**Neutrosophic Vague Decision Making Model Selection Of Educational Stream For Higher Education**

 **Ancy Vershinia1,Mohana K 2 , Radhika V R 3**

1PG student, Department of Mathematics, Nirmala College for Women, Coimbatore

e-mail: ancyvershinia11@gmail.com

2 Assistant Professor, Department of Mathematics, Nirmala College for Women, Coimbatore

e-mail: riyaraju1116@gmail.com

3 Research Scholar, Department of Mathematics, Nirmala College for Women, Coimbatore e-mail: radhikaramakrishnan2805@gmail.com

**ABSTRACT**

 In this paper the concept of Neutrosophic Vague Decision Making Model Selection Of Educational Stream For Higher Education is discussed with some examples.

**INTRODUCTION**

The idea of a fuzzy set was initially suggested in 1965 by Lofti A. Zadeh [7]. The key idea behind this approach is that it establishes the uncertainty of a set via a membership function that provides values to the components of the universal set that fall between [0,1]. These metrics are referred to as membership degrees. In 1986 Atanassov [1] introduced the Intuitionistic Fuzzy Set, which expands on the Fuzzy Set concept by additionally taking into account the non-membership degree. In this case, the cardinality of a finite member is indicated by the letter s.

 A special instance of context-dependent fuzzy sets, the theory of hazy sets was first put forth by Gau and Buehrer [4] as an extension of fuzzy set theory. By proposing the idea of a Neutrosophic set, Smarandache expanded the notion of an intuitionistic fuzzy set (NS). Smarandache originally discussed Neutrosophy in 1995, and in 2005 [3] he defined the Neutrosophic set theory, one of the most significant new mathematical techniques for dealing with issues involving erroneous, ambiguous, and inconsistent data. Many scholars go on to employ NS in both their theoretical and applied research after then.

 The term "Neutrosophic vague set," which combines the terms "Neutrosophic set" and "vague set," was first introduced by Shawkat Alkhazaleh [6] in 2015. Neutrosophic vague theory is a useful method for analysing ambiguous, conflicting, and incomplete data.

Indeterminacy was divided into three categories by Smarandache [7]: unknown, contradiction, and ignorance. He also developed Five Symbol Valued Neutrosophic Logic (FSVNL).

 In this work, we introduced and discussed the Neutrosophic Vague Decision Making Model Selection Of Educational Stream For Higher Education with examples.

**2. PRELIMINARIES**

**Definition 2.1 :**Let X be a nonempty set. A **Fuzzy set** A in X is given by

 A =

Where : X is the membership function of the Fuzzy Set A.

(i.e) , is the membership of in A.

**Definition 2.2:** An **Intuitionistic Fuzzy Set (IFS),** 𝐴 in 𝑋 is given by 𝐴 = {〈𝑥,𝜇𝐴(𝑥),𝜈𝐴(𝑥)〉/𝑥 ∈ 𝑋} where 𝜇𝐴: 𝑋 → [0,1] and 𝜈𝐴: 𝑋 → [0,1] with the condition 0 ≤ 𝜇𝐴(𝑥)+ 𝜈𝐴(𝑥) ≤ 1,∀𝑥 ∈ 𝑋.Here 𝜇𝐴(𝑥) and 𝜈𝐴(𝑥) ∈ [0,1] denote the membership and non-membership functions of the Fuzzy set 𝐴.

**Definition 2.3 :** A **vague set** is defined by a truth-membership function t𝑣 and a false membership function f𝑣, where s a lower bound on the grade of membership of 𝑥 derived from the evidence for 𝑥, and f(𝑥) is a lower bound on the negation of 𝑥 derived from the evidence against 𝑥. The values of t𝑣(𝑥) and 𝑓𝑣(𝑥) are both defined on the closed interval [0, 1] with each point in a basic set 𝑋, where t𝑣(𝑥) + f𝑣(𝑥) ≤ 1.

**Definition 2.4 :** Let U be a universe. A **Neutrosophic set** A on 𝑋 can be defined as follows:

 𝐴 = {〈𝑥,𝑇𝐴(𝑥),𝐼𝐴(𝑥),𝐹𝐴(𝑥)〉:𝑥 ∈ 𝑋} where 𝑇,𝐼,𝐹: 𝑋 → [0,1] and 0 ≤ 𝑇𝐴(𝑥)+𝐼𝐴(𝑥)+𝐹𝐴(𝑥) ≤ 3. Here is the degree of membership, (𝑥) is the degree of indeterminacy and (𝑥) is the degree of non-membership.

**Definition 2.5:** A **Neutrosophic vague set** 𝐴𝑁𝑉 (NVS ) on 𝑋 written as

 𝐴 = { , whose truth membership, indeterminacy membership and false membership functions is defined as:

 =

Where, (1) = 1− (2) = 1−and (3) 0 when X is continuous, a NVS A can be written as

 𝐴 =

When X is discrete, a NVS A can be written as

**3. Single valued neutrosophic vague multiple attribute decision making problems based on GRA with interval weight information**

A multi-criteria decision-making problem with m alternatives and n attributes is here considered. Let be a discrete set of alternatives, and be the set of criteria. The decision makers provide the ranking of alternatives. The ranking presents the performance of alternatives against the criteria . The values associated with the alternatives for MADM problems can be presented in the following decision matrix (see Table 1)

Table 1: Decision matrix

D=

 .

 .

The weight represent the relative importance of criteria to the decision-making process such that S is the set of partially known weight information that can be represented by the following forms due to Kim and Ahn[18] and Park[19]

**Form 1:** A weak ranking: for ;

**Form 2**: A strict ranking: ;

**Form 3:** A ranking of differences:

**Form 4:** A ranking with multiples: ;

F**orm 5:** An interval form

The steps of single valued neutrosophic vague multiple attribute decision making based on GRA under SVNS due to Biswal et at.[20] can be presented as follows.

Step 1: Construction of the decision matrix with SVNSs

Consider the above mention attribute decision making problem(8). The general from decision matrix as shown in Table 1 can be presented after data pre-processing. Here the rating of alternatives with respect to attributes are considered as SVNSs. The neutrosophic values associated with the alternative for MADM problems can be represented in the following decision matrix (see Table 2)

Table 2: Decision matrix with SVNSs

 .

 .

 (9)

In the matrix denote the degrees of truth membership degree of indeterminacy and degree of falsity membership of the alternative with respect to attribute . These three components for SNVSs satisfy the following properties

**Step 2: Determination of the ideal neutrosophic vague estimate reliability solution (INVERS) and the ideal neutrosophic vague estimate un-reliability solution (INVEURS)**

The ideal neutrosophic vague estimate reliability solution (INERS) and the ideal neutrosophic vague estimate un-reliability solution (INEURS) for single valued neutrosophic vague decision matrix can be determined from the definition 11 and 12

**Step 3: Calculation of the neutrosophic vague grey relational coefficient**

Grey relational coefficient of each alternative from INERS can be defined as follows

Where is the distinguishing coefficient or the identification coefficient. Smaller value of distinguishing coefficient reflects the large range of grey relational coefficient. Generally, is set for decision making situation.

**Step 4: Determination of the weights of the criteria**

The grey relational coefficient between INERS and itself is (1, 1, ….. 1). Similarly, the grey relational coefficient INEURS and itself is also (1, 1, … 1). The corresponding deviation are presented as follows:

 (14)

 (15)

A satisfactory weight vector is determined by making smaller all the distance

Using the max-min operator [21] to integrate all the distance

for I = 1, 2, …., m and , Biswas et al. [20] formulated the following programming model

 (16)

For i=1, 2, … m

 (17)

 Here

Solving these two models (Model-1a) and (Model-1b), the optimal solution and can be obtained. Combination of these two optimal solution provides the weight vector of the criterion, i.e. (18)

**Step 5: Calculation of the neutrosophic vague grey relational coefficient (NGRC)**

 The degree of neutrosophic vague grey relational coefficient of each alternative from Indeterminacy Truthfullness Falsity Positive Ideal Solution (ITFPIS) and Indeterminacy Truthfullness Falsity Negative Ideal Solution (ITFNIS) area obtained using the following relations:

**Step 6: Calculation of the neutrosophic vague relative relational degree (NRD)**

Neutrosophic vague relative relational degree of each alternative from ITFPIS can be obtained employing the following equation: (21)

**Step 7: Single valued neutrosophic vague decision-making model Selection of Educational stream for higher Education**

Based on the field study, five major criteria for are identified by domain experts for developing a model for the selection of educational stream by the parents for their children. The details are presented as follows

1)**Availability of courses:**

It includes the course details in that college which a student can choose.

2) **Facility of transportation**

It includes the cost of transportation facility availed by the student provided by college administration from student’s house to the college.

3) **Cost :**

It includes reasonable admission fees and other fees stipulated by the college administration

4) **Staff and curriculums :**

The degree of capability of the college administration in providing good competent staff, teaching and coaching, and extra curricular activities

5) **Placement programs:**

 It includes the placement availability provided by the college for the student’s good career path.

After initial screening, three schools listed below were considered as alternative and as attempt has been made to develop a model to select the best one based on the above-mentioned criteria

Table 3: Decision matrix with SVNVS

 (22)

Information of the attribute weights is partially known. The known information is given as follows:

**The problem is solved by the following steps:**

**Step 1: Determination of the ideal neutrosophic vague estimate reliability solution**

 The ideal neutrosophic vague estimate reliability solution (INERS) from the given decision matrix (see Table 3) can be obtained as follows

=

 =

**Step 2: Determination of the ideal neutrosophic vague estimate un-reliability solution**

 The ideal neutrosophic vague estimate un-reliability solution can be obtained as follows

 (24)

 =

**Step 3: Calculation of the neutrosophic vague grey relational coefficient of each alternative from INERS and INEURS**

 Using equation (12) the neutrosophic vague grey relational coefficient of each alternative from INERS can be obtained as follows:

 1.0000 0.5692 0.4805 0.5692 0.3333

 0.5692 0.6491 0.6491 0.5211 0.4253

 0.5692 0.6491 0.6491 0.6491 1.0000

 and from equation (13) the neutrosophic vague grey relational coefficient of each alternative from INEUS is obtained as follows:

 0.5211 1.0000 0.6491 0.6411 1.0000

 0.6411 0.6411 0.5692 1.0000 0.5692

 0.6411 0.6411 0.4805 0.5692 0.3333

**Step 4: Determination of the weights of attribute**

**Case 1:** Using the model (*Model- 1a)* and *(Model- 2a)* the single objective LPP models is formulated as follows:

Case 1a:

Min

Subject to,

Case 1b:

Min

Subject to

After solving Case 1a and Case 1b separately we obtain the solution set

 therefore the obtained weight vector of criteria is

**Step 5: Determination of the degree of neutrosophic Vague grey relational co-efficient (NGRC) of each alternative from INERS and INEUS.**

The required neutrosophic vague grey relational coefficient of each alternative from INERS is determined using equation (19). The corresponding obtained weight vector W for Case 1 and Case 2 is presented in the table 4. Similarly the neutrosophic vague grey relational coefficient of each alternative from INEURS is obtained with the help of equation (20)

**Step 6: Calculation of the neutrosophic Vague relative relational degree (NRD)**

Neutrosophic vague relative degree (NRD) of each alternative from INERS is obtained with the help of equation (21)

Table 4: Ranking of the alternative

|  |  |
| --- | --- |
| Weight vector  | (0.1601, 0.15, 0.30, 0.21, 0.1799) |
| NGRC from INERS | (0.5691, 0.5692, 0.6994) |
| NGRC from INEURS | (0.7427, 0.6820, 0.5224) |
| NRD from INERS | (0.4338, 0.4549, 0.5724) |
| Ranking Result  |  |
| Selection  |  |

**Step 7: Ranking of the alternatives**

From Table 4, we observe that i.e

**Conclusion**

 In this paper, we showed the application of neutrosophic vague decision making model on Selection Of Educational Stream For Higher Education based on hybridization of grey system theory . Five criteria’s are used to modeling the Educational Stream for higher education choice problem in neutrosophic vague environment which are realistic in nature. New criterion can be easily incorporated in the model for decision making if it is needed. Application of the neutrosophic vague multiple attribute decision-making in real life problems helps the people to take a correct decision from the available alternatives in grey and neutrosophic vague hybrid environment. The concept presented in this paper can also be easily extended when the weight information are incomplete.

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