Advances in Mathematics: Scientific Journal **9** (2020), no.12, 11011–11017
ISSN: 1857-8365 (printed); 1857-8438 (electronic)
https://doi.org/10.37418/amsj.9.12.84

RATING USING NEW TRIANGULAR NEUTROSOPHIC SINGLE VALUED NUMBER OF TYPE 1 MODEL

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ABSTRACT. In this paper, a new neutrosophic model is used to find the ranking for the problems of housemaids. This problem involves decision making under uncertain situations. It also involves the mood swings of house maids while at work. Their feelings are being considered as Triangular Neutrosophic Single Valued Number and have been graded with linguistic values such as very low, low, medium, high and very high. These values undergoes the algorithm which is being proposed and they have ranked with type 1 model. Part 1 contains the introduction to neutrosophic sets, Part 2 contains details of the linguistic variables taken according to the criteria, Part 3 contains the newly proposed algorithm and part 4 contains the solution and concludes with the ranking of the Parameters for the problems faced by the housemaids.

1. INTRODUCTION

The Single Valued Neutrosophic set theory has been extensively studied in books and monographs introducing Neutrosophic sets and its applications, by many authors around the world. Neutrosophic sets is a generalization of the theory of fuzzy set, intuitionistic fuzzy sets, interval-valued fuzzy sets and interval-valued intuitionistic fuzzy sets. The concept of neutron subsets involves three degrees

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2020 *Mathematics Subject Classification.* 03B99, 03E99.
Key words and phrases. Triangular Fuzzy Number, Triangular Neutrosophic Fuzzy Number, House maids.

of independence, namely, truth membership function (T), indeterminacy membership function (I), and falsity membership function (F) where these membership values from $f : X \to [0,1]$ and there is no restriction to the sum of the $0 \leq supT_{\tilde{a}} + supI_{\tilde{a}} + supF_{\tilde{a}} \leq 3$. The Single valued Neutrosophic sets have found their way into several areas, such as Neutrosophic soft set, rough Neutrosophic set, Neutrosophic bipolar set, Neutrosophic expert set, rough Bipolar Neutrosophic set, Neutrosophic hesitant fuzzy set, etc. Successful applications of single valued Neutrosophic sets have been developed in multiple criteria and multiple attribute decision making. Subas (2015) defined single valued triangular Neutrosophic numbers is a special form of single valued Neutrosophic numbers. Many uncertainties and complex situations arise in decision-making applications. It is impossible to come up with these uncertainties and complexities, especially with known numbers. For example, in multi-attribute decision making (MADM), multiple objects are evaluated according to more than one property and there is a choice of the most suitable one. Particularly in multi-attribute group decision making (MAGDM), the most appropriate object selection is made according to the data received from more than one decision maker. Subas (2015) defined $\tilde{a} =< (a_1, b_1, c_1); w_{\tilde{a}}, u_{\tilde{a}}, y_{\tilde{a}} >$ as a positive single valued triangular neutrosophic number for $a_1, b_1, c_1 \in R^+$ or a negative single valued triangular neutrosophic number for $a_1, b_1, c_1 \in R^-$. Single valued trapezoidal Neutrosophic number (SVTrNN) is another extension of single valued Neutrosophic sets single valued trapezoidal Neutrosophic number presents the situation, in which each element is characterized by trapezoidal number that has truth membership degree, indeterminate membership degree and falsity membership degree.

More information can be found in [1-8].

2. PRELIMINARIES

Definition 2.1 (Fuzzy Neutrosophic Set). *A fuzzy neutrosophic set A on the universe of discourse X is defined as $A = \{x, \omega_A(x), \mu_A(x), \vartheta_A(x) : x \in X\}$ where $\omega, \mu, \vartheta : X \to [0,1]$ and $0 \leq \omega_A(x) + \mu_A(x) + \vartheta_A(x) \leq 3$, where $\omega_A(x)$ is a membership function , $\mu_A(x)$ is indeterministic function and $\vartheta_A(x)$ is non-deterministic function.*

Definition 2.2 (Single Valued Neutrosophic set). *Let ε be a universal space of points with a generic elements of ε denoted by x. A single valued neutrosophic set S is* *characterized by a truth membership function $T_s(x)$, an indeterminacy membership function $I_s(x)$, a falsity membership function $F_s(x)$ with $T_s(x)\ I_s(x), F_s(x) \in [0,1]$ for all x in ε.*

When ε is continuous a SVNS can be written as:

$$S = \int < T_s(x), \quad F_s(x), \quad I_s(x) > x, \forall x \in \varepsilon.$$

When ε is discrete a SVNSs S can be written as:

$$S = \sum < T_s(x), F_s(x), I_s(x) > x, \forall x \in \varepsilon.$$

It is noted that for a SVNS S,

$$0 \leq \sup T_s(x) + \sup F_s(x) + \sup I_s(x) \leq 3, \forall x \in \varepsilon.$$

Definition 2.3 (Single Valued Triangular Neutrosophic Number). *A Triangular single Valued Neutrosophic number is defined as $\tilde{A}_{\text{Neu}} = (p_1, p_2, p_3; q_1, q_2, q_3; r_1, r_2, r_3)$ whose truth membership, indeterminacy and falsity membership is defined as follows",*

$$T_{\tilde{A}_{Neu}}(x) = \begin{cases} \frac{x-p_1}{p_2-p_1} \text{ when } p_1 \leq x < p_2 \\ 1 \text{ when } x = p_2 \\ \frac{p_3-x}{p_3-p_2} \text{ when } p_2 < x \leq p_3 \\ 0 \text{ otherwise} \end{cases}, \quad I_{\tilde{A}_{Neu}}(x) = \begin{cases} \frac{q_2-x}{q_2-q_1} \text{ when } q_1 \leq x < q_2 \\ 0 \quad \text{when } x = q_2 \\ \frac{x-q_2}{q_3-q_2} \text{ when } q_2 < x \leq q_3 \\ 1 \quad \text{otherwise} \end{cases},$$

$$F_{\tilde{A}_{Neu}}(x) = \begin{cases} \frac{r_2-x}{r_2-r_1} \text{ when } r_1 \leq x < r_2 \\ 0 \quad \text{when } x = r_2 \\ \frac{x-r_2}{r_3-r_2} \text{ when } r_2 < x \leq r_3 \\ 1 \quad \text{otherwise} \end{cases}.$$

The investigation revealed that several reforms by the housemaids and other issues have led to considerable uncertainty and indeterminacy about the data. As a result, we identified them as triangular single-valued neutrosophic numbers (TSVNNs). For example, for “housemaid problems,” we collected data in terms of “satisfaction,” “dissatisfaction,” and “abstention,” and for each term, the related data was expressed by a triangular fuzzy number. In addition, each triangular fuzzy number was constructed based on min, average, and max.

Linguistic Terms	**Triangular single-valued neutrosophic numbers (TSVNNs)**
Very low	<(0.3,0.4,0.5);(0.4,0.6,0.8);(0.5,07,08)>
Low	<(0.8,0.9,0.9);(0.4,0.5,0.6)(0.5,0.6,07)>
Medium	<(0.5,0.6,0.7);(0.6,0.7,0.8);(0.7,0.8,0.9)>
High	<(0.3,0.4,0.5);(0.5,0.6,0.7),(07,0.8,0.9)>
Very High	< (0.7,0.8,0.9);(0.8,0.9,0.9);(0.6,0.7,0.8)>

3. Method Of Determining The Hidden Pattern Of Triangular Single-Valued Neutrosophic Numbers (Tsvnns).

Step 1: Let $T_{SVNNS}C_1, T_{SVNNS}C_2, \dots, T_{SVNNS}C_n$ be the nodes of an TRIANGULAR SINGLE-VALUED NEUTROSOPHIC NUMBERS , with feedback, Let $T_{SVNNS}(M)$ be the associated adjacency matrix.

Step-2: The score function of the single valued triangular neutrosophic number

$$\tilde{A}_{neu} = \frac{a + 2b + c + d + 2e + f + g + 2h + k}{12}.$$

Step 3: Let us find the hidden pattern when $T_{SVNNS}C_1$ is switched ON. When an input is given as the vector $A_1 = (1, 0, \dots, 0)$, the data should pass through the relation matrix M. This is done by multiplying A_i by the triangular matrix M.

Step 4: Let $A_i\ T_{SVNNS}(M) = (a_1, a_2, \dots, a_n)$ will get a triangular vector. Suppose $A_1\ T_{SVNNS}(M) = (1, 0, \dots, 0)$ it gives a triangular weight of the attributes, we call it as $A_i\ T_{SVNNS}\ (M)_{weight}$.

Step 5: Adding the corresponding node of the three experts opinion, we call it as $A\ T_{SVNNS}\ (M)_{sum}$.

Step 6: The Threshold operation is denoted by $(\rightarrowtail)$ ie., $A_1\ T_{SVNNS}\ (M)_{Max(weight).}$ That is by replacing a_i by 1 if a_i is the maximum weight of the triangular node (ie.,$a_i = 1$), otherwise a_i by 0(ie., $a_i = 0$).

Step 7: Suppose $A_1\ T_{SVNNS}\ (M) \rightarrow A_2$ then consider $A_2\ T_{SVNNS}\ (M)$ weight is nothing but addition of weight age of the ON attribute and $A_1\ T_{SVNNS}\ (M)$ weight.

Step 8: Find $A_2\ T_{SVNNS}\ (M)_{sum}$ (ie., summing of the three experts opinion of each attributes).

Step 9: The threshold operation is denoted by$(\rightarrowtail)$ ie., $A_2\ T_{SVNNS}\ (M)_{Max(weight).}$ That is by replacing a_i by 1 if a_i is the maximum weight of the triangular node (ie.,$a_i = 1$), otherwise a_i by 0 (ie., $a_i = 0$).

Step 10: If the A_1 T_{SVNNS} $(M)_{Max(weight)} = A_2$ T_{SVNNS} $(M)_{Max(weight)}$. Then dynamical system end otherwise repeat the same procedure.

Step 11: This procedure is repeated till we get a limit cycle or a fixed point. We have taken 9 nodes / concepts related to the feelings of housemaids during their work as expressed by them: These concepts form the range space which is listed below.

$T_{SVNNS}R_1$- Happy and contented
$T_{SVNNS}R_2$ - Unsatisfied
$T_{SVNNS}R_3$ - Being loyal to the masters
$T_{SVNNS}R_4$- Disrespectful to the master
$T_{SVNNS}R_5$- Considering himself as the master
$T_{SVNNS}R_6$- Feeling Depressed
$T_{SVNNS}R_7$- Feeling insecure
$T_{SVNNS}R_8$- Oppressed and exploited
$T_{SVNNS}R_9$- Hypocritic

	$T_{SVNNS}R_1$	$T_{SVNNS}R_2$	$T_{SVNNS}R_3$	$T_{SVNNS}R_4$	$T_{SVNNS}R_5$	$T_{SVNNS}R_6$	$T_{SVNNS}R_7$	$T_{SVNNS}R_8$	$T_{SVNNS}R_9$
$T_{SVNNS}R_1$	0	h	VL	h	M	h	m	Vh	h
$T_{SVNNS}R_2$	h	0	m	m	L	L	h	h	Vh
$T_{SVNNS}R_3$	VL	m	0	m	vh	h	h	h	m
$T_{SVNNS}R_4$	h	m	m	0	m	L	m	m	VL
$T_{SVNNS}R_5$	m	VH	Vh	m	0	h	m	m	h
$T_{SVNNS}R_6$	h	L	h	L	h	0	vh	h	M
$T_{SVNNS}R_7$	m	h	h	m	m	vh	0	h	m
$T_{SVNNS}R_8$	Vh	h	h	m	m	h	h	0	vh
$T_{SVNNS}R_9$	h	Vh	m	VL	h	M	m	vh	0

	$T_{SVNNS}R_1$	$T_{SVNNS}R_2$	$T_{SVNNS}R_3$	$T_{SVNNS}R_4$	$T_{SVNNS}R_5$	$T_{SVNNS}R_6$	$T_{SVNNS}R_7$	$T_{SVNNS}R_8$	$T_{SVNNS}R_9$
$T_{SVNNS}R_1$	0	0.333	0.3776	0.333	0.3667	0.333	0.667	0.4111	0.333
$T_{SVNNS}R_2$	0.333	0	0.3667	0.3667	0.3667	0.3667	0.333	0.333	0.4111
$T_{SVNNS}R_3$	0.3776	0.3667	0	0.3667	0.4111	0.333	0.333	0.333	0.3667
$T_{SVNNS}R_4$	0.333	0.3667	0.3667	0	0.3667	0.5889	0.3667	0.3667	0.3776
$T_{SVNNS}R_5$	0.3667	0.4111	0.4111	0.3667	0	0.5889	0.3667	0.3667	0.333
$T_{SVNNS}R_6$	0.333	0.333	0.5889	0.4111	0.333	0	0.4111	0.333	0.3667
$T_{SVNNS}R_7$	0.3667	0.333	0.333	0.3667	0.3667	0.4111	0	0.333	0.3667
$T_{SVNNS}R_8$	0.4111	0.333	0.333	0.3667	0.3667	0.333	0.333	0	0.5889
$T_{SVNNS}R_9$	0.333	0.4111	0.3667	0.3776	0.333	0.3667	0.3667	0.3667	0

4. CALCULATION

Attribute T_{SVNNS} R_1 is ON: $A^{(1)} =$ (1 0 0 0 0 0 0 0 0 0 0)

$A^{(1)}$ T_{SVNNS} $(M)_{Average} =$ (0, 0.33, 0.376, 0.33, 0.367, 0.333, 0.3667,0.4111, 0.333)

$A^{(1)}$ T_{SVNNS} $(M)_{Max(Weight)}$ (0 0 0 0 0 0 0 0 0 0 1 0) $=A_1^{(1)}$
$A_1^{(1)}T_{SVNNS}$ $(M)_{Average}$ = (0.1690, 0.136, 0.136, 0.1507, 0.1507, , 0.136, 0.136, 0, 0.2420)
$A_1^{(1)}T_{SVNNS}$ $(M)_{Max(Weight)}$ (0 0 0 0 0 0 0 0 0 0 0 1) $=A_2^{(12)}$
$A_2^{(12)}T_{SVNNS}$ $(M)_{Average}$ = (0.0805, 0.099, 0.088, 0.091, 0.0805, , 0.088, 0.088, 0.088,0)
$A_2^{(12)}T_{SVNNS}$ $(M)_{Max(Weight)}$ (0 1 0 0 0 0 0 0 0) $=A_3^{(13)}$
$A_3^{(13)}T_{SVNNS}$ $(M)_{Average}$ = (0.0332, 0,0.036, 0.036, 0.036, , 0.036, 0.0332, 0.0332, 0.0410)
$A_3^{(13)}T_{SVNNS}$ $(M)_{Max(Weight)}$ (0 0 0 0 0 0 0 0 1) $=A_4^{(14)}$
$A_2^{(12)} = A_{14}^{(14)}$

Attributes	$T_{SVNNS}R_1$	$T_{SVNNS}R_2$	$T_{SVNNS}R_3$	$T_{SVNNS}R_4$	$T_{SVNNS}R_5$	$T_{SVNNS}R_6$	$T_{SVNNS}R_7$	$T_{SVNNS}R_8$	$T_{SVNNS}R_9$
100000000	0.0332	0	0.036	0.036	0.036	0.036	0.0332	0.0332	0.0410
010000000	0.136	0.136	0.168	0.1507	0.1551	0.136	0.1507	0.1507	0
001000000	0.080	0.080	0.1425	0.099	0.080	0	0.099	0.080	0.080
000100000	0.088	0.099	0.099	0.088	0	0.1425	0.088	0.088	0.088
000010000	0.1310	0.1272	0	0.1310	0.1426	0.1155	0.1155	0.1155	0.1272
000001000	0.0887	0.0995	0.0995	0.0887	0	0.1425	0.0887	0.0887	0.0806
000000100	0.0365	0.0409	0.0409	0.0365	0	0.0586	0.0365	0.0365	0.0331
000000010	0.0806	0	0.0887	0.0887	0.0887	0.0887	0.0806	0.0806	0.0995
000000001	0.1369	0	0.1508	0.1508	0.1508	0.1508	0.1369	0.1369	0.1690

Total Weight	0.8109	0.6146	0.8081	0.8738	0.6341	0.8853	0.8289	0.8101	0.7184
Average Weight	0.0901	0.05782	0.0897	0.097	0.070	0.0983	0.0907	0.0900	0.07681

5. Conclusion

Obtaining a solution to the problems faced by housemaids is being found by using a new fuzzy model which gives the ranking for the problems of House Maids. They are feeling Depressed (0.0983), Disrespectful to the master (0.097), Feeling insecure (0.0907), Happy and contented (0.0901), Oppressed and exploited (0.0900), Being loyal to the masters (0.0897), Hypocritic (0.07681), Considering himself as the master (0.070), Unsatisfied (0.5782).

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