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Alternatives Open to Working Women's for Infertility -A Mathematical Model Using the PentapartitionedNeutrosophic Borda Method

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Abstract:-A novel mathematical technique for handling uncertainties is the neutrosophic set. It is largely responsible for resolving issues in real life. In this paper, we first provide the overall idea of the pentapartitionedneutrosophic Borda method before delving more into it. The goal is to find the best alternative to working women's infertility by combining the Borda count with pentapartitionedneutrosophic sets.

Keywords: *Neutrosophic Sets, Soft Set, Neutrosophic Soft Set, PentapartitionedNeutrosophic Sets*

1. Introduction

Every woman aspires to go through the phase of parenthood at some point in her life. Some women plan it for later, while others plan it early by delaying their professions. Not everyone, though, finds it simple to get to that stage. Many women experience difficulties conceiving. Women who work rotating or night shifts have lower egg counts and are more likely to become infertile. The additional strain of juggling work and family demands working mothers, which might result in secondary infertility. For a variety of reasons, working women's infertility has increased dramatically in recent years.

In the context of uncertainty, numerous MCDM techniques have already been interpreted. Consequently, a large number of publications have been written about fuzzy (including intuitionistic fuzzy, soft, grey, rough, or neutrosophic) implementations of various MCDM techniques. Regarding the specific instance of the neutrosophic approach, neutrosophic variants of ARAS, MOORA, PROMETHEE, TOPSIS, VIKOR, and other techniques have already been developed. Thus, it is possible to use those algorithms when our data are marked with this kind of vagueness that can be modeled using neutrosophic sets.

Remember that there are five logical values in this theory: falsity (F), ignorance (G), truth (T), contradiction (C), and unknown (U). Given that they are all fuzzy, their values come from the interval [0, 1]. Additionally, they can add up to any value in the range [0, 3]. Therefore, there is considerable leeway for paraconsistent information (when $T(x) + I(x) + F(x) > 1$) and incomplete information (when $T(x) + C(x) + G(x) + U(x) + F(x) < 1$). There is a non-zero hesitating buffer permitted in every situation. All three values sum up exactly to 1. This indicates the completion of our understanding.

T. Witczak introduced the general concept of neutrosophic Borda method.

The Borda count can be viewed as a family of decision rules in general. We will only make use of one of them. Here, everything depends on the reality that neutrosophic sets provide assessments for each of the criteria. We compute five Borda subranks (one for each neutrosophic logical value) for every pair (scenario, criteria). Whether the criterion is an expensive or beneficial criterion determines the specifics of this computation. Next, we calculate the Borda ranking for the given pair by adding up those ranks. We determine these rankings based on every criterion, presuming that the situation remains unchanged. The Borda number for this specific circumstance is then obtained by adding them all together.

Next, we evaluate each scenario according to its Borda number. They are arranged in inverse order. The greatest outcomes are the largest. To determine the optimum alternate available to working women's for infertility, the researchers have sought to propose a mathematical model here employing pentapartitionedneutrosophic sets. The most basic version of the pentapartitionedneutrosophic Borda method, that is, without weights, will be developed in this study.

2.Basic Definitions

2.1 Definition

A neutrosophic set A is defined on the universe of discourse X as follows:A={ <x, $T_A(x)$, $I_A(x)$, $F_A(x)$ >, x ∈ X} the conditions $^-0 \le T_A(x)+I_A(x)+F_A(x) \le 3^+$ define respectively the degree of membership, the degree of indeterminacy, and the degree of non-membership respectively as T, I, F: X →] 0,1$^+$[.

2.2 Definition: If E and U are the set of parameters and the initial universe, Let A⊆ E, and let P(U) is the power set of U. A soft set over U is a pair (F, A), where F is the mapping defined by F: A→P(U).

In another way, a soft set over U is a parameterized family of subsets of the universe, U. An extra notation for the soft sets (F, A).

2.3 Definition: Let E and U be the set of parameters and the initial universe set. Consider A⊂B. Let N(U) be the set of all neutrosophic sets of U. The collection (F, A) over U can be called the neutrosophic soft set given a mapping F: A→ N(U).

2.4Definition

Let U be a universe. A **quadri partitioned neutrosophic set** A on U is defined as A = {<x, $T_A(x)$, $C_A(x)$,$U_A(x)$, $F_A(x)$ >: $x \in U$} Where T_A, C_A,U_A, F_A:$X \longrightarrow$ 0,1 *and* $0 \le T_A(x) + C_A(x) + U_A(x) + F_A(x) \le 4$ Here $T_A(x)$ is the truth membership, $C_A(x)$is contradiction membership, $U_A(x)$is ignorance membership and $F_A(x)$ is the false membership.

2.5 Definition

Let Y be a set defined by the universe. Then we define D as PentapartionedNeutrosophic sets over Y in the following way:D={Y,$T_D(Y)$,$C_D(Y)$, $G_D(Y)$, $U_D(Y)$, $F_D(Y)$; y ∈ Y},∀ y ∈ Y; $T_D(Y)$, $C_D(Y)$, $G_D(Y)$, $U_D(Y)$, $F_A(Y) \le [0,1]$. T-truth, C-contradiction, G-ignorance, U- unknown, and F-falsity. $0 \le \text{Sup } T_D(Y) + \text{Sup } C_D(Y) + \text{Sup } G_D(Y) + \text{Sup } U_D(Y) + \text{Sup } F_D(Y) \le 5$.

3. PentapartitionedNeutrosophic Algorithm

Let's say we have n criteria (parameters) and m scenarios (options, alternatives, and objects). We identify criteria with r_1, r_1, r_3, ...r_m and scenarios with s_1, s_2, s_3,.....s_m. With this, we derive our first choice matrix, $\lfloor s_{ij} \rfloor_{m\times n}$where s_{ij}represents a pentapartionedneutrosophic assessment $s_{ij}$with respect to criterion r_j. Therefore, it has the form

$$\left(T_{r_j}(s_i), C_{r_j}(s_i), G_{r_j}(s), U_{r_j}(s_i), F_{r_j}(s_i)\right)$$

Clearly, for any i∈ {1, 2, 3,...., m}, j ∈ {1, 2, 3,....., n}. We have $T_{r_j}(s_i), C_{r_j}(s_i), G_{r_j}(s), U_{r_j}(s_i), F_{r_j}(s_i) \in [0, 1]$, and $T_{r_j}(s_i) + C_{r_j}(s_i) + G_{r_j}(s_i) + U_{r_j}(s_i) + F_{r_j}(s_i) \le 5$. Regarding the criteria, we presume that some are favorable and some are unfavorable. As a result, we may illustrate these structures as follows:

Criterion / Scenario	r_1	r_2	....	r_n

s_1	s_{11}	s_{12}	….	s_{1n}
s_2	s_{21}	s_{22}	….	s_{2n}
….	….	….	….	….
s_m	s_{m1}	s_{m2}	….	s_{mn}

For any i ∈ {1,2,3,….,m}, and j ∈ {1,2,3,…..,n} we have

$$s_{ij} = \left(T_{r_j}(s_i), C_{r_j}(s_i), G_{r_j}(s_i), U_{r_j}(s_i), F_{r_j}(s_i)\right).$$

The ultimate rating that will enable us to identify the best possible and worst alternatives is what we are interested in. These are the algorithm's steps.

3.1 For each criterion r_j, where j ∈ {1,2,...,n}:

(a) If r_j is an unfavourable criterion, then:

i. For every i in the range {1, 2, 3,….,m}, sort the values $T_{r_j}(s_i)$ in inverse order.
ii. For every i in the range {1, 2, 3,….,m}, sort the values $C_{r_j}(s_i)$ in inverse order.
iii. For every i in the range {1, 2, 3,….,m}, sort the values $G_{r_j}(s_i)$ in elevation in order.
iv. For every i in the range {1, 2, 3,….,m}, sort the values $U_{r_j}(s_i)$ in elevation in order.
v. For every i in the range {1, 2, 3,….,m}, sort the values $F_{r_j}(s_i)$ in elevation in order.

(b) If r_j is a favorable criterion, then:

i. For every i in the range {1, 2, 3,….,m}, sort the values $T_{r_j}(s_i)$ in elevation order.
ii. For every i in the range {1, 2, 3,….,m}, sort the values $C_{r_j}(s_i)$ in elevation order.
iii. For every i in the range {1, 2, 3,….,m}, sort the values $G_{r_j}(s_i)$ in inverse order.
iv. For every i in the range {1, 2, 3,….,m}, sort the values $U_{r_j}(s_i)$ in inverse order.
v. For every i in the range {1, 2, 3,….,m}, sort the values $F_{r_j}(s_i)$ in inverse order.

The rank of s_i in the first order for any criterion shall be called Borda truth-subrank of (s_{ij}) and represented by $R_T(s_{ij})$. Borda contradiction-subrank of (s_{ij}) will be the term given to the rank of s_i in the second order, and it will be represented as $R_C(s_{ij})$. Borda ignorance-subrank of (s_{ij}) is the term for the rank of s_i in the third order, which is represented by $R_G(s_{ij})$. The rank of s_i in the fourth order will be represented by $R_U(s_{ij})$ and dubbed Borda unknown-subrank of (s_{ij}) . Borda falsity-subrank of (s_{ij}) is the rank of s_i in the fifth order, and it is represented by $R_F(s_{ij})$.

3.2. For each scenario s_i , i ∈ {1, 2, 3....m} and each criterion r_j , j ∈ {1, 2.....n}(that is each elements_{ij}) calculate it's Borda Rank:

BR$(s_{ij}) = R_T(s_{ij})+R_C(s_{ij})+R_G(s_{ij})+R_U(s_{ij})+ R_F(s_{ij})$.

3.3. For each scenario s_i (where i∈ {1,2,3....m}) sum up the complements of all its Borda ranks to 5m to obtain its Borda number: B$(s_i) = \sum_{j=1}^{n}\left(5m - BR\left(s_{ij}\right)\right)$.

3.4. Sort the Borda numbers you have obtained by inverse order. The best cases are shown by thelargest numbers.

4. Application of PentapartionedNeutrosophic Sets

The researchers gathered the opinions of fifty women who lived in Coimbatore city and belonged to five distinct categories, 10 from each category, to determine the best alternative accessible for women to infertility. They are described in more detail below:

W_1 - Women's are employment by software firms.

W_2 - Women's are employed by software businesses.

W_3- Women's are employed by government agencies

W_4 - Women's are who are employed by educational establishments.

W_5 - Women's are who are entrepreneurs.

The reasons for the infertility of the people that have been found are as follows:

A_1 - Unhealthy diet

A_2 - Age

A_3 - Obesity

A_4 - Genetic reason

A_5 - Stress

Using the five options as the universal set implies the formation of pentapartitionedneutrosophic sets.

The five groups of working women's are denoted by $U = \{A_1, A_2, \ldots A_5\}$ and $E = \{W_1, W_2, \ldots W_5\}$. The pentapartitioned neutrosophic sets are framed and provided in tabular form based on the respondents' opinions.

U	W_1	W_2	W_3	W_4	W_5
A_1	(0.4,0.2,0.25,0.1, 0.05)	(0.5,0.3,0.04,0.1 ,0.05)	(0.4,0.3,0.2,0.05 ,0.05)	(0.6,0.2,0.07,0.1 ,0.03)	(0.3,0.3,0.2,0.15 ,0.05)
A_2	(0.5,0.3,0.1,0.09, 0.01)	(0.6,0.2,0.1,0.02 ,0.08)	(0.3,0.3,0.2,0.06 ,0.04)	(0.4,0.2,0.1,0.15 ,0.15)	(0.2,0.4,0.3,0.04 ,0.06)
A_3	(0.8,0.02,0.01,0.0 9,0.08)	(0.5,0.2,0.1,0.07 ,0.03)	(0.3,0.4,0.15,0.1 ,0.05)	(0.4,0.3,0.15,0.1 , 0.05)	(0.5,0.3,0.1,0.09 ,0.01)
A_4	(0.7,0.15,0.1,0.05 ,0.05)	(0.5,0.2,0.1,0.15 ,0.05)	(0.4,0.3,0.15,0.1 ,0.05)	(0.35,0.3,0.2,0.1 ,0.05)	(0.2,0.4,0.3,0.05 ,0.05)
A_5	(0.6,0.2,0.1,0.05, 0.05)	(0.4,0.3,0.15,0.1 ,0.05)	(0.3,0.2,0.1,0.35 ,0.05)	(0.6,0.2,0.1,0.05 ,0.05)	(0.1,0.3,0.2,0.35 ,0.05)

Let us execute our algorithm

4.1. Take W_1. This is the unfavorable Criterion, We have the following arrangements:

1. T (A_{11}) = 0.4, 2. T (A_{21}) = 0.5, 3. T (A_{51}) = 0.6, 4. T (A_{41}) = 0.7, 5. T (A_{31}) = 0.8
1. C (A_{31}) = 0.02, 2. C (A_{41}) = 0.15, 3. C (A_{11}) = C (A_{51}) = 0.2, 4. C (A_{21}) = 0.3.
1. G (A_{11}) = 0.25, 2. G (A_{21}) = G (A_{41}) = 0.1, 3. G (A_{51}) = 0.05, 4. G (A_{31}) = 0.01.
1. U (A_{51}) = U (A_{11}) = 0.1, 2. U (A_{21}) = U (A_{31}) = 0.09, 3. U (A_{41}) = 0.05.
1. F (A_{51}) = 0.1, 2. F (A_{31}) = 0.08, 3. F (A_{41}) = F (A_{11}) = 0.05, 4. F (A_{21}) = 0.01.

Thus we have the following Borda Ranks:

BR $(A_{11}) = T(A_{11}) + C(A_{11}) + G(A_{11}) + U(A_{11}) + F(A_{11})$

= 1+3+1+1+3 = 9

Similarly, we calculate,

$BR(A_{21}) = 2 + 4 + 2 + 2 + 4 = 14$
$BR(A_{31}) = 5 + 1 + 4 + 2 + 2 = 14$
$BR(A_{41}) = 4 + 2 + 2 + 3 + 3 = 14$
$BR(A_{51}) = 3 + 3 + 3 + 1 + 1 = 11.$

4.2. Take W_2. This is the unfavorable Criterion, We have the following arrangements:

1. T (A_{52}) = 0.4, 2. T (A_{12}) = T (A_{32}) = T (A_{42}) = 0.5, 3. T (A_{22}) = 0.6
1. C (A_{22}) = C (A_{32}) = C (A_{42}) = 0.2, 2. C (A_{12}) = C (A_{52}) 0.3.
1. G (A_{52}) = 0.15, 2. G (A_{22}) = G (A_{32}) = G (A_{42}) = 0.1, 3. G (A_{12}) = 0.04.
1. U (A_{42}) =0.15, 2. U (A_{52}) = U (A_{12}) = 0.1, 3. U (A_{32}) = 0.07, 4. U (A_{22}) = 0.02.
1. F (A_{22}) = 0.08, 2. F (A_{12}) = 0.06, 3. F (A_{42}) = F (A_{52}) = 0.05, 4. F (A_{32}) = 0.03.

Thus we have the following Borda Ranks:

$BR(A_{12}) = 2 + 2 + 3 + 2 + 2 = 11$
$BR(A_{22}) = 3 + 1 + 2 + 4 + 1 = 11$
$BR(A_{32}) = 2 + 1 + 2 + 3 + 4 = 12$
$BR(A_{42}) = 2 + 1 + 2 + 1 + 3 = 9.$
$BR(A_{52}) = 1 + 2 + 1 + 2 + 3 = 9$

4.3. Take W_3. This is the favorable Criterion, We have the following arrangements:

1. T (A_{13}) = T (A_{43}) = 0.4, 2. T (A_{23}) = T (A_{33}) = T (A_{53}) = 0.3.
1. C (A_{33}) = 0.4, 2. C (A_{13}) = C (A_{23}) = C(A_{43}) = 0.3, 3. C (A_{53}) = 0.2.
1. G (A_{53}) = 0.1, 2. G (A_{33}) = G (A_{43}) = 0.15, 3. G (A_{13}) = G (A_{23}) = 0.2.
1. U (A_{13}) =0.05, 2. U (A_{23}) = 0.06, 3. U (A_{33}) = U (A_{43}) = 0.1, 4. U (A_{53}) = 0.35.
1. F (A_{23}) = 0.04, 2. F (A_{13}) = F (A_{33}) = F (A_{43}) = F (A_{53}) = 0.05.

Thus we have the following Borda Ranks:

$BR(A_{13}) = 1 + 2 + 3 + 1 + 2 = 9$
$BR(A_{23}) = 2 + 2 + 3 + 2 + 1 = 10$
$BR(A_{33}) = 2 + 1 + 2 + 3 + 2 = 10$
$BR(A_{43}) = 1 + 2 + 2 + 3 + 2 = 10$

$BR(A_{53}) = 2 + 3 + 1 + 4 + 2 = 12$

4.4. Take W_4. This is the favorable Criterion, We have the following arrangements:

1. T (A_{14}) = T (A_{54}) = 0.6, 2. T (A_{24}) = T (A_{34}) = 0.4, T (A_{44}) = 0.35.
1. C (A_{34}) = C (A_{44}) = 0.3, 2. C (A_{14}) = C (A_{24}) = C(A_{54}) = 0.2.
1. G (A_{14}) = 0.07, 2. G (A_{24}) = C (A_{54}) = 0.1, 3.G (A_{34}) = 0.15, 4. G (A_{44}) = 0.2.
1. U (A_{54}) = 0.05, 2. U (A_{14}) = U (A_{34}) = U (A_{44}) = 0.1, 3.U (A_{24}) = 0.15.
1. F (A_{14}) = 0.03, 2. F (A_{34}) = F (A_{44}) = F (A_{54}) = 0.05, 3. F (A_{24}) = 0.15.

Thus we have the following Borda Ranks:

$BR(A_{14}) = 1 + 2 + 1 + 3 + 1 = 8$
$BR(A_{24}) = 2 + 2 + 2 + 3 + 3 = 12$
$BR(A_{34}) = 2 + 1 + 3 + 2 + 2 = 10$
$BR(A_{44}) = 3 + 1 + 4 + 2 + 2 = 12$
$BR(A_{54}) = 1 + 2 + 2 + 1 + 2 = 8$

4.5. Take W_5. This is the favorable Criterion, We have the following arrangements:

1. T (A_{35}) = 0.5, 2. T (A_{15}) = 0.3, 3. T (A_{45}) = T (A_{25}) = 0.2, T (A_{55}) = 0.1.
1. C (A_{25}) = C (A_{45}) = 0.4, 2. C (A_{15}) = C (A_{35}) = C(A_{55}) = 0.3.
1. G (A_{35}) = 0.1, 2. G (A_{15}) = C (A_{55}) = 0.2, 3.G (A_{25}) = G (A_{45}) = 0.3.
1. U (A_{25}) = 0.04, 2. U (A_{45}) = 0.05, 3. U (A_{35}) = 0.09, 4.U (A_{15}) = 0.15, 5.U (A_{55}) = 0.35.
1. F (A_{35}) = 0.06, 2. F (A_{15}) = F (A_{55}) = F (A_{45}) 0.05, 3.F (A_{25}) = 0.06.

Thus we have the following Borda Ranks:

$BR(A_{15}) = 2 + 2 + 2 + 4 + 2 = 12$
$BR(A_{25}) = 3 + 1 + 3 + 1 + 3 = 11$
$BR(A_{35}) = 1 + 2 + 1 + 3 + 1 = 8$
$BR(A_{45}) = 3 + 1 + 3 + 2 + 2 = 11$
$BR(A_{55}) = 4 + 2 + 2 + 5 + 2 = 15.$

Borda Numbers:
$\mathbf{B(A_1) = \sum_{j=1}^{n} 5\boldsymbol{m} - BR(x_{ij})}$

$B(A_1) = (25- 9) + (25-11) + (25-9) + (25-8) + (25-12)$

$= 16 + 14+ 16 + 17 + 13$

$B(A_1) = 76.$
$B(A_2) = (25- 14) + (25-11) + (25-10) + (25-12) + (25-11)$

$= 11 + 14+ 15 + 13 + 14$

$B(A_2) = 67.$

$B(A_3) = (25- 14) + (25-12) + (25-10) + (25-10) + (25-8)$

= 11 + 13+ 15 + 15 + 17

$B(A_3) = 71$.

$B(A_4)$ = (25- 14) + (25-9) + (25-10) + (25-12) + (25-11)

= 11 + 16+ 15 + 13 + 14

$B(A_4) = 69$.

$B(A_5)$ = (25- 11) + (25-9) + (25-12) + (25-8) + (25-15)

= 14 + 16+ 13 + 17 + 10

$B(A_5) = 70$.

Now let us organize Borda numbers in inverse order:

$B(A_1) = 76, B(A_3) = 71, B(A_5) = 70, B(A_4) = 69, B(A_2) = 67.$

The best scenario is A_1 and the worst scenario is A_2.

The highest score in this case is 76.ie. Unhealthy diet = 76.

Therefore, an**"Healthy diet"** is the best alternative for working women who are infertile, according to this study.

5. Conclusion

In order to determine the optimal treatment option for infertility available to working women, the authors of this paper present and create a mathematical model utilizing the pentapartitionedneutrosophic Borda technique.

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