Southeast Europe Journal of Soft Computing ISSN 2233 – 1859
Available online: http://scjournal.ius.edu.ba

Vol 12, No. 2, September 2023, pp. 06-09

Decision making process over neutrosophic pythagorean soft sets using measure of correlation

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Article Info

Article history:

Article received on 09 10 2023.

Received in revised form 28 10 2023.

Keywords:

Neutrosophic Pythagorean set;
Neutrosophic Pythagorean soft set;
Correlation coefficient of NPSSs

ABSTRACT: Correlation is an analytical term that expresses how closely two variables are related linearly. It is an iconic tool to demonstrate simple relations without stating a cause-and-effect link. Correlations are useful for describing specifics relationships. In this paper, the correlation coefficient to Neutrosophic Pythagorean Soft Sets [NPSS] have introduced and studied some of its basic execution. The concept of NPSS correlation assessments is an extension of fuzzy set and neutrosophic set correlation measures. Then the application of college selection based on the students' preferences is given using the correlation of the NPSS measure.

1. INTRODUCTION

Every situation encounters uncertainty in every aspect of lives. While tossing a coin, you will get either a coin with a head or a tail, but you don't know which way it will fall, numerous hypotheses have been put forward to deal indeterminacy and to conclude the real-world situations, some of which are as follows: Blaise Pascal (1632-62) and Pierre Fermet (1602-65) the concept of pioneered, the concept of probability theory. Zadeh [10] introduced the notion of fuzzy sets (FSs) in the year 1965. Atanassov [1] provided his perspective on IFS in 1986.

Smarandache [2, 5] proposed the notion of NS in 1998, after Atanassov. According to his definition, the NS is defined by truthiness, indeterminacy, and falseness, and its value can be derived from usual and exceptional subsets of]0, 1[.

Wang et al [6] proposed single valued neutrosophic set in response to the challenge in applying NSs in realistic problems. To describe insufficient, unexpected, imprecise, and erroneous facts, it suggests another prospect that is present in the world.

The concept of similarity has vital implications in all scientific domains of study. Several approaches for computing similarity measures between FSs have been proposed by Wang. In terms of indeterminacy, these strategies are incapable of dealing with similarity measures [3].

Wang's single valued neutrosophic sets have progressed to neutrosophic pythaogrean soft sets.

In this study, the notion of correlation measures of neutrosophic pythagorean soft sets is defined, and some of its properties are demonstrated. The application for the process of selection of the best crops in a suitable land is illustrated.

2. DEFINITIONS AND NOTATIONS

2.1. Definition [9]

Let X be a universe. A Neutrosophic set P on X can be defined as follows:

$A = \{< x, T_P(x), I_P(x), F_P(x) >: x \in X\}$

where $T_P, I_P, F_P: U \to [0,1]$ and $0 \le T_P(x) + I_P(x) + F_P(x) \le 3$

Here, $T_P(x)$ is the degree of membership, $I_P(x)$ is the degree of inderminancy and $F_P(x)$ is the degree of non-membership.

2.2. Definition [4]

let X be a universe. T_P and F_P are dependent neutrosophic components in a Neutrosophic pythagorean set P on X is a void of form object, $P = \{< x, T_P(x), I_P(x), F_P(x) >: x \in X\}$

Where $T_P, I_P, F_P: U \to [0,1]$ and

$0 \le T_P(x)^2 + I_P(x)^2 + F_P(x)^2 \le 2$

2.3 Definition [4]

A set $(\mathcal{F}, P)$ is known as a neutrosophic pythagorean soft set [NPSS] over X, where F is a mapping

$\mathcal{F}: P \to \mathfrak{P}(X)$,

where X represent the universe set and E indicate the collection of parameters on X. Consider a nonempty set P on E, and define $\mathfrak{P}(X)$,as the set of all neutrosophic pythagorean sets of X.

2.4. Definition [4]

Let $(\mathcal{F}, P)$ be a neutrosophic pythagorean soft set over X, then the complement of $(\mathcal{F}, P)$ is denoted by $(\mathcal{F}, P)^c$ and it is defined by

$P = \{< x, F_P(x), 1 - I_P(x), T_P(x) >: x \in X\}$

2.5 Definition [8]

Let $P = \{< x, T_P(x), I_P(x), F_P(x) >: x \in X\}$ and $Q = \{< x, T_Q(x), I_Q(x), F_Q(x) >: x \in X\}$ be any two neutrosophic pythagorean soft sets over a nonempty set X, then

$$P \cup Q =< x, \max\left(T_P(x), T_Q(x)\right), \max\left(I_P(x), I_Q(x)\right), \min\left(F_P(x), F_Q(x)\right) >$$

$$P \cap Q =< x, \min\left(T_P(x), T_Q(x)\right), \min\left(I_P(x), I_Q(x)\right), \max\left(F_P(x), F_Q(x)\right) >$$

2.6 Definition [7]

A neutrosophic pythagorean soft topology on a nonempty set M is a family of a neutrosophic pythagorean soft sets in M satisfying the following axioms

$0,1 \in \tau$

$M_1 \cap M_2 \in \tau$ for any $M_1, M_2 \in \tau$

$\bigcup M_i \in \tau$ for any $M_i: i \in I \subseteq \tau$

The complement R* of neutrosophic pythagorean soft open set (NPSOS, in short) in neutrosophic pythagorean soft topological space [NPSTS] (M,τ), is called a neutrosophic pythagorean soft closed set [NPSCS].

2.7 Definition [1]

Let (X, τ) be an NPSTS and $P =< x, T_P(x), I_P(x), F_P(x) >$ be an NPSS in X. Then the interior and the closure of P are denoted by NPSInt(P) and NPSCl(P) and are defined as follows.

NPSCl(P) = ∩ {K|K is an NPSCS and P ⊆ K} and

NPSInt(P) = ∪ {G|G is an NPSOS and G ⊆ P}

Also, it can be established that

NPSCl(P) is an NPSCS and

NPSInt(P) is an NPSOS,

P is an NPSCS if and only if NPSCl(P) = P and

P is an NPSOS if and only if NPSInt(P) = P. We say that P is NPS- dense if NPSCl(P) = X.

3. CORRELATION CO-EFFICIENT BETWEEN NEUTROSOPHIC PYTHAGOREAN SOFT SETS

3.1 Definition

Let X be a nonempty set and I be the unit interval [0, 1]. Let P and Q be any two Neutrosophic Pythagorean Soft Set (in short, NPSS) on X which are in the form:

$P = \{(x, T_P(X), I_P(X), F_P(X)): x \in X\}$ and $Q = \{(x, T_Q(X), I_Q(X), F_Q(X)): x \in X\}$.

Then the correlation coefficient of P and Q is given by

$$\rho(P, Q) = \frac{K(P,Q)}{\sqrt{K(P,P).K(Q,Q)}} \quad (1)$$

where $K(P,Q) = \sum_{i=1}^{n}[(T_P(x_i))^2 . (T_Q(x_i))^2 + (I_P(x_i))^2 . (I_Q(x_i))^2 + (F_P(x_i))^2 . (F_Q(x_i))^2]$,

$K(P,P) = \sum_{i=1}^{n}[(T_P(x_i))^2 . (T_P(x_i))^2 + (I_P(x_i))^2 . (I_P(x_i))^2 + (F_P(x_i))^2 . (F_P(x_i))^2]$ and

$K(Q,Q) = \sum_{i=1}^{n}[(T_Q(x_i))^2 . (T_Q(x_i))^2 + (I_Q(x_i))^2 . (I_Q(x_i))^2 + (F_Q(x_i))^2]$

Proposition 3.1

The defined correlation measure between NPS sets P and Q satisfies the following properties:

(i) $0 \le \rho(P,Q) \le 1$

(ii) $\rho(P,Q) = 1$ if and only if P = Q

(iii) $\rho(P,Q) = \rho(Q,P)$.

Proof:

(i) $0 \le \rho(P,Q) \le 1$

As the truth-membership, indeterminacy membership and falsity membership of the NPSS lies between 0 and 1, $\rho(P,Q)$ also lies between 0 and 1.

Then

$K(P,Q) = \sum_{i=1}^{n}(((T_P(x_i))^2 . ((T_Q(x_i))^2 + ((I_P(x_i))^2((I_Q(x_i))^2 + ((F_P(x_i))^2 . ((F_Q(x_i))^2)$

$=(((T_P(x_1))^2 . ((T_Q(x_1))^2 + ((I_P(x_1))^2((I_Q(x_1))^2 + ((F_P(x_1))^2 . ((F_Q(x_1))^2 + (((T_P(x_2))^2((T_Q(x_2))^2 + ((I_P(x_2))^2((I_Q(x_2))^2 + ((F_P(x_2))^2 ((F_Q(x_2))^2 + \cdots + ((T_P(x_n))^2((T_Q(x_n))^2 + ((I_P(x_n))^2((I_Q(x_n))^2 + ((F_P(x_n))^2 . ((F_Q(x_n))^2$

By Cauchy – Schwarz inequality, $(x_1y_1 + x_2y_2 + \cdots + x_ny_n)^2 \le (x_1{}^2 + x_2{}^2 + \cdots + x_n{}^2).(y_1{}^2 + y_2{}^2 + \cdots + y_n{}^2)$, where $(x_1 + x_2 + \cdots + x_n) \in R^n$ and $(y_1 + y_2 + \cdots + y_n) \in R^n$, we get

$K(P,Q) \le (((T_P(x_1))^4 + ((I_P(x_1))^4 + ((F_P(x_1))^4 + ((T_P(x_2))^4 + ((I_P(x_2))^4 + ((F_P(x_2))^4 + \ldots + ((T_P(x_n))^4 + ((I_P(x_n))^4 + ((F_P(x_n))^4) \times (((T_Q(x_1))^4 + ((I_Q(x_1))^4 + ((F_Q(x_1))^4 + ((T_Q(x_2))^4 + ((I_Q(x_2))^4 + ((F_Q(x_2))^4 + \cdots + ((T_Q(x_n))^4 + ((I_Q(x_n))^4 + ((F_Q(x_n))^4)$

$\le (((T_P(x_1))^2((T_P(x_1))^2 + ((I_P(x_1))^2((I_P(x_1))^2 + ((F_P(x_1))^2((F_P(x_1))^2 + ((T_P(x_2))^2((T_P(x_2))^2 + ((I_P(x_2))^2((I_P(x_2))^2 + ((F_P(x_2))^2((F_P(x_2))^2 + \cdots + ((T_P(x_n))^2((T_P(x_n))^2 + ((I_P(x_n))^2((I_P(x_n))^2 + ((F_P(x_n))^2((F_P(x_n))^2) \times ((T_Q(x_1))^2((T_Q(x_1))^2 + ((I_Q(x_1))^2((I_Q(x_1))^2 + ((F_Q(x_1))^2((F_Q(x_1))^2 + ((T_Q(x_2))^2((T_Q(x_2))^2 + ((I_Q(x_2))^2((I_Q(x_2))^2 + ((F_Q(x_2))^2((F_Q(x_2))^2 + \cdots + ((T_Q(x_n))^2((T_Q(x_n))^2 + ((I_Q(x_n))^2((I_Q(x_n))^2 + ((F_Q(x_n))^2((F_Q(x_n))^2)$

$\le K(P,P).K(Q,Q)$.

Therefore $(K(P,Q))^2 \le K(P,P).K(P,Q)$ and thus $\rho(P,Q) \le 1$.

Hence, we obtain the following property $0 \le \rho(P,Q) \le 1$.

(ii) $\rho(P,Q) = 1$ if and only if P = Q

Let the two NPSS P and Q be equal (i.e) P = Q.

Hence for any $T_P(x_i) = T_Q(x_i)$, $I_P(x_i) = I_Q(x_i)$ and $F_P(x_i) = F_Q(x_i)$

Then $K(P,P) = K(Q,Q) = \sum_{i=1}^{n}(((T_P(x_i))^2 . ((T_P(x_i))^2 + ((I_P(x_i))^2((I_P(x_i))^2 + ((F_P(x_i))^2 . ((F_P(x_i))^2)$

And

$K(P,Q) = \sum_{i=1}^{n}(((T_P(x_i))^2 . ((T_Q(x_i))^2 + ((I_P(x_i))^2((I_Q(x_i))^2 + ((F_P(x_i))^2 . ((F_Q(x_i))^2)$

$K(P,Q) = \sum_{i=1}^{n}(((T_P(x_i))^2 . ((T_P(x_i))^2 + ((I_P(x_i))^2((I_P(x_i))^2 + ((F_P(x_i))^2 . ((F_P(x_i))^2)$

$= K(P,P)$

Hence

$$\rho(P,Q) = \frac{K(P,Q)}{\sqrt{K(P,P).K(Q,Q)}} = \frac{K(P,P)}{\sqrt{K(P,P)K(P,P)}} = 1$$

Let $\rho(P,Q) = 1$.Then the unit measure is possible only if

$$\frac{K(P,Q)}{\sqrt{K(P,P).K(Q,Q)}} = 1$$

This refer that $T_P(x_i) = T_Q(x_i)$, $I_P(x_i) = I_Q(x_i)$ and $F_P(x_i) = F_Q(x_i)$,for all i. Hence P = Q.

(iii) If $\rho(P,Q) = \rho(P,Q)$, it is obvious that

$$\rho(P,Q) = \frac{K(P,Q)}{\sqrt{K(P,P).K(Q,Q)}} = \frac{K(Q,P)}{\sqrt{K(Q,Q).K(P,P)}} = \rho(Q,P)$$

$K(P) = \sum_{i=1}^{n}(((T_P(x_i))^2 . ((T_Q(x_i))^2 + ((I_P(x_i))^2((I_Q(x_i))^2 + ((F_P(x_i))^2 . ((F_Q(x_i))^2)$
$= \sum_{i=1}^{n}(((T_Q(x_i))^2 . ((T_P(x_i))^2 + ((I_Q(x_i))^2((I_P(x_i))^2 + ((F_Q(x_i))^2 . ((F_P(x_i))^2)$

$= K(Q,P)$

Hence the Proof.

4. APPLICATION

Now a days, the yielding of crops in was low due to lack of knowledge about selecting the suitable crop for the suitable soil. Using the correlation measure for NPSS, the decision is made.

5. ILLUSTRATION

Let R = {R1, R2, R3}, be a set of crops.

Let Y = {Y1, Y2, Y3} be a set of lands and

N ={ Season, Water Level, Plant Protection} be a set of parameters.

Table 1: P (The relation between crops and parameters)

P	Season	Water Level	Plant Protection
R_1	(0.2,0.1,0.8)	(0.9,0.2,0.1)	(0.5,0.4,0.5)
R_2	(0.7,0.3,0.3)	(0.6,0.1,0.4)	(0.8,0.5,0.2)
R_3	(0.6,0.5,0.4)	(0.7, 0.4,0.3)	(0.9,0.1,0.1)

Table 2 Q (The relation between parameters and land)

Q	Y1	Y2	Y3
Season	(0.8,0.1,0.2)	(0.9,0.3,0.1)	(0.5,0.6,0.5)
Water Level	(0.3,0.5,0.7)	(0.7,0.5,0.3)	(0.9,0.2,0.1)
Plant Protection	(1,0.5,0)	(0.3,0.5,0.7)	(0.3,0.5,0.7)

Table 3 Correlation Measure for P and Q

ρ	Y1	Y2	Y3
R1	0.2908	0.4996	0.8306
R2	**0.9021**	0.6926	0.5858
R3	0.5245	**0.8632**	0.5935

The highest correlation measure from table 3 gives the suitable land for the crops. Therefore, Crop R1 yields a large quantity of production in land Y3. Crops R2 suitable for the land Y1. Crops R3 suitable for the land Y2.

6. CONCLUSION

In this study, measures of correlation coefficient between NPS sets are introduced and their properties are demonstrated.

In addition, cases illustration is done. In this investigated, for the selection of the crops in the suitable lands are considered and based on the value of the correlation coefficient between them. Finally, the decision is established for the selection of best crops for yielding in suitable lands.

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