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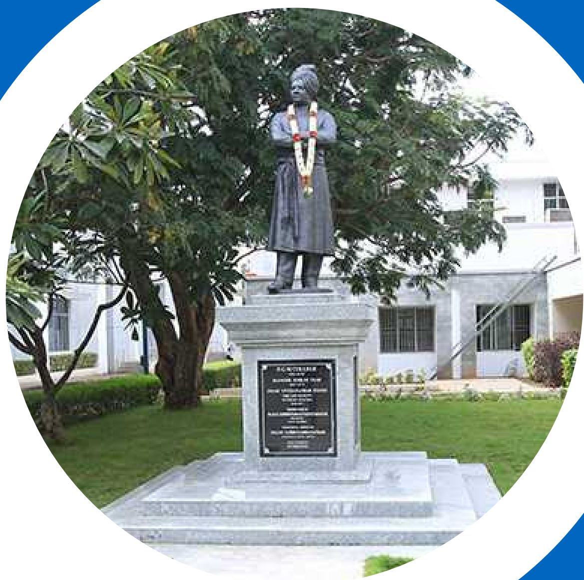

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Jointly Organized by

Department of Biological Science, Physical Science and Computational Science

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ABOUT THE INSTITUTION

A nations's growth is in proportion to education and intelligence spread among the masses. Having this idealistic vision, two great philanthropists late. S.P. Nallamuthu Gounder and Late. Arutchelver Padmabhushan Dr.N.Mahalingam formed an organization called Pollachi Kalvi Kazhagam, which started NGM College in 1957, to impart holistic education with an objective to cater to the higher educational needs of those who wish to aspire for excellence in knowledge and values. The College has achieved greater academic distinctions with the introduction of autonomous system from the academic year 1987-88. The college has been Re-Accredited by NAAC and it is ISO 9001 : 2015 Certified Institution. The total student strength is around 6000. Having celebrated its Diamond Jubilee in 2017, the college has blossomed into a premier Post-Graduate and Research Institution, offering 26 UG, 12 PG, 13 M.Phil and 10 Ph.D Programmes, apart from Diploma and Certificate Courses. The college has been ranked within Top 100 (72nd Rank) in India by NIRF 2021.

ABOUT CONFERENCE

The International conference on “Emerging Trends in Science and Technology (ETIST-2021)” is being jointly organized by Departments of Biological Science, Physical Science and Computational Science - Nallamuthu Gounder Mahalingam College, Pollachi along with ISTE, CSI, IETE, IEE & RIYASA LABS on 27th OCT 2021. The Conference will provide common platform for faculties, research scholars, industrialists to exchange and discus the innovative ideas and will promote to work in interdisciplinary mode.

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An Application of Hypersoft Sets in a Decision Making Problem

Dr. V. Inthumathi [1] - M. Amsaveni [2]

ABSTRACT: The aim of this paper is to provide an application of hypersoft sets in a decision making problems using hypersoft matrices.

Keywords: Hypersoft set, Reduct-hypersoft set, Choice value, Weighted choice value

1. INTRODUCTION

The process of selecting the best from the list of alternatives available for selection is called decision making. The decision making method requires a systematic procedure to define parameters which are necessary to take final decision as well as focused on how to bringing accuracy for collecting data for different parameters.

Molodtsov [1] defined Soft set as a mathematical tool to deal with uncertainities associated with real world problems. By definition, soft set can be identified by a pair (F, A) where F stands for a multi-valued function defined on the set of parameters A. Using the concept of Soft sets, many Mathematicians gave several applications in decision making problem. In [9], Inthumathi et al. presented some applications about soft matrices in decision making problems in the field of Medicine, Social Science and Agriculture.

Florentin Smarandache [10] generalized the soft set to the hypersoft set by transforming the function F into a multi-attribute function defined on the cartesian product of n different sets of parameters. This concept is more flexible than soft set and more suitable in the context of decision making problems. The notion of hypersoft set will attract the attention of researchers working on soft set theory and its diverse applications.

Mujahid Abbas et al. [12] defined the basic operations like union, intersection and difference of hypersoft sets. Also they have introduced hypersoft points and some basic properties of these points which laid the foundation for the hyper soft functions.

Muhammad Saeed et al. [11] introduced the fundamentals of hypersoft set such as hypersoft subset, complement, Not hypersoft set and aggregation operators. Also they defined the hypersoft set relation and their sub relation, complement relation, function, matrices.

In this paper, we provide an application of hypersoft sets in a decision making problem with the help of hypersoft matrices.

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2. PRELIMINARIES

Definition : 2.1 [1]

Let U be an initial universal set, E be a set of parameters and P(U) be the power set of U. A pair (F, E) is called a soft set over U, where F is a mapping from E into the set of all subsets of the set U.

Example : 2.2 [7]

Suppose that U = $\{u_1, u_2, u_3, u_4\}$ is the universe contains four cars under consideration in an auto agent and E = $\{x_1$ = safety, x_2 = cheap. x_3 = modern and x_4 = large$\}$ is the set of parameters. A customer to select a car from the auto agent, can construct soft set S that describes the characteristic of cars according to own requests. Assume that $f(x_1) = \{u_1, u_2\}$, $f(x_2) = \{ u_1, u_2, u_4\}$, $f(x_3) = \phi$, $f(x_4) = U$. Then the soft set S is written by S = $\{(x_1,\{u_1,u_2\}), (x_2,\{u_1,u_2,u_4\}),(x_4,U)\}$.

Definition 2.3[3]

For two soft sets (F,A) and (G,B) over a common universe U, we say that (F,A) is a soft subset of (G,B) if it satisfies :

i) $A \subset B$

ii) $\forall e \in A$, F(e) and G (e) are identical approximation.

Definition: 2.4 [10]

Let U be a universe of discourse, P(U) the power set of U. Let $a_1, a_2....,a_n$ for $n\geq1$, be n distinct attributes, whose corresponding attribute values are respectively the sets $A_1,A_2,....., A_n$ with $A_i \cap A_j = \phi$, for $i\neq j$, and $i,j\in\{1,2,....,n\}$. Then the pair (F, $A_1 x A_2 x...x A_n$) where F: $A_1 x A_2 x...x A_n \rightarrow P(U)$ is called a Hypersoft set over U.

Example : 2.5[12]

Let U = $\{R_1, R_2, R_3, R_4, R_5\}$ is the universal set, where R_1, R_2, R_3, R_4, R_5 represent the Refrigerators. Mr.X, Mrs.X goes to market and wants to buy such Refrigerator which is feasible and having more characteristic then that their expectation level.

Let a_1 = size, a_2 = freezing point, a_3 = pressure, a_4 = price be the attributes whose attribute values belonging to the sets B_1,B_2,B_3,B_4 given as

$B_1 = \{e_1$=small, e_2=medium, e_3=large$\}$

$B_2 = \{ e_4$=low freezing point$\}$

$B_3 = \{ e_5$ =high expectation pressure, e_6=low condensing pressure$\}$

$B_4 = \{e_7$ = low price$\}$

and hypersoft set can be written as

$(\phi, B_1 x B_2 x B_3 x B_4) = \{ ((e_1,e_4,e_5,e_7), \{R_1,R_2,R_3\}), ((e_1,e_4,e_6,e_7), \{R_1,R_2,R_4\}), ((e_3,e_4,e_5,e_7), \{R_3,R_5\})$
$((e_3,e_4,e_6,e_7), \{R_1,R_2,R_3\})\}$

Definition : 2.6[12]

Assume that (ϕ, $A_1 x A_2 x......x A_n$) and (ψ, $B_1 x B_2 x...x A_n$) be the two hypersoft sets over the same universal sets U. (ϕ, $A_1 x A_2 x......x A_n$) is the hyper soft subsets of (ψ, $B_1 x B_2 x...x B_n$) denoted by (ϕ, $A_1 x A_2$ $x......x A_n$) $\subseteq$ (ψ, $B_1 x B_2 x...x B_n$) if

i) $A_1 x A_2 x......x A_n \subseteq B_1 x B_2 x...x B_n$

ii) $\forall e\in A_1 x A_2 x......x A_n$, $\phi(e)$ and $\psi(e)$ are identical approximations.

3. APPLICATION OF HYPERSOFT SET THEORY

In this section, we present an application of hypersoft set theory in a decision making problem.

Let us now formulate our problem as follows:

Problem

Let $U = \{L_1, L_2, L_3, L_4, L_5, L_6, L_7\}$ be the set of seven Laptops.

Let a_1 = name of the company, a_2=operating System, a3 = processor,

be the attributes whose attribute values belonging to the sets E_1,E_2,E_3 given as

E_1 = {HB, Dell, Acer, Apple}

E_2 = {Window, Linux, Mac}

E_3 = {Intel, Athlon}

Consider the hypersoft set $(\phi, E_1xE_2xE_3)$ which represents the descriptions of Laptops given by

$(\phi, E_1xE_2xE_3)$ = {(HB, Window, Athlon) = $\{L_1, L_3, L_5, L6\}$,

(HB, Linux, Athlon) = $\{L_2, L_4\ L_5, L_7\}$,

(Dell, Window, Mac) = $\{L_3, L_4\}$,

(Dell, Linux, Intel) = $\{L_1, L_2, L_3\}$,

(Acer, Window, Athlon) = $\{L_2, L_3, L_6\}$,

(Acer, Linux, Athlon) = $\{L_3, L_5, L_7\}$,

(Apple, Mac, Intel) = $\{L_1, L_6\}$}

Suppose that Mr. X is interested to buy a Laptop on the basis of his choice parameters constitute the subsets

A_1 = {e_1 = HB, e_2 = Acer,}

A_2 = {e_3 = Window, e_4= Linux}

A_3 = {e_5 = Athlon}

of the sets E_1, E_2 and E_3.

That means out of available Laptops in U, he wish to select the Laptop which satisfies the maximum number of parameters of his choice of the hypersoft set.

Suppose that another customer Mr. Y wants to buy a Laptop on the basis of the set of his choice of parameters $B_1xB_2xB_3 \subseteq E_1xE_2xE_3$

Where

B_1 = {Apple} B_2 = {Mac} B_3 = {Intel}

Also, Mr. Z wants to buy a Laptop on the basis of another set of parameters $D_1xD_2xD_3 \subseteq E_1xE_2xE_3$. The problem is to select the Laptop which is most suitable with the choice parameters of Mr. X.

The Laptop which is most suitable for Mr. X need not be suitable for Mr. Y or Mr. Z as the selection is dependent upon the set of choice parameters of each buyer.

To solve the problem, we do some theoretical characterizations of the hypersoft set theory, which we present below.

3.1 Tabular Representation of a Hypersoft set (ϕ, $A_1 x A_2 x A_3$)

We present an almost analogous representation in the form of a binary table. For this consider the hypersoft set (ϕ, $E_1xE_2xE_3$) on the basis of the above sets $A_1xA_2xA_3$ of choice parameters of Mr. X.

Then, the hypersoft set (ϕ, A_1xA_2 xA_3) write as the following.

(ϕ, A_1xA_2 xA_3) = {{(e_1,e_3,e_5), {L_1, L_3, L_5,L_6} },{(e_1,e_4,e_5), {L_2, L_4 L_5, L_7 }}, {(e_2,e_3,e_5), {L_2, L_3, L_6}}, {(e_2,e_4,e_5), {L_3, L_5, L_7}}}

We can represent this hypersoft set (ϕ, A_1xA_2 xA_3) in a tabular form as shown below. This style of representation will be useful for storing a hypersoft set in a computer memory.

If $L_i \in \phi(\varepsilon)$ then $L_{ij} = 1$ otherwise $L_{ij} = 0$

Where L_{ij} we the entries in table 1 and $\varepsilon = (e_i, e_j, e_k)$.

Table 1

U / A_1xA_2 xA_3	(e_1,e_3,e_5)	(e_1,e_4,e_5)	(e_2,e_3,e_5)	(e_2,e_4,e_5)
L_1	1	0	0	0
L_2	0	1	1	0
L_3	1	0	1	1
L_4	0	1	0	0
L_5	1	1	0	1
L_6	1	0	1	0
L_7	0	1	0	1

where (e_i , e_j, e_k) $\in A_1xA_2$ xA_3

3.2 Reduct Table of a hypersoft set

Consider the hypersoft set (ϕ, $E_1xE_2xE_3$). Clearly for any $A_1xA_2xA_3 \subseteq E_1xE_2xE_3$, (ϕ, $A_1xA_2xA_3$) is a hypersoft subset of (ϕ, $E_1xE_2xE_3$).we will now define a reduct hypersoft set of the hypersoft set (ϕ, A_1xA_2 xA_3). Consider the tabular representation of the hypersoft set (ϕ, A_1xA_2 xA_3). If $B_1xB_2xB_3$ is a reduction of A_1xA_2 xA_3 then the hypersoft set (ϕ, B_1xB_2 xB_3) is called the reduct hypersoft set of the hypersoft set (ϕ, A_1xA_2 xA_3).

Intuitively, a reduct- hypersoft set (ϕ, B_1xB_2 xB_3) of the hypersoft set (ϕ, A_1xA_2 xA_3) is the essential part, which suffices to describe all basis approximate descriptions of the hypersoft set (ϕ, $A_1x....xA_n$).

3.3 Choice value of an object L_i

The choice value of an object $L_i \in U_i$ is given by

$$C_i = \sum_j L_{ij}$$

where L_{ij} are the entries in the table of the reduct hype soft set.

3.4 Algorithms for selection of the suitable Laptop.

The following algorithm may be followed by Mr. X to select the Laptop he wishes to buy it.

- Input the hypersoft set(ϕ, $E_1xE_2xE_3$)
- Input the sets $A_1xA_2xA_3$ of the choice parameters for Mr. X
- Find all reduced hypersoft sets of (ϕ, $A_1xA_2xA_3$)
- Choose one reduced hypersoft set say (ϕ, $B_1xB_2xB_3$) of (ϕ, $A_1xA_2xA_3$)
- Find k, for which $C_k = \max L_i$

Then C_k is the optimal choice object.

If k has more than one value, then any one of them could be chosen by Mr. X by using his option.

Now we use the above algorithm to solve our original problem.

Clearly from Table (1) we see that

$B_1xB_2xB_3 = \{(e_1,e_3,e_5), (e_1,e_4,e_5), (e_2,e_4,e_5)\}$ is the reduct of

$A_1xA_2xA_3 = \{(e_1,e_3,e_5), (e_1,e_4,e_5), (e_2,e_3,e_5), (e_2,e_4,e_5)\}$

In corresponding the choice values the reduct hyper soft set can be represented is Table (2) below.

Table 2

U / $B_1xB_2xB_3$	(e_1,e_3,e_5)	(e_1,e_4,e_5)	(e_2,e_3,e_5)	Choice Value $C_i = \sum_j L_{ij}$
L_1	1	0	0	1
L_2	0	1	0	1
L_3	1	0	1	2
L_4	0	1	0	0
L_5	1	1	1	3
L_6	1	0	0	1
L_7	0	1	1	2

Here max $C_i = L_5$.

Decision: Mr.X can buy the Laptop L_5.

It may happen that for buying a Laptop all the parameters belonging to A_1, A_2,A_3 are not of equal importance of Mr. X.

He likes to impose weights on his choice parameters, that is corresponding to each element in A_1, A_2, A_3 there is a weight $w_i \in [0,1]$.

3.5 Weighted Table of a Hypersoft Set

We define the weighted table of the reduct hypersoft set (ϕ, $B_1xB_2xB_3$) will have entries $d_{ij} = L_{ij} \times w_j$ instead of 0 and 1 only, where L_{ij} are the entries in the table of the reduct hypersoft set of (F, $B_1xB_2xB_3$).

3.6 Weighted choice value of an object L_i

The weighted choice value of an object $L_i \in U$ is Wc_i given by

$$Wc_i = \sum_j d_{ij} \qquad where\ d_{ij} = L_{ij} \times w_j$$

Imposing weights on his choice parameters, Mr. X could use the following revised algorithm for arriving at his final decision.

3.7 Revised Algorithm for selection of the Laptop

- Input the hypersoft set $(\phi, E_1xE_2xE_3)$
- Input the sets $A_1xA_2xA_3$ of the choice parameters of Mr. X which is a subset of $E_1xE_2xE_3$.
- Find all reduct-hypersoft sets of $(\phi, A_1xA_2xA_3)$
- Choose one reduced-hypersoft set say $(\phi, B_1xB_2xB_3)$ of $(\phi, A_1xA_2xA_3)$
- Find weighted table of hypersoft set $(\phi, B_1xB_2xB_3)$ according to the weights decided by Mr. X.
- Find k, for which $Wc_k = \max Wc_i$.

Then L_k is the optimal choice object. If k has more than one value, then any one of them could be chosen by Mr. X by using his option.

Let us solve now the original problem using the Weighted Algorithm.

Suppose that Mr. X assigns the following weights for the parameters of A_1, A_2 and A_3 as follows.

For the parameter “HB” put $w_1 = 0.5$

For the parameter “Acer” put $w_2 = 0.4$

For the parameter “Windows” put $w_3 = 0.7$

For the parameter “Linux” put $w_4 = 0.9$

For the parameter “Athlon” put $w_5 = 0.6$

Using these weights the reduct hypersoft set can be tabulated as Table (3).

Table 3

U / $B_1xB_2xB_3$	(e_1,e_3,e_5) $w_1=0.5$, $w_3 = 0.7$, $w_5 = 0.6$	(e_1,e_4,e_5) $w_1= 0.5$, $w_4 = 0.9$, $w_5 = 0.6$	(e_2,e_4,e_5) $w_2= 0.4$, $w_4 = 0.9$, $w_5 = 0.6$	Weighted Choice Value Wc_i
	$W_1 = 0.5+0.7+0.6$ $W_1=1.8$	$W_2 = 0.5+0.9+0.6$ $W_2 = 2.0$	$W_3= 0.4+0.9+0.6$ $W_3 = 1.9$	
L_1	1	0	0	1.8
L_2	0	1	0	2.0
L_3	1	0	1	3.7
L_4	0	1	0	2.0
L_5	1	1	1	5.7
L_6	1	0	0	1.8
L_7	0	1	1	3.9

From Table (3), it is clear that Mr. X will select the Laptop L_5 for buying according to his choice parameters in $A_1xA_2xA_3$.

Likewise based on their respective choice parameter of Mr. Y and Mr. Z, can also select the Laptop.

CONCLUSION

In this paper we give application of hypersoft set theory in a decision making problem for marketing. The research provides different parameters to solve decision making problems using hypersoft set.

The work can be further extended to enhance the existing work in fuzzy hypersoft set, Neutrosophic hypersoft set and plithogenic hypersoft set as well as create platforms for everyone to select the best as per parameters available to the customers.

REFERENCES

[1] Molodtsov,D, Soft Set Theory-First Results, Computers and Mathematics with Applcations, (1999), 37(4/5), 19-31.

[2] Maji,P.K, .Roy,A.R, and .Biswas,R, An Application of Soft Sets in a Decision Making Problem, Computers and Mathematics with Applications, (2002), (44), 1077-1083.

[3] Maji,P.K, Biswas,R, and Roy,A.R, Soft Set Theory, Computers and Mathematics with Applications, (2003), Vol-45, 555-562.

[4] Cagman,N, and Enginoglu,S, Soft Matrix Theory and its Decision Making, Computers and Mathematics with Applications, 2010, 3308-3314.

[5] Maji,P.K, A Neutrosophic Soft Set Approach to a Decision Making Problem, Annuals of Fuzzy Mathematics and Informatics, (April 2012), Vol.3, No.2, 313-319.

[6] Bhardwaj,R.K, Tiwari,S.K, Kailash Chandra Nayak, A Study of Solving Decision Making Problem using Soft Set, IJLTEMAS, ISSN.2278-2540, (Sep 2015), Vol.IV, Issue IX.

[7] Irfan Deli, Naim Cagman, Application of Soft Sets in Decision Making Based on Game Theory, Annals of Fuzzy Mathematics and Informatics (Sep 2015).

[8] Arafa Nasef, A, and Kamel, M, EL-Sayed, Molodtsov's Soft Set Theory and its Applications in Decision Making, International Journal of Engineering Science Invention, (Feb 2017), Vol.6 Issue 2, 86-90.

[9] Inthumathi, V, Chitra, V, and Jayasree, S, The Role of Operators on Soft Sets in Decision Making Problems, International Journal of Computational and Applied Mathematics, ISSN 1819-4966, (2017), Volume12, Number 3, 899-910.

[10] Florentin Smarandache, Extension of Soft Set to Hypersoft set and then to Plithogenic Hypersoft set, Neutrosophic sets and Systems, (2018), Vol.22.

[11] Muhammad Saeed, Muhammed Ahsan, Muhammad Khubab Siddique, Muhammad Rayees Ahmad, A Study of the Fundamentals of Hypersoft Set Theory, International Journal of Scientific and Engineering Research, ISSN 2229-5518 (2020), Volume 11, Issue 1.

[12] Mujahid Abbas, Ghulam Murtaza and Florentin Smarandache, Basic operations on hypersoft sets and hypersoft point, Nutrosophic Sets and Systems, (2020), Vol.35.

BIOGRAPHY

V. Inthumathi, received Doctoral degree in the field of Ideal topological spaces from Bharathiar University in 2012. She is working as an Associate professor in the department of mathematics in Nallamuthu Gounder Mahalingam College, Pollachi, India.

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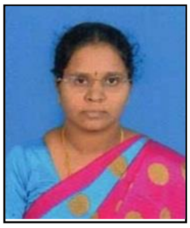

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