

Pentapartitioned Neutrosophic Pythagorean Correlation for MADM Research Study

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Abstract:

A correlation coefficient is a statistical measure which contributes to deciding the degree to which changes in one variable predict changes in another. Wang's single-valued neutrosophic sets have still continued to improve to pentapartitioned neutrosophic sets. In this article, we analyze the characteristics of pentapartitioned neutrosophic Pythagorean sets with improved correlation coefficients. We've also used the same approach in multiple attribute decision-making methodologies, including one with a pentapartitioned neutrosophic Pythagorean environment. Finally, we implemented the above technique to the problem of multiple attribute group decision-making.

Introduction

Fuzzy sets were introduced by Zadeh [23] in 1965, allowing the membership to perform values within the interval $[0,1]$, and set theory is an extension of classical pure mathematics. The fuzzy set helps to deal with the thought of uncertainty, unclearness and impreciseness that isn't attainable within the Cantorian set. As an Associate in Nursing extension of Zadeh's fuzzy set theory, intuitionistic fuzzy set (IFS) was introduced by Atanassov [1] in 1986, which consists of the degree of membership and degree of non-membership and lies within the interval of $[0,1]$. IFS theory is widely utilized in the areas of logic programming, decision-making issues, medical diagnosis, etc.

Florentin Smarandache [15] introduced the idea of a Neutrosophic set in 1995 that provides information on neutral thought by introducing the new issue referred to as uncertainty within the set. Thus, the neutrosophic set was framed, and it includes the parts of truth membership function (T), indeterminacy membership function (I), and falsity membership function (F) severally. Neutrosophic sets deal with non-normal intervals of $] -0 \ 1 +[$. Since neutrosophic sets deal with minuteness effectively, they play a very important role in several application areas, embracing info technology, decision web, multicriteria decision making, electronic database systems, diagnosis, multicriteria higher cognitive process issues, etc.

To method the unfinished data or imperfect data to unclearness a brand new mathematical approach, i.e., To deal the important world issues, Wang [16](2010) introduced the idea of single-valued neutrosophic sets (SVNS), which is additionally referred to as an extension of intuitionistic fuzzy sets and it became a really new hot analysis topic currently. Rama Malik., et al. [14] projected the idea of Pentapartitioned single-valued neutrosophic sets that rely on Belnap's five valued logic and

Smarandache's five numerical valued logic. In (PSVNS) indeterminacy is split into three functions referred to as 'Contradiction' (both true and false) 'Ignorance' (neither true nor false), and an 'unknown' membership in order that PSVNS has five parts, T, C, U, F, G that additionally lies within the non-normal unit interval $] -0 \ 1 +[$. Further, R. Radha and A. Stanis Arul Mary[7] outlined a brand new hybrid model of Pentapartitioned Neutrosophic Pythagorean sets (PNPS) in 2021. The correlation coefficient may be an effective mathematical tool to test the strength of the link between 2 variables. A lot of researchers pay attention to the idea of varied correlation coefficients of the various sets, such as fuzzy sets, IFS, SVN, and QSVN. In 1999, D.A. Chiang and N. P. Lin [3] projected the correlation of fuzzy sets underneath fuzzy settings. Later D.H. Hong [4] (2006) outlined fuzzy measures for a coefficient of correlation of fuzzy numbers below T_w (the weakest t-norm) based mostly on fuzzy arithmetic operations.

Correlation coefficients play a very important role in several universe issues like multiple attribute cluster higher cognitive process, cluster analysis, decision-making problems, pattern recognition, diagnosis, etc. Therefore, several authors targeted the idea of shaping correlation coefficients to resolve important world issues in significant multicriteria decision-making strategies. Jun Ye [19] outlined the improved correlation coefficients of single valued neutrosophic sets and interval neutrosophic sets for multiple attribute higher cognitive process to beat the drawbacks of the correlation coefficients of single valued neutrosophic sets (SVNSs) that is outlined in [22]. In this paper, we have applied an improved correlation coefficient on Pentapartitioned Neutrosophic Pythagorean sets and studied with an example.

Preliminaries

2.1 Definition [15]

Let X be a universe. A Neutrosophic set A on X can be defined.

2.2 Definition [7]

Let X be a universe. A Pentapartitioned neutrosophic Pythagorean set A with T , F , C and U as dependent neutrosophic components and I as an independent component for A on X is an object of the form.

Here, μ_A is the truth membership, μ_C is contradiction membership, μ_I is ignorance membership, μ_F is the false membership, and μ_U is an unknown membership.

2.3 Definition [14]

Let P be a non-empty set. A Pentapartitioned neutrosophic set A over P characterizes each element p

in P a truth -membership function, a contradiction membership function, an ignorance membership function, unknown membership function and a false membership function, such that for each p in P .

2.4 Definition [7]

The complement of a pentapartitioned neutrosophic Pythagorean set (F, A) on X Denoted by and is defined as

$$(x)=$$

2.5 Definition [7]

Let $A =$ and $B =$ be pentapartitioned neutrosophic Pythagorean sets. Then

$$A B = <$$

$$A B =$$

Improved Correlation Coefficients

Based on the concept of the correlation coefficient of PNPS s, we have defined the improved correlation coefficients of PNPS s in the following section.

3.1 Definition

Let P and Q be any two PNPs s in the universe of discourse $R = \{ r_1, r_2, r_3, \dots, r_n \}$, then the improved correlation coefficient between P and Q is defined as follows.

$$K (P, Q) =))))]$$

$$(3.1)$$

3.2 Theorem

For any two PNPS s P and Q in the universe of discourse $R = \{ r_1, r_2, r_3, \dots, r_n \}$, the improved correlation coefficient $K(P, Q)$ satisfies the following properties.

$$K (P, Q) = K (Q, P);$$

$$0 ;$$

$K(P, Q) = 1$ iff $P = Q$.

Proof

It is obvious and straightforward.

Here, 0 1, 0 1, 0 1, 0 0 1, 1 1,

1 1, 1 1, 1 1, 1 1, Therefore the following inequation satisfies

(1 5. Hence, we have 0

(3) If $K(P, Q) = 1$, then we get $(1 = 5$. Since 0 (1 1, 0 1, 0 1, 0 1 and 0 1, there are (1 1, 1, 1, 1 and 1. And also since 0 1, 1, 0 1, 0 1 and 0 1, 1 1, 1, 1, 1, 1. We get and $1 = 1 = 1$. This implies, Hence ,, and for any and $k = 1, 2, 3, \dots, n$. Hence, $P = Q$.

Conversely, assume that $P = Q$, this implies ,, and for any and $k = 1, 2, 3, \dots, n$. Thus Hence, we get $K(P, Q) = 1$.

The improved correlation coefficient formula, which is defined, is correct and also satisfies these properties in the above theorem.

3.3 Example

Let $A = \{r, 0, 0, 0, 0\}$ and $B = \{r, 0.4, 0.2, 0.5, 0.1, 0.2\}$ be any two PNPS s in R . Therefore, by equation (3.1); we get $K(A, B) = 0.871.56$. It shows that the above-defined improved correlation coefficient overcomes the disadvantages of the correlation coefficient.

In the following, we define a weighted correlation coefficient between PNPSs since the differences in the elements are considered into account,

Let be the weight of each element ($k = 1, 2, \dots, n$), and then the weighted correlation coefficient between the PNPS s A and B .

$(A, B) =))))]$

(3.2)

If $w = (1/n, 1/n, 1/n, \dots, 1/n)^T$, then equation (4) reduces to equation (3). (A, B) also satisfies the three properties in the above theorem.

3.4 Theorem

Let be the weight for each element ($k = 1, 2, \dots, n$), $[0, 1]$ and then the weighted correlation coefficient between the PNPS s A and B, which is denoted by (A, B) defined in equation () satisfies the following properties.

$$(A, B) = (B, A);$$

$$(A, B) ;$$

$$(A, B) = 1 \text{ iff } A = B.$$

It is similar to proving the properties in theorem 3.1

Decision Making using the improved correlation coefficient of PNPS s

Multiple attribute decision-making (MADM) problems refer to making decisions when several attributes are involved in real-life problems. For example, one may buy a vehicle by analysing the attributes given in terms of price, style, safety, comfort, etc.

Here we consider a multiple attribute decision making problem with pentapartitioned neutrosophic Pythagorean information, and the characteristic Of an alternative ($i = 1, 2, \dots, m$) on an attribute ($j = 1, 2, \dots, n$) is represented by the following PNPS s:

$$= \{ (, \setminus) \}$$

Where and

$$0 \text{ for and } l = 1, 2, \dots, m.$$

To make it convenient, we are considering the following five functions in terms of pentapartitioned neutrosophic Pythagorean value (PNPV)

Here, the values are usually derived from the evaluation of an alternative with respect to criteria by the expert or decision maker. Therefore, we got a pentapartitioned neutrosophic Pythagorean decision matrix.

In the case of an ideal alternative, an ideal PNPV can be defined by

$$= (= (1, 1, 0, 0, 0) (j = 1, 2, \dots, n) \text{ in the decision making method,}$$

For $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$.

By using the above-weighted correlation coefficient, We can derive the ranking order of all alternatives, and we can choose the best one among those.

4.1 Example

This section deals with the example of the multiple attribute decision-making problem with the given alternatives corresponding to the criteria allowed under the pentapartitioned neutrosophic Pythagorean environment.

For this example, the three potential alternatives are to be evaluated under the four diffident attributes. The types of intellectual property rights are the alternatives, and the various cybercrimes are the attributes of this example. The three potential alternatives are copyright, patent rights, and trademarks, and the four different attributes are infringement, piracy, cybersquatting, and hacking. The evaluation of an alternative with respect to an attribute is obtained from a domain expert's questionnaire. According to the attributes, we will derive the ranking order of all alternatives, and based on this ranking order, the customer will select the best one.

By assigning the weight vector of the above attributes given by $w = (0.2, 0.35, 0.25, 0.2)$, Here the alternatives are to be evaluated under the above four attributes by the form of PNPS s_j ; in general, the evaluation of an alternative A_i with respect to the attributes C_j ($i=1,2,3, j=1,2,3,4$) will be done by the questionnaire of a domain expert. In particular, while asking the opinion about an alternative A_1 with respect to an attribute C_1 , the possibility he (or) she says that the statement true is 0.4, the statement both true and false is 0.3, the statement neither true nor false is 0.2, the statement false is 0.1, and the statement unknown is 0.4. It can be denoted in neutrosophic notation as $d_{11} = (0.4, 0.3, 0.4, 0.2, 0.1)$.

\				
	[0.4,0.3,0.4,0.2,0.1]	[0.5,0.4,0.5,0.3,0.2]	[0.4,0.1,0.4,0.1,0.1]	[0.6,0.2,0.6,0.3,0.2]
	[0.4,0.2,0.6,0.1,0.2]	[0.3,0.3,0.5,0.2,0.1]	[0.1,0.4,0.2,0.3,0.2]	[0.5,0.3,0.6,0.1,0.1]
	[0.3,0.4,0.4,0.3,0.4]	[0.5,0.1,0.6,0.2,0.1]	[0.4,0.5,0.4,0.3,0.2]	[0.3,0.2,0.5,0.2,0.2]

Then, by using the proposed method, we will obtain the most desirable alternative. We can get the values of the correlation coefficient $M_w(A_i, A^*)$ ($i = 1,2,3$) by using Equation (3.3).

Hence $M_w(A_1, A^*) = 0.586276$, $M_w(A_2, A^*) = 0.5640$, $M_w(A_3, A^*) = 0.56921$.

Thus, the ranking order of the three potential alternatives is $A_1 > A_3 > A_2$. Therefore, we can say that

A1 alternative copyright has more cyber problems subsisting in original literary, dramatic, musical, artistic, cinematographic film, sound recording and computer programs as well than the other alternatives of intellectual property rights. The decision-making method provided in this paper is more judicious and more vigorous.

Conclusion

In this paper, we've outlined the improved correlation coefficient of PNPSs, and this is often applicable for a few cases once the correlation coefficient of PNPSs is undefined (or) meaningful. We have also studied its properties. Decision-making could be a process that plays a significant role in real-world issues. The most common method in the higher cognitive process is recognizing the matter (or) chance and deciding to deal with it. Here, we've mentioned the decision-making technique using the improved correlation of PNPSs. An illustrative example is given in multiple attribute higher cognitive process issues involving many alternatives supported by varied criteria. Therefore, our projected improved correlation of PNPSs helps to spot the foremost appropriate difference to the client supported on the given criteria.

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