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A STUDY ON POSSIBILITY FUZZY SOFT EXPERT SET

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Abstract: The decision making problems with imprecise data has a special significance in real life problems. In this article an attempt has been made to compare the concept of fuzzy soft expert set and possibility fuzzy soft expert set, in the car selection process. The methods to construct the comparison table for the fuzzy soft expert set and possibility fuzzy soft expert set in parametric sense are discussed. Numerical examples are illustrated for better decision making.

Keywords: Soft Set, Fuzzy Soft Set, Soft Expert Set, Fuzzy Soft Expert Set, Possibility Fuzzy Soft Expert Set.

AMS Subject Classification: 03B52, 90C70

1. Introduction:

The concept of soft set theory is defined by Molodsov [11] in 1999 and it is a new mathematical tool for dealing with uncertainties. The fuzzy soft set that is used to analyze the opinion of all experts without any operations, and it is developed by P.K.Maji.et.al [9]. The soft expert set and fuzzy soft expert set are applied by S.Alkhazaleh.et.al [2,3,4,13] in several directions such as parameterized, multi parameterized and interval valued. In 2011, S.Alkhazaleh.et.al generalized the concept of fuzzy soft set to possibility fuzzy soft set. Some of these applications are applied in decision making and medical diagnosis. The combination of possibility fuzzy soft set and fuzzy soft expert set is developed as possibility fuzzy soft expert set . In this article possibility fuzzy soft expert set is considered in decision making. An attempt has been made to compare the properties of fuzzy soft expert sets and possibility fuzzy soft expert set. The basic operations union, intersection, complement, AND and OR also studied. Finally, we present a mapping on the application of these two sets in the decision making problem.

The paper is organized as follows: Section 2 presents the work related to decision making using Fuzzy Soft Expert Set(FSES) and Possibility Fuzzy Soft Expert Set (PFSES). Section 3 provides the procedure for construction of comparison table using fuzzy soft expert set and possibility fuzzy soft expert set. Numerical illustrations are explained in brief and the conclusion is given in Section 4 and Section 5 respectively.

2. Preliminaries

In this section some basic definition and operations on soft expert set, fuzzy soft expert set and possibility fuzzy soft expert set are reviewed.

Let U be the universal set, such that U={$x_1, x_2, \ldots, x_n$} , let E be the set of parameter for U and I^U, the set of all fuzzy subsets of U, we mean the universal set U and E be the parameter set. Let A, B $\subset$E. let *P (U)* be the power set of U

2.1 Soft Set:

A pair (F, A) is called a soft set over U where F is a mapping

$$F: A \rightarrow P(U).$$

In other words, a soft set over *U* is a parameterized family of subsets of the universe *U* For $\varepsilon \in A$, $F(\varepsilon)$ may be considered as the set of ε -approximate elements of the soft set (*F*, *A*)

2.2 Fuzzy Soft Set:

Let U be an initial universal set and let E be a set of parameters. Let I^U denote the power set of all fuzzy subsets of U . Let A ⊆ E. A pair (F, E) is called a fuzzy soft set over U where F is a mapping given by

$$F : A \to I^U.$$

Let U be a universe, E a set of parameters, X a set of experts (agents), and O a set of opinions. Let Z = E × X ×O and A ⊆ Z .

2.3 Soft Expert Set: A pair (F, A) is called a soft expert set over U, where F is a mapping given by

$$F : A \to P(U)$$

2.4 Fuzzy Soft Expert Set: A pair (F, A) is called a fuzzy soft expert set over U, where F is a mapping given by

$$F : A \to I^U$$

2.5 Agree Soft Expert Set: A agree-soft expert set $(F, A)_1$ over U is a soft expert subset of (F, A) defined as follows:

$$(F, A)\ 1 = \{F_1(\alpha): \alpha \in E \times X \times \{1\}.$$

2.6 Disagree Soft Expert Set: A disagree-soft expert set $(F, A)_0$ over U is a soft expert subset of (F, A) defined as follows:

$$(F, A)_0 = \{ F_0(\alpha) : \alpha \in E \times X \times \{0\} .$$

2.7 Possibility Fuzzy Soft Set:

Let $F : E \to I^U$ and μ be a fuzzy subset of E, that is, $\mu : E \to I^U$, where I^U is the collection of all fuzzy subsets of U. Let $F_\mu : E \to I^U \times I^U$ be a function defined as follows:

$$F_\mu(e) = ((F(e)(x), \mu(e)(x)), \forall x \in U.$$

Then F_μ is called a possibility fuzzy soft set (PFSS in short) over the soft universe (U, E). For each parameter e_i, $F_\mu(e_i) = (F(e_i)(x), \mu(e_i)(x))$ indicates not only the degree of belongingness of the elements of U in $F(e_i)$ but also the degree of possibility of belongingness of the elements of U in $F(e_i)$, which is represented by $\mu(e_i)$. So we can write $F_\mu(e_i)$ as follows:

$$F\mu(e_i)=\left\{\left(\frac{x1}{F(ei)(x1)}, \mu(ei)(x1)\right), \ldots, \left(\frac{xn}{F(ei)(xn)}, \mu(ei)(xn)\right)\right\}$$

Sometime we write F_μ as (F_μ, E). If A ⊆ E, we can also have a PFSS (F_μ, A).

2.8 Possibility Fuzzy Soft Expert Set: Let X be a set of experts, and O= {1=agree, 0 = disagree} a set of opinions. Let Z= {E× X ×O} and A ⊆ Z. Let $F: Z \to I^U$ and μ be a fuzzy subset of Z, i.e.$\mu:Z\to I^U$ where I^U is the collection of all fuzzy subsets of U. Let $F_\mu:Z\to I^U \times I^U$ be a function defined as follows:

$$F_\mu(z) = ((F(z)(e), \mu(z)(u)), \forall u \in U.$$

Then F_μ is called a possibility fuzzy soft expert set (***PFSES*** in short) over the soft universe (U, Z).for each Z, $F_\mu(z_i) = (F(z)(u), \mu(z)(u))$ indicates the degree of belongingness of the elements of U in $F(z_i)$ and also the degree of possibility of such belongingness which is represented by $\mu(z_i)$ So we can write $F_\mu(z_i)$ as follows:

$$F\mu(Zi) = \left\{\left(\frac{u1}{F(Z1)(u1)}, \mu(Z1)(u1)\right), .\left(\frac{ui}{F(Zi)(ui)}, \mu(Zi)(ui)\right)\right\}$$

Sometime we write (F_μ, Z) as F_μ. If A ⊆ Z we can also have a PFSES (F_μ, A)

2.9 Possibility Agree-Fuzzy Soft Expert Set: A possibility agree - fuzzy soft expert Set $(F_\mu, A)_1$ over U is a possibility fuzzy soft expert subset of (F_μ, A) defined as follows:

$(F_\mu, A)_1 = (F(\alpha),\mu(\alpha))$, where $\alpha \epsilon E\times X\times\{1\}$.

2.10 Possibility Disagree-Fuzzy Soft Expert Set: A possibility agree - fuzzy soft expert Set $(F_\mu, A)_0$ over U is a possibility fuzzy soft expert subset of (F_μ, A) defined as follows:

$$(F_\mu, A)_0 = (F(\alpha),\mu(\alpha)), \text{ where } \alpha \epsilon E\times X\times\{0\}.$$

2.11 Union on fuzzy soft expert sets

The union of two soft expert sets (F, A) and (G,B) over U, denoted by (F, A) $\tilde{\cup}$ (G,B) , is the soft expert set (H,C) where C = A∪ B, and ∀ ε ∈ C,

$$H(\varepsilon)=\begin{cases} F(\varepsilon), & if\ \varepsilon \epsilon A - B \\ G(\varepsilon), & if\ \varepsilon \epsilon B - A \\ F(\varepsilon) \cup G(\varepsilon), & if\ \varepsilon \epsilon A \cup B \end{cases}$$

2.12 Intersection on fuzzy soft expert sets

The intersection of two soft expert sets (F, A) and (G,B) over U, denoted by (F, A) $\tilde{\cap}$ (G,B) , is the soft expert set (H,C) where C = A ∩B, and ∀ε ∈C,

$$H(\varepsilon)=\begin{cases} F(\varepsilon), & if\ \varepsilon \epsilon A - B \\ G(\varepsilon), & if\ \varepsilon \epsilon B - A \\ F(\varepsilon) \cap G(\varepsilon), & if\ \varepsilon \epsilon A \cap B \end{cases}$$

2.13 Union On PFSES

Union of two PFSESs (F_μ, A) and (G_δ, B) over *U*, denoted by $(F_\mu, A) \tilde{\cup} (G_\delta, B)$ is a PFSES (H_v, C) where C=A∪B is defined by

$$v(\alpha) = s(\mu(\alpha),\delta(\alpha)),\ \forall\ \alpha \epsilon C \quad and$$
$$H(\alpha) = F(\alpha)\ \tilde{\cup}\ G(\alpha), \forall\ \alpha \epsilon C$$

Where *s* is an *s*-norm and $\tilde{\cup}$ is a fuzzy soft expert union.

2.14 Intersection On PFSES

Intersection of two PFSESs (F_μ, A) and (G_δ, B) over U , denoted by $(F_\mu, A) \tilde{\cap} (G_\delta, B)$ is a PFSES (H_v, C) where C=A∩B is defined by

$$v(e) = t(\mu(e),\delta(e)),\ \forall\ e \epsilon C \quad and$$
$$H(e) = F(e)\ \tilde{\cap}\ G(e), \forall\ e \epsilon C$$

Where t is a t-norm and $\tilde{\cap}$ is a fuzzy soft expert union.

3. Methodology

3.1 Algorithm for Fuzzy Soft Expert Set

Step 1: (F, Z) be the Input for fuzzy soft expert set.
Step 2: find an agree and disagree-fuzzy soft expert sets.
Step 3: find $r_j = \sum_i u_{ij}$ for agree- fuzzy soft expert set.
Step 4: find $c_j = \sum_i u_{ij}$ for disagree- fuzzy soft expert set.
Step 5: Find $s_j = r_j - c_j$.
Step 6: Find m, for which s_m = max s_j then s_m is the optimal choice object. If m has more than one value, then any one of them could be chosen by the company using its option.

3.2 Algorithm for Possibility Fuzzy Soft Expert Set

Step 1: (F, Z) be the input for possibility fuzzy soft expert set.
Step 2: in agree and disagree possibility fuzzy soft expert set find the highest numerical grade.

Step 3: the agree-PFSES is denoted by (A_j) and the disagree- PFSES is denoted by (D_j), for the sum of the product of these numerical grades with the corresponding possibility λ, to compute the score of each locations.
Step 4: find $S_j = A_j - D_j$.
Step 5: Find m, for which $S_m = \max S_j$ Then S_m is the highest score. If m has more than one value, then any one of them could be chosen by the electricity board using its option.

4. Numerical Solution

In this section, we present the application of fuzzy soft expert set in the decision making problem. Suppose that Mr.Y wants to buy a car those are universe U= {C_1,C_2,C_3,C_4 } on his choice based on the parameters of " fuel efficiency", " spacious", " maintenance free"," high security measure" E={e_1 , e_2, e_3 , e_4} the parameter e_i(1,2,3,4) respectively. Let the experts (committee members) be X = {p, q} the committee constructs after a serious discussion the fuzzy soft expert set has followed by below, let 1be agree and 0 be disagreeing

$$(F,Z)_1 \quad \left\{\left((e1,\mathrm{p},1),\left\{\frac{C1}{0.4},\frac{C2}{0.2},\frac{C3}{0.5},\frac{C4}{0.9}\right\}\right),\left((e1,\mathrm{q},1),\left\{\frac{C1}{0.6},\frac{C2}{0.8},\frac{C3}{0.2},\frac{C4}{0.4}\right\}\right),\left((e2,\mathrm{p},1),\left\{\frac{C1}{0.1},\frac{C2}{0.3},\frac{1}{C3},\frac{C4}{0.1}\right\}\right),\left((e2,\mathrm{q},1),\left\{\frac{C1}{0.5},\frac{C2}{0.3},\frac{C3}{0.7},\frac{C4}{0.2}\right\}\right),\left((e3,\mathrm{p},1),\left\{\frac{C1}{0.4},\frac{C2}{0.8},\frac{C3}{0.3},\frac{C4}{0.1}\right\}\right),\left((e3,\mathrm{q},1),\left\{\frac{C1}{0.8},\frac{C2}{0.5},\frac{C3}{0.6},\frac{C4}{0.1}\right\}\right),\left((e4,\mathrm{p},1),\left\{\frac{C1}{0.5},\frac{C2}{0.3},\frac{C3}{0.6},\frac{C4}{0.5}\right\}\right),\left((e4,\mathrm{q},1),\left\{\frac{C1}{0.3},\frac{C2}{0.5},\frac{C3}{0.7},\frac{C4}{0.2}\right\}\right)\right\}$$

$$(F,Z)_0 \quad \left\{\left((e1,\mathrm{p},0),\left\{\frac{C1}{0.6},\frac{C2}{0.7},\frac{C3}{0.4},\frac{C4}{0.3}\right\}\right),\left((e1,\mathrm{q},0),\left\{\frac{C1}{0.5},\frac{C2}{0.7},\frac{C3}{0.2},\frac{C4}{0.1}\right\}\right),\left((e2,\mathrm{p},0),\left\{\frac{C1}{0.7},\frac{C2}{0.5},\frac{C3}{0.8},\frac{C4}{0.3}\right\}\right),\left((e2,\mathrm{q},0),\left\{\frac{C1}{0.3},\frac{C2}{0.8},\frac{C3}{0.3},\frac{C4}{0.7}\right\}\right),\left((e3,\mathrm{p},0),\left\{\frac{C1}{0.8},\frac{C2}{0.6},\frac{C3}{0.3},\frac{C4}{0.7}\right\}\right),\left((e3,\mathrm{q},0),\left\{\frac{C1}{0.4},\frac{C2}{0.4},\frac{C3}{0.1},\frac{C4}{0.4}\right\}\right),\left((e4,\mathrm{p},0),\left\{\frac{C1}{0.7},\frac{C2}{0.6},\frac{C3}{0.3},\frac{C4}{0.1}\right\}\right),\left((e4,\mathrm{q},1),\left\{\frac{C1}{0.5},\frac{C2}{0.3},\frac{C3}{0.2},\frac{C4}{0.1}\right\}\right)\right\}$$

TABLE 4.1: Agree-Fuzzy Soft Expert Set Table

U	C_1	C_2	C_3	C_4
(e_1,p)	0.4	0.2	0.5	0.9
(e_2,p)	0.1	0.3	1	0.1
(e_3,p)	0.4	0.8	0.3	0.1
(e_4,p)	0.5	0.3	0.6	0.5
(e_1,q)	0.6	0.8	0.2	0.4
(e_2,q)	0.5	0.3	0.7	0.2
(e_3,q)	0.8	0.5	0.6	0.1
(e_4,q)	0.3	0.5	0.7	0.2

TABLE 4.2: Disagree-Fuzzy Soft Expert Set Table

U	C_1	C_2	C_3	C_4
(e_1,p)	0.6	0.7	0.4	0.3
(e_2,p)	0.7	0.5	0.8	0.3
(e_3,p)	0.8	0.6	0.3	0.7
(e_4,p)	0.7	0.6	0.3	0.1
(e_1,q)	0.5	0.7	0.2	0.1
(e_2,q)	0.3	0.8	0.3	0.7
(e_3,q)	0.4	0.4	0.1	0.4
(e_4,q)	0.5	0.3	0.2	0.1

TABLE 4.3: $S_j = C_j - K_j$

C_j	K_j	S_j
3.6	4.6	-1
3.7	4.6	-0.9
4.6	2.6	2
2.5	2.7	-0.2

Then max $S_j = S_3$

From table 4.3 it is clear that Mr. Y will select the car C_3 of his choice of parameter in E to buy the car

Suppose that Mr.Z want to buy a car those are universe U= $\{C_1,C_2,C_3,C_4\}$ on his choice based on the parameters of " fuel efficiency", " spacious", " maintenance free"," high security measure" E=$\{e_1, e_2, e_3, e_4\}$ the parameter $e_i(1,2,3,4)$ respectively. Let the experts (committee members) be X = {p, q} the committee constructs after a serious discussion the possibility fuzzy soft expert set has followed by below, let 1be agree and 0 be disagree.

$$(F_\mu,Z)_1 \quad \Big\{\Big\{(e1,p,1),\Big\{\Big(\tfrac{C1}{0.4},0.3\Big),\Big(\tfrac{C2}{0.4},0.2\Big),\Big(\tfrac{C3}{0.5},0.4\Big),\Big(\tfrac{C4}{0.3},0.2\Big)\Big\}\Big\},$$
$$\Big\{(e2,p,1),\Big\{\Big(\tfrac{C1}{0.3},0.3\Big),\Big(\tfrac{C2}{0.4},0.4\Big),\Big(\tfrac{C3}{0.7},0.3\Big),\Big(\tfrac{C4}{0.2},0.1\Big)\Big\}\Big\},$$
$$\Big\{(e3,p,1),\Big\{\Big(\tfrac{C1}{0.4},0.1\Big),\Big(\tfrac{C2}{0.4},0.3\Big),\Big(\tfrac{C3}{0.3},0.3\Big),\Big(\tfrac{C4}{0.3},0.2\Big)\Big\}\Big\},$$
$$\Big\{(e4,p,1),\Big\{\Big(\tfrac{C1}{0.5},0.2\Big),\Big(\tfrac{C2}{0.4},0\Big),\Big(\tfrac{C3}{0.2},0.1\Big),\Big(\tfrac{C4}{0.4},0.2\Big)\Big\}\Big\},$$
$$\Big\{(e1,q,1),\Big\{\Big(\tfrac{C1}{0.7},0.2\Big),\Big(\tfrac{C2}{0.8},0.3\Big),\Big(\tfrac{C3}{0.6},0.2\Big),\Big(\tfrac{C4}{0.4},0.1\Big)\Big\}\Big\},$$
$$\Big\{(e2,q,1),\Big\{\Big(\tfrac{C1}{0.3},0.1\Big),\Big(\tfrac{C2}{0.4},0.3\Big),\Big(\tfrac{C3}{0.4},0.2\Big),\Big(\tfrac{C4}{0.5},0.1\Big)\Big\}\Big\},$$
$$\Big\{(e3,q,1),\Big\{\Big(\tfrac{C1}{0.6},0.2\Big),\Big(\tfrac{C2}{0.4},0.1\Big),\Big(\tfrac{C3}{0.4},0.4\Big),\Big(\tfrac{C4}{0.1},0\Big)\Big\}\Big\},$$
$$\Big\{(e4,q,1),\Big\{\Big(\tfrac{C1}{0.2},0.1\Big),\Big(\tfrac{C2}{0.3},0.2\Big),\Big(\tfrac{C3}{0.3},0.1\Big),\Big(\tfrac{C4}{0.4},0.1\Big)\Big\}\Big\}.$$

$$(F_\mu,Z)_0 \quad \Big\{\Big\{(e1,p,0),\Big\{\Big(\tfrac{C1}{0.5},0.6\Big),\Big(\tfrac{C2}{0.4},0.4\Big),\Big(\tfrac{C3}{0.6},0.7\Big),\Big(\tfrac{C4}{0.1},0.3\Big)\Big\}\Big\},$$
$$\Big\{(e2,p,0),\Big\{\Big(\tfrac{C1}{0.2},0.3\Big),\Big(\tfrac{C2}{0.4},0.7\Big),\Big(\tfrac{C3}{0.3},0.5\Big),\Big(\tfrac{C4}{0.2},0.4\Big)\Big\}\Big\},$$
$$\Big\{(e3,p,0),\Big\{\Big(\tfrac{C1}{0.3},0.5\Big),\Big(\tfrac{C2}{0.2},0.4\Big),\Big(\tfrac{C3}{0.1},0.3\Big),\Big(\tfrac{C4}{0.1},0.3\Big)\Big\}\Big\},$$
$$\Big\{(e4,p,0),\Big\{\Big(\tfrac{C1}{0.2},0.4\Big),\Big(\tfrac{C2}{0.3},0.5\Big),\Big(\tfrac{C3}{0.4},0.4\Big),\Big(\tfrac{C4}{0.2},0.4\Big)\Big\}\Big\},$$
$$\Big\{(e1,q,0),\Big\{\Big(\tfrac{C1}{0.1},0.7\Big),\Big(\tfrac{C2}{0.2},0.8\Big),\Big(\tfrac{C3}{0.1},0.3\Big),\Big(\tfrac{C4}{0.5},0.6\Big)\Big\}\Big\},$$
$$\Big\{(e2,q,0),\Big\{\Big(\tfrac{C1}{0.2},0.4\Big),\Big(\tfrac{C2}{0.5},0.7\Big),\Big(\tfrac{C3}{0.3},0.5\Big),\Big(\tfrac{C4}{0.2},0.4\Big)\Big\}\Big\},$$
$$\Big\{(e3,q,0),\Big\{\Big(\tfrac{C1}{0.4},0.7\Big),\Big(\tfrac{C2}{0.1},0.2\Big),\Big(\tfrac{C3}{0.4},0.1\Big),\Big(\tfrac{C4}{0.5},0.6\Big)\Big\}\Big\},$$
$$\Big\{(e4,q,0),\Big\{\Big(\tfrac{C1}{0.1},0.4\Big),\Big(\tfrac{C2}{0.2},0.4\Big),\Big(\tfrac{C3}{0.3},0.4\Big),\Big(\tfrac{C4}{0.4},0.5\Big)\Big\}\Big\}\Big\}.$$

TABLE 4.4: Grade For Agree PFSES

U	C_i	Highest numerical grade	λ_i
(e_1,p)	C_3	0.5	0.4
(e_2,p)	C_3	0.7	0.3
(e_3,p)	C_2	0.4	0.3
(e_4,p)	C_1	0.5	0.2
(e_1,q)	C_2	0.8	0.3
(e_2,q)	C_4	0.5	0.1
(e_3,q)	C_1	0.6	0.2
(e_4,q)	C_4	0.4	0.1

Score (C_1) = (0.5×0.2) + (0.6×0.2) = 0.22
Score (C_2) = (0.4×0.3) + (0.8×0.3) = 0.36
Score (C_3) = (0.7×0.3) + (0.5×0.4) = 0.41
Score (C_4) = (0.5×0.1) + (0.4×0.1) = 0.9

TABLE 4. 5: Grade For Disagree PFSES

U	C_i	Highest numerical grade	λ_i
(e_1,p)	C_3	0.6	0.7
(e_2,p)	C_2	0.4	0.7
(e_3,p)	C_1	0.3	0.5
(e_4,p)	C_3	0.4	0.4
(e_1,q)	C_4	0.5	0.6
(e_2,q)	C_2	0.5	0.7
(e_3,q)	C_4	0.5	0.6
(e_4,q)	C_4	0.4	0.5

Score (C_1) = (0.3×0.5) = 0.15
Score (C_2) = (0.4×0.7) + (0.5×0.7) = 0.63
Score (C_3) = (0.3×0.7) + (0.4×0.3) = 0.33
Score (C_4) = (0.5×0.6) + (0.5×0.6) + (0.4×0.5) = 0.8

TABLE 4. 6: $S_j = A_j - D_j$

A_j	D_j	S_j
0.22	0.15	0.7
0.36	0.63	-0.27
0.41	0.33	0.8
0.9	0.8	0.1

Then max $S_j = S_3$

From table 4.6 it is clear that Mr. Z will select the car C_3 of his choice of parameter in E to buy the car.

5. Conclusion

The fuzzy soft set theory in several forms plays an important role as a mathematical tool for dealing with problems involving uncertain, vague data. In this paper we compute the concepts of fuzzy soft expert set and possibility fuzzy soft expert set and conclude that possibility fuzzy soft expert set is more effective and useful in decision making environment. In future, it is proposed to extend the application of De-Morgan's law in possibility fuzzy soft expert set.

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