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Multi–criteria decision making towards housemaids using single valued neutrosophic fuzzy numbers and comparing with triangular neutrosophic fuzzy number

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ABSTRACT

The notion of Neutrosophic Numbers is quite popular and this paper showcases the varied viewpoints of it. Non - linear generalised triangular neutrosophic number plays a crucial role in theory of impreciseness and uncertainty. We have established the de-neutrosophication technique for triangular neutrosophic number. We have applied the theory in finding the major reason for the house maids being suppressed for various reasons.

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1. Introduction

Roughly about 1.8 million poor women in Tamil Nadu work as paid domestic workers. These are unorganized workers who are subjected to various forms of gendered exploitation, with their labour being expropriated without adequate compensation or any work security. The largest contingent of these women workers belong to the slums of Chennai (with inadequate sanitation facilities) and earn income to meet health crisis. The impact of Covid-19 on them is no less a threat than the virus itself. They are not sure of getting their job back. Even if some people continue engaging them, they face the problem of the transport, Tamil Nadu Domestic Workers Welfare Board (TNWWB): It is estimated that in Chennai alone there are 5.5 Lakh domestic workers. Of these only 64,825 women workers that form just 12 percent were registered with TNWEB. So the welfare schemes meant for the registered women workers cannot be availed by the remaining 88 percent of the domestic working women. Many families that employ them feel that they are the carriers of virus. Many resident associations have barred the entry of domestic workers and drivers into their families as they mostly live in slums which turned out to be containment areas. Neutrosophic Sets have been branched out from the topic called "Neutrosophy". Neutrosophic set cope up with uncertain, indeterminate and inconsistent information. We need human help and opinions while patterning problems with incompatible information. The Neutrosophic set theory was proposed by Florentin Smarandache. There are so many types in Neutrosophic Numbers but we are going to focus on single valued neutrosophic set. It has its own supremacy in dealing complex problems with improper information. The concept is being used and applied to several problems in scientific as well as engineering problems. This has really aroused the capacity of solving complex problems with simple solutions.Table 1.Table 2.

The topic is being extended and the exploration has led to several new concepts. It is being applied and have come out with neutrosophic rough sets, soft sets, bipolar sets, expert sets, rough bipolar, hesitant sets, and so on. The concept of neutrosophic numbers mainly aims at giving simple solutions to multi criterion problems.

The Neutrosophic number has truth membership, indeterminacy membership and falsity membership value where these membership values from $f : X \to [0, 1]$ and there is no restriction to the sum of the

$$0 \leq \sup T_\alpha + \sup I_\alpha + \sup f_\alpha \leq 3$$

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Table 1
Single valued neutrosophic decision matrix D= $(d_{ij})_{4\times6}$=

	N_1	N_2	N_3	N_4	N_5	N_6
M_1	(0.8, 0.3, 0.2)	(0.6, 0.1, 0.2)	(0.9, 0.1, 0.2)	(0.7, 0.3, 0.2)	(0.8, 0.1, 0.2)	(0.6, 0.3, 0.2)
M_2	(0.8, 0.2, 0.3)	(0.5, 0.0, 0.3)	(0.9, 0.1, 0.2)	(0.6, 0.3, 0.3)	(0.8, 0.2, 0.2)	(0.6, 0.3, 0.2)
M_3	(0.6, 0.3, 0.3)	(0.6, 0.2, 0.4)	(0.8, 0.2, 0.1)	(0.5, 0.2, 0.3)	(0.7, 0.2, 0.3)	(0.4, 0.1, 0.2)
M_4	(0.6, 0.3, 0.2)	(0.4, 0.1, 0.2)	(0.9, 0.0, 0.1)	(0.7, 0.3, 0.3)	(0.8, 0.3, 0.3)	(0.4, 0.1, 0.1)

Table 2

Attributes	Single valued neutrosophic score value
M2	0.725
M1	0.7166
M3	0.875
M4	0.775

2. Neutrosophic preliminaries

2.1. Definition on neutrosophic sets

Let δ be a course of points with common elements in δ denoted by$n$. Then a neutrosophic set ω in δ is designated by a truth membership function, $T_{\omega,}$ an indeterminacy membership function I_ω and a falsity membership functionF_ω. The function $T_\omega : \delta \to [0, 1^+]; I_\omega : \delta \to [0, 1^+]; F_\omega : \delta \to [0, 1^+]$.

It is noted that there is no restriction on the sum of $T_\omega(n), I_\omega(n), F_\omega(n)$ i.e. $0 \le T_\omega(n) + I_\omega(n) + F_\omega(n) \le 3^+$

2.2. Single valued neutrosophic set

Let δ be a universal course of points with a common elements of δ denoted by n. A single valued neutrosophic set S is designated by a degree of acceptance$T_s(n)$, degree of indeterminacy $I_s(n)$, degree of falsity $F_s(n)$ with $T_s(n), I_s(n), F_s(n) \in [0, 1]$ for all $n$in ε

When δ is continuous a SVNS can be written as:

$$S = \int < T_s(n), F_s(n), I_s(n) > n, \forall n \in \delta$$

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

$$S = \sum < T_s(n), F_s(n), I_s(n) > n, \forall n \in \delta$$

It is noted that for a SVNS S,

$$0 \le \sup T_s(n) + supF_s(n) + supI_s(n) \le 3, \forall n \in \delta$$

Step 1: Problem field selection

To find out the possible reason for House Maids The alternatives (Problems of House maids) are presented as follows:

A_1: Paying less salary

$A_{2:}$-Ill-treatment

A_3: Sexual Abuse

A_4: Treating with suspicion

For this purpose, the following attributes of feelings of housemaids during their work are considered as criterions in decision making process. These are given as follows.

1. Unsatisfied (N_1)
2. Feeling Depressed (N_2)
3. Feeling insecure (N_3)
4. Opressed and exploited (N_4)
5. Hypocratic (N_5)
6. Doing any kind of work for money (N_6)

Step 2: Single valued neutrosophic set score matrix

Single Valued Neutrosophic score function to each parameter using the below formula.

$$SVNFN(M_i) = \frac{1}{m}\sum_{n=1}^{m}\left[\frac{2 + T_{rj} - I_{rj} - F_{rj}}{3}\right]$$

Step = 3

By the triangular neutrosophic, the matrix changes to:

	N_1	N_2	N_3	N_4	N_5	N_6
M_1	<0.9,0.2,0.1><1.28,2,1><1.5,2,1>	<0.7,0.2,0.3><1.2,3><1.4,1,3>	<0.9,0.1,0.1><1.28,1,1><1.8,1,1>	<0.8,0.2,0.2><1.14,2,2><1.16,1,1>	<0.8,0.3,0.2><1.4,3,2><2.6,3,2>	<0.9,0.2,0.1><1.28,2,1><3,2,1>
M_2	<0.6,0.1,0.4><1,4><1,1,4>	<0.8,0.2,0.2><1.3,2,2><1.6,1,2>	<0.8,0.2,0.2><1.3,2,2><1.6,2,2,>	<0.7,0.2,0.3><1.16,2,3><1.4,1,1.5>	<0.9,0.3,0.1><1.5,3,1><3,3,1>	<0.7,0.2,0.3><1.16,2,3><2.3,2,3>
M_3	<0.9,0.2,0.1><3,2,1><1.5,2,1>	<0.6,0.2,0.4><2,2,4><1.2,1,4>	<0.5,0.1,0.5><1.6,1,5><1,1,5>	<0.5,0.2,0.5><0.6,2,5><1,1,2.5>	<0.4,0.1,0.6><1.3,1,6><1.3,1,6>	<0.3,0.1,0.7><1,1,7><1,1,7>
M_4	<0.6,0.3,0.4><2,1.5,1><1,3,4>	<0.5,0.3,0.5><1.6,1.5,5><1,1.5,5>	<0.6,0.2,0.4><2,2,1><1.2,2,4>	<0.6,0.3,0.4><2,1.5,1><1.2,1.5,2>	<0.3,0.2,0.7><1,1,1.75><1,2,7>	<0.5,0.3,0.5><1.16,1.5,1.25><1.6,3,5>

By using the formulae for triangular neutrosophic fuzzy numbers,

X=$\frac{a+2b+c+d+2e+f+g+2h+k}{12}$

Then matrix changes to,

	N_1	N_2	N_3	N_4	N_5	N_6
M_1	1.12	1.31	0.85	1.09	1.77	1.30
M_2	1.26	1.20	1.35	1.20	1.67	1.57
M_3	1.32	1.55	1.48	1.45	1.65	1.76
M_4	1.55	1.63	1.30	1.15	1.51	1.63

M_1=$\frac{1.12+1.31+0.85+1.09+1.77+1.3}{6}$ = 1.24

M_2 = 1.375

M_3 = 1.535

M_4 = 1.461

By comparing the ranking based on descending order,

M_3>M_4>M_2>M_1

Step-5

Or by using the another method from a matric by using the following formulae,

X=$\frac{a+2b+c}{4}$

By using this the following matrix was formed

	N_1	N_2	N_3	N_4	N_5	N_6
M_1	<0.35,1.57,1.625>	<0.35,2,1.6>	<0.3,1.07,1.2>	<0.35,1.785,1.15>	<0.4,2.285,2.65>	<0.35,1.57,2>
M_2	<0.3,1.75,1.75>	<0.35,1.825,1.4>	<0.35,1.825,1.9>	<0.35,2.04,1.225>	<0.4,2.125,2.5>	<0.35,2.04,2.325>
M_3	<0.35,2,1.625>	<0.35,2.5,1.8>	<0.3,2.15,2>	<0.35,2.65,1.375>	<0.3,2.325,2.325>	<0.3,2.5,2.5>
M_4	<0.4,1.5,2.75>	<0.4,1.4625,2.25>	<0.35,1.25,2.3>	<0.4,1.5,1.55>	<0.35,1.1875,3>	<0.4,1.3525,3.15>
M_5	<0.35,1.65,2.15>	<0.4,1.625,1.7>	<0.35,1.325,1.9>	<0.4,2,1.55>	<0.35,1.75,2.5>	<0.4,1.575,2.65>

M_1=$\frac{1}{6}\left[\frac{2+0.35-1.57-1.625}{3} + \frac{2+0.35-2-1.6}{3} + \frac{2+0.3-1.07-1.2}{3} + \frac{2+0.35-1.785-1.15}{3} + \frac{2+0.4-2.285-2.65}{3} + \frac{2+0.35-1.57-2}{3}\right]$

M_1 = 0.3558

M_2 = 0.4780

M_3 = 0.6442

M_4 = 0.4971

By ranking,

M_3>M_4>M_2>M_1

3. Conclusion

Comparing the single valued and triangular Neutrosophic fuzzy number in the case study of Housemaids, we reason that sexual abuse is the major problem for the housemaids, following that Treating with suspicion. We can liken the above subject by using trapezoidal Neutrosophic numbers and octagonal Neutrosophic numbers.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Further Reading

[1] Gabriel Scherer Schwening*, Álvaro Martins Abdalla** Selection of Agricultural Aircraft using AHP and TOPSIS methods in fuzzy environment 29th Congress of the International Council of the Aeronautical Sciences..
[2] A. Rajkumar, Vivek M, Aravinda Narayanan G3Selection of Agricultural Aircraft using Dodecagonal Fuzzy Relational Mapping(DgFRM) Int. J. Pure Appl. Math. Volume 120 No. 6 2018, 1813-1825.
[3] E. Albayrak, Y.C. Erensal, Using analytic hierarchy process (AHP) to improve human performance. An application of multiple criteria decision making problem, J. Intell. Manuf. 15 (2004) 491–503.
[4] Dag deviren M, Yvuz S and Nevzat M. Weapon. Selection usingAHP and TOPSIS methods in Fuzzy Environment. Expert Systems with applications, 2009.
[5] Ayağ, Z., & Ozdemir, R. G. (2006). A fuzzy AHP approach to evaluating machine tool alternatives. Journal of Intelligent Manufacturing, 17, 179–190.
[6] A.Victor Devadoss, N.Jose Parvin Praveena. A Study of Decision Making Problems Using hexadecagonal FuzzyRelational Maps (HDFRMS). Int. J. Pure Appl. Math., 2017.