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# Fuzzy Set Theory and Arithmetic Operations On Fuzzy N Umbers

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**Abstract**
In this paper we represent a fuzzy set theory and arithmetic operation on fuzzy numbers. The fuzzy set theory to derived operation on fuzzy set and fuzzy arithmetic operation. The produce with operation on closed interval.

**Introduction**
The development of fuzzy set theory, since its introduction in 1965 has been dramatic.The fuzzy set theory has pervaded almost all fields of study and its applications have percolated down to consumer goods level! Apart from this, it is being applied on a major scale in industries through intelligent robots for machine – building ( cars, engines, turbines, ship, etc.) and controls and of course for military purposes.
**Keywords:** Fuzzy set, Fuzzy numbers, Arithmetic operation, Arithmetic intervals.

**Preliminaries**
**Definition: Fuzzy set**
If X is a collection of objects denoted generally by X, then a fuzzy set A in X is a set of order pairs. $\tilde{A} = \{ X, \mu_{\tilde{A}}(x)/x \epsilon X \}$

Where $\mu_{\tilde{A}}(x)$ is called membership function or grade of membership.

**Example:**

Let X is a ten natural numbers

$X = \{2,3,6,8,9,11,12,14,16,17\}$

$\tilde{A} = \{(2,0.1),(3,0.2),(6,0.3),(8,0.4),(9,0.5),(11,0.6),(12,0.7),(14,0.8),(16,0.9),(17,1)\}$

**Arithmetic Operations On Fuzzy Numbers**
**Definition:**

Let A and B denote fuzzy numbers and let ∀ denote any of the four arithmetic operations. Then we define a fuzzy set on R, A∗B. by defining its $-cut$ , $\alpha_{(A*B)}$ as

$$\alpha_{(A*B)} = \alpha_A * \alpha_B \qquad \forall\, \alpha \,\epsilon\, (0,1\,]$$

$$A*B = \cup_{\alpha\, \epsilon\, [\,0,1]} \alpha^{A*B}$$

Since, $\alpha_{(A*B)}$ is closed interval for each $\alpha\,\epsilon\,[0,1]$ and A,B are fuzzy numbers are also a fuzzy numbers.

**Definition:**

Let * denote any of the four basic arithmetic operators and let A,B denote fuzzy numbers. Then we define a fuzzy set on R, A*B by the equation,

$$(A*B)\,(z) = \sup_{z=x*y} \min[\,A(x), B(y)] \qquad \forall\, z\,\epsilon\, R$$

**NOTE:**

i. $(A+B)\,(z) = \sup_{Z=x+y} \min[\,A(x), B(y)]$
ii. $(A-B)\,(z) = \sup_{Z=x-y} \min[\,A(x), B(y)]$
iii. $(A.B)\,(z) = \sup_{Z=x.y} \min[\,A(x), B(y)]$
iv. $(A/B)\,(z) = \sup_{Z=\frac{x}{y}} \min[\,A(x), B(y)]$

## Arithmetic Operation On Intervals

Let * denote any of the four arithmetic operations on closed intervals,

$+ \rightarrow$ Addition

$- \rightarrow$ Subtraction

$\times \rightarrow$ Multiplication

$/ \rightarrow$ Division

Then [ a , b ] * [ d , e ] = { f * g / $a \leq f \leq b , d \leq g \leq e$ } is a general property of all arithmetic operations on closed intervals accept that $[a, b]/[d, e]$ is not defined when 0 $\epsilon$ [ $d$ , $e$ ].

The result of an arithmetic operation on closed intervals is again a closed intervals.

$l\,(x_\alpha) = A\,(x_n) = \alpha$

$l\,(x_\alpha) \geq \alpha$

Similarly, we can prove that,

$y_\alpha \,\epsilon\, \alpha_A$

$\alpha_A$ is closed interval

$x_\alpha , y_\alpha \,\epsilon\, \alpha_A$

$[\, x_\alpha , y_\alpha \,] \leq \alpha_A$

A is a fuzzy number.

### Definition:

The four arithmetic operation on closed intervals are defined as followed.

i. [ a,b ] + [ d,e ] = [ a+d , b+c ]

ii. [ a,b ] - [ d,e ] = [ a-d , b-c ]

iii. [ a,b ] * [d,e ] = [ min ( ad ,ae ,bd ,be ) max ( ad, ae ,bd ,be ) ]

iv. $[a, b]/[d, e]$ = [a,b] * $[\frac{1}{d}, \frac{1}{e}]$

$$= \left[\min\left(\frac{a}{d}, \frac{a}{e}, \frac{b}{d}, \frac{b}{e}\right) \max\left(\frac{a}{d}, \frac{a}{e}, \frac{b}{d}, \frac{b}{e}\right)\right]$$

### Example:

1) [ a,b] + [ d,e ] = [ a+d , b+c ]
   [ 1,2 ] + [ 3,4 ] = [ 1+3, 2+4 ]
   = [ 4 , 6 ]
2) [ a,b ] – [ d,e ] = [ a-e ,b-d ]
   [ 1,2 ] – [ 3,4 ] = [ 1-4 , 2-3 ]
   = [ -3 ,-1 ]
3) [ a,b ] * [ d,e ] = [ min ( ad,ae,bd,be ) , max ( ad,ae,bd,be ) ]
   [ 1,2 ] * [ 3,4 ] = [ min ( 3,4,6,8) , max ( 3,4,6,8) ]
   = [ 3,8 ]
4) [ a,b ] / [ d,e ] = [ min $\left(\frac{a}{d}, \frac{a}{e}, \frac{b}{d}, \frac{b}{e}\right)$ , max $\left(\frac{a}{d}, \frac{a}{e}, \frac{b}{d}, \frac{b}{e}\right)$]
   [ 1,2 ] / [ 3,4 ] = [ min $\left(\frac{1}{3}, \frac{1}{4}, \frac{2}{3}, \frac{2}{4}\right)$ , max$\left(\frac{1}{3}, \frac{1}{4}, \frac{2}{3}, \frac{2}{4}\right)$ ]
   = $[\frac{1}{3}, \frac{2}{4}]$
   [ 1,2 ] / [ 3,4 ] = $[\frac{1}{3}, \frac{1}{2}]$

## Conclusion

In the paper discussed some result in fuzzy set theory and fuzzy arithmetic number. Here provide the fuzzy numbers as well as explain and example. This results obtained by using fuzzy arithmetic are applicable for the control system. In applied of fuzzy set theory the field of engineering has undoubtedly been leader. Fuzzy set theory is also becoming important in computer engineering.

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