AN APPLICATION OF SIMILARITY OF FUZZY SOFT SETS IN RECRUITMENT PROBLEM

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Abstract: Uncertainty plays an important role in everyday life. The theory of fuzzy soft sets is an important tool to deal with uncertainty. This paper aims to study the notion of similarity of fuzzy soft sets and its application in a decision making problem. We have taken a hypothetical case study while applying the notion of similarity in a recruitment problem.

Keywords: fuzzy set; soft set; fuzzy soft set; similarity of fuzzy soft set.

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1. INTRODUCTION


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new results.
Similarity measure between fuzzy soft sets has been very widely applied in different fields. It has been applied in pattern recognition, region extraction, coding theory, image processing and in many other areas. The notion of similarity between fuzzy soft sets has been studied by Majumder and Samanta in [4] and Neog and Dutta in [6]. In this paper, we are using our notion of similarity of fuzzy soft sets in solving a decision problem.

2. PRELIMINARIES
In this section, we recall some concepts and definitions which will be needed in the sequel.

A pair \((F, E)\) is called a soft set (over \(U\)) if and only if \(F\) is a mapping of \(E\) into the set of all subsets of the set \(U\). In other words, the soft set is a parameterized family of subsets of the set \(U\). Every set \(F(\varepsilon), \varepsilon \in E\), from this family may be considered as the set of \(\varepsilon\)-elements of the soft set \((F, E)\), or as the set of \(\varepsilon\)-approximate elements of the soft set.

2.2. Fuzzy Soft Set [5]
A pair \((F, A)\) is called a fuzzy soft set over \(U\) where \(F : A \rightarrow \tilde{P}(U)\) is a mapping from \(A\) into \(\tilde{P}(U)\). Here \(\tilde{P}(U)\) represents the fuzzy subsets of \(U\).

3. SIMILARITY BETWEEN TWO FUZZY SOFT SETS
In order to define similarity of fuzzy soft sets in our way, first we define scalar cardinality of a fuzzy soft set in the following way.

3.1 Scalar cardinality of a fuzzy soft set
Let \((F, E)\) be a fuzzy soft sets over \((U, E)\), where \(U = \{e_1, e_2, e_3, \ldots, e_m\}\) and \(E = \{e_1, e_2, e_3, \ldots, e_n\}\). The scalar cardinality of \((F, E)\) is defined as
\[
| (F, E) | = \sum_j | F(e_j) | , \text{ where } | F(e_j) | \text{ represent the scalar cardinality of each fuzzy set } F(e_j).
\]
3.2 Similarity between two fuzzy soft sets

Let \((F, E)\) and \((G, E)\) be two fuzzy soft sets over \((U, E)\), where \(U = \{e_1, e_2, e_3, \ldots, e_m\}\) and \(E = \{e_1, e_2, e_3, \ldots, e_n\}\).

Let \((F, E) \cup (G, E) = (P, E)\) and \((F, E) \cap (G, E) = (Q, E)\). We assume that \(A = [a_{ij}]\) and \(B = [b_{ij}]\) are the fuzzy soft matrices corresponding to the fuzzy soft sets \((P, E)\) and \((Q, E)\) respectively.

Let \(M((F, E), (G, E)) \in [0, 1]\) denote the similarity between the fuzzy soft sets \((F, E)\) and \((G, E)\).

We define \(M((F, E), (G, E)) = \frac{\|Q, E\|}{\|P, E\|}\)

3.3. Proposition

Let \((F, E)\), \((G, E)\) and \((H, E)\) be three fuzzy soft sets over \((U, E)\). Then the following results are valid.

(i) \(M((F, E), (G, E)) = M((G, E), (F, E))\)

(ii) \((F, E) \supseteq (G, E) \Rightarrow M((F, E), (G, E)) = 1\)

(iii) \((F, E) \cap (G, E) = \emptyset \Leftrightarrow M((F, E), (G, E)) = 0\)

(iv) \((F, E) \subseteq (H, E) \subseteq (G, E) \Rightarrow M((F, E), (G, E)) \leq M((H, E), (G, E))\)

Proof

(i) Let \((F, E) \cup (G, E) = (P, E)\) and \((F, E) \cap (G, E) = (Q, E)\). Let \(A = [a_{ij}]\) and \(B = [b_{ij}]\) be the fuzzy soft matrices corresponding to the fuzzy soft sets \((P, E)\) and \((Q, E)\) respectively. Then \(M((F, E), (G, E)) = \frac{\|Q, E\|}{\|P, E\|}\)

Since \((F, E) \cup (G, E) = (G, E) \cup (F, E)\) and \((F, E) \cap (G, E) = (G, E) \cap (F, E)\), the proof is obvious.

(ii) Here \((F, E) \cup (G, E) = (F, E) \cup (F, E) = (F, E)\)

and \((F, E) \cap (G, E) = (F, E) \cap (F, E) = (F, E)\).

respectively. Then \(M((F, E), (G, E)) = \frac{\|F, E\|}{\|F, E\|} = 1\).
(iii) Here $(F, E) \cap (G, E) = \emptyset$ so that $|(F, E) \cap (G, E)| = 0$

and hence $M((F, E), (G, E)) = 0$.

(iv) Let $(F, E) \subseteq (H, E) \subseteq (G, E)$

Then $\forall e \in E, F(e) \leq H(e) \leq G(e) \Rightarrow \forall e \in E, F(e) \cap G(e) \subseteq H(e) \cap G(e)$.

It follows that $M((F, E), (G, E)) \leq M((H, E), (G, E))$.

4. Application in Decision Making

4.1. Significantly Similar Fuzzy Soft Sets

Let $(F, E)$ and $(G, E)$ be two fuzzy soft sets over the same soft universe $(u, e)$; these two fuzzy soft sets will be called significantly similar if $M((F, E), (G, E)) \geq 0.5$

4.2. Illustration

Suppose an organization wants to recruit a person for the post of Personal Relation Officer.

Let $U = \{u_1, u_2\}$ be the universal set, where $u_1 = \text{Can be recruited}$ and $u_2 = \text{Can’t be recruited}$.

Let $E = \{e_1(\text{good communication skill}), e_2(\text{command over computer skill}), e_3(\text{pleasing personality}), e_4(\text{confident}), e_5(\text{confused})\}$ be the set of parameters under consideration for recruitment by the organization.

Step 1. A model fuzzy soft set is set by an expert committee of the organization.

Step 2. We form the fuzzy soft set of parameters for each candidate.

Step 3. We find the similarity of the model fuzzy soft set and the fuzzy soft set for each candidate. In this way, we can find the significantly similar fuzzy soft sets.

Step 4. Higher the similarity value, greater is the chance for recruitment.

Table 1 (Model fuzzy soft set for recruitment as Personal Relation Officer)

<table>
<thead>
<tr>
<th></th>
<th>$e_1$</th>
<th>$e_2$</th>
<th>$e_3$</th>
<th>$e_4$</th>
<th>$e_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$u_1$</td>
<td>1.0</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>$u_2$</td>
<td>0.0</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Table 2 (Fuzzy soft set for 1st candidate)

\[
(F, E) = \begin{pmatrix}
e_1 & e_2 & e_3 & e_4 & e_5 \\
u_1 & 0.6 & 0.5 & 0.8 & 0.7 & 0.4 \\
u_2 & 0.5 & 0.3 & 0.2 & 0.1 & 0.5
\end{pmatrix}
\]

Table 3 (Fuzzy soft set for 2nd candidate)

\[
(F, E) = \begin{pmatrix}
e_1 & e_2 & e_3 & e_4 & e_5 \\
u_1 & 0.6 & 0.4 & 0.8 & 0.6 & 0.5 \\
u_2 & 0.2 & 0.5 & 0.3 & 0.5 & 0.4
\end{pmatrix}
\]

Case (I) (Similarity between \((F, E)\) and \((F_1, E)\))

\[
(F, E) \bowtie (F_1, E) = (P_1, E)
\]

\[
(P_1, E) = \begin{pmatrix}
e_1 & e_2 & e_3 & e_4 & e_5 \\
u_1 & 1.0 & 0.8 & 0.9 & 0.9 & 0.4 \\
u_2 & 0.5 & 0.3 & 0.2 & 0.1 & 0.8
\end{pmatrix}
\]

\[
(Q_1, E) = \begin{pmatrix}
e_1 & e_2 & e_3 & e_4 & e_5 \\
u_1 & 0.6 & 0.5 & 0.8 & 0.7 & 0.2 \\
u_2 & 0.0 & 0.2 & 0.1 & 0.1 & 0.5
\end{pmatrix}
\]

The fuzzy soft matrices corresponding to these two fuzzy soft sets \((P_1, E)\) and \((Q_1, E)\) are given by,

\[
A_1 = \begin{bmatrix}
1.0 & 0.8 & 0.9 & 0.9 & 0.4 \\
0.5 & 0.3 & 0.2 & 0.1 & 0.8
\end{bmatrix}
\]

\[
B_1 = \begin{bmatrix}
0.6 & 0.5 & 0.8 & 0.7 & 0.2 \\
0.0 & 0.2 & 0.1 & 0.1 & 0.5
\end{bmatrix}
\]

We have, \(|(P_1, E)| = |A_1| = |P_1(e_1)| + |P_1(e_2)| + |P_1(e_3)| + |P_1(e_4)| + |P_1(e_5)| = 1.5 + 1.1 + 1.1 + 1.0 + 1.2 = 5.9\)

\(|(Q_1, E)| = |B_1| = |Q_1(e_1)| + |Q_1(e_2)| + |Q_1(e_3)| + |Q_1(e_4)| + |Q_1(e_5)|\)
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\[ 0.6 + 0.7 + 0.9 + 0.8 + 0.7 = 3.7 \]

Thus we have \[ M((F, E),(F_1, E)) = \frac{|(Q_1, E)|}{|(P_1, E)|} = \frac{3.7}{5.9} = 0.63 \]

**Case (I)** (Similarity between \((F, E)\) and \((F_2, E)\))

\[
(F, E) \bigcap (F_2, E) = (P_2, E)
\]

\[
(P_2, E) \begin{bmatrix} e_1 & e_2 & e_3 & e_4 & e_5 \\ u_1 & 1.0 & 0.8 & 0.9 & 0.9 & 0.5 \\ u_2 & 0.2 & 0.5 & 0.3 & 0.5 & 0.8 \end{bmatrix}
\]

\[
(F, E) \bigcap (F_2, E) = (Q_2, E)
\]

\[
(Q_2, E) \begin{bmatrix} e_1 & e_2 & e_3 & e_4 & e_5 \\ u_1 & 0.6 & 0.4 & 0.8 & 0.6 & 0.2 \\ u_2 & 0.0 & 0.2 & 0.1 & 0.1 & 0.4 \end{bmatrix}
\]

The fuzzy soft matrices corresponding to these two fuzzy soft sets \((P_2, E)\) and \((Q_2, E)\) are given by,

\[
A_2 = \begin{bmatrix} 1.0 & 0.8 & 0.9 & 0.9 & 0.5 \\ 0.2 & 0.5 & 0.3 & 0.5 & 0.8 \end{bmatrix}
\]

\[
B_2 = \begin{bmatrix} 0.6 & 0.4 & 0.8 & 0.6 & 0.2 \\ 0.0 & 0.2 & 0.1 & 0.1 & 0.4 \end{bmatrix}
\]

We have,

\[
| (P_2, E) | = | A_2 | = | P_2(e_1) | + | P_2(e_2) | + | P_2(e_3) | + | P_2(e_4) | + | P_2(e_5) | = 1.2 + 1.3 + 1.2 + 1.4 + 1.3 = 6.4
\]

\[
| (Q_2, E) | = | B_2 | = | Q_2(e_1) | + | Q_2(e_2) | + | Q_2(e_3) | + | Q_2(e_4) | + | Q_2(e_5) | = 0.6 + 0.6 + 0.9 + 0.7 + 0.6 = 3.4
\]
Thus we have \[ M((F, E), (F_2, E)) = \frac{|(Q_2, E)|}{|(P_2, E)|} = \frac{3.4}{6.4} \approx 0.53 \]

In view of our discussion, we can conclude that the first candidate has greater chance of recruitment.

**5. CONCLUSION**

We have applied the notion of similarity of fuzzy soft sets in a decision problem. It is hoped that our findings would help enhancing this study in fuzzy soft sets.

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**CONFLICT OF INTERESTS**

The authors declare that there is no conflict of interests.

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