USE OF Γ- SOFT MATRIX IN SOLVING DECISION MAKING PROBLEMS

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Abstract
The hypothesis of soft sets started by Molodtsov, in light of soft set hypothesis in this article we characterized some fundamental definitions, for example, Γ-Soft Matrix representation of Γ-Soft, Cartesian product of Γ-Soft sets. In this work we added a another constraint set, Γ which refers the title of an organization or an agency. Based on this theory, we defined Γ- Soft matrix and applied in decision making problem by explain with an example.

Keywords: 'T'(ΓAMMA)- Soft set, Approach matrix, 'T'(ΓAMMA)- soft matrix, Characteristic function, Product of 'T'(ΓAMMA)- soft Matrices

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INTRODUCTION
Molodtsov was first started the soft theory which is the significant Mathematical instrument to take care of the issues with unpredictability's. Molodtsov talked about the functionality of the idea of soft set for applications in some sort of different ways. Maji examined the itemized theoretical investigation of soft-sets alike soft-sub set, net-set, equality involving soft-sets. They discussed applications on soft-sets, for example, 'union', 'intersection', 'and' and 'or' operations. Haci Aktas et.al [1] imported some basic important components of soft sets in order to compare soft-sets in order to the related ideas associated with fuzzy-sets and rough-sets. Ahmad and A. Kharal [2] introduced notations on mapping of soft classes and also presented some properties of images of soft set in which these can be applied in the problems of medical diagnosis. P. K. Das and R. Borgahain [3] studied about fuzzy soft set and that may be applied within a multi-observer multi-criteria decision making difficulties. Athar kharal [4] presented an optimum choice problem and also studied the upper and lower soft approximations with some results. Xiaohong Zhang [5] introduced notation on interval soft sets. Also the author discussed that typically the forbidden portrayal of interim soft-sets; interval choice values to take care of dynamic issues. Anjan Mulherjee et.al [6] proposed an IFS based investment model by showing an example and also they presented the effect of non-membership degree of elements on decision making. V. E. Saskała, D. Siva Raj [7] the authors analyzed regarding foundations of soft-semi open sets and soft-semi closed sets within soft-topological spaces. Zhicai Liu et al. [8] proposed some sort of technique based on soft-set and ideal remedy access in decision-making problems. Jose Carlos R. Alcantud and Gustavo Santos-Garcia [9] discussed a new approach to clarify a decision making problem. Quinrong Feng, Xia Guo [10] considered another way to deal solve group-decision making problems depending on fuzzy soft-sets. Muhammed Akram et.al [11] discussed about bipolar fuzzy-soft advice combining bipolar fuzzy-soft sets with graphs. T.Geetha and S. Usha studied different hyper of matrices in fuzzy soft set theory. S. Senthil kumar [12] introduced a technique of applying threshold for selecting an optimal set is suggested when the user deals with huge amount of data. Pramanik S. et. al [13] the authors presented some operations on Nuetrosophic cubic soft set like ‘p-union’, ‘p-intersection’ ‘R-union’ and ‘R-intersection’ etc. Wang and Chang [14] discussed about the properties of parameterized vague soft-sets. We introduced in this article a new constraint, T'(ΓAMMA) in soft-set building which demonstrate the title of the organization or name of the agency. We defined an algorithm for decision making which consists of product matrix, approach matrix and optimum set by taking an example.

METHODOLOGY
Preliminaries: We have to discuss in this division some basic definitions and outcomes on 'T'(ΓAMMA)- soft-sets through suitable illustrations.

'T'(ΓAMMA)- soft-set: The universal discourse C also P(C) be the power set of C. Let the sets of parameters attributes be K and T'(ΓAMMA). The triode (J, L, 'Γ'(GAMMA)) is named as a T'(ΓAMMA)- soft-set above the universal set, C is (J, L, 'Γ'(GAMMA)) = { J(a, γ) : a ⊆ C, γ ≥ 1 }.

where J is a relation given by J : L X Γ --> P(C) also K is the super set of L.

Illustration.1. Suppose the universal set, Z = { z₁, z₂, z₃, z₄, z₅ } comprising lot of six Televisions under thought. Let the parameters sets, K = { k₁, k₂, k₃ } and 'T'(ΓAMMA) = { E₁, E₂ } with respect to Z, where k₁: implies that costly, k₂: implies that less expensive and k₃: implies that good looking and also E₁: implies that quality-1 organization, E₂: implies that quality - 2 organization.

Assume L = { k₁, k₂, k₃ } ⊆ K. Then the product, L X 'T'(ΓAMMA) = { (k₁, E₁), (k₁, E₁), (k₂, E₁), (k₃, E₁) }.

Assume that R(k₁, γ) = { z₁, z₂ }, R(k₂, γ) = { z₂, z₃, z₄ }, R(ε₂, E₁) = { z₂, z₃ }, R(k₂, E₂) = { z₃, z₅ }.

The set (R, L, 'T'(ΓAMMA)) is a T'(ΓAMMA)- soft-set, which is a family of parameters (R(k₁, E₁), J₁ = 1, 2) of sub sets of the universal set, Z and provides the gathering of alikeess agreed as pursues.

(R, L, 'T'(ΓAMMA)) = { { R(k₁, E₁), { z₁, z₂ } }, { R(k₂, E₁), { z₂, z₃, z₄ } }, { R(k₂, E₂), { z₂, z₃ } }, { R(k₂, E₁), { z₃, z₅ } })

Where
Illustration 2 Assume Z = { z₁, z₂, z₃, z₄, z₅ } be a universal set, K = { k₁, k₂, k₃, k₄, k₅ } and Γ = { ε₁, ε₂, ε₃ } are the sets of constraints regarding C. Suppose that (R, L, 'Γ'(GAMMA)) and (G, M, 'Γ'(GAMMA)) are two T'(GAMMA)- soft sets above a universal discourse, C, where L and M are sub sets of a constraint set K and T'(GAMMA) is additionally another parameter set.

Illustration 3 Suppose two T'(GAMMA)- soft-sets, (J, L, T'(GAMMA)) and (G, M, T'(GAMMA)) above a universal set, C is characterized as [J(a,b), E] = H [J(a,b), E] and [G(b,E)] be the Cartesian product of two T'(GAMMA)- soft-sets above a universal set, C is characterized as:

\[ R(\{ k₁, \epsilon₁ \}) = \text{Brand - 1 company costly Televisions} = \{ z₁, z₂ \} \]
\[ R(\{ k₂, \epsilon₂ \}) = \text{Brand -2 company costly Televisions} = \{ z₂, z₃, z₄ \} \]
\[ R(\{ k₃, \epsilon₃ \}) = \text{Brand -1 company cheaper Televisions} = \{ z₃, z₅ \} \]
\[ R(\{ k₄, \epsilon₄ \}) = \text{Brand -2 company less expensive Televisions} = \{ z₃, z₅ \} \]

T'(GAMMA)- soft-subset: Assume that (R, L, 'Γ'(GAMMA)) and (G, M, 'Γ'(GAMMA)) are the two T'(GAMMA)- soft-sets above a universal discourse, C, we call (R, L, 'Γ'(GAMMA)) as a T'(GAMMA)- soft sub set of (G, M, T'(GAMMA)) if,

1) L ⊆ M
2) Every single element \( e \in L \), \( e \in \text{'Γ'(GAMMA)} \), the sets R(e, E), G(e, E) having identical approximations, in which the sets L and M are sub sets of a constraint set K and T'(GAMMA) is additionally another parameter set.

Characteristic function: The characteristic function, \( N_{R'} \) of R' is defined by

\[ N_{R'} \left( \begin{array}{c} u \\ v \end{array} \right) = \left\{ \begin{array}{r} 1, \left( (u, E), (v, E) \right) \\ 0, \left( (u, E), (v, E) \right) \end{array} \right\} \]

\[ \left( (u, E), (v, E) \right) \in R' \text{, where } N_{R'} \left( \begin{array}{c} u \\ v \end{array} \right) = \left\{ 0, \left( (u, E), (v, E) \right) \right\} \]

Illustration 4 Assume that U be the universal set and let E and T'(GAMMA) be the parameters sets with respect to the universal set, U and A ⊆ E, let \( (f₁, E, Γ) \) be a soft set over U, where \( U = \{ m₁, m₂, m₃ \} \), T'(GAMMA) = \{ ε₁, ε₂ \}. Let \( A = \{ e₁, e₂ \} \) be the subset of E. The T'- soft set \( I \) is defined by \( f₁(ε₁, E), f₁(ε₂, E), f₁(ε₁, E), f₁(ε₂, E) \). Let the \( Γ \)- soft relation \( R = \{ ((m₁, E₁), e₁), ((m₂, E₂), e₂) \}, \{ (m₁, E₁), e₁ \}, \{ (m₂, E₂), e₂ \} \). Therefore the \( Γ \)- soft matrix is defined by

\[ \begin{array}{c|c|c|c|c|c|c} \text{Brand} & E₁ & E₂ & c₁ & c₂ & c₃ & c₄ \\ \hline m₁ & 0 & 0 & 0 & 0 & 0 \\ m₂ & 0 & 0 & 0 & 0 & 0 \\ m₃ & 0 & 0 & 0 & 0 & 0 \\ m₄ & 0 & 0 & 0 & 0 & 0 \\ m₅ & 0 & 0 & 0 & 0 & 0 \\ \end{array} \]

The matrix can also be represented by

\[ \begin{array}{c|c|c|c|c|c|c} \text{Brand} & E₁ & E₂ & c₁ & c₂ & c₃ & c₄ \\ \hline m₁ & 0 & 0 & 0 & 0 & 0 \\ m₂ & 0 & 0 & 0 & 0 & 0 \\ m₃ & 0 & 0 & 0 & 0 & 0 \\ m₄ & 0 & 0 & 0 & 0 & 0 \\ m₅ & 0 & 0 & 0 & 0 & 0 \\ \end{array} \]

DISCUSSION

Operations on Γ- soft Matrices:

Union of T'(GAMMA)- soft matrices: Assume that \( M = [ M₁ ] \), \( N = [ Nₐ ] \) be two T'(GAMMA)- soft matrices the union of these two matrices is represented by \( M \cup N \) and is termed as \( M \cup N = \text{max} \{ aᵢ \ bᵢ \} \).

Intersection of T'(GAMMA)- soft matrices: Assume that \( M = [ M₁ ] \), \( N = [ Nₐ ] \) be two T'(GAMMA)- soft matrices the union of these two matrices is denoted by \( M \cap N \) and is defined as \( M \cap N = \text{min} \{ aᵢ \ bᵢ \} \).

Complement of T'(GAMMA)- soft matrices: Assume that \( M = [ M₁ ] \) is a soft matrix, \( M \) is defined by \( M^c \) and is characterized by \( M^c = \text{1} - aᵢ \).

Product of T'(GAMMA)- soft matrices: \( 'AND' \ Product: Suppose that \( M = [ M₁ ] \), \( N = [ Nₐ ] \) be two T'(GAMMA)- soft matrices the 'AND' product of two T'(GAMMA)- soft matrices is defined by \( M \times N \), where \( A : M \times N \Rightarrow M \times N \) is characterized as \( [ aᵢ ] \ A [ bᵢ ] = cᵦ \), in which
c_{ip} = \min\{a_{ij}, b_{ik}\} and \ p = n (j-1) + k, \text{ where } n \text{ shows the number of columns in the matrices.}

**'OR' Product**: Suppose that \(M = \begin{bmatrix} a_{ij} \end{bmatrix}, N = \begin{bmatrix} b_{ik} \end{bmatrix}\) be two \(\Gamma\)-soft matrices the 'OR' product of two \(\Gamma\)-soft matrices is denoted by \(M \lor N = \begin{bmatrix} a_{ij} \end{bmatrix} \lor \begin{bmatrix} b_{ik} \end{bmatrix}\), where \(M = \begin{bmatrix} a_{ij} \end{bmatrix}\) is characterized as \(a_{ij} = c_{ip}\), in which \(c_{ip} = \max\{a_{ij}, 1-b_{ik}\}\) and \(p = n (j-1) + k\), where \(n\) is the numeral of columns in the matrices.

**AND-NOT Product**: Let \(M = \begin{bmatrix} a_{ij} \end{bmatrix}\) be two \(T'(\text{GAMMA})\)-soft matrices the AND-NOT product of two \(T'(\text{GAMMA})\)-soft matrices is denoted by \(\lnot M = \begin{bmatrix} a_{ij} \end{bmatrix}\), where \(\lnot M = \begin{bmatrix} a_{ij} \end{bmatrix}\) is characterized as \(a_{ij} = c_{ip}\), in which \(c_{ip} = \min\{a_{ij}, 1-b_{ik}\}\) and \(p = n (j-1) + k\), where \(n\) is the number of columns in the matrices.

**APPLICATION**

Parents function a significant guidance in their children's profession progress profession decision-making. Now a days it is difficult to the parent to choose a institute for their wards. The parent has to take right decision to choose good institute for their wards. On this context we try to construct a model using \(\Gamma\)-soft matrices with some suitable parameters.

Consider \(s\) set of institutions \(\{m_1, m_2, m_3, m_4, m_5\}\) where \(m_1\) indicates institutions with good infrastructure and good faculty, \(m_2\) indicates institutions with some faculty are good but poor infrastructure, \(m_3\) indicates institutions with no proper identification, \(m_4\) indicates institutions with good faculty but no facilities, \(m_5\) indicates institutions with facilities and poor in students strength. The parameter set \(E = \{ c_1, c_2, c_3 \}\), where \(c_1\) is institutions with qualified faculty and sufficient number of faculty, \(c_2\) is institutions with no qualified faculty, \(c_3\) is institutions with insufficient qualified faculty and other parameter set \(\Gamma = \{ E_1, E_2 \}\) represents two agencies.

A parent Mr. X has to select right institute to his ward based on the information given by the agencies. The two agencies give their report on their own parameters.

Let the two agencies \(E_1\) and \(E_2\) consider their parameters sets as \(A = \{c_1, c_2\}\) and \(B = \{c_1, c_2\}\) respectively.

Let \((P, A, \Gamma)\) and \((Q, B, \Gamma)\) be two \(\Gamma\)-soft sets constructed by two agencies, which are defined as follows.

\((P, A, \Gamma) = \{ (c_1, E_1), (m_1, E_1), (m_2, E_1) \}, (c_2, E_1), (m_3, E_1) \}, (c_1, E_2), (m_1, E_2) \}) \)

\((Q, B, \Gamma) = \{ (m_1, E_1), (m_2, E_1), (m_3, E_1), (m_4, E_1) \} \}

\((c_1, E_1), (m_3, E_1), (m_4, E_1) \}) \}

\((c_1, E_1), (m_3, E_1), (m_4, E_1) \}) \}

\((c_1, E_1), (m_3, E_1), (m_4, E_1) \}) \}

\((c_1, E_1), (m_3, E_1), (m_4, E_1) \}) \}

The \(\Gamma\)-soft matrix of \(\Gamma\)-soft set \((P, A, \Gamma)\) is

\[
\begin{bmatrix}
1 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 1 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 \\
0 & 1 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 \\
\end{bmatrix}
\]

We can observe graphically the Table-1 between \(hi\) values and \((e_l, E)\) values from the following figure.
**Algorithm**

1) Consider the Γ-soft set with required parameters
2) Construct the Γ-soft matrix from the Γ-soft set
3) Calculate the product matrix for the Γ-soft matrices
4) Find the count of product matrix
5) Construct the approach matrix
6) Define the Optimum set to take the decision of the problem

**Count of product matrix:**

The count of product matrix is denoted by $G_{in}$ and is defined as

$$G_{in} = \sum_i C_{ip}$$

corresponding to the parameters $\xi_1$ and $\xi_2$.

**Approach Matrix**

The Approach matrix is constructed by taking article names $h_1$, $h_2$, $h_3$, $h_4$, $h_5$ as rows and the sum of elements in each row corresponding to the parameters $\xi_1$ and $\xi_2$ as columns.

| $m_1$ | $\xi_1$ | $\xi_2$ |
|-------|---------|---------|
| 1     | 2       | 2       |
| 0     | 0       | 1       |
| 1     | 0       | 0       |
| 0     | 0       | 0       |
| 0     | 0       | 1       |

Analysis: According to the report given by the Agencies-1&2 the parent has not choose the institutions without good faculty and good infrastructure. Even though the institutions have good infrastructure without good faculty the parent is not advise to choose that institutes.

**Optimum set** = \[ \{ \sum \xi_1, \sum \xi_2 \} \] min.

**Decision:** Based on the Optimum set the parent has to take advise from Agency-1 and parent has to choose the institute recommended by Agency-1.

From Figure-3 we can view the decision very clearly, i.e., we have to take the minimum value of.

**Conclusion**

In this paper we have discussed about the definitions like Γ-Soft set, Γ-Soft set matrix, Γ-Soft Characteristic function etc with suitable examples. Also, we explained by defining an algorithm to take a right decision between two agencies with an example.

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