# USING MAPLE FOR RANKING GENERALIZED TRAPEZOIDAL INTUITIONISTIC FUZZY NUMBERS

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**ABSTRACT :** In the present paper I will present a necessary algorithm for comparison of two numbers generalized exponential trapezoidal intuitionistic fuzzy numbers based on rank, mode, divergence and left spread. The main advantage of the proposed approach is that the proposed algorithm enable a procedure (we chose the programming language MAPLE) to ranking quickly and easily two such numbers.

**KEY WORDS :** Intuitionistic fuzzy numbers, Ranking function, Mode, Divergence, Spread, Generalized exponential intuitionistic trapezoidal fuzzy numbers.

## 1. INTRODUCTION

Fuzzy numbers us to make the mathematical model of linguistic variable or fuzzy environment. The first time the idea of ranking fuzzy numbers was his Jain 1976, for decision making in fuzzy situations by representing the ill-defined quantity as a fuzzy set. In 1985 Bortolan and Degani reviewed some of these ranking methods for ranking fuzzy subsets and Chen in 1985 propose ranking fuzzy numbers with maximizing and minimizing set. Chen and Chen in 2007 presented a method for ranking generalized trapezoidal fuzzy numbers. Abbasbandy and Hajjari in 2009 proposes a different approach to this based on the left and right spreads at some $\alpha$-levels of trapezoidal fuzzy numbers. Rezvani in 2010 and 2011 presented a method for ranking generalized fuzzy numbers.
S. Rezvani, 2012 proposed a method for ranking of generalized trapezoidal fuzzy numbers based on rank, mode, divergence and spread. In [3] I have demonstrated that:

**Theorem 1.** Let $a=\langle(a,b,c,d);w_a,u_a\rangle$, be generalized exponential intuitionistic fuzzy number with $0<w_a\le 1, 0<u_a\le 1$ and c,d are positive real numbers, a,b are real numbers. Then

1) $\Re(a)=\dfrac{w_a(a+b+d-c)}{2}-\dfrac{u_a(a+b+d-c)}{2}$ (1)

2) $\text{Mode}(a)=\dfrac{(w_a-u_a)(c+b)}{2}$ (2)

3) $\text{Divergence}(a)=(w_a-u_a)(d-a)$ (3)

4) Left $\text{spread}(a)=(w_a-u_a)(b-a)$ (4)

5) Right $\text{spread}(a)=(w_{\tilde{a}}-u_{\tilde{a}})(d-c)$ (5)

In [3] have demonstrated that:

**Proposition** 1. Let
$a_1=\langle(a_1,b_1,c_1,d_1);w_{a_1},u_{a_1}\rangle$,
$a_2=\langle(a_2,b_2,c_2,d_2);w_{a_2},u_{a_2}\rangle$ be two generalized exponential intuitionistic fuzzy number with $0<w_{a_1}\le 1, 0<u_{a_1}\le 1$ , $0<w_{a_2}\le 1, 0<u_{a_2}\le 1$ and $c_1$, $d_1$, $c_2$ , $d_2$ are positive real numbers, $a_1$, $a_1$, $b_2$ , $b_2$ are real numbers such that

i) $\Re(a_1)=\Re(a_2)$

ii) $Mode(a_1)=Mode(a_2)$;

iii) $Divergence(a_1)=Divergence(a_2)$;

Then

1) Left spread$(a_1)>$ Left spread$(a_2)$ iff $(w_{a_1}-u_{a_1})b_1>(w_{a_2}-u_{a_2})b_2$;

2) Left spread$(a)<$ Left spread$(\tilde{b})$ iff $(w_{a_1}-u_{a_1})b_1<(w_{a_2}-u_{a_2})b_2$;

3) Left spread$(a)=$ Left spread$(\tilde{b})$ iff $(w_{a_1}-u_{a_1})b_1=(w_{a_2}-u_{a_2})b_2$

**Corollary 1**. All the results of Proposition 1 is true and right spread.

At [3] am demonstrated that:

**Proposition 2**. Let
$a_1=\langle(a_1,b_1,c_1,d_1);w_{a_1},u_{a_1}\rangle$,
$a_2=\langle(a_2,b_2,c_2,d_2);w_{a_2},u_{a_2}\rangle$ be two generalized exponential intuitionistic fuzzy number with $0<w_{a_1}\le 1, 0<u_{a_1}\le 1$ , $0<w_{a_2}\le 1, 0<u_{a_2}\le 1$ and $c_1$, $d_1$, $c_2$ , $d_2$ are positive real numbers, $a_1$, $a_1$, $b_2$ , $b_2$ are real numbers such that

i) $\Re(a_1)=\Re(a_2)$

ii) $Mode(a_1)=Mode(a_2)$;

iii) $Divergence(a_1)=Divergence(a_2)$;

Then

1) Left spread$(a_1)>$Left spread$(a_2)$ iff Right spread$(a_1)>$ Right spread$(a_2)$;

2) Left spread$(a_1)<$ Left spread$(a_2)$ iff Right spread$(a_1)<$ Right spread$(a_2)$;

3) Left spread$(a_1)=$ Left spread$(a_2)$ iff Right spread$(a_1)=$ Right spread$(a_2)$;

## 2. PROPOSED ALGORITHM FOR RANKING OF GENERALIZED TRAPEZOIDAL FUZZY NUMBERS

Let $A=\langle(a,b,c,d);w,u\rangle$,
$B=\langle(e,f,g,h);v,t\rangle$ be two generalized exponential intuitionistic fuzzy number with $0<w\le 1, 0<u\le 1$ , $0<v\le 1, 0<t\le 1$ and c, d, g , h are positive real numbers, a, e, b , f are real numbers, Then use the following steps to compare A,B:

Step 1: Find $\Re(A)$ and ) $\Re(B)$

1.1 If $\Re(A)>\Re(B)$ then A>B ( Maple procedure *"ranching"* we attribute value 1 );

1.2 If $\Re(A)<\Re(B)$ then A<B ( Maple procedure *"ranching"* we attribute value -1 );

1.3 If $\Re(A)=\Re(B)$ then go to step 2;

Step 2: Find Mode(A) and Mode(B)

2.1 If $Mode(A) > Mode(B)$ then A>B ( Maple procedure "ranching" we attribute value 1 );

2.2 If $Mode(A) < Mode(B)$ then A<B (Maple procedure "ranching" we attribute value -1);

2.3 If $Mode(A) = Mode(B)$ then go to step 3;

<u>Step 3</u>: Find Divergence (A) and Divergence (B)

3.1 If $Div(A) > Div(B)$ then A>B ( Maple procedure "ranching" we attribute value 1 );

3.2 If $Div(A) < Div(B)$ then A<B ( Maple procedure "ranching" we attribute value -1 );

3.3 If $Div(A) = Div(B)$ then go to step 4;

<u>Step 4</u>: Find Leaft speard(A) and Leaft speard (B)

4.1 If $Ls(A) > Ls(B)$ then A>B ( Maple procedure "ranching" we attribute value 1 );

4.2 If $Ls(A) < Ls(B)$ then A<B ( Maple procedure "ranching" we attribute value -1 );

4.3 If $Ls(A) = Ls(B)$ then go to step 5;

**Remark:** Following affirmations are true**:**

$Ls(A) > Ls(B) \Leftrightarrow$ (w-u)b >f (v-t);

$Ls(A) < Ls(B) \Leftrightarrow$ (w-u)b<f (v-t);

$Ls(A) = Ls(B) \Leftrightarrow$ (w-u)b =f (v-t);

<u>Step 5</u>: Considering w,u,v,t

5.1 If w>v and u<t then A>B ( Maple procedure "ranching" we attribute value 1 );

5.2 If w<v and u>t then A<B ( Maple procedure "ranching" we attribute value -1 );

5.3 If w=v and u=t then A=B;

## 3. USING THE ALGORITHM

For this algorithm can be created following procedures in MAPLE:

The procedure for determining rank:

$A := Array([a, b, c, d, w, u]);$

$B := Array([e, f, g, h, v, t]);$

$rankF := \textbf{proc}(A)$
$\textbf{local}\ r;$
$$r := \frac{(A[1] + A[2] + A[4] - A[3])}{2} \cdot (A[5] + A[6]);$$
$\textbf{return}\ r$
$\textbf{end proc};$

**Example 1**. Let be $A = \langle (0.1, 0.4, 0.5, 0.9); 0.35, 25 \rangle$ generalized exponential intuitionistic fuzzy number. Using the procedure "*rankF*" obtain:

$> rankF([0.1, 0.4, 0.5, 0.9, 0.35, 0.25]);$

$$0.2700000000$$

The procedure for determining Mode(A):

$modeF := \textbf{proc}(A)$
$\textbf{local}\ m;$
$$m := \frac{(A[5] - A[6])(A[2] + A[3])}{2};$$
$\textbf{return}\ m$
$\textbf{end proc};$

**Example 2**. Let be $A = \langle (0.5, 0.4, 0.6, 0.2); 0.35, 25 \rangle$ generalized exponential intuitionistic fuzzy number. Using the procedure "mode*F*" obtain:

$modeF([0.5, 0.4, 0.6, 0.2, 0.35, 0.25]);$

$$0.05000000000$$

The procedure for determining Divergence (A):

```
diveF := proc(A)
 local d;
 d := (A[5] - A[6])(A[4]-A[1]) / 2 ;
 return d
 end proc;
```

**Example 3**. Let be $A=\langle(0.5,0.4,0.6,0.2);0.35,25\rangle$ generalized exponential intuitionistic fuzzy number. Using the procedure "dive*F*" obtain:

```
> diveF([0.5, 0.4, 0.6, 0.2, 0.35, 0.25]);
                    0.05000000000
```

The procedure for determining Left spread (A):

```
lsF := proc(A)
 local l;
 l := (A[5] - A[6])(A[2]-A[1]) / 2 ;
 return l
 end proc;
```

**Example 4**. Let be $A=\langle(0.2,0.4,0.6,0.8);0.45,25\rangle$ generalized exponential intuitionistic fuzzy number. Using the procedure "ls*F*" obtain:

```
> lsF([0.2, 0.4, 0.6, 0.8, 0.45, 0.25]);
                    0.1000000000
```

Appealing previous procedures get:

```
ranching := proc(A, B)
 local r1, r2, m1, m2, d1, d2, l1, l2;
 r1 := rankF(A); r2 := rankF(B);
 if r1 > r2 then return 1 end if;
 if r1 < r2 then return -1 end if;
 m1 := modeF(A); m2 := modeF(B);
 if m1 > m2 then return 1 end if;
 if m1 < m2 then return -1 end if;
 d1 := diveF(A); d2 := diveF(B);
 if d1 > d2 then return 1 end if;
 if d1 < d2 then return -1 end if;
 l1 := lsF(A); l2 := lsF(B);
 if l1 > l2 then return 1 end if;
 if l1 < l2 then return -1 end if;
 if (A[5] > B[5]) and (A[6] < B[6]) then return 1 end if;
 if (A[5] < B[5]) and (A[6] > B[6]) then return -1 end if;
 if (A[5] = B[5]) and (A[6] = B[6]) then return 0 end if;
 return -2
 end proc;
```

```
printRF := proc(A, B)
 local r;
 print("A: ", A); print("B: ", B);
 r := ranching(A, B);
 if r = 1 then print("A>B") else
 if r =-1 then print("A<B") else
  if r = 0 then print("A=B")
   print("Not comparable")
    end if end if end if
 end proc;
```

**Example 5**. Let $A=\langle(0.1,0.4,0.6,0.7);0.35,25\rangle$ and $A=\langle(0.7,0.2,0.4,0.5);0.5,2\rangle$ be two generalized trapezoidal intuitionistic fuzzy number, then:

```
printRF([0.1, 0.4, 0.6, 0.7, 0.35, 0.25], [0.7, 0.2, 0.4, 0.5, 0.5, 0.2]);
            "A: ", [0.1, 0.4, 0.6, 0.7, 0.35, 0.25]
             "B: ", [0.7, 0.2, 0.4, 0.5, 0.5, 0.2]
                          "A<B"
```

## 4. CONCLUSION

In the [9] We complete the method for ranking of generalized exponential trapezoidal intuitionistic fuzzy numbers based on rank, mode, divergence and left spread. There We determine values equivalent for rank, mode, divergence and left spread (Theorem 1). Starting from [8] and [9], We extended the method for ranking of generalized exponential trapezoidal intuitionistic fuzzy numbers based on rank, mode, divergence and left spread.

The main advantage of the proposed algorithm is that it performs correctly ordering trapezoidal intuitionistic fuzzy numbers generalized and normal.

Making a procedure using the programming language MAPLE makes this comparison method proposed by me be easily applied to real-life problems.

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