The Partial Fuzzy Set

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Abstract
The Partial Fuzzy Set is a portion of the Fuzzy Set which is again a Fuzzy Set. In the Partial Fuzzy Set the baseline is shifted from 0 to 1 to any of its \( \alpha \) cuts. In this paper we have fuzzified a portion of the Fuzzy Set by transformation.

KEY WORDS
fuzzy set, baseline, interval

1. Introduction: Fuzzy Set is an interval. Its membership function is from 0 to 1 or in terms of \( \alpha \) cuts. Fuzzy Set can be linear or nonlinear. Partial fuzzy Set is a fuzzy Set which is a portion of the original fuzzy Set which is obtained by changing the base line. In other words the base line is at the \( \alpha \) cut. The partial fuzzy Set is important as the whole fuzzy Set may not be required but only a portion of it is required. Works on fuzzy statistics have started within the last few years (see eg. Klior and Yuan(1997), Goswami and Baruah (2008) Kaufmann and Gupta (1985) Goswami (2011) Zadeh (1965)). We have found that not much have been done on partial fuzzy Set by using fuzzy approach. We put forward one such example in this paper.

2. \( \alpha \) cuts and strong \( \alpha \) cuts
\( \alpha \) cuts and \( \alpha \) strong cuts is its capability to represent fuzzy sets. Each fuzzy set can uniquely be represented by either the family of all its \( \alpha \) cuts or the family of all its strong \( \alpha \) cuts.
3. Fuzzy Sets

The fuzzy Sets in terms of membership function are represented by

$$\mu_A(x) = \begin{cases} 
0, & x < -1 \\
\frac{x + 1}{2}, & -1 \leq x \leq 1 \\
\frac{3 - x}{2}, & 1 \leq x \leq 2 \\
0, & x > 3 
\end{cases} \quad \cdots(1)$$

and $$\mu_B(x) = \begin{cases} 
0, & x < 1 \\
\frac{x - 1}{2}, & 1 \leq x \leq 3 \\
\frac{5 - x}{2}, & 3 \leq x \leq 5 \\
0, & x \geq 5 
\end{cases} \quad \cdots(2)$$

Then the subtraction of two fuzzy Set in terms of membership function is represented by

$$\mu_{A-B}(x) = \begin{cases} 
0, & x \leq -6 \\
\frac{x + 6}{4}, & -6 \leq x \leq -2 \\
-\frac{x}{4} + 1, & -2 \leq x \leq 2 \\
0, & x \geq 2 
\end{cases} \quad \cdots(4)$$

which is represented graphically as shown below

**Addition of two fuzzy Set**

Then the addition of two fuzzy Set in terms of membership function is represented by

$$\mu_{A+B}(x) = \begin{cases} 
0, & x < 0 \\
\frac{x}{4}, & 0 \leq x \leq 4 \\
-\frac{x}{4} + 2, & 4 \leq x \leq 8 \\
0, & x > 8 
\end{cases} \quad \cdots(3)$$

which is represented graphically as shown below

**Subtraction of two fuzzy set**

The Multiplication of two Fuzzy Set in terms of Membership Function is Represented by
Multiplication of two fuzzy Set
The Division of two Fuzzy Set in terms of Membership is represented by

\[
\mu_{A,B}(x) = \begin{cases} 
0, & x \leq -1 \\
\frac{1 + \sqrt{17 + 16x}}{8}, & -1 \leq x \leq 3 \\
\frac{16 - \sqrt{16 + 16x}}{8}, & 3 \leq x \leq 15 \\
0, & x \geq 15 
\end{cases} \quad ...(5)
\]

Which can be represented graphically as shown below

\[A:B\]

Division of two fuzzy Set
If \(X_1\) and \(X_2\) are fuzzy variables and by changing the base line and by taking transformation by rotating the coordinate axis \(\alpha\) cuts. If \(X_1\) and \(X_2\) are fuzzy variables then

\[A.B \quad Y = X_1 - X_2\]

will follow the fuzzy function

\[F(Y) = Y + 0.84015625 - 1.95, \quad 1.95 \leq Y \leq 1.98\]

with \(F(1.95) = 0.84015625, F(1.98) = 0.870156\)

At exactness, these points and \(F(.)\) is the particular value of the fuzzy function

In the same way if we redefine the fuzzy variables \(X_1\) and \(X_2\)

\[Y = X_1 + X_2\]

will follow the fuzzy function

\[F(Y) = Y^2/2 - 1984375Y + 0.01984375, \quad 1.98 \leq Y \leq 2\]

With \(F(1.98) = 0.911065625, F(2) = 0.98015625\)

If we now integrate over \(Y\) then if \(X_1\) and \(X_2\) are fuzzy variables then
\[ Y = X_1 + X_2 \]
will follow the fuzzy function
\[ F(Y) = Y \quad , \quad 1 \leq Y \leq 0.9375 \]
with \( F(1) = 1 \), \( F(0.9375) = 0.9375 \).
Similarly, \[ F(Y) = -\frac{Y^2}{2} + 2.40625Y - 0.8825 \]
, \( 0.9375 \leq Y \leq 0.875 \).
\[ F(0.9375) = 0.9330625, \]
\[ F(0.875) = 0.84015625. \]

We stop integrating as while integrating over \( X \) we have shifted the base line to 0.84015625 where the two values are same.

The diagrams of fuzzy Set and Partial fuzzy Set are shown below

4. **CONCLUSION:** From the diagrams of fuzzy Set it is clear that the convergence occurs at the Partial fuzzy Set in case of addition, Subtraction, Multiplication and division when it is linear and non-linear. Moreover we get exact value or accuracy occurs at the partial fuzzy Set which is again an interval. It is normal when its value is 1. Also cluster occurs in the partial fuzzy set.

References:


