http://www.newtheory.org ISSN: 2149-1402

Journal of New Theory

Received: 13.03.2016 *Year*: **2016,** *Number*: **13**, *Pages*: **10-25**
Published: 26.04.2016 *Original Article*[**]

Q-SINGLE VALUED NEUTROSOPHIC SOFT SETS

Tahir Mahmood[1,*] <tahirbakhat@yahoo.com>
Qaisar Khan[1] <qaisarkhan421@gmail.com>
Mohsin Ali Khan[1] <mohsinali_3132@yahoo.com>

[1]*Department of Mathematics, International Islamic University, Islamabad, Pakistan*

Abstract - In this paper, we have introduced the concept of Q-single value neutrosophic soft set, multi Q-single valued neutrosophic set and defined some basic results and related properties. We have also defined the idea of Q-single valued neutrosophic soft set, which is the genralizations of Q-fuzzy set, Q-intuitionistic fuzzy set, multi Q-fuzzy set , Multi Q-intuitionistic fuzzy set, Q-fuzzy soft set, Q-intuitionistic fuzzy soft set. We have also defined and discussed some properties and operations of Q-single valued neutrosophic soft set.

Keywords - *Neutrosophic set,single valued neutrosophic set, Q-single valued neutrosophic set, Multi Q-Single valued neutrosophic set, Q-single valued neutrosophic soft set.*

1 Introduction

In 1965 L. A. Zadeh was the first person who presented theory of fuzzy set [23], whose fundamental component is just a degree of membership. After the introduction of fuzzy sets, the idea of intuitionistic fuzzy sets (IFS) was given by K. Attanassov in 1986 [6], whose basic components are the grade of membership and the grade of non-membership under the restrictions that the sum of the two degrees does not surpass one. Attanassov's IFS is more suitable mathematical tool to handle real life application. But in some cases Attanasove's IFS is difficult to apply because in IFS we cannot define degree of indeterminacy independently. To surmount this difficulty Smarandache introduced the concept of neutrosophic sets [21], which not only genrelized the Zadeh's fuzzy set and Attanassov's IFS but also generalized Gau's vague sets [17] philosophically. In neutrosophic set degree of indeterminacy is defined independently. Neutrosophic set contains degree of truth-membership function $T_A(a): X \to]0^-, 1^+[$, indeterminacy membership function $I_A(a): X \to]0^-, 1^+[$ *and* falsity membership function $F_A(a): X \to]0^-, 1^+[$, with for

---

[**]*Edited by* Said Broumi *(Area Editor) and* Naim Çağman *(Editor-in-Chief).*
[*]*Corresponding Author.*

each $a \in X$ and satisfy the condition $0^- \leq SupT_A(a) + SupI_A(a) + SupF_A(a) \leq 3^+$. In neutrosophic sets degree of indeterminacy is defined independently but it is hard to sue it in real life and engineering problem, because it contains non-standard intervals. It is important to overcome this practical difficulty. Wang et al [22] present the concept of Single Valued Neutrosophic Sets (SVNS) to overcome this difficulty. SVNS is a primary class of neutrosophic sets. SVNS is easy to apply in real life and engineering problems because it contains a single points in the standard unit interval $]0^-,1^+[$ instead of non-standard intervals of $]0^-,1^+[$.

Firstly Molodstov [20] introduced the concept of soft set theory. Maji et al. [18] gave some operations and primary properties on theory of soft set. Ali et al. [7] pointed out that the operations defined for soft sets are not correct and due to these operations many mathematical results leads to wrong answers. Fuzzy soft sets theory and fuzzy parametarized soft set theories was studied by Cagman et al [16] . Fuzzy soft set theory was studied by Ahmad, B., and Athar Kharal [5] . F.Adam and N. Hassan [4] introduced the concept of multi Q-fuzzy sets, multi Q-parameterized soft sets and defined some basic properties and operation such as complement, equality, union, intersection F. Adam and N. Hassan [2, 3] also introduced Q-fuzzy soft set,defined some basic operations and defined Q-fuzzy soft aggregation operators that allows constructing more efficient decision making methods. S. Broumi [9, 10] established the notion of Q- intuitionistic fuzzy set (Q-IFS), Q-intuitionistic fuzzy soft set (Q-IFSS) and defined some basic properties with illustrative examples, and also defined some basic operation for Q-IFSand Q-IFSS such as union, intersection, AND and OR operations. Broumi. S. et. al. [8] presented the concept of intuitionistic neutrosophic soft rings by applying intuitionistic neutrosophic soft set to ring theory.

Broumi S. et. al. [8, 11, 12, 13, 14, 15] presented concepts of single valued neutrosophic graphs, interval neutrosophic graphs, on bipolar single valued neutrosophic graphs, and also presented an introduction to bipolar single valued neutrosophic graph.

This article is arranged as proceed, Section 2 contains basic definitions of soft sets, Q-fuzzy sets, multi Q-fuzzy sets, Q-fuzzy soft sets, neutrosophic sets and SVNS are defined. In section 3 Q-SVNS and some basic operations are defined. In section 4 multi Q-SVNS and some basic operations such as union, intersection etc are defined. In section 5 we introduce the concept of Q-single valued neutrosophic soft set(Q-SVNSS) and defined some basic opertions and related results are discussed. At the end conclusion and references are given.

2 Preliminaries

2.1. Definition. **[20]** Let X be a universal set , E be a set of parameters and $A \subseteq E$. A pair (F, A) is said to be soft set over the universal set X, if and only if F is a mapping from A to the power set of X.

2.2. Definition. [2,3]. Assume X be a universal set and $Q \neq \emptyset$. A Q −fuzzy subset N of X is a function $X \times X \to [0,1]$." The union of two Q −fuzzy subsets N and M is defined as

$$N \cup M = \{\max(\mu_N(\tilde{\theta}, \hat{u}), \mu_M(\tilde{\theta}, \hat{u})): \tilde{\theta} \in X, \hat{u} \in Q\}$$

The intersection of two Q −fuzzy subsets N and M is defined as

$$N \cap M = \{\min(\mu_N(\tilde{\theta}, \hat{u}), \mu_M(\tilde{\theta}, \hat{u})): \tilde{\theta} \in X, \hat{u} \in Q\}$$

2.3. Definition[3]. Let I be unit interval $[0,1]$, $k \in Z^+$ (positive integer), X be universal set and $Q \neq \emptyset$. A multi Q −fuzzy set N_Q in X and Q is a set of ordered sequences,

$$N_Q = \{\max(\mu_j(\tilde{\theta}, \hat{u})): \tilde{\theta} \in X, \hat{u} \in Q\}$$

Where $\mu_j: X \times Q \to I^K$ The function $\mu_j(\theta, \hat{u})$ is termed as membership function of multi Q-fuzzy set N_Q, and $\sum_{j=0}^{k} \mu_j(\tilde{\theta}, \hat{u}) \leq 1, for\ j = 1,2,3, \dots, k. k$ is the dimension of multi Q fuzzy set N_Q.The set of all multi- Q − fuzzy set of dimension k in X and Q is denoted by $M^k FQ(X)$."

2.4. Definition[4]. Let X be a universal set, E be the set of parameters, $Q \neq \emptyset$. Let $M^k FQ(X)$ is the power set of all multi Q −fuzzy subsets of X with dimension $k = 1$. Let $D \subseteq E$. A pair (F_Q, D) is referred as Q −fuzzy soft set (in short QF −soft set)over X where F_Q, is defined by

$$F_Q: D \to M^k FQ(X) \ \ such\ that\ (F_Q(\tilde{\theta})) = \emptyset \ \ if\ \tilde{\theta} \notin D$$

Here a Q −fuzzy soft set can be represented by the set of ordered pairs

$$(F_Q, D) = \{\tilde{\theta}, F_Q(\tilde{\theta}): \tilde{\theta} \in X, F_Q(\tilde{\theta}) \in M^k FQ(X)\}$$

The set of all Q −fuzzy soft sets over X will be denoted by $QFS(X)$

2.5. Definition. [22] Let X be a space of points (objects), with a generic element in X denoted by $\tilde{\theta}$. A SVNS N in X has the features truth-membership function T_N, indeterminacy-membership function I_N, and falsity-membership function F_N. For each point $\tilde{\theta}$ in X,$T_N(\tilde{\theta}), I_N(\tilde{\theta}), F_N(\tilde{\theta}) \in [0,1]$.

Mathematically single valued neutrosophic is expressed as follows:

$$N = \{\langle\tilde{\theta}, \left(T_N(\tilde{\theta}), I_N(\tilde{\theta}), F_N(\tilde{\theta})\right)\rangle \,|\, \tilde{\theta} \in X\}$$

3 Q −Single Valued Neutrosophic Sets

3.1. Definition. Let X be a universal set and $Q \neq \emptyset$. A Q −SVNS $\tilde{\mathrm{N}}_Q$ in X and Q is an object of the form

$$\tilde{\mathrm{N}}_Q = \{(\tilde{\theta},\hat{u}), \mu_{\tilde{\mathrm{N}}}(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_{\tilde{\mathrm{N}}}(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_{\tilde{\mathrm{N}}}(\tilde{\theta},\hat{u}) : \tilde{\theta} \in X, \hat{u} \in Q\}$$

Where $\mu_{\tilde{\mathrm{N}}_Q}: X \times Q \to [0,1]$, $\boldsymbol{\nu}_{\tilde{\mathrm{N}}_Q}: X \times Q \to [0,1]$, $\boldsymbol{\lambda}_{\tilde{\mathrm{N}}_Q}: X \times Q \to [0,1]$, are respectively truth-membership, indeterminacy-membership and falsity membership functions for every $\tilde{\theta} \in X$ *and* $\hat{u} \in Q$ and satisfy the condition $0 \leq \mu_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u}) + \boldsymbol{\nu}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u}) + \boldsymbol{\lambda}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u}) \leq 3$.

3.2. Example. Let $X = \{\boldsymbol{p}_1, \boldsymbol{p}_1, \boldsymbol{p}_3\}$ and $Q = \{\hat{u}, \hat{v}\}$, then Q −SVNS $\tilde{\mathrm{N}}_Q$ is defined below,

$$\begin{aligned}\tilde{\mathrm{N}}_Q = \{< &(\boldsymbol{p}_1,\hat{u}),(0.4,0.3,0.5),(\boldsymbol{p}_1,\hat{v}),(0.2,0.4,0.6),(\boldsymbol{p}_2,\hat{u}),(0.6,0.1,0.3),\\ &(\boldsymbol{p}_2,\hat{v}),(0.7,0.2,0.1),(\boldsymbol{p}_3,\hat{u}),(0.3,0.6,0.4),(\boldsymbol{p}_3,\hat{v}),(0.5,0.4,0.6) >\}\end{aligned}$$

Now we define some basic operations for $\boldsymbol{Q}$ −SVNS.

3.3. Definition. Let X be a universal set, $Q \neq \emptyset$and $\tilde{\mathrm{N}}_Q$ be a Q −SVNS. The complement of $\tilde{\mathrm{N}}_Q$ is denoted and defined as follows

$$\tilde{\mathrm{N}}_Q^C = \{(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u}), 1 - \boldsymbol{\nu}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u}), \mu_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u}) : \tilde{\theta} \in X, \hat{u} \in Q\}$$

3.4. Definition. Let $\tilde{\mathrm{A}}_Q$ and $\tilde{\mathrm{N}}_Q$be two Q −SVNS. Then the union and intersection is denoted and defined by

$$\begin{aligned}\tilde{\mathrm{A}}_Q \cup \tilde{\mathrm{N}}_Q = \{&(\tilde{\theta},\hat{u}), \max(\mu_{\tilde{\mathrm{A}}_Q}(\tilde{\theta},\hat{u}), \mu_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u})), \min(\boldsymbol{\nu}_{\tilde{\mathrm{A}}_Q}(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u})),\\ &\min(\boldsymbol{\lambda}_{\tilde{\mathrm{A}}_Q}(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u})) : \tilde{\theta} \in X, \hat{u} \in Q\}\end{aligned}$$

$$\tilde{\mathrm{A}}_Q \cap \tilde{\mathrm{N}}_Q = \{(\tilde{\theta},\hat{u}), \min(\mu_{\tilde{\mathrm{A}}_Q}(\tilde{\theta},\hat{u}), \mu_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u})), \max(\boldsymbol{\nu}_{\tilde{\mathrm{A}}_Q}(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_{\tilde{\mathrm{N}}_Q}(\tilde{\theta},\hat{u})),$$

$$\max(\boldsymbol{\lambda}_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\boldsymbol{\lambda}_{\tilde{N}_Q}(\tilde{\theta},\hat{u}))\}$$

3.5. Definition. Let $\tilde{A}_Q$ and $\tilde{N}_Q$ be two $Q-$SVNSs over two non-empty universal sets G and H respectively and Q be any non-empty set. Then the product of $\tilde{A}_Q$ and $\tilde{N}_Q$ is denoted by $\tilde{A}_Q \times \tilde{N}_Q$ and defined as

$$\tilde{A}_Q \times \tilde{N}_Q = \{< ((\tilde{\theta},b),\hat{u}), \mu_{\tilde{A}_Q\times\tilde{N}_Q}((\tilde{\theta},b),\hat{u}), \nu_{\tilde{A}_Q\times\tilde{N}_Q}((\tilde{\theta},b),\hat{u}), \lambda_{\tilde{A}_Q\times\tilde{N}_Q}((\tilde{\theta},b),\hat{u}) >: \tilde{\theta} \in G, b \in H, \hat{u} \in Q\}$$

Where

$$\mu_{\tilde{A}_Q\times\tilde{N}_Q}((\tilde{\theta},b),\hat{u}) = \min\{\mu_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\mu_{\tilde{N}_Q}(b,\hat{u})\}$$

$$\boldsymbol{\nu}_{\tilde{A}_Q\times\tilde{N}_Q}((\tilde{\theta},b),\hat{u})=\max\{\boldsymbol{\nu}_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\boldsymbol{\nu}_{\tilde{N}_Q}(b,\hat{u})\}$$

$$\boldsymbol{\lambda}_{\tilde{A}_Q\times\tilde{N}_Q}\left((\tilde{\theta},b),\hat{u}\right) = \max\left\{\boldsymbol{\lambda}_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\boldsymbol{\lambda}_{\tilde{N}_Q}(b,\hat{u})\right\}$$

$For\ all\ \tilde{\theta}, b\ in\ G\ and\ \hat{u} \in Q.$

3.6. Definition. Let $\tilde{A}_Q$ a $Q-$single valued neutrosophic subset in a set G, the strongest $Q-$single valued neutrosophic relation on G, that is a $Q-$single valued neutrosophic relation on $\tilde{A}_Q$ is H given by

$$\mu_H((\tilde{\theta},b),\hat{u}) = \min\{\mu_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\mu_{\tilde{N}_Q}(b,\hat{u})\}$$

$$\boldsymbol{\nu}_H((\tilde{\theta},b),\hat{u})=\max\{\boldsymbol{\nu}_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\boldsymbol{\nu}_{\tilde{N}_Q}(b,\hat{u})\}$$

$$\boldsymbol{\lambda}_H\left((\tilde{\theta},b),\hat{u}\right) = \max\left\{\boldsymbol{\lambda}_{\tilde{A}_Q}(\tilde{\theta},\hat{u}),\boldsymbol{\lambda}_{\tilde{N}_Q}(b,\hat{u})\right\}$$

$For\ all\ \tilde{\theta}, b\ in\ G\ and\ \hat{u} \in Q.$

4. Multi Q −Single Valued Neutrosophic Sets

4.1. Definition. Let X be a non-empty set and Q be any non-empty set , l be any positive integer and I be a unit interval $[0,1]$ .A multi $Q-$SVNS $\tilde{A}_Q$ in $\boldsymbol{X}$ and $\boldsymbol{Q}$ is a set of ordered sequences

$$\tilde{A}_Q = \{(\tilde{\theta},\hat{u}), \mu_j(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_j(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_j(\tilde{\theta},\hat{u}) : \tilde{\theta} \in X, \hat{u} \in Q\ for\ all\ j = 1,2,..,l\}$$

Where $\mu_j: X \times Q \to I^K$, $\boldsymbol{\nu}_j: X \times Q \to I^K$,$\boldsymbol{\lambda}_j: X \times Q \to I^K$,$for\ all\ j = 1,2, \dots, l$

and are respectively truth-membership, indeterminacy-membership and falsity membership functions for each $\tilde{\theta} \in X$ and $\hat{u} \in Q$ and satisfy the condition

$$0 \leq \mu_j(\tilde{\theta},\hat{u}) + \boldsymbol{\nu}_j(\tilde{\theta},\hat{u}) + \boldsymbol{\lambda}_j(\tilde{\theta},\hat{u}) \leq 3, for\ all\ j = 1,2, \dots, l$$

The functions $\mu_j(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_j(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_j(\tilde{\theta},\hat{u})$ $for\ all$ $j = 1,2, \dots, l$ are called the "truth-membership , indeterminacy-membership and falsity-membership" functions respectively of the multi Q −SVNS $\tilde{A}_Q$ and satisfy the condition

$$0 \leq \mu_j(\tilde{\theta},\hat{u}) + \boldsymbol{\nu}_j(\tilde{\theta},\hat{u}) + \boldsymbol{\lambda}_j(\tilde{\theta},\hat{u}) \leq 3, for\ all\ j = 1,2, \dots, l$$

l is called the dimension of the Q −SVNS $\tilde{A}_Q$.The set of all Q −SVNS is denoted by $Z^k QSVN(X)$.

4.2. Example. Let $X = \{\boldsymbol{p}_1, \boldsymbol{p}_2, \boldsymbol{p}_3\}$ be a universal set and $Q = \{\hat{u}, v\}$ be a non-empty set and $l = 2$ be a positive integer. If $\tilde{A}_Q: X \times Q \to I^2$,Then the set

$$\tilde{A}_Q = \{< ((\boldsymbol{p}_1,\hat{u}), (0.2,0.3,0.6), (0.6,0.2,0.3)), ((\boldsymbol{p}_1,\hat{v}), (0.5,0.1,0.3), (0.4,0.4,0.5)), \\ ((\boldsymbol{p}_2,\hat{u}), (0.4,0.3,0.5), (0.6,0.1,0.3)),((\boldsymbol{p}_2,\hat{v}), (0.7,0.2,0.1), (0.2,0.4,0.8)) >\}$$

is a multi Q −SVNS in X and Q.

4.3. Remark. Note that if $\boldsymbol{\nu}_j(\tilde{\theta},\hat{u}) = 0$ and $\boldsymbol{\lambda}_j(\tilde{\theta},\hat{u}) = 0$ then multi Q −SVNS reduces to multi Q −fuzzy set.

4.4. Definition. Let $\tilde{A}_Q$ be a Q −SVNS. The the complement of $\tilde{A}_Q$ is denoted and defined as follows

$$\tilde{A}_Q^c = \{(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_j(\tilde{\theta},\hat{u}), 1 - \boldsymbol{\nu}_j(\tilde{\theta},\hat{u}), \mu_j(\tilde{\theta},\hat{u}) : \tilde{\theta} \in X\ and\ \hat{u} \in Q, for\ all\ j = 1,2, \dots, l\}$$

4.5. Definition. Let $\tilde{A}_Q$ and A_Q $\boldsymbol{and}$ B_Q be two Q −SVNSs, and l be a positive integer such that

A=$\{(\tilde{\theta},\hat{u}), \mu_j(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_j(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_j : \tilde{\theta} \in X\ and\ \hat{u} \in Q\ for\ all\ j = 1,2, \dots, l\}$ and

B=$\{(\tilde{\theta},\hat{u}), \mu_j^*(\tilde{\theta},\hat{u}), \boldsymbol{\nu}_j^*(\tilde{\theta},\hat{u}), \boldsymbol{\lambda}_j^*(\tilde{\theta},\hat{u}) : \tilde{\theta} \in X\ and\ \hat{u} \in Q\ for\ all\ j = 1,2, \dots, l\}$

Then we define the following basic operations for Q −SVNSs.

1. $A \subset B$ iff $\mu_j(\hat{\theta},\hat{u}) \leq \mu_j^*(\hat{\theta},\hat{u}), \boldsymbol{\nu}_j(\hat{\theta},\hat{u}) \geq \boldsymbol{\nu}_j^*(\hat{\theta},\hat{u})$ and $\boldsymbol{\lambda}_j(\hat{\theta},\hat{u}) \geq \boldsymbol{\lambda}_j^*(\hat{\theta},\hat{u})$ $for\ all\ j = 1,2,\dots,l.$
2. $A = B$ iff $\mu_j(\hat{\theta},\hat{u}) = \mu_j^*(\hat{\theta},\hat{u}), \boldsymbol{\nu}_j(\hat{\theta},\hat{u}) = \boldsymbol{\nu}_j^*(\hat{\theta},\hat{u})$ and $\boldsymbol{\lambda}_j(\hat{\theta},\hat{u}) = \boldsymbol{\lambda}_j^*(\hat{\theta},\hat{u})$ $for\ all\ j = 1,2,\dots,l.$
3. $A \cup B = \{(\hat{\theta},\hat{u}), \max(\mu_j(\hat{\theta},\hat{u}), \mu_j^*(\hat{\theta},\hat{u})), \min\left(\boldsymbol{\nu}_j(\hat{\theta},\hat{u}), \boldsymbol{\nu}_j^*(\hat{\theta},\hat{u})\right), \min(\boldsymbol{\lambda}_j(\hat{\theta},\hat{u}), \boldsymbol{\lambda}_j^*(\hat{\theta},\hat{u}))\}$
4. $A \cap B = \{(\hat{\theta},\hat{u}), \min(\mu_j(\hat{\theta},\hat{u}), \mu_j^*(\hat{\theta},\hat{u})), \max\left(\boldsymbol{\nu}_j(\hat{\theta},\hat{u}), \boldsymbol{\nu}_j^*(\hat{\theta},\hat{u})\right), \max(\boldsymbol{\lambda}_j(\hat{\theta},\hat{u}), \boldsymbol{\lambda}_j^*(\hat{\theta},\hat{u}))\}$

5. Q −Single Valued Neutrosophic Soft Sets

In this section we introduce the concept of Q −SVNSSs by combining soft sets and Q − SVNS. We also define some basic operations and properties of Q − SVNSSs.

5.1. Definition. Let X be a universal set, Q be any non-empty set and E be the set of parameters. Let $Z^l QSVN(X)$ denote the set of all multi Q −single valued neutrosophic subsets of X with dimension $l = 1$ Let $K \subset E$ A pair (F_Q, K) is called Q − SVNSS over X where F_Q is a mapping given

$$F_Q : K \longrightarrow Z^l QSVN(X) \quad such\ that\ (F_{Q,}(\hat{\theta})) = \emptyset\ \ if\ \hat{\theta} \notin K$$

A Q − SVNSS can be represented by the set of ordered pairs

$$(F_Q, K) = \{\hat{\theta}, F_Q(\hat{\theta}) : \hat{\theta} \in X, F_Q(\hat{\theta}) \in Z^l QSVN(X)\}$$

5.2. Example. Let $X = \{\boldsymbol{p}_1, \boldsymbol{p}_2, \boldsymbol{p}_3, \boldsymbol{p}_4\}$ be a universal set, $E = \{\boldsymbol{k}_1, \boldsymbol{k}_2, \boldsymbol{k}_3, \boldsymbol{k}_4\}$ and $Q = \{\hat{u}, \hat{v}\}$ be a non-empty set. If $K = \{\boldsymbol{k}_1, \boldsymbol{k}_2, \boldsymbol{k}_3\} \subset E$,

$F_{Q,}(\boldsymbol{k}_1) = \{((\boldsymbol{p}_1,\hat{u}),(0.3,0.4,0.6)),((\boldsymbol{p}_1,\hat{v}),(0.2,0.3,0.5)),((\boldsymbol{p}_2,\hat{u}),(0.6,0.2,0.4))\}$

$F_{Q,}(\boldsymbol{k}_1) = \{((\boldsymbol{p}_1,\hat{u}),(0.5,0.3,0.4)),((\boldsymbol{p}_1,\hat{v}),(0.4,0.1,0.7)),((\boldsymbol{p}_3,\hat{u}),(0.8,0.1,0.2))\}$

$F_{Q,}(\boldsymbol{k}_3) = \{((\boldsymbol{p}_1,\hat{u}),(0.9,0.1,0.1)),((\boldsymbol{p}_1,\hat{v}),(0.8,0.2,0.3)),((\boldsymbol{p}_3,\hat{v}),(0.4,0.3,0.6))\}$

Then

$(F_Q,K) = \{(\boldsymbol{k}_1, ((\boldsymbol{p}_1,\hat{u}),(0.3,0.4,0.6)),((\boldsymbol{p}_1,\hat{v}),(0.2,0.3,0.5)), \quad ((\boldsymbol{p}_2,\hat{u}),(0.6,0.2,0.4)),$
$\boldsymbol{k}_2,((\boldsymbol{p}_1,\hat{u}),(0.5,0.3,0.4)),((\boldsymbol{p}_1,\hat{v}),(0.4,0.1,0.7)),((\boldsymbol{p}_3,\hat{u}),(0.8,0.1,0.2)),$
$\boldsymbol{k}_3,((\boldsymbol{p}_1,\hat{u}),(0.9,0.1,0.1)),((\boldsymbol{p}_1,\hat{v}),(0.8,0.2,0.3)),((\boldsymbol{p}_3,\hat{v}),(0.4,0.3,0.6))\}$

is a Q −SVNSS.

5.3. Definition. Let $(F_Q,K) \in QSVNSS(X)$. If $F_Q(\hat{\theta}) = \emptyset$ for all $\hat{\theta} \in E$ then (F_Q,K) is called a null Q −SVNSS denoted by $(\emptyset,K)$.

5.4. Example. Let X, E *and* Q be defined in the above example 5.2 then

$$(\emptyset,K) = \{(\boldsymbol{k}_1,((\boldsymbol{p}_1,\hat{u}),(0,1,1)),((\boldsymbol{p}_1,\hat{v}),(0,1,1)),((\boldsymbol{p}_2,\hat{u}),(0,1,1)),\boldsymbol{k}_2,$$
$$((\boldsymbol{p}_1,\hat{u}),(0,1,1)),((\boldsymbol{p}_1,\hat{v}),(0,1,1)),((\boldsymbol{p}_3,\hat{u}),(0,1,1)),$$
$$\boldsymbol{k}_3,((\boldsymbol{p}_1,\hat{u}),(0,1,1)),((\boldsymbol{p}_1,\hat{v}),(0,1,1)),((\boldsymbol{p}_3,\hat{v}),(0,1,1))\}$$

5.5. Definition. Let $(F_Q,K) \in QSVNSS(X)$, If $F_Q(\hat{\theta}) = X$ for all $\hat{\theta} \in E$ then (F_Q,K) is called a null $Q - SVNSS$ denoted by (X,K).

5.6. Example. Let X, E *and* Q be defined in the above example 5.2 then

$(X,K) = \{(\boldsymbol{k}_1,((\boldsymbol{p}_1,\hat{u}),(1,0,0)),((\boldsymbol{p}_1,\hat{v}),(1,0,0)),((\boldsymbol{p}_2,\hat{u}),(1,0,0)),$
$\boldsymbol{k}_2,((\boldsymbol{p}_1,\hat{u}),(1,0,0)),((\boldsymbol{p}_1,\hat{v}),(1,0,0)),((\boldsymbol{p}_3,\hat{u}),(1,0,0)),$
$\boldsymbol{k}_3,((\boldsymbol{p}_1,\hat{u}),(1,0,0)),((\boldsymbol{p}_1,\hat{v}),(1,0,0)),((\boldsymbol{p}_3,\hat{v}),(1,0,0))\}$

5.7. Definition. Let $(F_Q,K),(G_Q,L) \in QSVNS(X)$. Then (F_Q,K) is Q −SVNSS subset of (G_Q,L) , denoted by $(F_Q,K) \subset (G_Q,L)$ if $K \subset L$ and $F_Q(\hat{\theta}) \subset G_Q(\hat{\theta})$ for all $\theta \in X$.

5.8. Proposition. Let $(F_Q,K),(G_Q,L),(M_Q,N) \in QSVNS(X)$. Then

1. $(F_Q,K) \subset (G_Q,E)$
2. $(\emptyset,K) \subset (G_Q,L)$
3. $(F_Q,K) \subset (G_Q,L)$ *and* $(G_Q,L) \subset (M_Q,N)$ then $(F_Q,K) \subset (M_Q,N)$.
4. If $(F_Q,K) = (G_Q,L)$ and $(G_Q,L)= (M_Q,N)$ *then* $(F_Q,K) = (M_Q,N)$

Proof : Straightforward.

$5.9.$ **Definition.** Let $(F_Q, K) \in QSVNS(X)$, Then the complement of $Q-$ SVNSS set is written as $(F_Q, K)^C$ and is defined by $(F_Q, K)^C = (F_Q^C, \neg K)$ where

$$F_Q^C : \neg K \to QSVNS(X)$$

is the mapping given by F_Q^C(e) Q $-$single valued neutrosophic complement for each $e \in K$.

5.10. **Proposition.** Let $(F_Q, K) \in QSVNS(X)$, Then

1. $((F_Q, K)^C)^C = (F_Q, K)$
2. $(\emptyset, K)^C = (X, E)$
3. $(X, E)^C = (\emptyset, E)$

Proof . 1. Let $k \in K$. Then

$$(F_Q, K) = F_Q(k) = \{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$$

$$(F_Q, K)^C = (F_Q(k))^C = \left\{(\boldsymbol{p}_1, \hat{u}), \left(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 1 - \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right)\right\}$$

$$((F_Q, K)^C)^C = \left\{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 1 - \left(1 - \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right)\right\}$$

$$((F_Q, K)^C)^C = \left\{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right)\right\}$$

$$((F_Q, K)^C)^C = (F_Q, K)$$

2. *Let* $(\emptyset, K) = (F_Q, K)$, Than for all $k \in K$

$$F_Q(k) = \{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$$
$$= \{(\boldsymbol{p}_1, \hat{u}), (0,1,1) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$$

$$(\emptyset, K)^C = (F_Q, K)^C = (F_Q(k))^C = \{(\boldsymbol{p}_1, \hat{u}), (1, 1-1, 0) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$$
$$= \{(\boldsymbol{p}_1, \hat{u}), (1,0,0) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$$
$$= (X, E)$$

3. *Let* $(X, E) = (F_Q, E)$, Then for all $k \in K$

$$F_Q(k) = \{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$$

$= \{(\boldsymbol{p_1}, \hat{u}), (1,0,0) : \hat{u} \in Q, \boldsymbol{p_1} \in X\}$

$(X, E)^C = (F_Q, E)^C = (F_Q(k))^C = \{(\boldsymbol{p_1}, \hat{u}), (0,1-0,1) : \hat{u} \in Q, \boldsymbol{p_1} \in X\}$

$= \{(\boldsymbol{p_1}, \hat{u}), (0,1,1) : \hat{u} \in Q, \boldsymbol{p_1} \in X\}$

$= (\emptyset, E)$

5.11. Definition. Let (F_Q, K) *and* $(G_Q, L) \in QSVNS(X)$ .Then the union of two Q –SVNSSs (F_Q, K) *and* (G_Q, L) is the Q –SVNSS, (M_Q, N) written as $(F_Q, K) \cup (G_Q, L) = (M_Q, N)$ where $N = K \cup L$ for all $l \in N$ and

$$(M_Q, N) = \begin{cases} F_Q(l) & if\ l \in K - L \\ G_Q(l) & if\ l \in L - K \\ F_Q(l) \cup G_Q(l) & if\ l \in K \cap L \end{cases}$$

5.12. Example. Let $X = \{\boldsymbol{p_1}, \boldsymbol{p_2}, \boldsymbol{p_3}, \boldsymbol{p_4}, \boldsymbol{p_5}\}$ be a universal set, $E = \{\boldsymbol{a_1}, \boldsymbol{a_2}, \boldsymbol{a_3}, \boldsymbol{a_4}, \boldsymbol{a_5}\}$ be a set of parameters and $Q = \{\hat{u}, \hat{v}, w\}$ be a non-empty set. Let $N = \{\boldsymbol{a_1}, \boldsymbol{a_3}, \boldsymbol{a_4}\} \subset E, and\ M = \{\boldsymbol{a_1}, \boldsymbol{a_2}, \boldsymbol{a_3}\}$

$(F_Q, N) = \{(\boldsymbol{a_1}, ((\boldsymbol{p_1}, \hat{u}), (0.3,0.4,0.5)), ((\boldsymbol{p_1}, \hat{v}), (0.5,0.3,0.4)), ((\boldsymbol{p_1}, w), (0.6,0.1,0.2)))$
$(\boldsymbol{a_3}, ((\boldsymbol{p_1}, \hat{u}), (0.2,0.3,0.4)), ((\boldsymbol{p_1}, \hat{v}), (0.4,0.2,0.3)), ((\boldsymbol{p_1}, w), (0.6,0.2,0.4)), ((\boldsymbol{p_3}, \hat{u}), (0.7,0.1,0.2)),$
$((\boldsymbol{p_3}, \hat{v}), (0.8,0.2,0.2)), ((\boldsymbol{p_3}, w), (0.2,0.4,0.6))\}), (\boldsymbol{a_4}, \{((\boldsymbol{p_2}, \hat{u}), (0.6,0.2,0.1)), ((\boldsymbol{p_2}, \hat{v}), (0.4,0.2,0.5))$
$, ((\boldsymbol{p_2}, w), (0.5,0.4,0.4))\},$

and

$(G_Q, M) = \{(\boldsymbol{a_1}, ((\boldsymbol{p_1}, \hat{u}), (0.4,0.3,0.5)), ((\boldsymbol{p_1}, \hat{v}), (0.3,0.3,0.4)), ((\boldsymbol{p_1}, w), (0.4,0.2,0.3))),$
$(\boldsymbol{a_2}, ((\boldsymbol{p_2}, \hat{u}), (0.4,0.5,0.2)), ((\boldsymbol{p_2}, \hat{v}), (0.7,0.1,0.1)), ((\boldsymbol{p_2}, w), (0.6,0.2,0.3)),$
$(\boldsymbol{a_3}, \{((\boldsymbol{p_1}, \hat{u}), (0.4,0.3,0.5), (\boldsymbol{p_1}, \hat{v}), (0.2,0.2,0.4), (\boldsymbol{p_1}, w), (0.4,0.1,0.4))$
$, ((\boldsymbol{p_3}, \hat{v}), (0.6,0.1,0.2)), ((\boldsymbol{p_3}, w), (0.7,0.2,0.3))\},$

Then

$(K_Q, L) = \{(\boldsymbol{a_1}, \{((\boldsymbol{p_1}, \hat{u}), (0.4,0.3,0.5)), ((\boldsymbol{p_1}, \hat{v}), (0.5,0.3,0.4)), ((\boldsymbol{p_1}, w), (0.6,0.1,0.2))\}),$
$\boldsymbol{a_2}, ((\boldsymbol{p_2}, \hat{u}), (0.4,0.5,0.2)), ((\boldsymbol{p_2}, \hat{v}), (0.7,0.1,0.1)), ((\boldsymbol{p_2}, w), (0.6,0.2,0.3)),$
$\boldsymbol{a_3}, ((\boldsymbol{p_1}, \hat{u}), (0.4,0.3,0.4)), ((\boldsymbol{p_1}, \hat{v}), (0.4,0.2,0.3)), ((\boldsymbol{p_1}, w), (0.6,0.1,0.4)), (\boldsymbol{p_3}, \hat{u}), (0.8,0.1,0.1),$
$(\boldsymbol{p_3}, \hat{v}), (0.8,0.1,0.2),$

$(\boldsymbol{p}_3, w), (0.7,0.2,0.3))\})$, $\boldsymbol{a}_4, \{((\boldsymbol{p}_2, \hat{u}), (0.6,0.2,0.1)), ((\boldsymbol{p}_2, \hat{v}), (0.4,0.2,0.5)), ((\boldsymbol{p}_2, w), (0.5,0.4,0.4))\}$.

5.13. Definition. Let (F_Q, K) *and* $(G_Q, L) \in QSVNSS(X)$ .Then the intersection of two Q −SVNSSs, (F_Q, K) *and* (G_Q, L) is the $Q-$ SVNSS (M_Q, N) written as $(F_Q, K) \cap (G_Q, L) = (M_Q, N)$ where $N = K \cap L$ for all $l \in N$ and

$$(M_Q, N) = \{e, \min\left(\mu_{F_Q}(\hat{\theta}, \hat{u}), \mu_{G_Q}(\hat{\theta}, \hat{u})\right), \max\left(\boldsymbol{\nu}_{F_Q}(\hat{\theta}, \hat{u}), \boldsymbol{\nu}_{G_Q}(\hat{\theta}, \hat{u})\right),$$
$$\max\left(\boldsymbol{\lambda}_{F_Q}(\hat{\theta}, \hat{u}), \boldsymbol{\lambda}_{G_Q}(\hat{\theta}, \hat{u})\right) : \hat{\theta} \in X, \hat{u} \in Q \text{ and } j = 1,2, \dots, l\}$$

5.14. Example. Let $X = \{\boldsymbol{p}_1, \boldsymbol{p}_2, \boldsymbol{p}_3, \boldsymbol{p}_4, \boldsymbol{p}_5\}$ be a universal set, $E = \{\boldsymbol{a}_1, \boldsymbol{a}_2, \boldsymbol{a}_3, \boldsymbol{a}_4, \boldsymbol{a}_5\}$ be a set of parameters and $Q = \{\hat{u}, \hat{v}, w\}$ be a non-empty set. Let $N = \{\boldsymbol{a}_1, \boldsymbol{a}_3, \boldsymbol{a}_4\} \subset E, \text{and } M = \{\boldsymbol{a}_1, \boldsymbol{a}_2, \boldsymbol{a}_3\}$

$(F_Q, N) = \{(\boldsymbol{a}_1, ((\boldsymbol{p}_1, \hat{u}), (0.3,0.4,0.5)), ((\boldsymbol{p}_1, \hat{v}), (0.5,0.3,0.4)), ((\boldsymbol{p}_1, w), (0.6,0.1,0.2)))$
$(\boldsymbol{a}_3, ((\boldsymbol{p}_1, \hat{u}), (0.2,0.3,0.4)), ((\boldsymbol{p}_1, \hat{v}), (0.4,0.2,0.3)), ((\boldsymbol{p}_1, w), (0.6,0.2,0.4)), ((\boldsymbol{p}_3, \hat{u}), (0.7,0.1,0.2)),$
$((\boldsymbol{p}_3, \hat{v}), (0.8,0.2,0.2)), ((\boldsymbol{p}_3, w), (0.2,0.4,0.6))\}), (\boldsymbol{a}_4, \{((\boldsymbol{p}_2, \hat{u}), (0.6,0.2,0.1)), ((\boldsymbol{p}_2, \hat{v}), (0.4,0.2,0.5))$
$, ((\boldsymbol{p}_2, w), (0.5,0.4,0.4))\},$

and

$(G_Q, M) = \{(\boldsymbol{a}_1, ((\boldsymbol{p}_1, \hat{u}), (0.4,0.3,0.5)), ((\boldsymbol{p}_1, \hat{v}), (0.3,0.3,0.4)), ((\boldsymbol{p}_1, w), (0.4,0.2,0.3))),$
$(\boldsymbol{a}_2, ((\boldsymbol{p}_2, \hat{u}), (0.4,0.5,0.2)), ((\boldsymbol{p}_2, \hat{v}), (0.7,0.1,0.1)), ((\boldsymbol{p}_2, w), (0.6,0.2,0.3)),$
$(\boldsymbol{a}_3, \{((\boldsymbol{p}_1, \hat{u}), (0.4,0.3,0.5), (\boldsymbol{p}_1, \hat{v}), (0.2,0.2,0.4), (\boldsymbol{p}_1, w), (0.4,0.1,0.4))$
$, ((\boldsymbol{p}_3, \hat{v}), (0.6,0.1,0.2)), ((\boldsymbol{p}_3, w), (0.7,0.2,0.3))\},$

Then

$(K_Q, L) = \{(\boldsymbol{a}_1, \{((\boldsymbol{p}_1, \hat{u}), (0.3,0.4,0.5)), ((\boldsymbol{p}_1, \hat{v}), (0.3,0.3,0.4)), ((\boldsymbol{p}_1, w), (0.4,0.2,0.3))\}),$
$\boldsymbol{a}_3, ((\boldsymbol{p}_1, \hat{u}), (0.2,0.3,0.5)), ((\boldsymbol{p}_1, \hat{v}), (0.2,0.2,0.4)), ((\boldsymbol{p}_1, w), (0.4,0.2,0.4)), (\boldsymbol{p}_3, \hat{u}), (0.7,0.2,0.2),$
$(\boldsymbol{p}_3, \hat{v}), (0.6,0.2,0.2), (\boldsymbol{p}_3, w), (0.2,0.4,0.6))\})$

5.15 Proposition. Let $(F_Q, K), (M_Q, N)$ *and* $(G_Q, L) \in QSVNSS(X)$. Then

1. $(F_Q, K) \cup (\emptyset, K) = (F_Q, K)$
2. $(F_Q, K) \cup (X, K) = (X, K)$
3. $(F_Q, K) \cup (F_Q, K) = (F_Q, K)$

4. $(F_Q, K) \cup (G_Q, L) = (G_Q, L) \cup (F_Q, K)$
5. $(F_Q, K) \cup ((G_Q, L) \cup (M_Q, N)) = ((G_Q, L) \cup (F_Q, K))) \cup (M_Q, N)$

Proof. 1. We have

$(F_Q, K) = \{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X$

$(\emptyset, K) = \{(\boldsymbol{p}_1, \hat{u}), (0,1,1) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$

$(F_Q, K) \cup (\emptyset, K)$

$= \{k, \left(\left\{(\boldsymbol{p}_1, \theta\hat{u}), \max\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 0\right), \min\left(\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 1\right), \min\left(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 1\right)\right\}\right)\}$

$=\{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \tilde{\hat{u}})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X$

$=(F_Q, K)$

2. Let $(X, K) = (G_Q, K)$ then

$(F_Q, K) = \{(\boldsymbol{p}_1, \tilde{\hat{u}}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$

$(G_Q, L) = \{(\boldsymbol{p}_1, \hat{u}), (1,0,0) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$

$(F_Q, K) \cup (G_Q, K)$

$= \{k, \left(\left\{(\boldsymbol{p}_1, \hat{u}), \max\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 1\right), \min\left(\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 0\right), \min\left(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), 0\right)\right\}\right)\}$

$=\{(\boldsymbol{p}_1, \hat{u}), (1,0,0) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}$

$=(G_Q, K) = (X, K)$

3. Let

$(F_Q, K) = \{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X$

$(F_Q, K) \cup (F_Q, K)$

$$= \{k, \left(\left\{\begin{array}{c}(\boldsymbol{p}_1, \hat{u}), \max\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right), \min\left(\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right), \\ \min\left(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X\}\end{array}\right\}\right)\}$$

$= \{(\boldsymbol{p}_1, \hat{u}), \left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u}), \boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1, \hat{u})\right) : \hat{u} \in Q, \boldsymbol{p}_1 \in X$

$=(F_Q, K)$

4 and 5 can be proved easily in a similar way.

5.16. Proposition. Let $(F_Q,K),(M_Q,N)$ *and* $(G_Q,L) \in QSVNSS(X)$. Then

1. $(F_Q,K) \cap (\emptyset,K) = (\emptyset,K)$
2. $(F_Q,K) \cap (X,K) = (F_Q,K)$
3. $(F_Q,K) \cap (F_Q,K) = (F_Q,K)$
4. $(F_Q,K) \cap (G_Q,L) = (G_Q,L) \cap (F_Q,K)$
5. $(F_Q,K) \cap ((G_Q,L) \cap (M_Q,N)) = ((G_Q,L) \cap (F_Q,K)) \cap (M_Q,N)$

Proof. 1. We have

$(F_Q,K) = \{(\boldsymbol{p}_1,\hat{u}),\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right):\hat{u} \in Q,\boldsymbol{p}_1 \in X$

$(\emptyset,K) = \{(\boldsymbol{p}_1,\hat{u}),(0,1,1):\hat{u} \in Q,\boldsymbol{p}_1 \in X\}(F_Q,K) \cap (\emptyset,K)$

$= \{k,\left(\left\{(\boldsymbol{p}_1,\hat{u}),\min\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),0\right),\max\left(\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),1\right),\max\left(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),1\right)\right\}\right)\}$

$=\{(\boldsymbol{x}_1,\hat{u}),(0,1,1):\hat{u} \in Q,\boldsymbol{p}_1 \in X$

$= (\emptyset,K)$

2. Let $(X,K) = (G_Q,L)$ then

$(F_Q,K) = \{(\boldsymbol{p}_1,\hat{u}),\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right):\hat{u} \in Q,\boldsymbol{p}_1 \in X\}$

$(G_Q,L) = \{(\boldsymbol{p}_1,\tilde{u}),(1,0,0):\tilde{u} \in Q,\boldsymbol{p}_1 \in X\}$

$(F_Q,K) \cap (G_Q,L)$

$= \{k,\left(\left\{(\boldsymbol{p}_1,\hat{u}),\min\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),1\right),\max\left(\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),0\right),\max\left(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),0\right)\right\}\right)\}$

$=\{(\boldsymbol{p}_1,\hat{u}),\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right):\hat{u} \in Q,\boldsymbol{p}_1 \in X\}$

$= (F_Q,K)$

3. Let

$(F_Q,K) = \{(\boldsymbol{p}_1,\hat{u}),\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right):\hat{u} \in Q,\boldsymbol{p}_1 \in X\}$

$(F_Q,K) \cap (F_Q,K) = \{(\boldsymbol{p}_1,\hat{u}),(min\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right),$

$\min\left(\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right),\boldsymbol{min}(\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})):\hat{u} \in Q,\boldsymbol{p}_1 \in X\}$

$=\{(\boldsymbol{p}_1,\hat{u}),\left(\mu_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\nu}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u}),\boldsymbol{\lambda}_{F_{Q(k)}}(\boldsymbol{p}_1,\hat{u})\right):\hat{u} \in Q,\boldsymbol{p}_1 \in X\}$

$=(F_Q,K)$

4 and 5 can be proved easily in a similar way.

5.17. Proposition. Let (F_Q,K) and $(G_Q,L) \in QSVNSS(X)$. Then

1. $((F_Q,K) \cup (G_Q,L))^C = (F_Q,K)^C \cap (G_Q,L)^C$
2. $((F_Q,K) \cap (G_Q,L))^C = (F_Q,K)^C \cup (G_Q,L)^C$

Proof. Straightforward

5.18. Proposition. Let $(F_Q,K), (M_Q,N)$ and $(G_Q,L) \in QSVNSS(X)$. **Then**

$(F_Q,K) \cap ((G_Q,L) \cup (M_Q,N)) = ((F_Q,K) \cap (G_Q,L)) \cup ((F_Q,K)) \cap (M_Q,N))$

$(F_Q,K) \cup ((G_Q,L) \cap (M_Q,N)) = ((F_Q,K) \cup (G_Q,L)) \cap ((F_Q,K) \cup (M_Q,N)$

Proof. Straightforward.

5.19. Definition. Let $(F_Q,K), (M_Q,N)$ and $(G_Q,L) \in QSVNSS(X)$. Then the "AND" operation of two $Q-$ SVNSSs (F_Q,K) and $(G_Q,L)$is the $Q-$ SVNSS denoted by $(F_Q,K) \wedge (G_Q,L)$ and is defined by

$$(F_Q,K) \wedge (G_Q,L) = (M_Q,K \times L)$$

Where $M_Q(\gamma,\delta) = F_Q(\gamma) \cap G_Q(\delta)$ for all $\gamma \in K$, $\delta \in L$ is the intersection of two $Q-$ SVNSSs.

5.20. Definition. Let $(F_Q,K), (M_Q,N)$ and $(G_Q,L) \in QSVNS(X)$.Then the "OR" operation of two $Q-$ SVNSSs (F_Q,K) and (G_Q,L) is the $Q-$ SVNSS denoted by $(F_Q,K) \vee (G_Q,L)$ and is defined by

$$(F_Q,K) \vee (G_Q,L)) = (M_Q,K \times L)$$

Where $M_Q(\gamma,\delta) = F_Q(\gamma) \cup G_Q(\delta)$ for all $\gamma \in K$, $\delta \in L$ is the union of two $Q-$SVNSSs.

Conclusion

In this paper we have inaugurated the concept of Q-SVNS, Multi Q-SVNS. We also gave the concept of Q- SVNSS and studied some related properties with associate proofs. The equality, subset, complement, union, intersection, AND or OR operations have been defined on the Q- SVNSS. This new wing will be more useful than Q-fuzzy soft set, Q-intuitionistic fuzzy soft set and provide a substantial addition to existing theories for handling uncertainties, and pass to possible areas of further research and relevant applications.

Acknowledgements

The authors are thankful to the referees and reviewers for their valuable comments and suggestions for the improvement of this article. The authors are also thankful to editors for their co-operation.

References

[1] F. Adam, and H. Nasruddin. "Multi Q-fuzzy parameterized soft set and its application." Journal of Intelligent and Fuzzy System (2014).
[2] F. Adam, and H. Nasruddin. "Q-fuzzy soft set." Applied Mathematical Sciences 8.174 (2014): 8689-8695.
[3] F. Adam, and H. Nasruddin. "Operations on Q-Fuzzy Soft Set."Applied Mathematical Sciences 8.175 (2014): 8697-8701.
[4] F. Adam, and H. Nasruddin."Multi Q-Fuzzy Soft Set and Its Application"FAR EAST JOURNAL OF MATHEMATICAL SCIENCES 97(7)(2015) 871-881.
[5] B. Ahmad, and K. Athar. "On fuzzy soft sets." Advances in Fuzzy Systems 2009 (2009).
[6] K. T. Atanassov, "Intuitionistic fuzzy sets." Fuzzy sets and Systems 20.1 (1986): 87-96.
[7] M. I. Ali, et al. "On some new operations in soft set theory." Computers & Mathematics with Applications 57.9 (2009): 1547-1553.
[8] S. Broumi, F. Smarandache and P. K. Maji, Intuitionistic neutrosophic soft set over rings, Mathematics and Statistics 2(3): (2014) 120-126, DOI: 10.13189/ms.2014.020303.
[9] S..Broumi, Multi Q-intuitionistic fuzzy soft set (2015) submitted.
[10] S. Broumi, "Q-INTUITIONISTIC FUZZY SOFT SETS." Journal of New Theory 5 (2015): 80-91.
[11] S. Broumi, M. Talea, A. Bakali, F. Smarandache, "Single Valued Neutrosophic Graphs," Journal of New Theory, N 10, 2016, pp. 86-101.
[12] S. Broumi, M. Talea, A. Bakali, F. Smarandache, "On Bipolar Single Valued Neutrosophic Graphs," Journal of New Theory, N11, 2016, pp.84-102.
[13] S. Broumi, M. Talea, A. Bakali, F. Smarandache, Interval Valued Neutrosophic Graphs, SISOM (2016) in press.
[14] S. Broumi, M. Talea, F. Smarandache, A. Bakali, Single Valued Neutrosophic Graphs: Degree, Order and Size, FuzzIEEE, 8 pages (2016) accepted.
[15] S Broumi, F. Smarandache, M. Talea , A. Bakali, An Introduction to Bipolar Single Valued Neutrosophic Graph Theory, Applied Mechanics and Materials, Vol. 841, pp 184-191, doi:10.4028/www.scientific.net/AMM.841.184.
[16] N. Çağman, C. Filiz, and E. Serdar. "Fuzzy parameterized fuzzy soft set theory and its applications." Turkish Journal of Fuzzy System (2010): 1-1.
[17] W. L. Gau, and J. B. Daniel. "Vague sets." IEEE transactions on systems, man, and cybernetics 23.2 (1993): 610-614.
[18] P. K. Maji, B. Ranjit, and R. R. Akhil. "Soft set theory." Computers & Mathematics with Applications 45.4 (2003): 555-562.
[19] P. K. Maji, B. Ranjit, and R. R. Akhil."A fuzzy soft set theoretic approach to decision making problems." Journal of Computational and Applied Mathematics203.2 (2007): 412-418.
[20] D. Molodtsov, Soft set theory---first results, Computers &Mathematics with Applications, vol. 37, no. 4-5, pp. 19--31, 1999.

[21] F. Smarandache,"A Unifying Field in Logics: Neutrosophic Logic."Philosophy (1999): 1-141.
[22] H. Wang, et al. "Single valued neutrosophic soft sets." (2010): 10.
[23] L. A. Zadeh, "Fuzzy sets." Information and control 8.3 (1965): 338-353.