctly and is simple to handle.

α_1= ([.4018, .561] , [.1738, .3213]) α_2= ([.3628, .477] , [.1515, .2458]) α_3= ([.4899, .7483] , [.1515, .2517]) By applying definition 3.1.1 we get $S(\alpha_i)$ as follows $S(\alpha_1)$= .5662 , $S(\alpha_2)$= .4878 , $S(\alpha_3)$= .7833

Here $S(\alpha_3) > S(\alpha_1) > S(\alpha_2)$

Therefore the alternatives are ranked in accordance with the accuracy degree as $A_3 > A_1 > A_2$. You can select job A_3.

This score function can be applied for multi person decision making also, by giving weights to decision makers. The next section deals with multiperson decision making.

5. Multi-person Multi-criteria Decision Making in IVIF environment.

Xu in [6] elicit a method for group decision making. There, all the information provided by the decision makers is expressed as intuitionistic fuzzy decision matrices, where each of the elements is characterized by intuitionistic fuzzy number.

I apply this method to interval valued intuitionistic fuzzy decision making model, but in a different way as follows.

5.1. Computational procedure.

Step.1

First we calculate intuitionistic fuzzy weighted geometric average value for each alternatives. (Here we assume that criteria weights are known, otherwise calculate them by the method given by Xu).

Step.2

Find the score for each alternatives (definition 3.1). i.e., Obtain the collective score matrix as follows.

	A_1	A_2	...	A_m
D_1	$S11$	$S12$	...	$S1m$
D_2	$S21$	$S22$	...	$S2m$
.				
.				
D_n	$Sm1$	$Sm2$	...	Snm

Aggregated Matrix

	A_1	A_2	A_3
D_1	[.376,.503],[.253,.354]	[.537,.639],[.153,.240]	[.568,.668],[.1,.230]
D_2	[.286,.489],[.235,.337]	[.529,.630],[.173,.274]	[.570,.672],[.1,.216]
D_3	[.363,.502],[.235,.337]	[.473,.593],[.203,.304]	[.348,.449],[.278,.38]

We know that each weighted geometric average value is an IVIFN. So we can find the collective score for each alternative as given in step-3. It is elicited in the table given below. **Collective Score Matrix**

	A_1	A_2	A_3
D_1	.490	.741	.796
D_2	.4178	.722	.801
D_3	.4840	.642	.424

Let the weight for each decision maker be as follows.

Weight for decision maker-1, $W_{D1} = 0.4$

Weight for decision maker-2, $W_{D2} = 0.3$

Weight for decision maker-3, $W_{D3} = 0.3$

Thus the collective score for each alternative be,

$S(A_1) = (0.4 \times 0.49) + (0.3 \times 0.4178) + (0.3 \times 0.4840)$,

Similarly we can find the score for other alternatives also.

i.e., $S(A_1) = 0.4666$, $S(A_2) = 0.7056$ $S(A_3) = 0.6859$

Thus we rank the alternatives according to their score as follows,

[redacted]

Conclusion

A new score function, which ranks all comparable and incomparable IVIFSs is introduced in this paper. It can rank single person as well as multiperson decision making problems.Since ranking IVIFSs is an important problem in real life situation such as decision making, it has wide application.