**Improved Correlation Coefficients of Fermatean Pentapartitioned single valued neutrosophic sets and interval Fermatean Pentapartitioned neutrosophic sets for multiple attribute decision making**

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**Abstract:** A correlation coefficients is individual of the statistical measure that helps to find the strength of changes to the worth predict change to the profit of another.Fermatean Pentapartitioned single valued

neutrosophic sets is an improvisation of wang’s single valued neutrosophic sets. In this paper we have

intentional the Improved Correlation Coefficients of Fermatean Pentapartitioned single valued neutrosophic sets and interval Fermatean Pentapartitioned neutrosophic sets and consider its characteristics. Further

we have used this idea in multiple attribute decision making methods accompanying Fermatean Pentapartitioned single valued neutrosophic environment and interval Fermatean Pentapartitioned single valued neutrosophic environment and interval Fermatean Pentapartitioned

single valued neutrosophic surroundings. Finally we pictorial an example in the same projected

 order to the multiple attribute decision making problems.

**Keywords:**

Fermatean Pentapartitioned single valued neutrosophic sets, Interval Fermatean Pentapartitioned

neutrosophic sets, improved correlation coefficient.

**Introduction:** Fuzzy sets were introduced by Zadeh in 1965 that admits the participation function valued in theinterval [0,1] and again it is an continuation of classical set hypothesis. As an extension of Zadhe’s fuzzy set theory intuitionistic fuzzy set(IFS) was introduced by Atanassov[1] in 1986,that consists of degree of membership and degree of non-membership and lies in the intervening time of [0,1]. IFS hypothesis wirely

used in the extents of sanity prioritize, decision making problems, healing disease etc.
Florentin Smarandache[11] introduce the idea of Neutrosphic set in 1995 that provides the

information of noncommittal concept by introducing the new determinant named indeterminacy in the set. Therefore neutrosophic set was constructed and it includes the elements of truth participation function (T), indeterminacy membership function (I), and deception participation function (F) individually. Neutrosophic sets dealswith non standard interval [0,1]. Since neutrosophic set deal the Indeterminacy efficiently it plays an lively role in many use extents involve information technology, conclusion group providing support to members, relative databse systems, healing diagonosis, multicriteria conclusion making questions etc.

Wang[12](2010) introduced the idea of single valued nuetrosophic sets (SVNS) which is as known or name data another time or place an extension of  intuitionistic fuzzy  sets and it became a new vehement

research matter now Rajashi Chatterjee., and others [10] projected the idea of Fermatean

Pentapartitioned single valued neutrosophicsets that is established Belnap’s four logic and

Smarandache’s four mathematical valued logic. In (FPSVNS) indeterminacy is splitted  into two

functions known as  ‘Contradiction’ (Two together true and false) and ‘unknown’

(neither true nor false) for fear that (FPSVNS) has five components TA , CA , KA , UA , FA that too display or take public the nonstandard unit interval [0,1]. Correlation coefficient is an active Mathematical

form to measure the substance of the connection between two variables. In 1999 D.A Chiang and

N.P.Lin [3] projected the correlation of fuzzy sets under fuzzy atmosphere. Correlation Coefficients

plays an main part in many realworld questions like diversified attribute group decision making, clustering

study, pattern acknowledgment, healing diagnosis etc., Jun Ye[20] delineated the improved  correlation

coefficients of single valued neutrosophic sets and interval nuetrosophicsets for multiple attribute

decision making to overcome the disadvantages of the correlation of single valued neutrosophic sets

(SVNSs) that is delineated in [16]. In this paper Section 2 gives few basic definitions of Quadripartitioned

single valued neutrosophic sets and Fermatean Pentapartitioned nuetrosophic sets and its

complement, union, intersection, interval neutrosophicsets, correlation coefficient of FPSVNS.

In Section 3, we brought in the idea of improved correlation coefficient of FPSVNS to overcome

the disadvantages of correlation coefficient that is outlined and also conferred few of allure properties and

decision making method utilizing the improved correlation coefficient of FPSVNSs. In Section 4, we imported the concept of interval Fermatean Pentapartitioned Neutrosophicsets (IFPNS) accompanying

few basic definitions and outlined correlation coefficient of IFPNS. Further we have also considered few of allure properties and decision making method utilizing the improved correlation coefficient with interval

Fermatean Pentapartitioned partitioned neutrosophic environment. Section 5 an explanatory instance is

given in above proposed correlation method particularly in multiple criteria decision making problems.

Section 6 decides the paper.

**2. Preliminaries:**

**2.1 Quadripartitioned single valued neutrosophic sets:**

**Definition 2.1. [5]**

Neutrosophic set is defined over the non-standard unit interval [0, 1] whereas single valued neutrosophic set is defined over standard unit interval [0,1]. It means a single valued neutrosophic set A is defined by

 x X}

where such that .

**Definition 2.2. [4]**

Let X be a non-empty set. A quadripartitioned single valued neutrosophic set (QSVNS) A over X characterizes each element in X by a truth membership function , a contradiction membership function , an ignorance membership function and a falsity membership function such that x X, and when X is discrete. A is represented as A = .

**Definition 2.2. [15]**

Consider X a universe. An object of the form A Fermatean pentapartitioned neutrosophic set (FPN)

A on X. A = {< x, TA , CA , KA , UA , FA ,) >: x X }

(TA)3 + (CA)3 + (KA)3+ (UA)3 + (FA)3 ≤ 3

Here, TA(x ) is the truth membership.

CA(x) is contradiction membership,

KA(x) is ignorance membership

UA (x) is unknown membership,

FA(x) is the false membership,

**3. Fermatean Pentapartioned single valued neutrosophic sets**

**3.1 Definition:**

Let X be a non-empty set. A Fermatean pentapartitioned single valued neutrosophic set (QSVNS)

A over X distinguishes each aspect in X by a truth membership function TA (x), a contradiction

membership function CA (x), an ignorance membership function  KA(x), a unknown membership

function UA (x) and a falsity membership function FA (x) said that x ϵ X, TA , CA , KA , UA , FA ϵ [0,1]

and . When X is discrete.

A is represented as A =.

**3.2 Definition**

The complement of a FPSVNS is denoted by and is defined as,

**3.3 Definition**

The union of two FPSVNS A and B is denoted by and is defined as

**3.4 Definition;**

The intersection of two FPSVNS A and B and is defined as,

**3.5 Definition:**

Let X be a space of points (object) with generic elements in X denoted by x. An INS interval neutrosophic set A in X is characterized by a truth membership function, an indeterminacy membership function, and a falsity function For each point x in X, there are,

 and . Thus, an INS A can be expressed as

 x X}

 =

Then the sum of satisfies the condition. .

Obviously, when the upper and lower ends of the interval values of in an INS are equal, the INS reduce to the SVNS. However, SVNSs and INSs are all the subclasses of neutrosophic sets.

**3.6. Definition**

The complement of an INS A is denoted by and is defined as

, and

for any x in X.

**3.7. Definition**

An INS A is contained in the other INS B, AB if and only if and.

**3.8. Definition**

Two INSs A and B are equal, written as A = B, if and only if AB and B.

**3.9. Definition: Correlation coefficient of QSVNSs**

Rajashi Chatterjee [4] defined the concept of the correlation coefficient of QSVNSs which is based on the correlation coefficient of SVNSs and is defined as follows:

K (A, B) =

--------- (1)

The correlation coefficient K (A, B) satisfies the following properties.

1. K(A,B) = K(B,A);
2. 0
3. K (A, B) = 1, iff A = B.

There will be some drawbacks in using Equation (1) which is given below.

For any two QSVNSs A and B, if and /or

 for any in X (i=1,2,3,…n).

Equation (1) is infinite or unmeaningful. In this case it is not likely to use ability that is likely in Equation (1).Equation (1) answer only the unavoidable condition of the property (3), but not the sufficient condition.

That is A≠B. Equation (1) concede possibility add up to 1.

**3.9.1 Example**

Let A and B be QSVNSs in X which are given by and

. Here obviously AB. Then

K (A, B) = = 1\_\_\_\_\_\_\_\_\_\_\_ (2)

Hence in this place case it is not likely to ask in legitimate existence model problems. To overcome these type of losses we be going to delineate an improved correlation coefficient in the following division.

**4. Improved Correlation coefficients**

Based on the idea or correlation coefficient of FPSVNSs, we have delimited the improved correlation coefficient of FPSVNSs in the following department.4.1.

**Definition 4.1**

Let A and B be some two FPSVNSs in outer space of discourse X = { therefore the improved correlation coefficient between A and B is outlined as follows:

M (A, B) = …..(3)

Where ,

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For any and i =1, 2, 3….n.

**Theorem 4.2**

For some two FPSVNSs A and B in outer space of discourse X = {x\_1,x\_(2 ,)…..x\_n}, the improved correlation coefficient M (A, B) satisfies the following features: M(A,B) = M(B,A); ;

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**PROOF**:

It is obvious ad straight forward.

Here ,,,,

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. Therefore the following inequation satisfies

Hence we have .

If M (A, B) = 1, then we get, =5. Since,,,

,, there are

= 1.

And also since ,,,,,,

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We get and

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Hence,, , , ,

 for any , and i = 1,2,3,….n.

Hence A = B. ,,,

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Now assume that A=B , implies , , , , for any , and i = 1,2,3,….n.

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Hence we get M (A, B) = 1.

The improved correlation coefficient formula that is defined in (3) is correct and too appease the three possessions in Theorem 3.1 when we use any constant λ>3 in the following expressions.

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When AB, consider the same example 2.12 we can get M (A, B) = 0.912 by applying Equation (3).

**Example 4.3**.Let A={〈x,0,0,0,0,0〉} and B={〈x,0.6,0.5,0.4,0.3,0.2〉} be two FPSVNSs in X. Then unmistakably equating (1) is undefined. Therefore by utilizing equating (3) we get M (A, B) = 0.912. It shows that the same defined improved correlation coefficient overcome the loss of the correlation coefficient in [10] In the following, we delimit a weighted correlation coefficient between FPSVNSs because the distinctness’s in the components are thought-out into an report.Let w\_i be the weight for each element xi in X (i=1, 2, 3, …. n), and , then the weight correlation coefficient between the FPSVNSs A and B

 ..(4)

If , then equation (4) reduces to equation (3). also satisfies the three properties in Theorem 3.1.

**Theorem 4.4**

Let be the weight for each element in X (i=1,2,3,…n), and , then the weight correlation coefficient between the FPSVNSs A and B which is denoted by, defined by (4) also satisfies the following properties.

1. ;
2. ;

(iii) it is similar to prove the properties in Theorem 3.1.

**4.5. Decision making form utilizing the improved correlation coefficient of FPSVNSs.**

Multiple tests decision making (MCDM) problems refers to form decisions when various attributes are complicated in real – life question. For example individual concede possibility buy a limousine by resolving the attributes that is given in conditions of price, style, security, comfort etc. Here we feel a diversified attribute decision making problem accompanying Feramatean pentapartitioned single valued neutrosophic facts, and the characteristic of an alternative Ai,(i=1,2,3,…m) on an attribute Cj, (j=1,2,3….n) is presented apiece following FPSVNS.

….. (5)

Where and

 , for and

i =1, 2, 3….m.

To make it convenient, we are considering the following five functions in terms of a fermatean pentapartitioned single valued neutrosophic value (FPSVNV)

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Here the principles of are generally derived from the judgment of an alternative concerning a test apiece expert or decision maker. Therefore we took a fermatean pentapartitioned single valued neutrosophic decision matrix D =. In the case of ideal alternative an ideal FPSVNV can be defined by

 In the decision making method.

Hence the weight correlation coefficient between an alternative and the ideal alternative is given by,

 ..(6)

Where ,

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 for I = 1,2,….m and j = 1,2,…n

By utilizing the same weighted correlation coefficient M\_w (A\_i,A^\* ) (i=1, 2…m), we can obtain the ranking order of all opportunities and we can pick best choice individual between those. Interval Fermatean Pentapartitioned Neutrosophic sets (IFPNS)

**Definition 5.1**

An IFPNS A in x is designated by a truth membership functionT\_A (x), an contradiction membership function CA(x), an ignorance membership function KA (x) , an unknown membership function UA (x) and a falsity membership functionFA (x). For each point x in X, there are

 and

. Therefore an IFPNS a can be denote as

 x X}

= / x X}

Then the sum of satisfies the condition,

. If the lower and upper ends of the interval values of in an IFPNS are equal then IFPNS reduces to the FPSVNS. Both IFPNS and FPSVNS are all the subclasses of Fermatean pentapartitioned neutrosophic sets (FPNS).

**Definition 5.2** The complement of an IFPNS A is denoted by and is defined as

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 for any x in X.

**Definition 5.3.** An IFPNS A is contained in the other IFPNS B, iff

For any x in X.

**Definition 5.4**

Two IFPNS A and B are equal i.e., A =B, iff and .

**5.5. Correlation coefficient between IFPNSs**.

In this section we projected a correlation coefficient between IFPNS as a inference of the improved correlation coefficient of FPSVNSs.

**Definition 5.6.** The correlation coefficient between two IFPNS A and B in the universe of discourse

 is defined as follows:

N (A, B) = …..(7)

Where , ,

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Here we present a weighted a correlation coefficient between IFPNSs A and B by favor the weight of the element xi (I = 1,2,…n) into an give reason for some xi ϵX and I = 1,2,…n. Let wi be the weight each component xi (i=1, 2…n), wi ϵ[0,1] and, wi =1, therefore the weighted correlation coefficient between the IFPNSs A and B that is meant by Nw (A,B) delimited In following equating (8).

…….(8)

If , then equation (8) reduces to equation (7). When

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 in the IFPNS A and ,

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, in the IFPNS B for any in X and i=1,2,…..n, then the IFPNS A and B reduces to the FPSVNSs A and B respectively, and also the equation (7) and (8) reduce to equations (3) and (4). Both N (A, B) and also satisfies the three properties of theorem 3.1 and theorem 3.2.

**Theorem 5.7**. For any two IFPNSs A and B in the universe of discourse, the correlation coefficient N (A, B) satisfies the following properties

1. N(A,B) = N(B,A);
2. ;
3. .

It is similar to prove the properties in Theorem 3.1.

**Theorem 5.8**

Let be the weight for each element and, then the weighted correlation coefficient between the IFPNSs A and B which is denoted by defined in equation (8) also satisfies the following properties.

1. ;
2. ;

It is similar to prove the properties in Theorem 3.1.

**5.9. Decision making method using the improved correlation coefficient of IFPNSs.**

Here we believe a multiple attribute decision making problem accompanying interval Fermatean Pentapartieioned neutrosophic information, and the characteristic of an alternative A\_i (i=1,2,……m) on an attribute C\_j (j=1,2,……n) is depicted apiece following IFPNS.

Where and

for and I = 1,2,….m.

To make it convenient, we are considering the following five functions

, ,

, ,

, in terms of a interval fermatean pentapartitioned neutrosophic value (IFPNV)

Here the values of are usually derived from the evaluation of an alternative with respect to a criterion by the expert or decision maker. Therefore we got an interval Fermatean pentapartitioned neutrosophic decision maker . In this an ideal IFPNV can be defined by

In the ideal alternative, Hence by applying equation (8) the weighted correlation coefficient between an alternative and the ideal alternative is given by,

 = …..(9)

Where , , ,

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For i =1, 2…m and j = 1, 2, 3….n.

By using the above weighted correlation coefficient,

we can evolve the ranking order of all alternatives and we can pick highest in rank individual between those. Illustrative exampleThis division deals the model for the multiple attribute decision making problem accompanying the likely alternative complements to the tests assigned under fermatean pentapartitioned single valued neutrosophic environment and interval feramatean pentapartitioned neutrosophic environment. Decision making under feramatean pentapartitioned single valued neutrosophic environment. The model that will review present is about best choice cellular telephone between all accessible options based on differing tests. The options A1, A2, A3 individually designates the mobile1, mobile2, mobile3. The consumer must conclude in accordance with the following four attributes namely (1) C1 is the cost (2) C2 is the average space (3) C3 is the camcorder character (1) C4 is the looks. According to this attributes we will assume the ranking order of all alternatives and established this order consumer will select highest in rank individual. The weight vector of the same attributes is likely by . Here the opportunities search out be

judged under the same five attributes by the form of FPSVNSs. In general the judgment of an alternative Ai with respect to an attribute C j ,( i =1,2,3; j = 1,2,3,4,5)Will be approved apiece inquiry of a rule expert. In specifically, while wanting to know the belief about an alternative A1with respect to an attribute C1, the possibility he (or) she say that the assertion true is 0.5 the assertion two together true and false is 0.4, the statement neither true nor false is 0.3 and the charge false is 0.2. It maybe meant in neutrosophic documentation as d11 = 〈0.5, 0.4, 0.3, 0.2〉. Continuing this process for all three opportunities concerning four attributes we will take the following fermatean pentapartitioned single valued neutrosophic decision cast.

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|  | [ | [ | [ | [ |
|  | [ | [ | [ | [ |

Then by using the proposed method we will obtain the most desirable alternative. We can get the values of the correlation coefficient by using equation (6).

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Therefore the ranking order is . The alternative (Mobile 1) is the best choice among all the three alternatives.

**6.3. Decision making under interval Fermatean pentapartitioned nuetrosophic environment.**

Consider the same example here the three possible alternatives are to be evaluated under the above four attributes by the form of IFPNSs. In general the evaluation of an alternative with respect to an attribute (i=1,2,3;j=1,2,3,4) will be done by the fermatean pentapartitioned of a domain expert. Therefore we get the following interval fermatean pentapartitioned nuetrosophic decision matrix R.

Then by using the proposed method we will obtain the most desirable alternative. We can get the values of the correlation coefficient by using equation (9).

Hence ,,

Therefore the ranking order is . The alternative (Mobile 2) is the best choice among all the three alternatives with respect to the given criteria under interval fermatean pentapartitioned neutrosophic environment.

**7 conclusion**

In this paper we have delineated the improved correlation coefficient of FPSVNSs, IFPNSs and this person's friend appropriate for some cases when the correlation coefficient of FPSVNSs outlined in [ ] is undefined (or) unmeaningful and more intentional its features. Decision making is a process which plays a essential duty in real life questions. The main process in decision making is recognizing the problem (or) opportunity and deciding to address it. Here we have considered the decision making arrangement using the improved correlation coefficient of FPSVNSs, IFPNSs and in particularly an explanatory model is likely in multiple attribute decision making problems that includes the several options established miscellaneous tests. Hence our proposed improved correlation coefficient of FPSVNss, IFPNSs helps to identify ultimate appropriate alternative to the customer established the given criteria.

**References**

1. D.A Chiang and N.P. Lin. Corrleation of fuzzy sets, fuzzy sets and systems 102 (1999), 221-226.
2. Mohana.K, Chiristy V, F.Smarandache, On Multi-criteria decision Making problem via Bipolar single valued neutrosophic settings, Neutrosophic sets and Systems 25(2019)125-135.
3. K Mohana, M Mohanasundari, Improved Correlation Coefficients of Quadripartitoned single valued neutrosophic sets and interval quadripartitioned neutrosophic sets for multiple attribute decision making 10.4018/978-1-7998-2555-5.ch014 (2020)
4. Rajashi Chatterjee, P majundar and S.K. Samanta, on some similarity measures and entropy on quadripartitioned single valued neeutrosophic sets, Journal of intelligent and Fuzzy Systems 30, 2016, 2475-2485.
5. F. Smarandache, A Unifying field in Logics, Neutrosophic Probability, Set and logic, American Reseach Press, Rcholoth,1999
6. Wang H. Smarandache F, Zhang Y Q, Sunderraman R (2010) single valued neutrosophic sets Multspace multistruct 4-410-113.
7. G.W.Wei,H.J.Wang and R. Lin, Application of correlation coefficient of Interval-valued intuitionistic fuzzy multiple attribute decision making with incomplete weight I formation. Knowledge and Information Systems 26 (2011), 337-349.
8. J.Ye, Multicriteria fuzzy decisision-making method using entropy weights-based correlation coefficients of interval valued intuitionistic fuzzy sets, applied mathematical Modeling 34 (2010), 3864-3870.
9. Jun Ye, Another form of correlation Coefficient between single valued neutrosophic sets and its multiple attribute decision Making Method, Neutrosophic Sets and Systems, 1,8-12.doi.org/10.5281/zenodo.571265
10. J.Ye.Multicriteria decision making method using the correlation coefficient under single valued neutrosophic environment, International of general Systems 42(4) (2013), 386-394.
11. Jun Ye and Qiansheng Zhang(2014), Single valued Neutrosophic Similarity Measures for Multiple attribute decision making Neutrosophic Sets and Systems, 2.48-54.doi.org/10.5281/zenodo.571756
12. Jun Ye, Florentin smarandache (2016), Similarity Measure of refined single valued Neutrosophic Sets and its multicriteria Decision making method, Neutrosophic sets and Systems, 12,41-44.doi.org/10.5281/zenodo.571146
13. J Ye. Correlation coefficient of dual hesitant fuzzy sets and its application to multiple attribute decision making, Applied mathematical Modeling 38 (2014), 659-666.
14. J.Ye. Improved correlation coefficients single valued neutrosophic sets and interval neutrosophic sets for multiple attribute decision making. Journal of intelligent and Fuzzy Systems 27 (2014) 2453-2462.
15. Subha R., K.Mohana (2023), Fermatean pentapartitioned nuetrosophic sets, Indain Journal of Natural Sciences, vol.14/Issue 77/April/2023, international Bimonthly (Print) – Open Access. ISSN:0976-0997