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VAGUE SOFT MULTISET THEORY

Khaleed Alhazaymeh[1], Nasruddin Hassan[2 §]
[1,2]School of Mathematical Sciences
Universiti Kebangsaan Malaysia
43600 UKM, Bangi Selangor, MALAYSIA

Abstract: In this paper we introduce the concept of vague soft multiset which is an extension of soft set. We define the notion of equality, subset hood and nullity vague soft multisets. We illustrate several operations with examples and an application of vague soft multiset theory to a decision making problem.

AMS Subject Classification: 03B52, 03E72
Key Words: soft multiset theory, vague set, vague soft set

1. Introduction

Decision making problems are usually solved by goal programming [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12] or data envelopment analysis [13], [14], [15]. Fuzzy set [16] was introduced as a mathematical tool to solve the problem and vagueness in everyday life. This was extended to fuzzy soft set [17], [18], [19], [20], [21] and vague soft sets [22], [23], [24], [25], [26], [27], [28], [29], [30] and used to solve genetic algorithms [31], [32] and further extended to multi Q-fuzzy [33]. In this paper, we introduce the concept of vague soft multiset and some operations with illustrative example on decision making.

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§Correspondence author

2. Preliminaries

Molodtsov [34] defined soft set in the following way. Let U be a universal set and E be a set of parameters. Let $P(U)$ denotes the power set of U and $A \subseteq E$.

Definition 2.1. (see [34]) A pair (F, A) is called a soft set over U, where F is a mapping $F : A \to P(U)$.

In other words, a soft set over U is a parameterized family of subsets of the universe U. For $\varepsilon \in A$, $F(\varepsilon)$ may be considered as the set of ε-approximate elements of the soft set (F, A).

Definition 2.2. (see [17]) Let $\{U_i : i \in I\}$ be a collection of universes such that $\bigcap_{i\in I} U_i = \phi$ and let $\{E_{U_i} : i \in I\}$ be a collection of sets of parameters. Let $U = \prod_{i\in I} P(U_i)$ where $P(U_i)$ denotes the power set of U_i, $E = \prod_{i\in I} E_{U_i}$ and $A \subseteq E$. A pair (F, A) is called a soft multiset over U, where F is a mapping given by $F : A \longrightarrow U$

In other words, a soft multiset over U is a parameterized family of subsets of U. For $\varepsilon \in A$, $F(\varepsilon)$ may be considered as the set of ε-approximate elements of the soft multiset (F, A). Based on the above definition, any change in the order of universes will produce a different soft multiset.

Definition 2.3. (see [17]) For any soft multiset (F, A), a pair $(e_{U_ij}, F_{e_{U_i,j}})$ is called a U_i-soft multiset part $\forall e_{U_ij} \in a_k$ and $F_{e_{U_i,j}} \subseteq F(A)$ is an approximate value set, where $a_k \in A$, $k = \{1, 2, ..., n\}$, $i = \{1, 2, ..., m\}$ and $j = \{1, 2, ..., r\}$.

Definition 2.4. (see [17]) For two soft multisets (F, A) and (G, B) over U, (F, A) is called a soft multisubset of (G, B) if:

(i) $A \subseteq B$ and,

(ii) $\forall e_{U_ij} \in a_k$, $(e_{U_ij}, F_{e_{U_i,j}}) \subseteq (e_{U_ij}, G_{e_{U_i,j}})$,

where $a_k \in A$, $k = \{1, 2, ..., n\}$, $i = \{1, 2, ..., m\}$ and $j = \{1, 2, ..., r\}$.

This relationship is denoted by $(F, A)\tilde{\subseteq}(G, B)$.

3. Vague Soft Multiset

In this section, we introduce the definition of a vague soft multiset, and its basic operations such as complement, union and intersection with examples.

Definition 3.1. Let $\{U_i : i \in I\}$ be a collection of universes such that $\bigcap_{i\in I} U_i = \phi$ and let $\{E_{U_i} : i \in I\}$ be a collection of sets of parameters. Let $U = \prod_{i\in I} V(U_i)$ where $V(U_i)$ denotes the set of all vague subset of U_i, $E = \prod_{i\in I} E_{U_i}$

and $A \subseteq E$. A pair (F, A) is called a vague soft multiset over U, where F is a mapping given by $F : A \to U$.

Definition 3.2. For any vague soft multiset(F, A), a pair $(e_{U_ij}, F_{e_{U_i,j}})$ is called a U_i-vague soft multiset part $\forall e_{U_ij} \in a_k$ and $F_{e_{U_i,j}} \subseteq F(A)$ is a vague approximate value set, where $a_k \in A$, $k = \{1, 2, ..., n\}$, $i = \{1, 2, ..., m\}$ and $j = \{1, 2, ..., r\}$.

Definition 3.3. For two vague soft multisets $(\tilde{F}, A)$ and $(\tilde{G}, B)$ over U, $(\tilde{F}, A)$ is called a vague soft multisubset of $(\tilde{G}, B)$ if:

(i) $A \subseteq B$ and,

(ii) $\forall e_{U_ij} \in a_k$, $(e_{U_ij}, F_{e_{U_i,j}})$ is a vague subset of $(e_{U_ij}, G_{e_{U_i,j}})$,

where $a_k \in A$, $k = \{1, 2, ..., n\}$, $i = \{1, 2, ..., m\}$ and $j = \{1, 2, ..., r\}$.

This relationship is denoted by $(F, A)\tilde{\subseteq}(G, B)$. In this case (G, B) is called a soft multisuperset of (F, A).

Definition 3.4. The complement of a vague soft multiset (F, A) is denoted by $(F, A)^c$ and is defined by $(F, A)^c = (F^c, A)$, where $F^c : A \longrightarrow U$ is a mapping given by $F^C(\alpha) = U - F(\neg\alpha), \forall \alpha \in \neg A$.

4. An Application in Decision Making

In this section we recall the algorithm designed for solving a fuzzy soft multiset theoretic approach to decision making problem presented by Alkhazaleh et al. [16]. We note here that we will use the abbreviation (RMA) for Roy and Maji's Algorithm.

(a) Input the vague soft multiset (H, C) which is introduced by making any operations between (F, A) and (G, B).

(b) Apply RMA to the first vague soft multiset part in (H, C) to get S_{k_1}.

(c) Redefine the vague soft multiset (H, C) by keeping all values in each row where S_{k_1} is maximum and replacing the values in the other rows by zero.

(d) Apply RMA to the second vague soft multiset part in $(H, C)_1$ to get S_{k_2}.

(e) Redefine the vague soft multiset $(F, A)_1$ by keeping the first and second parts and apply the method in step 3 to the third part.

(f) Apply RMA to the third vague soft multiset part in $(H,C)_2$ to get S_{k_3}.

(g) The decision is $(S_{k_1}, S_{k_2}, S_{k_3})$.

Let $U_1 = \{h_1, h_2, h_3\}$, $U_2 = \{c_1, c_2, c_3\}$ and $U_3 = \{v_1, v_2, v_3\}$ be the sets of "venue", "machine" and "trucks", respectively. Let $\{E_{U_1}, E_{U_2}, E_{U_3}\}$ be a collection of sets of decision parameters related to the above universes, where:

$E_{U_1} = \{e_{U_1,1} =$ in Kuala Lumpur,$e_{U_1,2}=$ Bangi,$e_{U_1,3}=$ Shah Alam$\}$.

$E_{U_2} = \{e_{U_1,1} =$ synchronous machines,$e_{U_1,2}=$ DC machines,$e_{U_1,3}=$ induction or asynchronous machines$\}$.

$E_{U_3} = \{e_{U_1,1} =$ light trucks,$e_{U_1,2}=$ medium trucks,$e_{U_1,3}=$ heavy trucks$\}$.

$A = \{a_1 = (e_{U_1,1}, e_{U_2,1}, e_{U_3,1}),$

$a_2 = (e_{U_1,1}, e_{U_2,3}, e_{U_3,1}),$

$a_3 = (e_{U_2,1}, e_{U_1,2}, e_{U_3,3}),$

$a_4 = (e_{U_3,1}, e_{U_1,3}, e_{U_3,2})\}$, and

$B = \{b_1 = (e_{U_1,1}, e_{U_2,1}, e_{U_3,1}),$

$b_2 = (e_{U_1,2}, e_{U_2,1}, e_{U_3,1}),$

$b_3 = (e_{U_1,3}, e_{U_3,1}, e_{U_3,2}),$

$b_4 = (e_{U_3,1}, e_{U_1,3}, e_{U_3,2})\}$.

Suppose that a person wants to buy objects from the sets of given objects with respect to the sets of choice parameters. Let there be two observations (F,A) and (G,B) by two experts Y_1 and Y_2 respectively. Let

$$\begin{aligned}(F,A) = \{&a_1, \{\frac{h_1}{[0.5,0.5]}, \frac{h_2}{[0.6,0.7]}, \frac{h_3}{[0.8,0.9]}, \frac{h_4}{[1,1]}\},\\ &\{\frac{c_1}{[0.6,0.8]} \frac{c_2}{[0.5,0.5]} \frac{c_3}{[0.6,0.9]}\}, \{\frac{v_1}{[0.8,0.9]} \frac{v_2}{[0.7,0.8]} \frac{v_3}{[0.2,0.6]}\}),\\ &a_2, \{\frac{h_1}{[0.2,0.7]}, \frac{h_2}{[0.1,0.1]}, \frac{h_3}{[0,0]}, \frac{h_4}{[0.9,0.9]}\}, \{\frac{c_1}{[0.5,0.5]} \frac{c_2}{[0.7,0.7]} \frac{c_3}{[0.2,0.3]}\},\\ &\{\frac{v_1}{[0.1,0.8]} \frac{v_2}{[0.5,0.9]} \frac{v_3}{[0.2,0.8]}\}), a_3, \{\frac{h_1}{[0.3,0.6]}, \frac{h_2}{[0.7,0.8]}, \frac{h_3}{[0.9,0.9]}, \frac{h_4}{[0.1,0.9]}\},\\ &\{\frac{c_1}{[0.7,0.8]} \frac{c_2}{[0.6,0.7]} \frac{c_3}{[0.3,0.5]}\}, \{\frac{v_1}{[0.3,0.6]} \frac{v_2}{[0,0]} \frac{v_3}{[1,1]}\}),\\ &a_4, \{\frac{h_1}{[0.4,0.7]}, \frac{h_2}{[0.8,0.9]}, \frac{h_3}{[0.9,0.9]}, \frac{h_4}{[0.3,1]}\}, \{\frac{c_1}{[0.8,0.9]} \frac{c_2}{[0.6,0.6]} \frac{c_3}{[0.5,0.6]}\},\\ &\{\frac{v_1}{[0.4,0.4]} \frac{v_2}{[1,1]} \frac{v_3}{[0,0]}\}),\end{aligned}$$

$$(G,B)=\{b_1,\{\frac{h_1}{[0.6,0.6]},\frac{h_2}{[0.6,0.9]},\frac{h_3}{[0.2,0.2]},\frac{h_4}{[0,1]}\},$$
$$\{\frac{c_1}{[0.7,0.7]}\frac{c_2}{[0.6,0.9]}\frac{c_3}{[0.8,0.9]}\},\{\frac{v_1}{[0.9,0.9]}\frac{v_2}{[0.6,0.8]}\frac{v_3}{[0.4,0.6]}\}),$$
$$b_2,\{\frac{h_1}{[0.4,0.4]},\frac{h_2}{[0.1,0.9]},\frac{h_3}{[0,1]},\frac{h_4}{[0.1,1]}\},\{\frac{c_1}{[0.6,0.7]}\frac{c_2}{[0.8,0.8]}\frac{c_3}{[0.2,0.6]}\},$$
$$\{\frac{v_1}{[0.2,0.9]}\frac{v_2}{[0.5,1]}\frac{v_3}{[0.5,0.5]}\}),b_3,\{\frac{h_1}{[0.4,0.5]},\frac{h_2}{[0.8,0.9]},\frac{h_3}{[0.1,0.1]},\frac{h_4}{[0.3,1]}\},$$
$$\{\frac{c_1}{[0.2,0.9]}\frac{c_2}{[0.7,0.8]}\frac{c_3}{[0.4,0.6]}\},\{\frac{v_1}{[0.4,0.7]}\frac{v_2}{[0,1]}\frac{v_3}{[0,0]}\}),$$
$$b_4,\{\frac{h_1}{[0.4,0.7]},\frac{h_2}{[0.8,0.9]},\frac{h_3}{[0.9,0.9]},\frac{h_4}{[0.3,1]}\},$$
$$\{\frac{c_1}{[0.8,0.9]}\frac{c_2}{[0.6,0.6]}\frac{c_3}{[0.5,0.6]}\},\{\frac{v_1}{[0.4,0.4]}\frac{v_2}{[1,1]}\frac{v_3}{[0,0]}\}).$$

By using the basic fuzzy union we have

$$(F,A)\tilde{\cup}(G,B)=(H,D)=\{d_1,\{\frac{h_1}{[0.5,0.5]},\frac{h_2}{[0.6,0.7]},\frac{h_3}{[0.2,0.2]},\frac{h_4}{[0,1]}\},$$
$$\{\frac{c_1}{[0.6,0.7]}\frac{c_2}{[0.5,0.5]}\frac{c_3}{[0.6,0.9]}\},\{\frac{v_1}{[0.8,0.9]}\frac{v_2}{[0.5,0.5]}\frac{v_3}{[0.2,0.6]}\}),$$
$$d_2,\{\frac{h_1}{[0.4,0.7]},\frac{h_2}{[0.8,0.9]},\frac{h_3}{[0.9,0.9]},\frac{h_4}{[0.3,1]}\},$$
$$\{\frac{c_1}{[0.8,0.9]}\frac{c_2}{[0.6,0.6]}\frac{c_3}{[0.5,0.6]}\},\{\frac{v_1}{[0.4,0.4]}\frac{v_2}{[1,1]}\frac{v_3}{[0,0]}\}),$$
$$d_3,\{\frac{h_1}{[0.2,0.7]},\frac{h_2}{[0.1,0.1]},\frac{h_3}{[0,0]},\frac{h_4}{[0.9,0.9]}\},$$
$$\{\frac{c_1}{[0.5,0.5]}\frac{c_2}{[0.7,0.7]}\frac{c_3}{[0.2,0.3]}\},\{\frac{v_1}{[0.1,0.8]}\frac{v_2}{[0.5,0.9]}\frac{v_3}{[0.2,0.8]}\}),$$
$$d_4,\{\frac{h_1}{[0.3,0.6]},\frac{h_2}{[0.7,0.8]},\frac{h_3}{[0.9,0.9]},\frac{h_4}{[0.1,0.9]}\},$$
$$\{\frac{c_1}{[0.7,0.8]}\frac{c_2}{[0.6,0.7]}\frac{c_3}{[0.3,0.5]}\},\{\frac{v_1}{[0.3,0.6]}\frac{v_2}{[0,0]}\frac{v_3}{[1,1]}\}),$$
$$d_5,\{\frac{h_1}{[0.4,0.4]},\frac{h_2}{[0.1,0.9]},\frac{h_3}{[0,1]},\frac{h_4}{[0.1,1]}\},$$
$$\{\frac{c_1}{[0.6,0.7]}\frac{c_2}{[0.8,0.8]}\frac{c_3}{[0.2,0.6]}\},\{\frac{v_1}{[0.2,0.9]}\frac{v_2}{[0.5,1]}\frac{v_3}{[0.5,0.5]}\}),$$
$$d_6,\{\frac{h_1}{[0.4,0.5]},\frac{h_2}{[0.8,0.9]},\frac{h_3}{[0.1,0.1]},\frac{h_4}{[0.3,1]}\},\{\frac{c_1}{[0.2,0.9]}\frac{c_2}{[0.7,0.8]}\frac{c_3}{[0.4,0.6]}\},$$

$$\{\frac{v_1}{[0.4, 0.7]}\frac{v_2}{[0, 1]}\frac{v_3}{[0, 0]}\}).$$

Apply RMA to the first vague soft multiset part in (H, D) to take the decision from the availability set U_1 and subtract the truth membership function from the false-membership functions. The tabular representation of the first resultant vague soft multiset part will be as in Table 1.

Table 1: Representation of U_1-vague soft multiset part of (H, D)

U_1	$d_{1,1}$	$d_{1,2}$	$d_{1,3}$	$d_{1,4}$	$d_{1,5}$	$d_{1,6}$
h_1	0	-0.3	-0.5	-0.3	0	-0.1
h_2	-0.3	-0.1	0	-0.1	-0.8	-0.1
h_3	0	0	0	0	-1	0
h_4	0	-0.7	-0.7	-0.8	-0.9	-0.7

Table 2 is the comparison table for the first resultant vague soft multiset.

Table 2: Comparison table of U_1-vague soft multiset part of (H, D)

U_1	h_1	h_2	h_3	h_4
h_1	6	2	2	6
h_2	4	6	1	5
h_3	5	5	6	5
h_4	1	1	1	6

The row-sum, column-sum, and the score for each h_i is shown in Table 3.

Table 3: Score of U_1-vague soft multiset part of (H, D)

U_1	Row sum (r_i)	Column sum (t_i)	Membership score (s_i)
h_1	16	16	0
h_2	16	14	2
h_3	21	10	11
h_4	9	22	-13

From Table 3, the maximum score is 11 scored by h_3.
Redefine the vague soft multiset (H, D) by keeping all values in each row where h_3 is maximum and replacing the values in the other rows by zero.

$$(H,D)_1 = \{d_1, \{\frac{h_1}{[0.5,0.5]}, \frac{h_2}{[0.6,0.7]}, \frac{h_3}{[0.2,0.2]}, \frac{h_4}{[0,1]}\}, \{\frac{c_1}{[0,1]} \frac{c_2}{[0,1]} \frac{c_3}{[0,1]}\},$$
$$\{\frac{v_1}{[0,1]} \frac{v_2}{[0,1]} \frac{v_3}{[0,1]}\}), d_2, \{\frac{h_1}{[0.4,0.7]}, \frac{h_2}{[0.8,0.9]}, \frac{h_3}{[0.9,0.9]}, \frac{h_4}{[0.3,1]}\},$$
$$\{\frac{c_1}{[0.8,0.9]} \frac{c_2}{[0.6,0.6]} \frac{c_3}{[0.5,0.6]}\}, \{\frac{v_1}{[0.4,0.4]} \frac{v_2}{[1,1]} \frac{v_3}{[0,0]}\}),$$
$$d_3, \{\frac{h_1}{[0.2,0.7]}, \frac{h_2}{[0.1,0.1]}, \frac{h_3}{[0,0]}, \frac{h_4}{[0.9,0.9]}\}, \{\frac{c_1}{[0,1]} \frac{c_2}{[0,1]} \frac{c_3}{[0,1]}\}, \{\frac{v_1}{[0,1]} \frac{v_2}{[0,1]} \frac{v_3}{[0,1]}\}),$$
$$d_4, \{\frac{h_1}{[0.3,0.6]}, \frac{h_2}{[0.7,0.8]}, \frac{h_3}{[0.9,0.9]}, \frac{h_4}{[0.1,0.9]}\}, \{\frac{c_1}{[0.7,0.8]} \frac{c_2}{[0.6,0.7]} \frac{c_3}{[0.3,0.5]}\},$$
$$\{\frac{v_1}{[0.3,0.6]} \frac{v_2}{[0,0]} \frac{v_3}{[1,1]}\}), d_5, \{\frac{h_1}{[0.4,0.4]}, \frac{h_2}{[0.1,0.9]}, \frac{h_3}{[0,1]}, \frac{h_4}{[0.1,1]}\},$$
$$\{\frac{c_1}{[0.6,0.7]} \frac{c_2}{[0.8,0.8]} \frac{c_3}{[0.2,0.6]}\}, \{\frac{v_1}{[0.2,0.9]} \frac{v_2}{[0.5,1]} \frac{v_3}{[0.5,0.5]}\}),$$
$$d_6, \{\frac{h_1}{[0.4,0.5]}, \frac{h_2}{[0.8,0.9]}, \frac{h_3}{[0.1,0.1]}, \frac{h_4}{[0.3,1]}\}, \{\frac{c_1}{[0,1]} \frac{c_2}{[0,1]} \frac{c_3}{[0,1]}\}, \{\frac{v_1}{[0,1]} \frac{v_2}{[0,1]} \frac{v_3}{[0,1]}\}).$$

Apply RMA to the second vague soft multiset part in $(H, D)_1$ to take the decision from the availability set U_2 and subtract the truth membership from the false-membership functions. The second resultant vague soft multiset part will be as in Table 4.

Table 4: Representation of U_2-vague soft multiset part of $(H, D)_1$

U_2	$d_{1,1}$	$d_{1,2}$	$d_{1,3}$	$d_{1,4}$	$d_{1,5}$	$d_{1,6}$
c_1	0	-0.1	0	-0.1	-0.1	0
c_2	0	0	0	-0.1	0	0
c_3	0	-0.1	0	-0.2	-0.4	0

The corresponding comparison table will be as in Table 5.
The row-sum, column-sum, and the score for each c_i are in Table 6.

From Table 6, the maximum score is 3 scored by c_2.
Redefine the vague soft multiset (H, D) by keeping all values in each row where c_1 is maximum and replacing the values in the other rows by zero.

Table 5: Comparison table of U_2-vague soft multiset part of $(H, D)_1$

U_2	c_1	c_2	c_3
c_1	6	3	6
c_2	6	6	6
c_3	4	3	6

Table 6: Score of U_1-vague soft multiset part of (H, D)

U_2	Row sum (r_i)	Column sum (t_i)	Membership score (s_i)
c_1	15	14	1
c_2	18	15	3
c_3	13	18	-5

$$(H,D)_2 = \{d_1, \{\frac{h_1}{[0.5,0.5]}, \frac{h_2}{[0.6,0.7]}, \frac{h_3}{[0.2,0.2]}, \frac{h_4}{[0,1]}\}, \{\frac{c_1}{[0,1]}\frac{c_2}{[0,1]}\frac{c_3}{[0,1]}\},$$

$$\{\frac{v_1}{[0,1]}\frac{v_2}{[0,1]}\frac{v_3}{[0,1]}\}), d_2, \{\frac{h_1}{[0.4,0.7]}, \frac{h_2}{[0.8,0.9]}, \frac{h_3}{[0.9,0.9]}, \frac{h_4}{[0.3,1]}\}, \{\frac{c_1}{[0,1]}\frac{c_2}{[0,1]}\frac{c_3}{[0,1]}\},$$

$$\{\frac{v_1}{[0,1]}\frac{v_2}{[0,1]}\frac{v_3}{[0,1]}\}), d_3, \{\frac{h_1}{[0.2,0.7]}, \frac{h_2}{[0.1,0.1]}, \frac{h_3}{[0,0]}, \frac{h_4}{[0.9,0.9]}\}, \{\frac{c_1}{[0,1]}\frac{c_2}{[0,1]}\frac{c_3}{[0,1]}\},$$

$$\{\frac{v_1}{[0,1]}\frac{v_2}{[0,1]}\frac{v_3}{[0,1]}\}), d_4, \{\frac{h_1}{[0.3,0.6]}, \frac{h_2}{[0.7,0.8]}, \frac{h_3}{[0.9,0.9]}, \frac{h_4}{[0.1,0.9]}\}, \{\frac{c_1}{[0,1]}\frac{c_2}{[0,1]}\frac{c_3}{[0,1]}\},$$

$$\{\frac{v_1}{[0,1]}\frac{v_2}{[0,1]}\frac{v_3}{[0,1]}\}), d_5, \{\frac{h_1}{[0.4,0.4]}, \frac{h_2}{[0.1,0.9]}, \frac{h_3}{[0,1]}, \frac{h_4}{[0.1,1]}\},$$

$$\{\frac{c_1}{[0.6,0.7]}\frac{c_2}{[0.8,0.8]}\frac{c_3}{[0.2,0.6]}\}, \{\frac{v_1}{[0.2,0.9]}\frac{v_2}{[0.5,1]}\frac{v_3}{[0.5,0.5]}\}),$$

$$d_6, \{\frac{h_1}{[0.4,0.5]}, \frac{h_2}{[0.8,0.9]}, \frac{h_3}{[0.1,0.1]}, \frac{h_4}{[0.3,1]}\}, \{\frac{c_1}{[0,1]}\frac{c_2}{[0,1]}\frac{c_3}{[0,1]}\}, \{\frac{v_1}{[0,1]}\frac{v_2}{[0,1]}\frac{v_3}{[0,1]}\}).$$

Apply RMA to the third vague soft multiset part in $(H, D)_2$ to take the decision from the availability set U_3 and subtract the truth membership function from the false-membership functions. The third resultant vague soft multiset part will be as in Table 7.
The corresponding comparison table will be as in Table 8.
Compute the row-sum, column-sum, and the score for each v_i as in Table 9.

From Table 9, the maximum score is 3 scored by c_2. Thus the most suitable

Table 7: Representation of U_3-vague soft multiset part of $(H, D)_2$

U_3	$d_{1,1}$	$d_{1,2}$	$d_{1,3}$	$d_{1,4}$	$d_{1,5}$	$d_{1,6}$
v_1	0	0	0	0	-0.1	0
v_2	0	0	0	0	0	0
v_3	0	0	0	0	-0.4	0

Table 8: Comparison table of U_3-vague soft multiset part of $(H, D)_2$

U_3	c_1	c_2	c_3
v_1	6	5	6
v_2	6	6	6
v_3	5	5	6

Table 9: Score table: U_1-vague soft multiset part of (H, D)

U_2	Row sum (r_i)	Column sum (t_i)	Membership score (s_i)
v_1	17	17	0
v_2	18	16	2
v_3	16	18	-2

decision for the person is (h_3, c_2, v_2). This means that the person will chose venue Shah Alam h_3, to buy DC machine c_2 and heavy trucks v_2.

5. Conclusion

The concept of vague soft multiset theory is proposed and an application to solve a decision making problem is illustrated. It is also desirable to further explore the applications of using the vague soft multiset approach to solve real world decision making problems. A potential area of research involves extending our work to study the relationship between soft set, multiset and vague soft set.

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