NEUTROSOPHIC PARAMETRIZED SOFT SET THEORY AND ITS DECISION MAKING

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Abstract. In this work, we present definition of neutrosophic parameterized (NP) soft set and its operations. Then we define NP-aggregation operator to form NP-soft decision making method which allows constructing more efficient decision processes. We also give an example which shows that they can be successfully applied to problem that contain indeterminacy.

Keywords: soft set, neutrosophic set, neutrosophic soft set, neutrosophic parameterized soft set, aggregation operator.

1. Introduction

In 1999, Smarandache firstly proposed the theory of neutrosophic set (NS) [28], which is the generalization of the classical sets, conventional fuzzy set [30] and intuitionistic fuzzy set [5]. After Smarandache, neutrosophic sets has been successfully applied to many fields such as;control theory [1], databases [2], [3], medical diagnosis problem [4], decision making problem [21], topology [22], and so on.

In 1999, a Russian researcher [27] firstly gave the soft set theory as a general mathematical tool for dealing with uncertainty and vagueness and how soft set theory is free from the parameterization inadequacy syndrome of fuzzy set theory, rough set theory, probability theory. Then, many interesting results of soft set theory have been studied on fuzzy soft sets [8], [12], [23], on intuitionistic fuzzy soft set theory [14], [25], on possibility fuzzy soft set [7], on generalized fuzzy soft sets [26], [29], on generalized intuitionistic fuzzy soft [6], on interval-valued intuitionistic fuzzy soft sets [20], on intuitionistic neutrosophic soft set [9], on generalized neutrosophic soft set [10], on fuzzy parameterized soft set theory [17], [18], on fuzzy parameterized fuzzy soft set theory [13], on intuitionistic fuzzy parameterized soft set theory [15], on IFP-fuzzy soft set theory [16], on neutrosophic soft set [24], interval-valued neutrosophic soft set [11], [19]. In this paper, our main objective is to introduce the notion of neutrosophic parameterized soft set which is a generalization of fuzzy parameterized soft set and intuitionistic fuzzy parameterized soft set. The paper is structured as follows. In Section 2, we first recall the necessary background on neutrosophic and soft set. In Section 3, we give neutrosophic parameterized soft set theory and their respective properties. In Section 4, we present a neutrosophic parameterized aggregation operator. In Section 5, a neutrosophic parameterized decision methods is presented with example. Finally, we conclude the paper.

2. Preliminaries

Throughout this paper, let U be a universal set and E be the set of all possible parameters under consideration with respect to U, usually, parameters are attributes, characteristics, or properties of objects in U.

We now recall some basic notions of neutrosophic set and soft set. For more details, the reader could refer to [23], [27].

Definition 1. [27] Let U be a universe of discourse then the neutrosophic set A is an object having the form

$$A = \{\langle x : \mu_{A(x)}, \nu_{A(x)}, \omega_{A(x)} \rangle,\ x \in U\},$$

where the functions $\mu, \nu, \omega : U \to]^-0, 1^+[$ define respectively the degree of membership, the degree of indeterminacy, and the degree of non-membership of the element $x \in X$ to the set A with the condition.

$$^-0 \leq \mu_{A(x)} + \nu_{A(x)} + \omega_{A(x)} \leq 3^+. \tag{1}$$

From the philosophical point of view, the neutrosophic set takes the value from real standard or non-standard subsets of $]^-0, 1^+[$. So, instead of $]^-0, 1^+[$, we need to take the interval $[0, 1]$ for technical applications, because $]^-0, 1^+[$ will be difficult to apply in the real applications such as in scientific and engineering problems.

For two NS,

$$A_{NS} = \{\langle x, \mu_A(x), \nu_A(x), \omega_A(x)\rangle \mid x \in X\}$$

and

$$B_{NS} = \{\langle x, \mu_B(x), \nu_B(x), \omega_B(x)\rangle \mid x \in X\}.$$

Then,

1. $A_{NS} \subseteq B_{NS}$ if and only if
   $\mu_A(x) \leq \nu_B(x),\ \nu_A(x) \geq \nu_B(x),\ \omega_A(x) \geq \omega_B(x)$.
2. $A_{NS} = B_{NS}$ if and only if
   $\mu_A(x) = \mu_B(x),\ \nu_A(x) = \nu_B(x),\ \omega_A(x) = \omega_B(x)$ for any $x \in X$.
3. The complement of A_{NS} is denoted by A°_{NS} and is defined by
   $A^{\circ}_{NS} = \{\langle x, \omega_A(x), 1 - \nu_A(x), \mu_A(x)\rangle \mid x \in X\}$.
4. $A \cap B$=$\{\langle x, \min\{\mu_A(x), \mu_B(x)\}, \max\{\nu_A(x), \nu_B(x)\}, \max\{\omega_A(x), \omega_B(x)\}\rangle : x \in X\}$.
5. $A \cup B$=$\{\langle x, \max\{\mu_A(x), \mu_B(x)\}, \min\{\nu_A(x), \nu_B(x)\},\ \min\{\omega_A(x), \omega_B(x)\}\rangle : x \in X\}$.

As an illustration, let us consider the following example.

Example 1. Assume that the universe of discourse $U = \{x_x, x_2, x_3, x_4\}$. It may be further assumed that the values of x_1, x_2, x_3 and x_4 are in $[0,1]$. Then, A is a neutrosophic set (NS) of U, such that,

$$A = \{\langle x_1, 0.4, 0.6, 0.5\rangle, \langle x_2, 0.3, 0.4, 0.7\rangle, \langle x_3, 0.4, 0.4, 0.6\rangle, \langle x_4, 0.5, 0.4, 0.8\rangle\}.$$

Definition 2. [23] Let U be an initial universe set and E be a set of parameters. Let $P(U)$ denotes the power set of U. Consider a nonempty set A , $A \subset E$. A pair (K, A) is called a soft set over U, where K is a mapping given by $K : A \to P(U)$.

As an illustration, let us consider the following example.

Example 2. Suppose that U is the set of houses under consideration, say

$$U = \{h_1, h_2, h_3, h_4, h_5\}.$$

Let E be the set of some attributes of such houses, say

$$E = \{e_1, e_2, e_3, e_4, e_5\},$$

where e_1, e_2, e_3, e_4, e_5 stand for the attributes "beautiful", "costly", "in the green surroundings", "moderate" and technically, respectively. In this case, to define a soft set means to point out expensive houses, beautiful houses, and so on. For example, the soft set (K, A) that describes the "attractiveness of the houses" in the opinion of a buyer, says Thomas, and may be defined like this:

$$A = \{e_1, e_2, e_3, e_4, e_5\},$$
$$K(e_1) = \{h_2, h_3, h_5\},$$
$$K(e_2) = \{h_2, h_4\},$$
$$K(e_3) = \{h_1\},$$
$$K(e_4) = U,$$
$$K(e_5) = \{h_3, h_5\}.$$

3. Neutrosophic parameterized soft set theory

In this section, we define neutrosophic parameterized soft set and their operations.

Definition 3.1. Let U be an initial universe, $P(U)$ be the power set of U, E be a set of all parameters and K be a neutrosophic set over E. Then, a neutrosophic parameterized soft sets

$$\Psi_K = \{(\langle x, \mu_K(x), \nu_K(x), \omega_K(x), f_K(x)\rangle : x \in E\},$$

where $\mu_K : E \to [0,1]$, $\nu_K : E \to [0,1]$, $\omega_K : E \to [0,1]$ and $f_K : E \to P(U)$ such that $f_K(x) = \Phi$ if $\mu_K(x) = 0$, $\nu_K(x) = 1$ and $\omega_K(x) = 1$. Here, the functions μ_K, ν_K and ω_K are called membership function, indeterminacy function and non-membership function of neutrosophic parameterized soft set (NP-soft set), respectively.

Example 3.2. Assume that $U = \{u_1, u_2, u_3\}$ is a universal set and $E = \{x_1, x_2\}$ is a set of parameters. If $K = \{\langle x_1, 0.2, 0.3, 0.4\rangle, \langle x_2, 0.3, 0.5, 0.4\rangle\}$ and $f_K(x_1) = \{u_2, u_3\}$, $f_K(x_2) = U$, then, a neutrosophic parameterized soft set Ψ_K is written by

$$\Psi_K = \{(\langle x_1, 0.2, 0.3, 0.4\rangle, \{u_2, u_3\}), (\langle x_2, 0.3, 0.5, 0.4\rangle, U)\}.$$

Definition 3.3. Let $\Psi_K \in NP$-soft set. If $f_K(x) = U$, $\mu_K(x) = 0$, $\nu_K(x) = 1$ and $\omega_K(x) = 1$, for all $x \in E$, then Ψ_K is called a K-empty NP-soft set, denoted by Ψ_{Φ_K}. If $K = \Phi$, then the K-empty NP-soft set is called an empty NP-soft set, denoted by Ψ_Φ.

Definition 3.4. Let $\Psi_K \in NP$-soft set. If $f_K(x) = U$, $\mu_K(x) = 1$, $\nu_K(x) = 0$ and $\omega_K(x) = 0$, for all $x \in E$, then Ψ_K is called a K- universal NP-soft set, denoted by $\Psi_{\widetilde{K}}$. If $K = E$, then the K-universal NP-soft set is called a universal NP-soft set, denoted by $\Psi_{\widetilde{E}}$.

Definition 3.5. Ψ_K and Ω_L are two NP-soft sets. Then, Ψ_K is an NP-subset of Ω_L, denoted by $\Psi_K \sqsubseteq \Omega_L$ if and only if $\mu_K(x) \leq \mu_L(x)$, $\nu_K(x) \geq \nu_L(x)$ and $\omega_K(x) \geq \omega_L(x)$, and $f_K(x) \sqsubseteq g_L(x)$ for all $x \in E$.

Definition 3.6. Ψ_K and Ω_L are two NP-soft sets. Then, $\Psi_K = \Omega_L$, if and only if $\Psi_K \sqsubseteq \Omega_L$ and $\Omega_L \sqsubseteq \Psi_K$, for all $x \in E$.

Definition 3.7. Let $\Psi_K \in NP$-soft set. Then, the complement of Ψ_K, denoted by Ψ_K^c, is defined by

$$\Psi_K^c = \{(\langle x, \omega_K(x), \nu_K(x), \mu_K(x)\rangle, f_{K^c}(x)) : x \in E\},$$

where $f_{K^c}(x) = U \setminus f_K(x)$.

Definition 3.8. Let Ψ_K and Ω_L be two NP-soft sets. Then, the union of Ψ_K and Ω_L, denoted by $\Psi_K \sqcup \Omega_L$, is defined by

$$\Psi_K \sqcup \Omega_L = \{(\langle x, \max\{\mu_K(x), \mu_L(x)\}, \min\{\nu_K(x), \nu_L(x)\}, \min\{\omega_K(x), \omega_L(x)\}\rangle, f_{K\cup L}(x)) : x \in E\},$$

where $f_{K\cup L}(x) = f_K(x) \cup f_L(x)$.

Definition 3.9. Let Ψ_K and Ω_L be two NP-soft sets. Then, the intersection of Ψ_K and Ω_L, denoted by $\Psi_K \sqcap \Omega_L$, is defined by

$$\Psi_K \sqcap \Omega_L = \{(\langle x, \min\{\mu_K(x), \mu_L(x)\}, \max\{\nu_K(x), \nu_L(x)\}, \max\{\omega_K(x), \omega_L(x)\}\rangle, f_{K\cap L}(x)) : x \in E\},$$

where $f_{K\cap L}(x) = f_K(x) \cap f_L(x)$.

Example 3.10. Let $U = \{u_1, u_2, u_3, u_4\}$, $E = \{x_1, x_2, x_3\}$. Then,

$$\begin{aligned} \Psi_K &= \{(\langle x_1, 0.2, 0.3, 0.4\rangle, \{u_1, u_2\}), (\langle x_2, 0.3, 0.5, 0.4\rangle, \{u_2, u_3\})\} \\ \Omega_L &= \{(\langle x_2, 0.1, 0.2, 0.4\rangle, \{u_3, u_4\}), (\langle x_3, 0.5, 0.2, 0.3\rangle, \{u_3\})\}. \end{aligned}$$

Then

$$\begin{aligned} \Psi_K \sqcup \Omega_L &= \{(\langle x_1, 0.2, 0.3, 0.4\rangle, \{u_1, u_2\}), (\langle x_2, 0.3, 0.2, 0.4\rangle, \{u_2, u_3, u_4\}), \\ &\qquad (\langle x_3, 0.5, 0.20.3\rangle, \{u_3\})\} \\ \Psi_K \sqcap \Omega_L &= \{(\langle x_2, 0.1, 0.5, 0.4\rangle, \{u_3, u_4\})\} \\ \Psi_K^c &= \{(\langle x_1, 0.4, 0.3, 0.2\rangle, \{u_3, u_4\}), (\langle x_2, 0.4, 0.5, 0.3\rangle, \{u_1, u_4\})\}. \end{aligned}$$

Remark 3.11. $\Psi_K \sqsubseteq \Omega_L$ does not imply that every element of Ψ_K is an element of Ω_L as in the definition of classical subset. For example, assume that $U = \{u_1, u_2, u_3, u_4\}$ is a universal set of objects and $E = \{x_1, x_2, x_3\}$ is a set of all parameters, if NP-soft sets Ψ_K and Ω_L are defined as

$$\begin{aligned} \Psi_K &= \{(\langle x_1, 0.2, 0.3, 0.4\rangle, \{u_1, u_2\}), (\langle x_2, 0.3, 0.5, 0.4\rangle, \{u_2\})\} \\ \Omega_L &= \{(\langle x_1, 0.3, 0.2, 0.4\rangle, U), (\langle x_2, 0.5, 0.20.3\rangle, \{u_1, u_4\})\}. \end{aligned}$$

It can be seen that $\Psi_K \sqsubseteq \Omega_L$, but every element of Ψ_K is not an element of Ω_L.

Proposition 3.12. *Let $\Psi_K, \Omega_L \in NP$-soft sets. Then*

(i) $\Psi_K \sqsubseteq \Psi_{\widetilde{E}}$.

(ii) $\Psi_\Phi \sqsubseteq \Psi_K$.

(iii) $\Psi_K \sqsubseteq \Psi_K$.

Proof. It is clear from Definitions 3.3-3.5.

Proposition 3.13. *Let Ψ_K, Ω_L and $\gamma_M \in NP$-soft sets. Then*

(i) $\Psi_K = \Omega_L$ *and* $\Omega_L = \gamma_M \Longleftrightarrow \Psi_K = \gamma_M$,

(ii) $\Psi_K \sqsubseteq \Omega_L$ *and* $\Omega_L \sqsubseteq \Psi_K \Longleftrightarrow \Psi_K = \Omega_L$,

(iii) $\Psi_K \sqsubseteq \Omega_L$ *and* $\Omega_L \sqsubseteq \gamma_M \Longrightarrow \Psi_K \sqsubseteq \gamma_M$.

Proof. It can be proved by Definitions 3.3-3.5.

Proposition 3.14. *Let $\Psi_K \in NP$-soft set. Then*

(i) $(\Psi_K^c)^c = \Psi_K$,

(ii) $\Psi_\Phi^c = \Psi_{\widetilde{E}}$,

(iii) $\Psi_E^c = \Psi_{\widetilde{\Phi}}$.

Proof. It is trial.

Proposition 3.15. *Let Ψ_K, Ω_L and $\gamma_M \in NP$-soft sets. Then*

(i) $\Psi_K \sqcup \Psi_K = \Psi_K$,

(ii) $\Psi_K \sqcup \Psi_{\widetilde{\Phi}} = \Psi_K$,

(iii) $\Psi_K \sqcup \Psi_{\widetilde{E}} = \Psi_{\widetilde{E}}$,

(iv) $\Psi_K \sqcup \Omega_L = \Omega_L \sqcup \Psi_K$,

(v) $(\Psi_K \sqcup \Omega_L) \sqcup \gamma_M = \Psi_K \sqcup (\Omega_L \sqcup \gamma_M)$.

Proof. It is clear.

Proposition 3.16. *Let Ψ_K, Ω_L and $\gamma_M \in NP$-soft sets. Then*

(i) $\Psi_K \sqcap \Psi_K = \Psi_K$,

(ii) $\Psi_K \sqcap \Psi_{\widetilde{\Phi}} = \Psi_{\widetilde{\Phi}}$,

(iii) $\Psi_K \sqcap \Psi_{\widetilde{E}} = \Psi_K$,

(iv) $\Psi_K \sqcap \Omega_L = \Omega_L \sqcap \Psi_K$,

(v) $(\Psi_K \sqcap \Omega_L) \sqcap \gamma_M = \Psi_K \sqcap (\Omega_L \sqcap \gamma_M)$.

Proof. It is clear.

Proposition 3.17. *Let Ψ_K, Ω_L and $\gamma_M \in NP$-soft sets. Then*

(i) $\Psi_K \sqcup (\Omega_L \sqcap \gamma_M) = (\Psi_K \sqcup \Omega_L) \sqcap (\Psi_K \sqcup \gamma_M)$,

(ii) $\Psi_K \sqcap (\Omega_L \sqcup \gamma_M) = (\Psi_K \sqcup \Omega_L) \sqcup (\Psi_K \sqcup \gamma_M)$.

Proof. It can be proved by Definitions 3.8 and 3.9.

Proposition 3.18. *Let $\Psi_K, \Omega_L \in NP$-soft set. Then*

(i) $(\Psi_K \sqcup \Omega_L)^c = \Psi_K^c \sqcap \Omega_L^c$,

(ii) $(\Psi_K \sqcap \Omega_L)^c = \Psi_K^c \sqcup \Omega_L^c$.

Proof. It is clear.

Definition 3.19. Let $\Psi_K, \Omega_L \in NP$-soft set. Then

(i) An OR-product of Ψ_K and Ω_L denoted by $\Psi_K \underline{\vee} \Omega_L$ is defined as follows

$$\Psi_K \underline{\vee} \Omega_L = \{(\langle (x,y), (\max\{\mu_K(x), \mu_L(y)\}, \min\{\nu_K(x), \nu_L(x)\}, \min\{\omega_K(x), \omega_L(y)\}\rangle, \Psi_K \cup \Omega_L(x,y))) : x, y \in E\},$$

where $\Psi_K \cup \Omega_L(x,y) = \Psi_K(x) \cup \Omega_L(y)$.

(ii) An AND-product of Ψ_K and Ω_L, denoted by $\Psi_K \overline{\wedge} \Omega_L$, is defined as follows

$$\Psi_K \overline{\wedge} \Omega_L = \{(\langle (x,y), (\min\{\mu_K(x), \mu_L(y)\}, \max\{\nu_K(x), \nu_L(y)\}, \max\{\omega_K(x), \omega_L(y)\}\rangle, \Psi_K \cap \Omega_L(x,y)))\} : x, y \in E\},$$

where $\Psi_K \cap \Omega_L(x,y) = \Psi_K(x) \cap \Omega_L(y)$.

Proposition 3.20. *Let Ψ_K, Ω_L and $\gamma_M \in NP$-soft sets. Then*

(i) $\Psi_K \overline{\wedge} \Psi_\Phi = \Psi_\Phi$

(ii) $(\Psi_K \overline{\wedge} \Omega_L) \overline{\wedge} \gamma_M = \Psi_K \overline{\wedge} (\Omega_L \overline{\wedge} \gamma_M)$

(iii) $(\Psi_K \underline{\vee} \Omega_L) \underline{\vee} \gamma_M = \Psi_K \underline{\vee} (\Omega_L \underline{\vee} \gamma_M)$.

Proof. It can be proved by Definition 3.15.

4. NP-aggregation operator

In this section, we define an NP-aggregation operator of an NP-soft set to construct a decision method by which approximate functions of a soft set are combined to produce a single neutrosophic set that can be used to evaluate each alternative.

Definition 4.1. Let $\Psi_K \in NP$-soft set. Then an NP-aggregation operator of Ψ_K, denoted by Ψ_K^{agg}, is defined by

$$\Psi_K^{agg} = \{(\langle u, \mu_K^{agg}(u), \nu_K^{agg}(u), \omega_K^{agg}(u)\rangle) : u \in U\},$$

which is a neutrosophic set over U,

$$\mu_K^{agg} : U \to [0,1] \qquad \mu_K^{agg}(u) = \frac{1}{|U|} \sum_{\substack{x\in E\\ u\in U}} \mu_K(x)\gamma_{f_{K(x)}}(u),$$

$$\nu_K^{agg} : U \to [0,1] \qquad \nu_K^{agg}(u) = \frac{1}{|U|} \sum_{\substack{x\in E\\ u\in U}} \nu_K(x)\gamma_{f_{K(x)}}(u),$$

and

$$\omega_K^{agg} : U \to [0,1] \qquad \mu_K^{agg}(u) = \frac{1}{|U|} \sum_{\substack{x\in E\\ u\in U}} \omega_K(x)\gamma_{f_{K(x)}}(u),$$

and where

$$\gamma_{f_{K(x)}}(u) = \begin{cases} 1, & x \in f_K(x), \\ 0, & \text{otherwise.} \end{cases}$$

$|U|$ is the cardinality of U.

Definition 4.2. Let $\Psi_K \in NP$-soft set and Ψ_K^{agg} an aggregation neutrosophic parameterized soft set, then a reduced fuzzy set of Ψ_K^{agg} is a fuzzy set over U denoted by

$$\Psi_K^{agg} = \left\{ \frac{\mu_{\Psi_{Kf}}^{agg}(u)}{u} : u \in U \right\},$$

where $\mu_{\Psi_{Kf}}^{agg}(u) : U \to [0,1]$ and $\mu_{\Psi_{Kf}}^{agg}(u) + \nu_K^{agg}(u) - \omega_K^{agg}(u)$.

5. NP-Decision methods

Inspired by the decision making methods regard in [13]-[15]. In this section, we also present an NP-decision method to a neutrosophic parameterized soft set. Based on Definitions 4.1 and 4.2, we construct an NP-decision making method by the following algorithm. Now, we construct an NP-soft decision making method by the following algorithm to produce a decision fuzzy set from a crisp set of the alternatives.

According to the problem, the decision maker

(i) constructs a feasible Neutrosophic subsets K over the parameters set E,

(ii) constructs an NP-soft set Ψ_K over the alternatives set U,

(iii) computes the aggregation neutrosophic parameterized soft set Ψ_K^{agg} of Ψ_K,

(iv) computes the reduced fuzzy set $\mu_{\Psi_{Kf}^{agg}(u)}$ of Ψ_K^{agg},

(v) chooses the element of $\mu_{\Psi_{Kf}^{agg}(u)}$ that has maximum membership degree.

Now, we can give an example for the NP-soft decision making method.

Example. Assume that a company wants to fill a position. There are four candidates who fill in a form in order to apply formally for the position. There is a decision maker (DM) that is from the department of human resources. He wants to interview the candidates, but it is very difficult to make it all of them. Therefore, by using the NP-soft decision making method, the number of candidates are reduced to a suitable one. Assume that the set of candidates $U = \{u_1, u_2, u_3, u_4\}$ which may be characterized by a set of parameters $E = \{x_1, x_2, x_3\}$. For $i = 1, 2, 3$, the parameters i stand for experience, computer knowledge and young age, respectively. Now, we can apply the method as follows:

Step i. Assume that DM constructs a feasible neutrosophic subsets K over the parameters set E as follows:

$$K = \{\langle x_1, 0.2, 0.3, 0.4\rangle, \langle x_2, 0.3, 0.2, 0.4\rangle, \langle x_3, 0.5, 0.20.3\rangle\}.$$

Step ii. DM constructs an NP-soft set Ψ_K over the alternatives set U as follows:

$$\Psi_K = \{(\langle x_1, 0.2, 0.3, 0.4\rangle, \{u_1, u_2\}), (\langle x_2, 0.3, 0.2, 0.4\rangle, \{u_2, u_3, u_4\}), (\langle x_3, 0.5, 0.2, 0.3\rangle, \{u_3\})\}.$$

Step iii. DM computes the aggregation neutrosophic parameterized soft set Ψ_K^{agg} of Ψ_K as follows¿

$$\Psi_K^{agg} = \{\langle u_1, 0.05, 0.075, 0.1\rangle, \langle u_2, 0.1, 0.125, 0.2\rangle, \langle u_3, 0.2, 0.1, 0.175\rangle, \langle u_4, 0.125, 0.05, 0.075\rangle\}.$$

Step iv. Computes the reduced fuzzy set $\mu_{\Psi_{Kf}^{agg}(u)}$ of Ψ_K^{agg} as follows:

$$\mu_{\Psi_{Kf}^{agg}(u_1)} = 0.025$$
$$\mu_{\Psi_{Kf}^{agg}(u_2)} = 0.025$$
$$\mu_{\Psi_{Kf}^{agg}(u_3)} = 0.125$$
$$\mu_{\Psi_{Kf}^{agg}(u_4)} = 0.1$$

Step v. Finally, DM chooses u_3 for the position from $\mu_{\Psi_{Kf}^{agg}(u)}$ since it has the maximum degree 0.125 among the others.

6. Conclusion

In this work, we have introduced the concept of neutrosophic parameterized soft set and studied some of its properties. The complement, union and intersection operations have been defined on the neutrosophic parameterized soft set. The definition of NP-aggregation operator is introduced with application of this operation in decision making problems.

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