Fuzzy Conditional Inference with Twofold Fuzzy Set on Fuzzy Intuitions: An Application to Data Analytics

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Abstract Fukami, Muzumoto and Tanak (FMK) are studied based on Godel and Standard sequence definitions. These conditional inference are based on certain conditions. In this paper, fuzzy conditional inference is studied for fuzzy intuitions which contain “and/or ”, “if $\cdots$ then $\cdots$ else $\cdots$ ” and truth variables. some more fuzzy intuitions are proposed. The proposed methods satisfy many fuzzy intuitions. Zadeh first defined fuzzy set as a single membership function. The two fold fuzzy sets with two membership functions will give more evidence than a single membership. The fuzzy intuitions are studied with two fold fuzzy sets. The fuzzy certainty factor (FCF) is studied to made as a single membership function. Business intelligence is given as an example for the fuzzy intuitions.

Keywords Fuzzy sets · Fuzzy logic · Fuzzy reasoning · Two fold fuzzy set · Fuzzy conditional inference · Fuzzy certainty factor · Fuzzy truth variables· Business intelligence

1. Introduction

There are many theories proposed to deal with incomplete information. The fuzzy logic[20] deals with “Belief”rather than “likelihood”(probability). Zadeh [15]. Mamdani [2] and Takagi-Sugeno-Kang (TSK [4] proposed fuzzy conditional inference. FMK [1] proposed fuzzy intuitions and shown that Zadeh fuzzy conditional inference is not suitable for these intuitions. FMK [6] adapting the Godel definition to prove

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smoe fuzzy intuitions. The methods used by FMK are having the certain restrictions. There is a need of method to prove some more fuzzy intuitions. Zadeh defined fuzzy set with a single membership function. The fuzzy set with a two membership functions will give more evidence than a single membership function. Here considered the two fold fuzzy set with “True”and The fuzzy intuition contained “and/or ”, “if $\cdots$ then $\cdots$ else $\cdots$ ” and truth variables are studied.
consider the given fuzzy inference

Type-1
If x is $\tilde{P}\tilde{Q}$ and x is $\tilde{Q}$ or x is $\tilde{R}$ then y is $\tilde{S}$ is τ
x is $\tilde{P}_1$ and x is $\tilde{Q}_1$ or x is $\tilde{R}_1$

---

y is ?

If apple is red and apple is ripe or apple is sweet then apple is good is true
apple is very red and apple is more or less ripe or apple is not sweet

---

apple is ?

Type-2
If x is $\tilde{P}$ then y is $\tilde{Q}$ else y is $\tilde{R}$ is τ
x is $\tilde{P}_1$

---

y is ?

If *Rama* is *Tall* then *Sita* is *Small* else *Sita* is *Middle* is true
Rama is very *Tall*

Sita is ?

2. Fuzzy Logic Based on Truth Functions

Zadeh defined fuzzy set with a single membership function [20]. The fuzzy set with two fuzzy member functions “True” and “False”will give more evidence than the single fuzzy membership function to deal with incomplete information. In the following “two fold fuzzy set” is defined with “True” and “False”fuzzy membership functions. The fuzzy logic and fuzzy reasoning of single membership function is extended to fuzzy logic with two membership functions “True” and “False”.

2.1. The Two Fold Fuzzy Sets

“A two fold fuzzy set” may be defined with two membership functions “True” and “False” for the proposition of type “x is A”. The fuzzy set with two membership functions “True”and “False” will give more evidence than the single membership function.

For instance “Rama has Headache ”.

In this fuzzy proposition, the fuzzy set "Headache" may be defined with "True" and "False".

Definition 2.1 *The "a two fold fuzzy set" $\tilde{A}$ in a universe of discourseX is defined by its membership function* $\mu_{\tilde{A}}(x) \to [0,1]$, *where* $\tilde{A} = \{\mu_A^{True}(x), \mu_A^{False}(x)\}$ *and* $x \in X\}$

$\mu_A^{True}(x)$ and $\mu_A^{False}(x)$ are the fuzzy membership functions of the "a two fold fuzzy set"$\tilde{A}$,

$\mu_A^{True}(x) = \int \mu_A^{True}/x(x) = \mu_A^{True}(x_1)/x_1 + \cdots + \mu_A^{True}(x_n)/x_n,$

$\mu_A^{False}(x) = \int \mu_A^{False}(x)/x = \mu_A^{False}(x)\mu_A^{False}(x_1)/x_1 + \cdots + \mu_A^{False}(x_n)/x_n$, where "+" is union,

For example, "young"may be given for the fuzzy proposition "x is young "

$$\text{young} = \{\mu_{young}^{True}(x), \mu_{young}^{False}(x)\},$$

$$\begin{aligned}\mu_{young}^{True}(x) = \{&0.9/10 + 0.8/15 + 0.69/20 + 0.59/25 + 0.5/30,\\ &+ 0.42/35 + 0.36/40 + 0.31/45 + 0.26/50\},\end{aligned}$$

$$\begin{aligned}\mu_{young}^{False}(x) = \{&0.36/10 + 0.31/15 + 0.26/20 + 0.23/25 + 0.2/30 + 0.18/35\\ &+ 0.16/40 + 0.14/45 + 0.12/50\}.\end{aligned}$$

For instance. "Rama is young" with fuzziness $\{0.8, 02\}$, where 0.8 is "True" and 0.2 is "False".

The Graphical representation of "True" and "False" of "young" is shown in Fig.1.

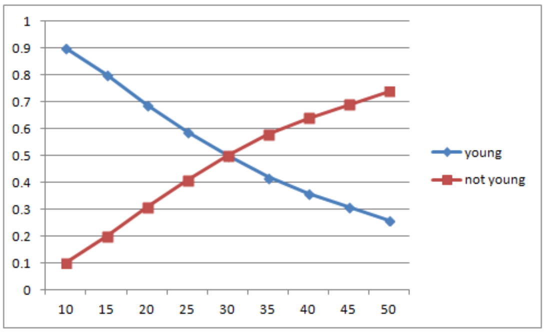

Fig.1 Two fold fuzzy set membership functions

2.2. The Fuzzy Logic with Truth Functions

The fuzzy logic is combination of fuzzy sets using logical operators. The fuzzy logic with "two fold fuzzy sets" is combination of "two fold fuzzy sets" using logical operators. The fuzzy logic bases on "two fold fuzzy sets" can be studied similar lines of Zadeh's fuzzy logic.

Some of the logical operations are given below for fuzzy sets with two fold fuzzy membership functions.

$\tilde{A}$, $\tilde{B}$ and $\tilde{C}$ are fuzzy sets with two fold fuzzy membership functions.

Let tall, weight and more or less weight are two fold fuzzy sets.

$\tilde{\text{tall}} = \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.4/x_4 + 0.2/x_5,$
$0.5/x_1 + 0.4/x_2 + 0.3/x_3 + 0.2/x_4 + 0.1/x_5\}$

$\tilde{\text{weight}} = \{0.8/x_1 + 0.7/x_2 + 0.5/x_3 + 0.3/x_4 + 0.2/x_5,$
$0.2/x_1 + 0.2/x_2 + 0.1/x_3 + 0.1/x_4 + 1/x_5\}$

more or less $\tilde{\text{weight}}= \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.5/x_4 + 0.4/x_5,$
$0.4/x_1 + 0.4/x_2 + .3/x_3 + .3/x_4 + 0.3/x_5\}.$

Negation

x is not $\tilde{A}$

$\tilde{A}'(x) = \{1 - \mu_A^{True}(x), 1 - \mu_A^{False}(x)\}/x$

x is not $\tilde{\text{tall}}$

$\tilde{\text{tall}} = \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.4/x_4 + 0.2/x_5,$
$0.5/x_1 + 0.4/x_2 + 0.3/x_3 + 0.2/x_4 + 0.1/x_5\}$

$1 - \tilde{\text{tall}} = \{0.1/x_1 + 0.2/x_2 + 0.3/x_3 + 0.6/x_4 + 0.8/x_5,$
$0.5/x_1 + 0.6/x_2 + 0.7/x_3 + 0.8/x_4 + 0.9/x_5\}.$

Disjunction

x is $\tilde{A}$ or y is $\tilde{B}$

$\tilde{A} \vee \tilde{B} = \{\max(\mu_A^{True}(x), \mu_B^{True}(y)), \max(\mu_A^{False}(x), \mu_B^{False}(y))\}/(x, y),$

$\tilde{\text{tall}} \vee \tilde{\text{weight}}= \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.6/x_4 + 0.5/x_5,$
$0.4/x_1 + 0.3/x_2 + 0.2/x_3 + .1/x_4 + .1/x_5\}.$

Conjunction

x is $\tilde{A}$ and y is $\tilde{B}$

$\tilde{A} \wedge \tilde{B} = \{\min(\mu_A^{True}(x), \mu_B^{True}(y)), \min(\mu_A^{False}(x), \mu_B^{False}(y))\}/(x, y),$

$\tilde{\text{tall}} \wedge \tilde{\text{weight}} = \{0.8/x_1 + 0.7/x_2 + 0.5/x_3 + 0.2/x_4 + 0.2/x_5,$
$0.1/x_1 + 0.1/x_2 + 0.1/x_3 + 0.1/x_4 + 0.1/x_5\}.$

Implication

Zadeh [18] fuzzy conditional inference is given as

if x is $\tilde{A}$ then y is $\tilde{B} = \tilde{A} \to \tilde{B} = \min\{1, 1 - \tilde{A} + \tilde{B}\},$ (2.1)

$=\{\min(1, 1 - \mu_A^{True}(x) + \mu_B^{True}(y)), \min(1, 1 - \mu_A^{False}(x) + \mu_B^{False}(y))\}/(x, y),$

$\tilde{\text{tall}} \to \tilde{\text{weight}}=\{0.9/x_1 + 0.9/x_2 + 0.8/x_3 + 0.9/x_4 + 1/x_5,$
$0.7/x_1 + 0.8/x_2 + 0.9/x_3 + 0.9/x_4 + 1/x_5\}.$

Mamdani [5] fuzzy conditional inference is given as

if x is $\tilde{A}$ then y is $\tilde{B} = \tilde{A} \to \tilde{B} = \tilde{A} \times \tilde{B}$ (2.2)

if x_1 is $\tilde{A}_1$ and x_2 is $\tilde{A}_2$ and $\cdots$ and x_n is $\tilde{A}_n$ then y is $\tilde{B}$ =min$\{\tilde{A}_1, \tilde{A}_2, .. , \tilde{A}_n, \tilde{B}\}$

$\tilde{\text{tall}} \times \tilde{\text{weight}} = \{0.8/x_1 + 0.7/x_2 + 0.5/x_3 + 0.2/x_4 + 0.2/x_5,$
$0.1/x_1 + 0.1/x_2 + 0.1/x_3 + 0.1/x_4 + 0.1/x_5\}.$

TSK [5] fuzzy conditional inference is given as

if x is $\tilde{A}$ then y=t(x) is $\tilde{B}$

if x_1 is $\tilde{A}_1$ and x_2 is $\tilde{A}_2$ and $\cdots$ and x_n is $\tilde{A}_n$ then y is $\tilde{B} = t(\tilde{A}_1, \tilde{A}_2, \cdots, \tilde{A}_n) = \min\{\tilde{A}_1,$

$\tilde{A}_2, .. , \tilde{A}_n, \tilde{B}\}$
Using t-norm, the fuzzy inference is given as
if x is $\tilde{A}$ then y is $\tilde{B} = t(A) = A$
i.e., $\int \mu_B(y) = \int \mu_A(x)$ quad (2.3)
if x_1 is $\tilde{A}_1$ and x_2 is $\tilde{A}_2$ and $\cdots$ and x_n is $\tilde{A}_n$ then y is $\tilde{B} = \tilde{A}_1$and$\tilde{A}_2, \cdots, \tilde{A}_n = \min\{\tilde{A}_1,$
$\tilde{A}_2, .. , \tilde{A}_n, \tilde{A}_1, \tilde{A}_2, .. , \tilde{A}_n\}$
$=\min\{\tilde{A}_1, \tilde{A}_2, .. , \tilde{A}_n\}$
$\tilde{B} = \tilde{A}_1$and$\tilde{A}_2, \cdots, \tilde{A}_n$

The fuzzy conditional inference is given as,
if x_1 is $\tilde{A}_1$ and x_2 is $\tilde{A}_2$ and $\cdots$ and x_n is $\tilde{A}_n$ then y is $\tilde{B}$
$=\{\min(\tilde{A}_1, \tilde{A}_2, .. , \tilde{A}_n)\}$
if x is $\tilde{A}$ then y is $\tilde{B}$=$\{$A$\}$ (2.4)

$$\widetilde{\text{tall}} \rightarrow \widetilde{\text{weight}} = \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.4/x_4 + 0.2/x_5,$$
$$0.5/x_1 + 0.4/x_2 + 0.3/x_3 + 0.2/x_4 + 0.1/x_5\}$$

Zadeh [18] fuzzy conditional inference is given as
if x is $\tilde{A}$ then y is $\tilde{B}$ else y is $\tilde{C} = (\tilde{A} \times \tilde{B} + \tilde{A}' \times \tilde{C},)$ where "+ " is union

Reddy [13] fuzzy conditional inference is given for "if x is $\tilde{A}$ then y is $\tilde{B}$ else y is $\tilde{C}$ " as,

if x is $\tilde{A}$ then y is $\tilde{B} = \tilde{A} \rightarrow \tilde{B}$
if x is not $\tilde{A}$ then y is $\tilde{C} = \tilde{A}' \rightarrow \tilde{C}$

Composition

if x is $\tilde{A}$ then y is $\tilde{B}$
x is $\tilde{A}_1$
——————-
y is $\tilde{A}_1$ o $(\tilde{A} \rightarrow \tilde{B})$

$$\tilde{A} \text{ o } (\tilde{A} \rightarrow \tilde{B}) = \{\min\{\mu_A^{True}(x), \min(1, 1 - \mu_A^{True}(x) + \mu_B^{True}(y))\},$$
$$\min\{\mu_A^{Diselief}(x), \min(1, 1 - \mu_A^{False}(x) + \mu_B^{False}(y)\}\}/y$$

if $x = y$
$$= \{\min\{\mu_A^{True}(x), \min(1, 1 - \mu_A^{True}(x) + \mu_B^{True}(x))\},$$
$$\min\{\mu_A^{Diselief}(x), \min(1, 1 - \mu_A^{False}(x) + \mu_B^{False}(x))\}$$

if x is $\widetilde{\text{tall}}$ then x is $\widetilde{\text{weight}}$
x is very $\widetilde{\text{tall}}$
—————————-
x is very $\widetilde{\text{tall}}$ o $(\widetilde{tall} \rightarrow \widetilde{\text{weight}})$

Fuzzy quantifiers

The fuzzy propositions may contain quantifiers like "very" , "more or less" etc. These fuzzy quantifiers may be eliminated as

Concentration

x is very $\tilde{A}$
$\mu_{very\ \tilde{A}}(x)=\{\mu_{very\,A}^{True}(x)^2, \mu_{very\,A}^{False}(x)^2\}$

x is very $\tilde{tall}$

$\mu_{very\ \ \tilde{tall}}(x) = \{0.81/x_1 + 0.64/x_2 + 0.49/x_3 + 0.16/x_4 + 0.04/x_5,$
$0.25/x_1 + 0.16/x_2 + 0.09/x_3 + 0.04/x_4 + 0.01/x_5\}$

Diffusion

if x is more or less $\tilde{A}$

$\mu_{more\ or\ less\ \ \tilde{A}}(x)=\{\mu^{True}_{more\ or\ less\ A}(x)^2, \mu^{False}_{more\ or\ less\ A}(x)^{0.5}\}$

if x is more or less $\tilde{tall}$

$\mu_{more\ or\ less\ \ \tilde{tall}}(x) = \{0.95/x_1 + 0.89/x_2 + 0.84/x_3 + 0.63/x_4 + 0.45/x_5,$
$0.70/x_1 + 0.63/x_2 + .054/x_3 + 0.44/x_4 + 0.31/x_5\}.$

3. Fuzzy Inference for Fuzzy Intuitions

Consider the logical inferences

Modus Ponesr

$p \to q$
P
——
q

Modus Tollens

$p \to q$
q’
——
P’

Generalization

$p \vee q = p$
$P \vee q = q$
$p' \vee p$ = Contradictory

Specialization

$p \wedge q = p$
$p \wedge q = q$
$p' \wedge p$ = Contradictory

The inference is given using generalization and specialization

$p \wedge q \vee r = p \vee r = p$
$p \wedge q \vee r = q \vee r = q$
$p \wedge q \vee r = p \vee r = r$

Consider fuzzy inference Type-1

If x is $\tilde{P}$ and x is $\tilde{Q}$ or x is $\tilde{R}$ then y is $\tilde{S}$
x is $\tilde{P}_1$ and x is $\tilde{Q}_1$ or x is $\tilde{R}_1$

---

y is ?

The fuzzy inference is given for Type-1 using generalization and specialization

If x is $\tilde{P}$ then y is $\tilde{S}$
x is $\tilde{P}_1$

---

y is ?

If x is $\tilde{Q}$ then y is $\tilde{S}$
x is $\tilde{Q}_1$

---

y is ?

If x is $\tilde{R}$ then y is $\tilde{S}$
x is $\tilde{R}_1$

---

y is ?

Confider fuzzy inference Type-2

If x is $\tilde{P}$ then y is $\tilde{Q}$ else y is $\tilde{R}$
x is $\tilde{P}_1$

---

y is ?

The fuzzy inference is given for Type-2 using generalization and specialization

indent (if x is $\tilde{P}$ then x is $\tilde{Q}$)
x is $\tilde{P}_1$

---

y is ?

(if x is P' then x is $\tilde{R}$)
x is $\tilde{P}_1$

---

y is ?

From fuzzy conditional inference Type-1 and Type-2, the two criterions may be given as

Criteria-1

If x is $\tilde{P}$ then y is $\tilde{S}$
x is $\tilde{P}_1$

---

y is ?

Criteria-2
(if x is P' then x is $\tilde{R}$)
x is $\tilde{P}_1$

---

y is ?

The fuzzy inference is drawing a conclusion from fuzzy propositions.
The fuzzy intuitions for Criteria-1 Based on FMK are given as.

I-1
if x is $\tilde{P}$ then y is $\tilde{S}$
x is $\tilde{P}$

---

y is $\tilde{S}$

I-2
if x is $\tilde{P}$ then y is $\tilde{S}$
x is $\tilde{S}$

---

y is $\tilde{P}$

II-1
if x is $\tilde{P}$ then y is $\tilde{S}$
x is very $\tilde{P}$

---

y is very $\tilde{S}$

II-2
if x is $\tilde{P}$ then y is $\tilde{S}$
x is very $\tilde{S}$

---

y is $\tilde{P}$

III-1
if x is $\tilde{P}$ then y is $\tilde{S}$
x is more or less $\tilde{P}$

---

y is $\tilde{S}$

III-2
if x is $\tilde{P}$ then y is $\tilde{S}$
x is more or less $\tilde{S}$

---

y is $\tilde{P}$

IV-1
if x is $\tilde{P}$ then y is $\tilde{S}$
x is not $\tilde{P}$

---

y is not $\tilde{S}$

IV-2
if x is $\tilde{P}$ then y is $\tilde{S}$
x is not $\tilde{S}$

---

y is not $\tilde{P}$

The fuzzy inference is given for Criteria-1 according to fuzzy intuitions.

Table 1 : Fuzzy inference for Criteria-1.

Intution	Proposition	Inference
I-1	x is $\tilde{P}$	y is $\tilde{S}$
I-2	y is $\tilde{S}$	x is $\tilde{P}$
II-1	x is very $\tilde{P}$	y is very $\tilde{S}$
II-2	y is very $\tilde{S}$	x is $\tilde{P}$
III-1	x is more or less $\tilde{P}$	y is $\tilde{S}$
III-2	y is mor or less $\tilde{S}$	is $\tilde{P}$
IV-1	x is not $\tilde{P}$	y is not $\tilde{S}$
IV-2	y is $\tilde{S}$	x is not $\tilde{P}$

4. Verification of fuzzy intuition using Fuzzy Conditional Inference

Verification of fuzzy intuitions for Criteria-1

4.1.1 In the case of intuition I-1

$\tilde{P}$ o $(\tilde{P} \rightarrow \tilde{S})$
$= \tilde{P}$ o $(\tilde{P} \times \tilde{S})$
$= \int \mu_{\tilde{P}}(x)$ o $(\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y))$
Using (2.4)

$= \int \mu_{\tilde{P}}(x) \text{ o } (\int \mu_{\tilde{P}}(x))$
$= \int \mu_{\tilde{S}}(y) \wedge (\int \mu_{\tilde{S}}(y))$
$= \int \mu_{\tilde{S}}(x)$
$= y \text{ is } \tilde{\tilde{S}}$
intuition I-1 satisfied.

4.1.2 In the case of intuition I-2

$(\tilde{P} \to \tilde{S}) \text{ o } \tilde{S}$
$= (\tilde{P} \times \tilde{S}) \text{ o } \tilde{S}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y)) \text{ o } \int \mu_{\tilde{S}}(y)$
Using (2.4)
$= \int \mu_{\tilde{P}}(x)) \text{ o } \int \mu_{\tilde{S}}(y)$
Using (2.3)
$= \int \mu_{\tilde{P}}(x)) \wedge \int \mu_{\tilde{P}}(x)$
$= \int \mu_{\tilde{P}}(x)$
$= x \text{ is } \tilde{\tilde{P}}$
intuition I-2 satisfied.

4.1.3 In the case of intuition II-1

very $\tilde{P}$ o $(\tilde{P} \to \tilde{S})$
=very $\tilde{P}$ o $(\tilde{P} \times \tilde{S})$
$= \int \mu_{very\tilde{P}}(x) \text{ o } (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y))$
Using (2.4)
$= \int \mu_{very\tilde{P}}(x) \text{ o } (\int \mu_{\tilde{P}}(x))$
Using (4.1)
$= \int \mu_{\tilde{S}}(x)^2 \wedge (\int \mu_{\tilde{S}}(y))$
$\int \mu_{\tilde{S}}(y)^2$
$= \int \mu_{very\tilde{S}(}x)$
$= y$ is very$\tilde{\tilde{S}}$
Where
$\int \mu_{\tilde{S}}(y)^2 \subseteq \int \mu_{\tilde{S}}(y).$
$\int \mu_{\tilde{S}}(y)^2 \leq \int \mu_{\tilde{S}}(y).$
intuition II-1 satisfied.

4.1.4 In the case of intuition II-2

$(\tilde{P} \to \tilde{S})$ o very $\tilde{S}$
$= (\tilde{P} \times \tilde{S})$ o very $\tilde{S}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y)) \text{ o } \int \mu_{veryQ}(y)$
Using (2.4)
$= (\int \mu_{\tilde{P}}(x)) \text{ o } \int \mu_{very\tilde{S}}(y)$
Unking (2.3)
$= (\int \mu_{\tilde{P}}(x)) \wedge \int \mu_{very\tilde{P}}(x)^2$
$\int \mu_{\tilde{P}}(x)^2$
$= \int \mu_{very\tilde{P}(}x)$
$= x$ is very $\tilde{\tilde{P}}$

Where

$\int \mu_{\tilde{P}}(x)^2 \subseteq \int \mu_{\tilde{P}}(x).$
$\int \mu_{\tilde{P}}(x)^2 \leq \int \mu_{\tilde{P}}(x).$
intuition II-2 satisfied.

4.1.5 In the case of intuition III-1

more or less $\tilde{P}$ o $(\tilde{P} \rightarrow \tilde{S})$
$=$ more or less $\tilde{P}$ o $(\tilde{P} \times \tilde{S})$
$= \int \mu_{moreorless\tilde{P}}(x)$ o $(\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y))$
Using (2.4)
$= \int \mu_{moreorless\tilde{P}}(x)$ o $(\int \mu_{\tilde{S}}(y))$
Using (2.3)
$= \int \mu_{moreorless\tilde{S}}(x) \wedge (\int \mu_{\tilde{S}}(y))$
$\int \mu_{\tilde{S}}(y)^{0.5}$
$= \int \mu_{moreless\tilde{S}(y)}$
$=y$ is more or less $\tilde{\tilde{S}}$

Where

$\int \mu_{\tilde{S}}(y)^{0.5} \supseteq \int \mu_{\tilde{S}}(y).$
$\int \mu_{\tilde{S}}(y)^{0.5} \geq \int \mu_{\tilde{S}}(y).$
intuition III-1 satisfied.

4.1.6 In the case of intuition III-2

$(\tilde{P} \rightarrow \tilde{S})$ o more or less $\tilde{S}$
$= (\tilde{P} \times \tilde{S})$ o very $\tilde{S}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y))$ o $\int \mu_{moreorless\tilde{S}}(x)$
Using (2.4)
$= (\int \mu_{\tilde{P}}(x))$ o $\int \mu_{moreorless\tilde{S}}(y)$
Unking (2.3)
$= (\int \mu_{\tilde{P}}(x)) \wedge \int \mu_{moreorless\tilde{P}}(x)$
$\int \mu_{\tilde{P}}(x)^{0.5}$
$= \int \mu_{moreorless(\tilde{P}}x)$
$=x$ is more or less $\tilde{\tilde{P}}$

Where

$\int \mu_{\tilde{P}}(x)^{0.5} \supseteq \int \mu_{\tilde{P}}(x).$
$\int \mu_{\tilde{P}}(x)^{0.5} \geq \int \mu_{\tilde{P}}(x).$
intuition III-2 satisfied.

4.1.7 In the case of intuition IV-1

not $\tilde{P}$ o $(\tilde{P} \rightarrow \tilde{\tilde{S}})$
$=\tilde{P}'$ o $(\tilde{P} \times \tilde{\tilde{S}})$
$= \int \mu_{\tilde{P}'}(x)$ o $(\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y))$
$= \int \mu_{\tilde{P}'}(x)$ o $(\int \mu_{\tilde{P}}(x))$
Using (2.4)
$= \int \mu_{\tilde{P}'}(x) \wedge (\int \mu_{\tilde{P}}(x))$

= contradictory
intuition IV-1 not satisfied.

4.1.8 In the case of intuition IV-2

$(\tilde{P} \rightarrow \tilde{S})$ o $\tilde{S}'$
$= (\tilde{P} \times \tilde{S})$ o $\tilde{S}'$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{S}}(y))$ o $\int \mu_{\tilde{S}'}(x)$

Using (2.4)

$= (\int \mu_{\tilde{P}}(x))$ o $\int \mu_{\tilde{S}'}(y)$

Using (2.3)

$= (\int \mu_{\tilde{P}}(x))$ o $\int \mu_{\tilde{P}'}(x)$
= Contradictory
intuition IV-2 not satisfied.

Criteria-1 is suitable for I-1,I-2, II-1, II-2, III-1 and III-2.

The fuzzy intuitions are give based on FMK for Criteria-2 .

I'-1
if x is $\tilde{P}$' then y is $\tilde{R}$
x is $\tilde{P}$

---

y is $\tilde{R}$

I'-2
if x is P' then y is $\tilde{R}$
x is $\tilde{R}$

---

y is $\tilde{P}$

II'-1
if x is P' then y is $\tilde{R}$
x is very $\tilde{P}$

---

y is very $\tilde{R}$

II'-2
if x is P' then y is $\tilde{R}$
x is very $\tilde{R}$

---

y is $\tilde{P}$

III'-1
if x is P' then y is $\tilde{R}$
x is more or less $\tilde{P}$

y is $\tilde{R}$

III'-2
if x is P' then y is $\tilde{R}$
x is more or less $\tilde{R}$

---

y is $\tilde{S}$

IV'-1
if x is P' then y is $\tilde{R}$
x is not $\tilde{P}$

---

y is not $\tilde{R}$

IV'-2
if x is P' then y is $\tilde{R}$
x is not *R]S*

---

y is not $\tilde{P}$

The inference is given for Criteria-1 according to intuitions.

Table 2 : Fuzzy inference for Criteria-2.

Intution	Proposition	Inference
I'-1	x is $\tilde{P}$	y is $\tilde{R}$
I'-2	y is $\tilde{R}$	x is $\tilde{P}$
II'-1	x is very $\tilde{P}$	y is very $\tilde{R}$
II'-2	y is very $\tilde{R}$	x is $\tilde{P}$
III'-1	x is more or less $\tilde{P}$	y is $\tilde{R}$
III'-2	y is mor or less $\tilde{R}$	is $\tilde{P}$
IV'-1	x is not $\tilde{P}$	y is not $\tilde{R}$
IV'-2	y is $\tilde{R}$	x is not $\tilde{P}$

Verification of fuzzy intuitions for Criteria-2

4.2.1 In the case of intuition I'-1

$\tilde{P}$ o $(\tilde{P'} \rightarrow \tilde{R})$
$=\tilde{P}$ o $(\tilde{P'} \times \tilde{R})$
$= \int \mu_{\tilde{P}}(x)$ o $(\int \mu_{\tilde{P'}}(x) \wedge \int \mu_{\tilde{R}}(y))$
Using (2.4)

$= \int \mu_{\tilde{P}}(x) \text{ o } (\int \mu_{\tilde{P}'}(x))$
indent $= \int \mu_{\tilde{P}}(x) \wedge (\int \mu_{\tilde{P}'}(x))$
= Contradictory
intuition I'-1 not satisfied.

4.2.2 In the case of intuition I'-2

$(\tilde{P}' \rightarrow \tilde{R})\text{o } \tilde{R}$
$= (\tilde{P}' \times \tilde{R}) \text{ o } \tilde{R}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{R}}(y)) \text{ o } \int \mu_{\tilde{R}}(y)$
Using (2.4)
$= (\int \mu_{\tilde{P}'}(x)) \text{ o } \int \mu_{\tilde{R}}(y)$
$= (\int \mu_{\tilde{P}'}(x)) \wedge \int \mu_{\tilde{R}}(y)$
Using (2.3)
$= \min\{\int \mu_{\tilde{R}'}(x), \int \mu_{\tilde{R}}(y)\}$
= Contradictory
intuition I'-2 not satisfied.

4.2.3 In the case of intuition II'-1

very $\tilde{P}$ o $(\tilde{P}' \rightarrow \tilde{R})$
= very $\tilde{P}$ o $(\tilde{P}' \times \tilde{R})$
$= \int \mu_{\tilde{P}}(x)^2 \text{ o } (\int \mu'_{\tilde{P}}(x) \wedge \int \mu_{\tilde{R}}(y))$
Using (2.4)
$= \int \mu_{\tilde{P}}(x)^2 \text{ o } (\int \mu_{\tilde{P}'}(x))$
indent $= \int \mu_{\tilde{P}}(x)^2 \wedge (\int \mu_{\tilde{P}'}(x))$
= Contradictory
intuition II'-1 not satisfied.

4.2.4 In the case of intuition II'-2 $(\tilde{P}' \rightarrow \tilde{R})$o very $\tilde{R}$

$= (\tilde{P}' \times \tilde{R})$ o very $\tilde{R}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{R}}(y)) \text{ o } \int \mu_{\tilde{R}}(y)^2$
Using (2.4)
$= (\int \mu_{\tilde{P}'}(x)) \text{ o } \int \mu_{\tilde{R}}(y)^2$
$= (\int \mu_{\tilde{P}'}(x)) \wedge \int \mu_{\tilde{R}}(y)^2$
Using (2.3)
$= \min\{\int \mu'_{\tilde{R}}(x), \int \mu_{\tilde{R}}(y)^2\}$
= Contradictory
intuition II'-2 not satisfied.

4.2.5 In the case of intuition III'-1

more or less $\tilde{P}$ o $(\tilde{P}' \rightarrow \tilde{R})$
= more or less $\tilde{P}$ o $(\tilde{P}' \times \tilde{R})$
$= \int \mu_{\tilde{P}}(x)^{0.5} \text{ o } (\int \mu_{\tilde{P}'}(x) \wedge \int \mu_{\tilde{R}}(y))$
Using (2.4)
$= \int \mu_{\tilde{P}}(x)^{0.5} \text{ o } (\int \mu_{\tilde{P}'}(x))$
indent $= \int \mu_{\tilde{P}}(x)^{0.5} \wedge (\int \mu_{\tilde{P}'}(x))$

= Contradictory
intuition III'-1 not satisfied.

4.2.6 In the case of intuition III'-2

$(\tilde{P}' \to \tilde{R})$ o more or less $\tilde{R}$
$= (\tilde{P}' \times \tilde{R})$ o more or less $\tilde{R}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{R}}(y))$ o $\int \mu_{\tilde{R}}(y)^{0.5}$
Using (2.4)
$= (\int \mu_{\tilde{P}'}(x))$ o $\int \mu_{\tilde{R}}(y)^{0.5}$
$= (\int \mu_{\tilde{P}'}(x)) \wedge \int \mu_{\tilde{R}}(y)^{0.5}$
Using (2.3)
$= \min\{\int \mu_{\tilde{R}'}(y), \int \mu_{\tilde{R}}(y)\}$
= Contradictory
intuition II'-2 not satisfied.

4.2.7 In the case of intuition IV'-1

not $\tilde{P}$ o $(\tilde{P}' \to \tilde{R})$
$=\tilde{P}'$ o $(\tilde{P}' \times \tilde{R})$
$= \int \mu_{\tilde{P}'}(x)$ o $(\int \mu'_{\tilde{P}}(x) \wedge \int \mu_{\tilde{R}}(y))$
Using (2.4)
$= \int \mu_{\tilde{P}}(x)$ o $(\int \mu'_{\tilde{P}}(x))$
using (2.3)
$= \int \mu_{\tilde{R}'}(x) \wedge (\int \mu'_{\tilde{R}}(x))$
$= \int \mu_{\tilde{R}'}(y)$
$=y$ is *not* $\tilde{\tilde{R}}$
intuition IV'-1 satisfied.

4.2.8 In the case of intuition IV'-2

$(\tilde{P}' \to \tilde{R})$ o not $\tilde{R}$
$= (\tilde{P}' \times \tilde{R})$ o not $\tilde{R}$
$= (\int \mu_{\tilde{P}}(x) \wedge \int \mu_{\tilde{R}}(y))$ o $\int \mu'_{\tilde{R}}(y)$
Using (2.4)
$= (\int \mu_{\tilde{P}'}(x))$ o $\int \mu'_{\tilde{R}}(y)$
$= (\int \mu_{\tilde{P}'}(x)) \wedge \int \mu'_{\tilde{R}}(y)$
Using (2.3)
$= \min\{\int \mu_{\tilde{P}'}(x), \int \mu'_{\tilde{P}}(y)\}$
$=y$ is *not* $\tilde{P}$
intuition IV'-2 satisfied.

Criteria-2 is suitable for IV-1 and IV-2.

5. Fuzzy Truth Variables

Zadeh [16] defined quantification of truth variables as composition of fuzzy set and truth variables.

Definition 5.1 *The quantification of fuzzy truth variables for fuzzy set of fuzzy proposition of the type "x is A is τ" is defined as $\mu_A^{-1}(x)$ o τ,where $\mu_A(x)^{-1}$ is inverse of comparability function of A , "o" is composition and τ is fuzzy truth variable like true, false, very true etc.*

Definition 5.2 *The composition of fuzzy truth variables for "a two fold fuzzy set"of fuzzy proposition of the type "x is $\tilde{A}$ is τ" may be defined as*
$\tilde{A}(x)^\tau = \mu_{\tilde{A}}(x)^\tau = \{\mu_A^{True}(x), \mu_A^{False}(x)\}$ *o* τ
where quantification of truth variable applied on respective truth functions. i.e.,

$\tilde{A}(x)^{\tau_1} = \{\mu_A(x)^{\tau_1}, \mu_A^{False}(x)\}$, where τ_1= not true, very true, more or less true e.tc.
For instance,τ_1= very true
$\tilde{A}(x)^{\tau_1} = \{\mu_A(x)^2, \mu_A^{False}(x)\}$

$\tilde{A}(x)^{\tau_2} = \{\mu_A(x)^{True}, \mu_A^{\mu_2}(x)\}$, where τ_2= not false, very false, more or less false e.tc.
For instance,τ_2= more or less false
$\tilde{A}(x)^{\tau_1} = \{\mu_A(x)^{True}, \mu_A^{0.2}(x)\}$

The truth functional modification of fuzzy proposition "x is $\tilde{A}$ is very true" is given $\{\mu_A^{True}(x), \mu_A^{False}(x)\}$ o very true=$\{\mu_{very\,A}^{True}(x), \mu_A^{False}(x)\}$
The truth functional modification of fuzzy proposition "x is $\tilde{A}$ is very false"is given $\{\mu_A^{True}(x), \mu_A^{False}(x)\}$ o very false =$\{\mu_A^{True}(x), \mu_{very\,A}^{False}(x)\}$,
The truth functional modification of fuzzy proposition "x is tall is very true" is given as

$$\tilde{\text{tall}} = \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.4/x_4 + 0.2/x_5, \\ 0.5/x_1 + 0.4/x_2 + 0.3/x_3 + 0.2/x_4 + 0.1/x_5\},$$
$$\tilde{\text{very tall}} = \{0.81/x_1 + 0.64/x_2 + 0.49/x_3 + 0.16/x_4 + 0.04/x_5, \\ 0.5/x_1 + 0.4/x_2 + 0.3/x_3 + 0.2/x_4 + 0.1/x_5\}.$$

The truth functional modification of fuzzy proposition "x is tall is very false" is given as

$$\tilde{\text{tall}} = \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.4/x_4 + 0.2/x_5, \\ 0.5/x_1 + 0.4/x_2 + 0.3/x_3 + 0.2/x_4 + 0.1/x_5\},$$
$$\tilde{\text{very tall}} = \{0.9/x_1 + 0.8/x_2 + 0.7/x_3 + 0.4/x_4 + 0.2/x_5, \\ 0.25/x_1 + 0.16/x_2 + 0.09/x_3 + 0.04/x_4 + 0.01/x_5\}.$$

The nested fuzzy propositions of the form
x is $\tilde{A}$ is (τ_1 is (τ_2... is τ_n)) = x is $\tilde{A}$ o τ_1) o τ_2 o $\cdots$ o τ_n.

Consider quantification of truth variables for fuzzy inference Type-1

If x is $\tilde{P}$ and x is $\tilde{Q}$ or x is $\tilde{R}$ then y is $\tilde{S}$ is τ
x is $\tilde{P}_1$ and x is $\tilde{Q}_1$ or x is $\tilde{R}_1$

---

y is ?

The fuzzy inference is given for Type-1 using generalization and specialization

is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is $\tilde{P}_1$

---

y is ?

If x is $\tilde{Q}$ then y is $\tilde{S}$ is τ
x is $\tilde{Q}_1$

---

y is ?

If x is $\tilde{R}$ then y is $\tilde{S}$ is τ
x is $\tilde{R}_1$

---

y is ?

Confider fuzzy inference Type-2

If x is $\tilde{P}$ then y is $\tilde{Q}$ else y is $\tilde{R}$ is τ
x is $\tilde{P}_1$

---

y is ?

The fuzzy inference is given for Type-2 using generalization and specialization

indent (if x is $\tilde{P}$ then x is $\tilde{Q}$) is τ
x is $\tilde{P}_1$

---

y is ?

(if x is P' then x is $\tilde{R}$) is τ
x is $\tilde{P}_1$

---

y is ?

From fuzzy conditional inference Type-1 and Type-2, two criteria may be given as

Criteria-1
If x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is $\tilde{P}_1$

---

y is ?

Criteria-2
(if x is P' then x is $\tilde{R}$) is τ

x is $\tilde{P}_1$

---

y is ?

The fuzzy inference is drawing a conclusion from fuzzy propositions.
The fuzzy intuitions are defined based on FMK for Criteria-1.

$I_\tau - 1$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is $\tilde{P}$

---

y is $\tilde{S}^\tau$

$I_\tau - 2$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is $\tilde{S}$

---

y is $\tilde{P}^\tau$

$II_\tau - 1$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is very $\tilde{P}$

---

y is very $\tilde{S}^\tau$

$II_\tau - 2$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is very $\tilde{S}$

---

y is $\tilde{P}^\tau$

$III_\tau - 1$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is more or less $\tilde{P}$

---

y is $\tilde{S}^\tau$

$I_\tau - 2$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is more or less $\tilde{S}$

---

y is $\tilde{P}^\tau$

$IV_\tau - 1$

if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is not $\tilde{P}$

---

y is not $\tilde{S}^{\tau}$

$IV_{\tau} - 2$
if x is $\tilde{P}$ then y is $\tilde{S}$ is τ
x is not $\tilde{S}$

---

y is not $\tilde{P}^{\tau}$

The inference is given for Criteria-1 according to intuitions.

Table 1 : Fuzzy inference for Criteria-1.

Intution	Proposition	Inference
$I_{\tau} - 1$	x is $\tilde{P}$ o τ	y is $\tilde{S}^{\tau}$
$I_{\tau} - 2$	y is $\tilde{S}$ o τ	x is $\tilde{P}^{\tau}$
$II_{\tau} - 1$	x is very $\tilde{P}$ o τ	y is very $\tilde{S}^{\tau}$
$II_{\tau} - 2$	y is very $\tilde{S}$ o τ	x is $\tilde{P}^{\tau}$
$III_{\tau} - 1$	x is more or less $\tilde{P}$ o τ	y is $\tilde{S}^{\tau}$
$III_{\tau} - 2$	y is mor or less $\tilde{S}$ o τ	is $\tilde{P}^{\tau}$
$IV_{\tau} - 1$	x is not $\tilde{P}$ o τ	y is not $\tilde{S}^{\tau}$
$IV_{\tau} - 2$	y is $\tilde{S}$ o τ	x is not $\tilde{P}^{\tau}$

Where $\tau = \tau_1$ or τ_2
Fuzzy Conditional Inference is straight forward based on verification of fuzzy intuitions for Criteria-1

Criteria-1 is suitable for $I_{\tau} - 1$,$I_{\tau} - 2$, $II_{\tau} - 11$, $II_{\tau} - 2$, I$III_{\tau} - 1$ and $III_{\tau} - 2$.

The fuzzy intuitions are defined based on FMK for Criteria-2 .

$I'_{\tau} - 1$
if x is $\tilde{P}$' then y is $\tilde{R}$ is τ
x is $\tilde{P}$

---

y is $\tilde{R}^{\tau}$

$I'_{\tau} - 2$
if x is P' then y is $\tilde{R}$ is τ
x is $\tilde{R}$

y is $\tilde{P}^{\tau}$

$II'_{\tau} - 1$

if x is P' then y is $\tilde{R}$ is τ
x is very $\tilde{P}$

y is very $\tilde{R}^{\tau}$

$II'_{\tau} - 2$

if x is P' then y is $\tilde{R}$ is τ
x is very $\tilde{R}$

y is $\tilde{P}^{\tau}$

$III'_{\tau} - 1$

if x is P' then y is $\tilde{R}$ is τ
x is more or less $\tilde{P}$

y is $\tilde{R}^{\tau}$

$III;_{\tau}$ −2

if x is P' then y is $\tilde{R}$ is τ
x is more or less $\tilde{R}$

y is $\tilde{S}^{\tau}$

$IV'_{\tau} - 1$

if x is P' then y is $\tilde{R}$ is τ
x is not $\tilde{P}$

y is not $\tilde{R}^{\tau}$

$IV'_{\tau} - 2$

if x is P' then y is $\tilde{R}$ is τ
x is not $R]S$

y is not $\tilde{P}^{\tau}$

The inference is given for Criteria-2 according to intuitions.

Table 2 : Fuzzy inference for Criteria-2.

Intution	Proposition	Inference
$I'_\tau - 1$	x is $\tilde{P}$ o is τ	y is $\tilde{R}^\tau$
$I'_\tau - 2$	y is $\tilde{R}$ o is τ	x is $\tilde{P}^\tau$
$II_\tau - 1$	x is very $\tilde{P}$ o is τ	y is very $\tilde{R}^\tau$
$II'_\tau - 2$	y is very $\tilde{R}$ o is τ	x is $\tilde{P}$
$III'_\tau - 1$	x is more or less $\tilde{P}$ o is τ	y is $\tilde{R}^\tau$
$III'_\tau - 2$	y is mor or less $\tilde{R}$ o is τ	is $\tilde{P}^\tau$
$IIV'_\tau - 1$	x is not $\tilde{P}$ o is τ	y is not $\tilde{R}^\tau$
$IV'_\tau - 1$	y is $\tilde{R}$ o is τ	x is not $\tilde{P}^\tau$

Where $\tau = \tau_1$ or τ_2
Fuzzy Conditional Inference is straight forward based on verification of fuzzy intuitions for Criteria-2

Criteria-2 is suitable for $IV'_\tau - 1$ and $IV'_\tau - 2$.

4. Fuzzy Certainty Factor

The fuzzy certainty factor(FCF) shall made as single fuzzy membership functions with two fuzzy membership functions to eliminate the conflict of evidence between “True ”and “False”.

Definition 4.1 *The FCF of $\mu_{\tilde{A}}$ for propositions “x is $\tilde{A}$” is characterized by its membership function $\mu_{\tilde{A}}^{FCF}(x) \to [0,1]$, where $\mu_{\tilde{A}}^{FCF}(x) = \{\mu_A^{True}(x) - \mu_A^{False}(x)\}/x$,*
$\mu_{\tilde{A}}^{F}CF(x) < 0, \mu_{\tilde{A}}^{F}CF(x) = 0$ *and* $\mu_{\tilde{A}}^{F}CF(x) > 0$
are the redundant, insufficient and sufficient respectively.

The FCF will compute the conflict of evidence of the incomplete information.
For Example
$\mu_{young}^{True}(x)$ =$\{0.9/10 + 0.8/15 + 0.69/20 + 0.59/25 + 0.5/30 + 0.42/35 + 0.36/40 + 0.31/45 + 0.26/50\}$
$\mu_{young}^{False}(x)$ =$\{0.9/10+0.8/15+0.69/20+0.59/25+0.5/30+0.42/35+0.36/40+0.31/45+0.26/50$ $\}$

The Graphical representation of FCF is shown in Fig. 3.

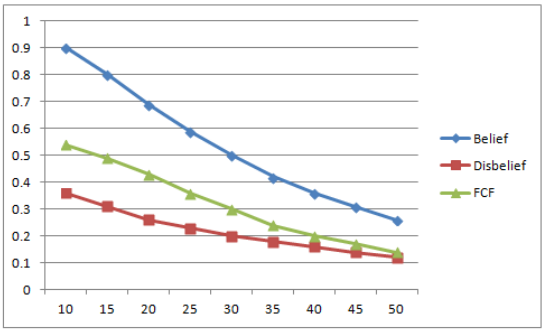

Fig.3 Fuzzy certainty factor

6. Application to New Fuzzy Conditional Inference for Fuzzy Intuitions

The Business intelligence needs reasoning. The Business data is defied with fuzziness with linguistic variables.

If x is Production and x is Supply or x is Demand then y is Profit
x is less Production and x is less Supply or x is more Demand

---

y is ?
If x is Production then y is Profit
x is less Production

---

y is ?
If x is Supply then y is Profit
x is less Supply

---

y is ?
If x is Demand then y is Profit
x is more Demand

---

y is ?

$I_\tau - 1$
if x is *Demand* then y is *Profit*
x is *Profit*

---

y is *Demand*

$I_\tau - 2$
if x is *Demand* then y is *Profit*
x is *Demand*

---

y is *Profit*

$II_{\tau} - 1$

if *x* is *Demand* then *y* is *Profit*
x is very *Profit*

---

y is very *Demand*

$II_{\tau} - 2$

if *x* is *Demand* then *y* is *Profit*
x is very less *Demand*

---

y is *very less Profit*

$III_{\tau} - 1$

if *x* is *Demand* then *y* is *Profit*
x is more *Demand*

---

y is *more Profit*

$III_{\tau} - 2$

$III_{\tau} - 2$

if *x* is *Demand* then *y* is *Profit*
x is more or less *Demand*

---

y is *Profit*

$IV'_{\tau} - 1$

if *x* is *Demand'* then *y* is *Profit*
x is not *Demand*

---

y is not *Profit*

$IV'_{\tau} - 2$

if *x* is *Demand'* then *y* is *Profit*
x is not *Profit*

---

y is not *Demand*

Consider the fuzzy data sets for production

Table 3 : Fuzzy data sets.

Item No.	Denand	FCF
Item1	{0.5,0.1}	0.4
Item2	{0.6,0.1}	0.5
Item3	{0.9,0.2}	0.7
Item4	{0.9,0.1}	0.8
Item5	{1.0,0.0}	1.0

The fuzzy conditional inference using is given by
Profit=Demand

Table 3 : Fuzzy data sets.

Item No.	Profit	FCF
Item1	{0.5,0.1}	0.4
Item2	{0.6,0.1}	0.5
Item3	{0.9,0.2}	0.7
Item4	{0.9,0.1}	0.8
Item5	{1.0,0.0}	1.0

The fuzzy conditional inference for Criteria-1 and Criteria-2 is given as

Table – 4 : Fuzzy inference.

Item No.	I-1	I-2	II-1	II-2	III-1	III-2	IV'-1	IV'-2
Item1	0.3	0.2	0.09	0.09	0.55	0.55	0.7	0.7
Item2	0.5	0.5	0.25	0.25	0.71	0.71	0.5	0.5
Item3	0.7	0.7	0.49	0.49	0.84	0.84	0.3	0.3
Item4	0.8	0.8	0.64	0.64	0.89	0.89	0.2	0.2
Item5	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0

The fuzzy intuitions are suitable for I-1,I-2, II-1, II-2, III-1, III-2, IV'-1 and IV'-2.

The Business intelligence needs reasoning. The Business data is defied with fuzziness with linguistic truth variables.

If x is Production and x is Supply or x is Demand then y is Profit is very true
x is less Production and x is less Supply or x is more Demand

---

y is ?
If x is Production then y is Profit is very true
x is less Production

---

y is ?
If x is Supply then y is Profit is very true
x is less Supply

---

y is ?
If x is Demand then y is Profit is very true
x is more Demand

---

y is ?

$I_\tau - 1$ if x is *Demand* then y is *Profit* is very true
x is *Profit*

---

y is $\mathit{Demand}^{\text{very true}}$
$=\{0.4, 0.1\}^{\text{very true}}$
$=\{0.25, 0.1\}$
FCF = {0.15}

$I_\tau - 2$ if x is *Demand* then y is *Profit* is very false
x is *Demand*

---

y is $\mathit{Profit}^{\text{very false}}$
$=\{0.4, 0.1\}^{\text{very false}}$
$=\{0.5, 0.01\}$
FCF = {0.49}

$II_\tau - 1$ if x is *Demand* then y is *Profit* is very true
x is very *Profit*

---

y is very $\mathit{Demand}^{\text{very true}}$
$=\{0.25, 0.01\}^{\text{very true}}$
$=\{0.35, 0.01\}$
FCF = {0.34}

$II_\tau - 2$ if x is *Demand* then y is *Profit* is very false

x is very less *Demand*

---

y is *very less Profit*$^{\text{very false}}$
$=\{0.25, 0.01\}^{\text{more or less true}}$
$=\{0.25, 0.001\}$
FCF = {0.25}

$III_\tau - 1$ if x is *Demand* then y is *Profit* is very true
x is more *Demand*

---

y is more *Profit*$^{\text{very true}}$
$=\{0.63, 0.31\}^{\text{very true}}$
$=\{0.39, 0.31\}$
FCF = {0.08}

$III_\tau - 2$ if x is *Demand* then y is *Profit*is more or less false
x is more *Demand*

---

y is more *Profit*$^{\text{more or less false}}$
$=\{0.63, 0.31\}^{\text{very true}}$
$=\{0.63, 0.55\}$
FCF = {0.08}

$IV'_\tau - 1$ if x is *Demand'* then y is *Profit* is very true
x is not *Demand*

---

y is not *Profit*$^{\text{very true}}$
$=\text{not}\{0.4, 0.1\}^{\text{very true}}$
$=\text{not}\{0.16, 0.1\}$
FCF =not {0.06}
=0.94

$IV'_\tau - 2$ if x is *Demand'* then y is *Profit* is very false
x is not *Profit*

---

y is not *Demand*$^{\text{very false}}$
$=\text{not}\{0.4, 0.1\}^{\text{very false}}$
$=\text{not}\{0.4, 0.01\}$
FCF =not {0.39}
=0.61

The fuzzy conditional inference using is given by

Profit=Demand

The fuzzy conditional inference for Criteria-1 and Criteria-2 is given as

Table – 5 : Fuzzy inference.

Item No.	$I_\tau - 1$	$I_\tau - 2$	$II_\tau - 1$	$II_\tau - 2$	$III_\tau - 1$	$III_\tau - 2$	$IV'_\tau - 1$	$IV'_\tau - 2$
Item1	0.15	0.49	0.34	0.25	0.08	0.08	0.94	0.61
Item2	0.26	0.59	0.45	0.77	0.28	0.22	0.65	0.41
Item3	0.61	0.76	0.81	0.94	0.59	0.74	0.21	0.14
Item4	0.71	0.89	0.84	0.94	0.62	0.85	0.20	0.11
Item5	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0

The fuzzy intuitions are suitable for $I_\tau - 1$, $I_\tau - 2$, $II_\tau - 1$, $II_\tau - 2$, $III_\tau - 1$, $III_\tau - 2$, $IV'_\tau - 1$ and $IV'_\tau - 2$.

7. Conclusion

FMK studied fuzzy intuitions based on Godel and Standard sequence methods. some more intuitions are proposed. These methods satisfy some fuzzy intuitions. The proposed methods satisfy some more fuzzy intuitions. The fuzzy set with the two fold fuzzy membership function will give more evidence than a single fuzzy membership one. The fuzzy logic with two fold fuzzy membership function is discussed based on “True”and “False”. The fuzzy intuitions are discussed using to fold fuzzy sets. The fuzzy Inference and fuzzy reasoning are studied for “a two fold fuzzy sets”. The FCF is studied as the difference between the two fuzzy membership functions “True”and “False”. The fuzzy Certainty Factor is made as a single fuzzy membership function to compute the conflict of evidence of the Incomplete Information. The fuzzy intuition with truth variables are studied for “a two fold fuzzy set”. The business intelligence is discussed as application for “a two fold fuzzy set” for fuzzy intuitions.

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