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ARTICLE

On Soft Pre-Rough Approximation Space with Applications in Decision Making

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ABSTRACT

A soft, rough set model is a distinctive mathematical model that can be used to relate a variety of real-life data. In the present work, we introduce new concepts of rough set based on soft pre-lower and soft pre-upper approximation space. These concepts are soft pre-rough equality, soft pre-rough inclusion, soft pre-rough belonging, soft pre-definability, soft pre-internal lower, and soft pre-external lower. We study the properties of these concepts. Finally, we use the soft pre-rough approximation to illustrate the importance of our method in decision-making for Chikungunya medical illnesses. In reality, the impact factors of Chikungunya's medical infection were determined. Moreover, we develop two new algorithms to address Chikungunya virus issues. Our proposed approach is sensible and effective.

KEYWORDS

Soft rough set; soft pre-rough set approach; soft pre-internal lower and soft pre-external upper; soft nowhere dense set and Chikungunya medical application; intelligence discovery

1 Introduction

The chikungunya virus is transmitted to humans by the bite of an infected mosquito. Fever and joint discomfort are the most typical symptoms of infection. Headache, muscle soreness, joint swelling, and rash are some of the other symptoms. The chikungunya virus was first discovered in the Americas in late 2013 on the Caribbean islands. The number of research articles published has exploded at a quick pace, particularly in mathematics. Several proposals were given for solving real-world problems with mathematical methodologies and relevant formulas to assist decision-makers in making the best decisions possible. To deal with challenges that are uncertain ([1–3]).

To reduce the uncertainty and vagueness of knowledge, Molodtsov [4] developed soft sets; as a novel technique for modeling uncertainty, creating the fundamentals of the corresponding theory. He has demonstrated how this theory may be used to solve a variety of practical issues in economics, engineering, social science, and medicine, among other fields. Many researchers introduced several applications of soft set theory ([5–7]). We are implementing new classes of concepts in this paper based on soft pre-rough set [8–11].

In our everyday lives, we are often constantly faced with challenges that necessarily require rational decision-making. Yet, we get uncertain about the correct answer in several of these situations. We must consider different criteria related to the solution in order to arrive at the best possible solution to these problems. For this, in our paper we can use the best mathematical tool namely soft, rough set theory in decision making. The classical soft sets were also applied to fuzzy soft sets by the same authors [12–14]. Maji et al. [15,16] discussed the application of soft set theory to a problem of decision-making, and the implementation of soft set theory was explored. They created soft, rough approximations, soft, rough sets, and several related concepts based on this granulation structure. The soft rough sets model established by Feng et al. [17] is generalized in this paper. The goal was to exert some influence on the ongoing issue. This approximation is a generalization to Feng et al. [17]; we have demonstrated that our approach is more accurate and comprehensive than that of Feng et al. [17] defined the soft rough model as a generalization of the Pawlak rough models (SRs) [18]. Since then, many researchers have further studied RS as in the following published articles [19–21]. The authors in [22–24] introduced a new approach coupled with applications based on relation in soft generalized topological spaces and they studied their properties. Mathematical modeling of vagueness and ambiguity is becoming an increasingly important in a variety of fields of study. Another statistical tool that has been used in many aspects of life is regression analysis [25,26].

In this paper, we used this approximation to define many new concepts based on it, namely soft pre-rough belonging, soft pre-rough inclusion, soft pre-rough definability, soft pre-rough equality, and we studied the properties of these concepts. The present approximations are significant not just because they reduce or eliminate border areas. Finally, we will introduce an application in decision making of these concepts. At the end of the paper, we will present an algorithm that can be used to decide on an information system to show the importance of this approximation.

Here's how the document goes: Originality starts from Sections 2 and 3, and the preliminary basic concepts are covered. Sections 4 and 5 discuss both the rough and soft sets, as well as the use of soft pre-rough for each subclass of characteristics in information systems and applications. In Section 6, a few concluding notes provide a discussion and recommendations for future scope.

2 Preliminaries

We offer some fundamental concepts and outcomes that are utilized in the paper:

Definition 2.1 [3] Let $S = (\Gamma, \mathrm{A})$be a soft set over upon $U$and $\mathrm{A} = (U, S)$be a space. Consequently, the soft "pre-lower" and "pre-upper" approximations of any subset $X \subseteq U$ are defined respectively, by: the soft pre-lower $\mathrm{B}_{-s}(\mathrm{X}) = X \cap \underline{\mathrm{N}}(\overline{\mathrm{N}}(\mathrm{X}))$ and the soft pre-upper $\mathrm{B}^{-s}(\mathrm{X}) = \mathrm{X} \cup \overline{\mathrm{N}}(\underline{\mathrm{N}}(\mathrm{X}))$.

We refer to $(\mathrm{B}_{-s}(\mathrm{X}),\ \mathrm{B}^{-s}(\mathrm{X}))$ as "soft pre-rough approximations" with respect to A_s.

Definition 2.2 [3] Assuming that $\mathrm{A}_s = (U, S)$be a space and $\mathrm{X} \subseteq U$. Consequently, the soft "pre-positive, pre-negative, pre-boundary" regions and the "pre-accuracy" of the soft pre-approximations are defined respectively by: $POS(X) = \mathrm{B}_{-S}(X)$, $NEG(\mathrm{X}) = U - \mathrm{B}^{-S}(\mathrm{X})$, $BND(\mathrm{X}) = \mathrm{B}^{-S}(\mathrm{X}) - \mathrm{B}_{-S}(\mathrm{X})$ and $\mu = \left|\frac{\mathrm{B}_{-S}(\mathrm{X})}{\mathrm{B}^{-S}(\mathrm{X})}\right|$, where $\mathrm{B}^{-S}(\mathrm{X}) \neq 0$.

Clearly, if $\mathrm{B}_{-S}(X) = \mathrm{B}^{-S}(X)$, $BND(X) = \varphi$ and $\mu = 1$. Then $X \subseteq U$ it is called "soft pre-definable" or "soft pre-exact" set; otherwise X it is called a "soft pre-rough" set.

The principal purpose of the following outcomes is to present and superimpose the fundamental features of soft pre-rough approximations $\mathrm{B}_{-S}(X)$ and $\mathrm{B}^{-S}(X)$.

Proposition 2.1 [3] Let $S = (\Gamma, \mathrm{A})$ be a soft set upon U and $\mathrm{A}_s = (U, S)$ be a space. Thus, the soft pre-lower and pre-upper approximations of $X \subseteq U$ satisfy the following properties:

(i) $\mathrm{B}_{-s}(\varphi) = \mathrm{B}^{-s}(\varphi) = \varphi$

(ii) $\mathrm{B}_{-s}(U) = \cup_{e \in A} f(e), \mathrm{B}^{-s}(U) = U$

(iii) I$X \subseteq Y$ then $\mathrm{B}_{-s}(X) \subseteq \mathrm{B}_{-s}(Y)$

(iv) If $X \subseteq Y$, then $\mathrm{B}^{-s}(X) \subseteq \mathrm{B}^{-s}(Y)$

(v) $\mathrm{B}_{-s}(X \cap Y) = \mathrm{B}_{-s}(X) \cap \mathrm{B}_{-s}(Y)$

(vi) $\mathrm{B}_{-s}(X \cup Y) \supseteq \mathrm{B}_{-s}(X) \cup \mathrm{B}_{-s}(Y)$

(vii) $\mathrm{B}^{-s}(X \cap Y) \subseteq \mathrm{B}^{-s}(X) \cap \mathrm{B}^{-s}(Y)$

(viii) $\mathrm{B}^{-s}(X \cup Y) = \mathrm{B}^{-s}(X) \cup \mathrm{B}^{-s}(Y)$

3 Approaches on Soft Set

3.1 Soft Pre-Definability of Sets

In this section, we presented the definitions of definability of sets by using soft pre-rough approximation, namely, soft pre-internal upper, soft pre-external lower of a set A, and we denote to the soft pre-internal upper, soft pre-external lower of a set A by $Inte^{-S}(\mathrm{A})$ and $Exte^{-S}(A)$, respectively.

The definition that follows introduces new concepts of definability for a subset $\mathrm{A} \subseteq X$ in soft pre-rough approximation space.

Definition 3.1 Assuming $S = (\Gamma, \mathrm{A})$ be a soft set upon U and $\mathrm{A}_s = (U, S)$ be a space. Then, the soft pre-lower and pre-upper approximations of and $\mathrm{A} \subseteq X$, $\mathrm{A} \neq \varphi$. Then A is called.

i. Soft pre-internally definable if and only if $Exte^{-S}(\mathrm{A}) = \varphi$ and $Inte^{-S}(\mathrm{A}) \neq \varphi \Rightarrow \mathrm{A} = app_{-S}(\mathrm{A})$.

ii. Soft pre-externally definable if and only if $Inte^{-S}(\mathrm{A}) = \varphi$ and $Exte^{-S}(\mathrm{A}) \neq \varphi \Rightarrow \mathrm{B}^{-S}(A) = A$.

iii. Soft pre-roughly undefinable if and only if $\mathrm{B}_{-S}(\mathrm{A}) \neq \mathrm{B}^{-S}(\mathrm{A}) \neq \mathrm{A}$. This means that some elements of X belong to A and some elements belongs to A^C.

iv. Soft pre-exact (briefly Soft pre-exact) set if and only if $\mathrm{A} = \mathrm{B}_{-S}(\mathrm{A}) = \mathrm{B}^{-S}(\mathrm{A})$ and hence $b^S(\mathrm{A}) = \varphi$.

Definition 3.2 Let $S = (\Gamma, \mathrm{A})$ be a soft set upon $U$and $\mathrm{A}_s = (U, S)$ a soft approximation space. and $\mathrm{A} \subseteq U$, $A \neq \varphi$. Consequently A is called:

i. Soft pre-internally definable (resp. Soft pre-externally definable and soft pre-exact).

ii. Soft pre-internally definable set if and only if $\mathrm{A} = \mathrm{B}_{-S}(\mathrm{A})$, i.e., $Exte^S(\mathrm{A}) = \varphi$.

iii. Soft pre-externally definable set if and only if $\mathrm{A} = app^{-S}(A)$, i.e., $Inte^{-S}(A) = \varphi$.

Definition 3.3 Let $S = (\Gamma, \mathrm{A})$be a soft set upon, $\mathrm{A}_s = (U, S)$ be a soft space. Then, the soft pre-lower and pre-upper approximations of and $\mathrm{A} \subseteq U$, $\mathrm{A} \neq \varphi$. Then A is called:

i. Soft pre-external lower (briefly $Exste_{-p}(A)$) if $Exste_{-p}(A) = A - \mathrm{B}_{-S}(A)$.

ii. Soft pre-external lower (briefly $Ixste_{-p}(A)$ *)* if $Ixste_{-p}(A) = \mathrm{B}^{-S}(A) - A$.

iii. Soft pre-exterior (briefly $ext_p(A)$ *)* if $ext_p(A) = U - \mathrm{B}^{-S}(A)$.

Proposition 3.1 Let $S = (\Gamma, \mathrm{A})$be a soft set upon U, $\mathrm{A}_s = (U, S)$ be a soft space, $\mathrm{A}, B \subseteq U$, A, $B \neq \varphi$. Then, the next announcements are held:

i. *If* $A \subseteq B$, then $ext_p(B) \subseteq ext_p(\mathrm{A})$.

ii. $ext_p(A \cup B) = ext_p(A) \cup ext_p(B)$.

iii. $ext_p(A \cap B) \supseteq ext_p(A) \cup ext_p(B)$.

Proof.

i. Since $\mathrm{B}^{-S}(A) \subseteq \mathrm{B}^{-S}(B)$ by taken the complement for both sides, we get $X - \mathrm{B}^{-S}(B) \subseteq X - \mathrm{B}^{-S}(A)$ and hence $ext_p(B) \subseteq ext_p(A)$.

ii. Since $ext_p(A \cup B) = U - \mathrm{B}^{-S}(A \cup B) = (U - \mathrm{B}^{-S}(A)) \cap (U - \mathrm{B}^{-S}(B)) = ext_p(A) \cup ext_p(B)$ then $ext_p(A \cup B) = ext_p(A) \cup ext_p(B)$.

iii. Since $ext_p(A \cap B) = U - \mathrm{B}^{-S}(A \cap B) \supseteq (U - \mathrm{B}^{-S}(A)) \cup (U - \mathrm{B}^{-S}(B) = ext_p(A) \cup ext_p(B)$. Then $ext_p(A \cap B) \supseteq ext_p(A) \cup ext_p(B)$.

The following example shows the equality in (iii) of the above proposition.

Example 3.1 Suppose that $S = (\Gamma, \mathrm{A})$ be a soft set upon U, $\mathrm{A}_s = (U, S)$ a soft approximation space, where, $U = \{\chi_1, \chi_2, \chi_3, \chi_4, \chi_5\}$, $E = \{\delta^1, \delta^2, \delta^3, \ldots, \delta^6\}$ and $\mathrm{A} = \{\delta^1, \delta^2, \delta^3, \delta^4\} \subseteq E$, so that $(\Gamma, \mathrm{A}) = \{(\delta^1, \{\chi_1\}), (\delta^2, \{\chi_2, \chi_5\}), (\delta^3, \{\chi_3\}), (\delta^4, \{\chi_5\})\}$. Now let $\mathrm{X} = \{\chi_1, \chi_2, \chi_3\}$, $Y = \{\chi_3, \chi_4, \chi_5\}$. Then, we get $\mathrm{B}^{-s}(\mathrm{X}) = \{\chi_1, \chi_2, \chi_3\}$ and $\mathrm{B}^{-s}(Y) = \{\chi_2, \chi_3, \chi_4, \chi_5\}$ which implies $ext_p X = \{\chi_4, \chi_5\}$ and $ext(Y) = \{\chi_1\}$. Hence, $ext(\mathrm{X}) \cup ext(Y) = \{\chi_1, \chi_4, \chi_5\} \ldots (i)$since $appr^{-s}(\mathrm{X} \cap Y) = \{\chi_3\}$. Then $ext(\mathrm{X} \cap Y) = \{\chi_1, \chi_2, \chi_4, \chi_5\} \ldots (ii)$ thus from (i), (ii) we get $ext_p(A \cap B) \neq ext_p(A) \cup ext_p(B)$.

Proposition 3.2 Let be full soft set upon U, $\mathrm{A}_s = (U, S)$ be a soft space, $\mathrm{X} \subseteq U$, $\mathrm{X} \neq \varphi$. Then,

i. $(\mathrm{B}_{-S}(\mathrm{X}))^C \subseteq \mathrm{B}^{-S}(\mathrm{X}^C)$

ii. $NEG(\mathrm{X}) = (\mathrm{B}^{-S}(\mathrm{X}))^C \subseteq \mathrm{B}_{-S}(\mathrm{X}))^C$

Proof.

i. Since $\mathrm{B}_{-S}(\mathrm{X}) = \mathrm{X} \cap \mathrm{B}_{-S}(\mathrm{B}^{-S}(\mathrm{X}))$ then $\mathrm{B}_{-S}(\mathrm{X}))^c = (\mathrm{X} \cap \underline{\mathrm{N}}(\overline{\mathrm{N}}(\mathrm{X})))^c =$

$\mathrm{X}^C \cup (\underline{\mathrm{N}}(\overline{\mathrm{N}}(\mathrm{X})))^c \subseteq \mathrm{X}^C \cup \overline{\mathrm{N}}((\overline{\mathrm{N}}(\mathrm{X}))^c) \subseteq \mathrm{X}^C \cup \overline{\mathrm{N}}(\underline{\mathrm{N}}(\mathrm{X})^C) = \mathrm{B}_{-S}(\mathrm{X})^C$ Then $(\mathrm{B}_{-S}(X))^C \subseteq \mathrm{B}^{-S}(X^C)$.

ii. Since $NEG(\mathrm{X}) = (\mathrm{B}^{-S}(\mathrm{X}))^C$and since $\mathrm{B}^{-S}(\mathrm{X}) = \mathrm{X} \cap \overline{\mathrm{N}}(\underline{\mathrm{N}}(\mathrm{X})$ thus $(\mathrm{B}^{-S}(\mathrm{X}))^C =$

$(\mathrm{X} \cup \overline{\mathrm{N}}(\underline{\mathrm{N}}(\mathrm{X})))^C = \mathrm{X}^C \cap (\overline{\mathrm{N}}\,(\underline{\mathrm{N}}(\mathrm{X}))^C \subseteq \mathrm{X}^C \cap (\underline{\mathrm{N}}\,(\underline{\mathrm{N}}(\mathrm{X}))^C \subseteq \mathrm{X}^C \cap \underline{\mathrm{N}}(\overline{\mathrm{N}}(\mathrm{X}^C) = \mathrm{B}_{-S}(\mathrm{X}^C)$.

Proposition 3.3 Assumption that $S = (\Gamma, \mathrm{A})$ be a soft set upon, $\mathrm{A}_s = (U, S)$ be a soft space, $\mathrm{A} \subseteq \mathrm{X}$, $\mathrm{A} \neq \varphi$. Then:

i. A is soft pre-exact set then A is soft pre-internally and soft pre-externally definable.

ii. A is soft pre-roughly un-definable set if and only if A is neither soft pre-internally nor soft pre-externally definable.

Proof.

i. Let A be a soft pre-exact. Then, $A = \mathrm{B}_{-S}(A) = \mathrm{B}^{-S}(A)$. Since $A = \mathrm{B}_{-S}(A)$. Then $Ext^S(A) = \varphi$. And hence A is soft pre-internally definable since $A = \mathrm{B}^{-S}(A)$. Then $Int -^S(A) = \varphi$ therefore A is soft pre-externally definable.

ii. Let A be a soft pre-rough undefinable set hence $\mathrm{B}_{-S}(\mathrm{A}) \neq \mathrm{B}^{-S}(\mathrm{A}) \neq \mathrm{A}$. Then A is neither soft pre-internally and soft pre-externally definable. Conversely, it is obvious.

Proposition 3.4 Assumption that $S = (\Gamma, A)$ be a soft set over upon U, $\mathrm{A}_s = (U, S)$ be a space, $A \subseteq X$, $A \neq \varphi$. If A is soft pre-roughly undefinable the $\mathrm{B}_{-S}(\mathrm{A}) \neq \mathrm{B}^{-S}(\mathrm{A}) \neq \mathrm{A}$.

Proof. Let A be a soft pre-roughly undefinable. Therefore A is not soft pre-exact and hence $B_{-S}(A) \neq B^{-S}(A) \neq A$.

Proposition 3.5 Assumption that $S = (\Gamma, A)$ be a soft set over upon U, $A_s = (U, S)$ be a space, $A \subseteq X$, $A \neq \varphi$. Thence A is soft pre-roughly undefinable if and only if $B_{-S}(A) \neq B^{-S}(A) \neq A$.

Proof. Let A be a soft pre-roughly undefinable. Thus, is not soft pre-exact then $B_{-S}(A) \neq B^{-S}(A) \neq A$. Conversely, let $B_{-S}(A) \neq B^{-S}(A) \neq A$. Thus, A is not soft pre-exact. Therefore, A is not simply open set and $B_{-S}(A) \neq B^{-S}(A) \neq A$. Hence, A is soft pre-roughly undefinable.

3.2 Soft Pre-Rough Belonging

In this section, we introduce new definitions on rough membership relation which indicates belonging to the elements of the set by using soft pre lower and soft pre upper approximations and we are studying some of their properties.

Definition 3.4 Assumption that $S = (\Gamma, A)$ be a soft set over upon U, $A_s = (U, S)$ be a space and upper belong as follows:

i. a is soft pre-lower belonging to A (briefly $a \underset{-p}{\in} A$) iff $a \in B_{-S}(A)$.

ii. a is soft pre-upper belonging to A (briefly $a \overset{-p}{\in} A$) iff $a \in B^{-S}(A)$.

Remark 3.1 Assumption that $S = (\Gamma, A)$ be a soft set over upon U and $A_s = (U, S)$ be a space. and $A \subseteq U$, $A \neq \varphi$. Then, for each $a \in U$ we have:

i. If $a \underset{-p}{\in} A$, then $a \overset{-p}{\in} A$.

ii. If $a \underset{-R}{\in} A$, then $a \underset{-p}{\in} A$.

iii. If $a \overset{-p}{\in} A$, then $a \overset{-R}{\in} A$.

The next example clarifies the above remark. Also, this example shows the concepts of soft pre-lower belong and soft pre lower belong which we shall use in the following application.

Example 3.2 Assumption that $S = (\Gamma, A)$ be a soft set upon U, $A_s = (U, S)$ is a space, where $U = \{\chi_1, \chi_2, \chi_3, \chi_4, \chi_5, \chi_6\}, E = \{\delta_1, \delta_2, \ldots, \delta_6\}$ and $A = \{e_1, e_2, e_3, e_4\} \subseteq E$ such that $(\Gamma, A) = \{(\delta_1, \{\chi_1, \chi_6\}), (\delta_2, \{\chi_3\}), (\delta_3, \varphi), (\delta_4, \{\chi_1, \chi_2, \chi_5\})\}$. Now let $X = \{\chi_3, \chi_4, \chi_5\}$ but $B_{-s}(X) = \{\chi_3, \chi_5\}$ and $B^{-s}(X) = \{\chi_3, \chi_4, \chi_5\}$. It is clear that an element $\chi_4 \in X$, but $\chi_4 \notin_{-p} X$ hence $\chi_4 \notin B_{-s}(X)$. Also, the same element $\chi_4 \in B^{-s}(X)$ and hence $\chi_4 \in_p^- X$.

Proposition 3.6 Assumption that $S = (\Gamma, A)$ be a soft set upon U, $A_s = (U, S)$ is a space, and N, $\hat{H} \subseteq U$. Consequently the next assumptions are valid:

i. If $N \subseteq \hat{H}$, then $(z \underset{-P}{\in} N \rightarrow z \underset{-P}{\in} \hat{H}$ and $z \overset{-P}{\in} N \rightarrow z \overset{-P}{\in} \hat{H})$.

ii. If $z \overset{-P}{\in} (N \cap H)$ then $z \overset{-P}{\in} N$ and $z \overset{-P}{\in} \hat{H}$.

iii. $z \overset{-P}{\in} (N \cup \hat{H}) \Leftrightarrow z \overset{-P}{\in} N$ or $z \overset{-P}{\in} \hat{H}$.

iv. If $z \underset{-P}{\in} N$ or $z \underset{-P}{\in} \hat{H}$ Then $z \underset{-P}{\in} (N \cup \hat{H})$.

v. $z \underset{-P}{\in} (N \cap \hat{H}) \Leftrightarrow z \underset{-P}{\in} N$ and $z \underset{-P}{\in} \hat{H}$.

vi. $z \overset{-P}{\in} N^C \Leftrightarrow z \notin_{-P} N$.

vii. $z \underset{-P}{\in} N^C \Leftrightarrow z \notin^{-P} N$.

Proof.

i. Let $N \subseteq \hat{H}$. Thus $\mathrm{B}_{-S}(N) \subseteq \mathrm{B}_{-S}(\hat{H})$ and $\mathrm{B}^{-S}(N) \subseteq \mathrm{B}^{-S}(\hat{H})$ if $z \underset{-p}{\in} N$. Then $z \in \mathrm{B}_{-S}(N)$ but $\mathrm{B}_{-S}(N) \subseteq \mathrm{B}_{-S}(\hat{H})$. Thus $z \in \mathrm{B}_{-S}(\hat{H})$ and hence $z \underset{-p}{\in} \hat{H}$. Similarly we can prove the second part.

ii. Let $z \overset{-P}{\in} (N \cap \hat{H})$. Thus $z \in \mathrm{B}^{-S}(N \cap \hat{H})$ and hence $z \in (\mathrm{B}^{-S}(N) \cap \mathrm{B}^{-S}(\hat{H}))$. This tends to $z \in \mathrm{B}^{-S}(N)$ and $z \in \mathrm{B}^{-S}(\hat{H})$. Then $z \overset{-P}{\in} A$ and $z \overset{-P}{\in} \hat{H}$.

iii. Let $z \overset{-P}{\in} (N \cup \hat{H})$. Thus $z \in \mathrm{B}^{-S}(N \cup \hat{H}) \Leftrightarrow z \in \mathrm{B}^{-S}(N)$ or $z \in \mathrm{B}^{-S}(\hat{H}) \Leftrightarrow z \overset{-P}{\in} N$ or $z \overset{-P}{\in} \hat{H}$.

iv. Let $z \underset{-p}{\in} N$ or $z \underset{-p}{\in} \hat{H}$. Then $z \in \mathrm{B}_{-S}(N)$ or $z \in \mathrm{B}_{-S}(\hat{H})$. Hence $z \in \mathrm{B}_{-S}(N) \cup \mathrm{B}_{-S}(\hat{H}) \subseteq \mathrm{B}_{-S}(N \cup \hat{H})$ thus $z \in \mathrm{B}_{-S}(N \cup \hat{H})$. Therefore $z \underset{-p}{\in} (N \cup \hat{H})$.

v. Let $z \underset{-p}{\in} (N \cap \hat{H})$. Thus $z \in \mathrm{B}_{-S}(N \cap \hat{H})$ but $\mathrm{B}_{-S}(N \cap \hat{H}) = \mathrm{B}_{-S}(N) \cap \mathrm{B}_{-S}(\hat{H})$. Then $z \in \mathrm{B}_{-S}(N)$ and $z \in \mathrm{B}_{-S}(\hat{H}) \Leftrightarrow z \underset{-p}{\in} N$ and $z \underset{-p}{\in} \hat{H}$.

3.3 Soft Pre-Rough Equality

We will introduce in this section a new class of equality by using soft pre-lower and soft pre -upper approximations namely, soft pre lower equal, soft pre upper equal and approximations of any two sets and we study some of their properties.

Definition 3.5 Assuming that $S = (\Gamma, \mathrm{A})$ be a soft set upon U, $\mathrm{A}_S = (U, S)$ is a space and A, $\hat{H} \subseteq U$, then:

i. The sets A and $\hat{H}$ are soft pre lower equal (briefly $A \overset{-p}{\sim} \hat{H}$) if $\mathrm{B}_{-S}(A) = \mathrm{B}_{-S}(\hat{H})$

ii. The sets A and $\hat{H}$ are soft upper equal (briefly $A \simeq_p \hat{H}$) if $\mathrm{B}^{-S}(A) = \mathrm{B}^{-S}(\hat{H})$.

iii. The sets A and $\hat{H}$ are soft approximations (briefly $A \approx_p \hat{H}$) if $A \overset{-p}{\sim} \hat{H}$ and $A \simeq_p \hat{H}$.

Proposition 3.7 Assumption that $S = (\Gamma, \mathrm{A})$ be a soft set upon U,$\mathrm{A}_s = (U, S)$ is a space, Consequently and $\hat{W}$, $\hat{J}$, C and $D \subseteq X$ Then:

i. If $\hat{W} \simeq_P C$ and $J \simeq_P D$ subsequently, $\hat{W} \cup \hat{J} \simeq_P C \cup D$.

ii. If $\hat{W} \simeq_P \hat{J}$ and $\hat{W} \cup \hat{J} \simeq_P \hat{W}$ subsequently, $\hat{W} \cup \hat{J} \simeq_P \hat{W} \simeq_P \hat{J}$.

Proof.

i. Since $\hat{W} \simeq_P C$ and $J \simeq_P D$ Then $\mathrm{B}^{-S}(\hat{W}) = \mathrm{B}^{-S}(C)$ and $\mathrm{B}^{-S}(\hat{J}) = \mathrm{B}^{-S}(D)$ Hence $\mathrm{B}^{-S}(\hat{W} \cup \hat{J}) = \mathrm{B}^{-S}(\hat{W}) \cup \mathrm{B}^{-S}(\hat{J}) = \mathrm{B}^{-S}(C) \cup \mathrm{B}^{-S}(D) = \mathrm{B}^{-S}(C \cup D)$. Therefore $\hat{W} \cup \hat{J} \simeq_P C \cup D$.

ii. Since $\hat{W} \simeq_p \hat{J}$ then $\mathrm{B}^{-S}(\hat{W}) = \mathrm{B}^{-S}(\hat{J})$. But $\mathrm{B}^{-S}(\hat{W} \cup \hat{J}) = \mathrm{B}^{-S}(\hat{W}) \cup \mathrm{B}^{-S}(\hat{J})$. Then $\mathrm{B}^{-S}(\hat{W} \cup \hat{J}) = \mathrm{B}^{-S}(\hat{W})$ and $\mathrm{B}^{-S}(\hat{W} \cup \hat{J}) = \mathrm{B}^{-S}(\hat{J})$. Then $\hat{W} \cup \hat{J} \simeq_p \hat{W}$. and $\hat{W} \cup J \simeq_P \hat{J}$. Conversely, since $\hat{W} \cup \hat{J} \simeq_P \hat{W}$ and $\hat{W} \cup \hat{J} \simeq_P \hat{J}$. Then $\mathrm{B}^{-S}(\hat{W} \cup \hat{J}) = \mathrm{B}^{-S}(\hat{W}) \cup \mathrm{B}^{-S}(\hat{H}) = \mathrm{B}^{-S}(\hat{W})$ and $\mathrm{B}^{-S}(\hat{W} \cup \hat{J}) = \mathrm{B}^{-S}(\hat{W}) \cup \mathrm{B}^{-S}(\hat{J}) = \mathrm{B}^{-S}(\hat{J})$. Therefore $\mathrm{B}^{-S}(\hat{J}) \subseteq \mathrm{B}^{-S}(\hat{W})$ and $\mathrm{B}^{-S}(\hat{W}) \subseteq \mathrm{B}^{-S}(\hat{J})$ thus $\mathrm{B}^{-S}(\hat{W}) = \mathrm{B}^{-S}(\hat{J})$ and hence $\hat{W} \simeq_P \hat{J}$

Definition 3.6 Assumption that $S = (\Gamma, \mathrm{A})$ be a soft set upon U and $\mathrm{A}_S = (U, S)$ is a soft space. *and $A \subseteq U$* Then, A is called:

i. Soft pre dense in $A_S = (U, S)$ if and only if $A \simeq_p U$.

ii. Soft pre co-dense in $A_S = (U, S)$ if and only if $A \overset{-p}{\sim} \varphi$.

Proposition 3.8 Assumption that $S = (\Gamma, A)$ be a soft set upon U, $A_S = (U, S)$ is a space and $A \subseteq U$. Then we have:

i. Any set which contains soft pre dense is also soft pre dense set $A_S = (U, S)$.

ii. Any subset of soft pre condense set is soft pre co-dense set $A_S = (U, S)$.

Proof.

i. Let $A \subseteq B \subseteq U$ and since A is soft pre dense then $A \simeq_p U$ and hence $B^{-S}(A) = B^{-S}(U)$., $B^{-S}(A) \subseteq B^{-S}(B)$. This implies $B^{-S}(A) = B^{-S}(U) = U \subseteq B^{-S}(B)$. But $B^{-S}(B) \subseteq U$ thus $B^{-S}(B) = U = B^{-S}(U)$ and hence B is soft pre dense set in $A_S = (U, S)$.

ii. Let $A \subseteq B$, since B is soft pre co-dense set then $B \overset{-p}{\sim} \varphi$ then $B_{-S}(\varphi) \subseteq B_{-S}(A) \subseteq B_{-S}(B) = B_{-S}(\varphi)$ hence $B_{-S}(A) = B_{-S}(\varphi)$. Then $A \overset{-p}{\sim} \varphi$ therefore A is soft pre co-dense set $A_S = (U, S)$.

3.4 Soft Pre-Rough Inclusion

In this section, we present a new type of inclusion based on the soft pre rough approximation space called soft pre-upper inclusion, soft pre-lower inclusion, and soft pre-upper inclusion and we studied some of their results.

Definition 3.7 Assumption that $S = (\Gamma, A)$ be a soft set over upon U, $A_S = (U, S)$ be a space and A, $\hat{H} \subseteq X$. Then, we called:

i. A is soft pre-upper included in $\hat{H}$ (rough upper subset of $\hat{H}$) (briefly, $A \overset{\sim P}{\subseteq} \hat{H}$) if and only if $B^{-S}(A) \subseteq B^{-S}(\hat{H})$

ii. A is soft pre-lower included in $\hat{H}$ (rough lower subset of $\hat{H}$) (briefly, $A \underset{\sim p}{\subseteq} \hat{H}$) if and only if $B_{-S}(A) \subseteq B_{-S}(\hat{H})$

iii. A is soft pre roughly included in $\hat{H}$ (rough subset of $\hat{H}$) (briefly, $A \underset{\sim P}{\subseteq^{\sim}} \hat{H}$) if and only if $B_{-S}(A) \subseteq B_{-S}(\hat{H})$ and $B^{-S}(A) \subseteq B^{-S}(\hat{H})$

In the following example we show that the rough inclusion of sets does not imply to the inclusion of the ordinary sets.

Example 3.3 Assumption that $S = (\Gamma, A)$ is a soft set upon, $A_S = (U, S)$ is a space, where, $U = \{\chi^1, \chi^2, \chi^3, \chi^4, \chi^5, \chi^6\}$, $E = \{\delta^1, \delta^2, \ldots, \delta^6\}$, $A = \{\delta^1, \delta^2, \delta^3, \delta^4\} \subseteq E$ and $(\Gamma, A) = \{(\delta^1, \{\chi^1, \chi^6\}), (\delta^2, \{\chi^3\}), (\delta^3, \varphi), (\delta^4, \{\chi^1, \chi^2, \chi^5\})\}$. Let us now $X = \{\chi^6\}$ and $Y = \{\chi^3, \chi^5\}$. But $B^{-s}(X) = \varphi, B^{-s}(Y) = \{\chi^3, \chi^5\}$. It is clear that $X \tilde{\subseteq}_P Y$.

Example 3.4 Assumption that $S = (\Gamma, A)$ be a soft set upon, $A_S = (U, S)$ is a space, where $U = \{\chi^1, \chi^2, \chi^3, \chi^4\}$, $E = \{\delta^1, \delta^2, \ldots, \delta^6\}$ and $A = \{\delta^1, \delta^2, \delta^3\} \subseteq E$ such that $(\Gamma, A) = \{(\delta^1, \{\chi^1\}), (\delta^2, \{\chi^1, \chi^3\}), (\delta^3, \{\chi^2, \chi^3\})\}$. Now let $X = \{\chi^3, \chi^4\}$ and $Y = \{x^2, x^3\}$. But $B_{-s}(X) = \{x^3\}, B_{-s}(Y) = \{x^2, x^3\}$. It is clear that $X \underset{\sim p}{\subseteq} Y$.

Proposition 3.9 Assumption that $S = (\Gamma, \mathrm{A})$ be a soft set upon, $\mathrm{A}_S = (U, S)$ is a space and $\mathrm{A}, \hat{H} \subseteq U$. Then we have:

i. If $A \subseteq \hat{H}$, then $A \underset{\sim p}{\subseteq} \hat{H}$, $A \tilde{\subseteq}_P \hat{H}$ and $A \underset{\sim p}{\tilde{\subseteq}} \hat{H}$.

ii. If $A \underset{\sim p}{\subseteq} \hat{H}$ and $\hat{H} \underset{\sim p}{\subseteq} A \Leftrightarrow A \overset{-p}{\sim} \hat{H}$.

iii. If $A \tilde{\subseteq}_P \hat{H}$ and $\hat{H} \tilde{\subseteq}_P A \Leftrightarrow A \simeq_p \hat{H}$

Proof.

i. Obvious.

ii. Since $A \underset{\sim p}{\subseteq} \hat{H}$ and $\hat{H} \underset{\sim p}{\subseteq} A$ Then $\mathrm{B}_{-S}(A) \subseteq \mathrm{B}_{-S}(\hat{H})$ and $\mathrm{B}_{-S}(\hat{H}) \subseteq \mathrm{B}_{-S}(A)$ which implies that $\mathrm{B}_{-S}(A) = \mathrm{B}_{-S}(\hat{H})$ and hence $A \overset{-p}{\sim} \hat{H}$. Conversely, let $A \overset{-p}{\sim} \hat{H}$ Then $\mathrm{B}_{-S}(A) = \mathrm{B}_{-S}(\hat{H})$ and this means that $\mathrm{B}_{-S}(A) \subseteq \mathrm{B}_{-S}(\hat{H})$ and $\mathrm{B}_{-S}(\hat{H}) \subseteq \mathrm{B}_{-S}(A)$. This implies that $A \underset{\sim p}{\subseteq} \hat{H}$ and $\hat{H} \underset{\sim p}{\subseteq} A$. If $A \underset{\sim P}{\subseteq^{\sim}} \hat{H}$ and hence $A \overset{-p}{\sim} \hat{H}$.

iii. Similarly, as (*ii*).

iv. Similarly, as (*ii*).

Proposition 3.10 Assumption that $S = (\Gamma, \mathrm{A})$ be a soft set upon U, $\mathrm{A}_S = (U, S)$ is a space, $\hat{W}, N, C$ and $D \subseteq U$. Consequently:

i. $\hat{W} \tilde{\subseteq}_P N \Leftrightarrow \hat{W} \cup N \simeq_p N$.

ii. $\hat{W} \cap N \underset{\sim p}{\subseteq} \hat{W} \subset_{P}^{\sim} \hat{W} \cup N$

iii. $\hat{W} \subseteq N, \hat{W} \overset{-p}{\sim} C$, and $N \overset{-p}{\sim} D \Rightarrow C \underset{\sim}{\subseteq} D$

iv. $\hat{W} \subseteq N, \hat{W} \simeq_p C$, and $N \simeq_p D \Rightarrow C \tilde{\subseteq}_P D$.

v. $\hat{W} \subseteq N, \hat{W} \approx_p C$, and $N \approx_p D \Rightarrow C \underset{\sim p}{\tilde{\subseteq}} D$.

vi. $C \tilde{\subseteq} \hat{W}, D \tilde{\subseteq}_P N \Rightarrow C \cup D \tilde{\subseteq}_P \hat{W} \cup N$.

vii. $C \underset{\sim p}{\subseteq} \hat{W}$ and $D \underset{\sim p}{\subseteq} N \Rightarrow C \cap D \underset{\sim p}{\subseteq} \hat{W} \cap N$.

Proof.

i. Since $\hat{W} \underset{\sim p}{\subseteq} N$. Then $\mathrm{B}^{-S}(\hat{W}) \subseteq \mathrm{B}^{-S}(N)$. Since $\mathrm{B}^{-S}(\hat{W} \cup N) = \mathrm{B}^{-S}(\hat{W}) \cup \mathrm{B}^{-S}(N)$. Then $\mathrm{B}^{-S}(\hat{W} \cup N) = \mathrm{B}^{-S}(\hat{W})$. Therefore $\hat{W} \cup N \overset{-p}{\sim} \hat{W}$. Conversely, let $\hat{W} \cup N \overset{-p}{\sim} \hat{W}$. Thus $\mathrm{B}^{-S}(\hat{W} \cup N) = \mathrm{B}^{-S}(\hat{W}) \cup \mathrm{B}^{-S}(N) = \mathrm{B}^{-S}(\hat{W})$, where $\mathrm{B}^{-S}(\hat{W}) \supseteq \mathrm{B}^{-S}(N)$. Therefore $\hat{W} \underset{\sim}{\subseteq} N$.

ii. Since $\hat{W} \cap N \subset \hat{W}$. Then $\mathrm{B}_{-S}(\hat{W} \cap N) \subseteq \mathrm{B}_{-S}(\hat{W})$ hence $\hat{W} \cap N \underset{\sim p}{\subseteq} \hat{W}$ and since $\hat{W} \subseteq \hat{W} \cup N$. Thus $\mathrm{B}^{-S}(\hat{W}) \subseteq \mathrm{B}^{-S}(\hat{W} \cup N)$ then $\hat{W} \tilde{\subseteq}_P \hat{W} \cup N$. Hence $\hat{W} \cap N \underset{\sim P}{\subseteq} \hat{W} \tilde{\subseteq}_P \hat{W} \cup N$.

iii. Since $\hat{W} \subseteq N$ and $\hat{W} \overset{-P}{\sim} C$, $N \simeq_P D$. Then $B_{-S}(\hat{W}) = B_{-S}(C)$ and $B_{-S}(N) = B_{-S}(D)$ since $B_{-S}(\hat{W}) \subseteq B_{-S}(N)$ therefore $B_{-S}(C) \subseteq B_{-S}(D)$. Thus $C \underset{\sim P}{\subseteq} D$.

iv. Similarly (3).

v. It is obvious from (3), (4).

vi. Since $C \underset{\sim p}{\subseteq} \hat{W}$, and $D \underset{\sim p}{\subseteq} N$ Then $B_{-S}(C) \subseteq B_{-S}(\hat{W})$ and $B_{-S}(D) \subseteq B_{-S}(N)$ which leads to $B_{-S}(C) \cup B_{-S}(D) \subseteq B_{-S}(\hat{W}) \cup B_{-S}(N) \Rightarrow B_{-S}(C \cup D) \subseteq B_{-S}(\hat{W} \cup N)$. Therefore $C \cup D \underset{\sim p}{\subseteq} \hat{W} \cup N$.

vii. Obvious.

Definition 3.8 Assumption that $S = (\Gamma, A)$ be a full soft set upon U, $A_S = (U, S)$ be a space a subset $X \subseteq U$ is called soft pre-residual, soft pre-residual dense and soft pre-dense if $app^{-s}(X^C) = U$or $B_{-s}(X) = \varphi$, $B_{-S}B^{-s}(X) = \varphi$, and $app^{-s}(X) = U$.

Example 3.5 Assumption that $S = (F, A)$ be a soft set upon U, $A_S = (U, S)$ be a space, where $U = \{\chi^1, \chi^2, \chi^3, \chi^4, \chi^5, \chi^6\}$, $E = \{\delta^1, \delta^2, \ldots, \delta^6\}$ and $A = \{\delta^1, \delta^2, \delta^3, \delta^4\} \subseteq E$ such that $(\Gamma, A) = \{(\delta^1, \{\chi^1, \chi^6\}), (\delta^2, \{\chi^3\}), (\delta^3, \{\chi^1, \chi^3, \chi^5\}), (\delta^4, \{\chi^2, \chi^6\})\}$. Now let $X = \{x^1, x^4, x^6\}$, $Y = \{x^4, x^5\}$ and $Z = \{\chi^4\}$. But $B^{-s}(X) = U$, $B_{-s}(Y) = \varphi$ and $B_{-S}B^{-s}(Z) = \varphi$. Then we have X, Y and Z are soft pre-dense, soft pre-residual and soft pre-residual, respectively.

Proposition 3.11 Assumption that $S = (\Gamma, A)$ be a soft set upon, $A_S = (U, S)$ be a space $A \subseteq U$. Then, two soft the residuals contain the soft pre boundary of a set A.

Proof. Suppose that $A \cap B^{-S}(A)^C$ and $A^c \cap B^{-S}(A)$ are soft pre residuals we shall prove that the union of these sets is soft pre boundary of a set A thus $(A \cap B^{-S}(A)^C) \cup (A^c \cap B^{-S}(A)) = ((A \cap B^{-S}(A)^C) \cup A^c) \cap (A \cap B^{-S}(A)^C) \cup B^{-S}(A) = ((A \cup A^C) \cap$
$(A^C \cup B^{-S}(A)^C)) \cap ((A \cup B^{-S}(A)) \cap (B^{-S}(A) \cup B^{-S}(A)^C) = (X \cap B^{-S}(A)^C) \cap (B^{-S}(A) \cap X) =$
$B^{-S}(A) \cap B^{-S}(A)^C) \supseteq B^{-S}(A) \cap (B_{-S}(A))^c) = B(A)$.

3.5 Algorithms and Frameworks

This study concludes the method for dealing with chikungunya viral information. The algorithms (Algorithm 1, Algorithm 2) and frameworks (Figs. 1, 2) are shown to demonstrate the suggested method's logic and organization structure.

Algorithm 1:

Step 1: Input the soft set (Γ, E).
Step 2: Find the set of patients having chikungunya X.
Step 3: Compute the soft pre-upper approximation, say, $app_{-s}(X)$ and soft pre-upper approximation, say$app^{-s}(X)$, for every $X \subseteq U$. According to Definition 2.1.
Step 4: We Specify a boundary region, say, $BND(X)$ from Step 2, for every $X \subseteq U$. According to Definition 2.1.
Step 5: Calculate the approximation's accuracy, say, $\mu(X)$ by Step 3, for every $X \subseteq U$. Apparently to Definition 2.1.
Step 6: We deduce, the set of boundaries. The Algorithm 1 as follows.

Algorithm 2:

Step 1: Input the soft set (Γ, E).
Step 2: Find all reducts of the soft set (Γ, E).
Step 3: Choose one reduct say (Γ, D)
Step 4: We remove the duplicate rows.
Step 5: We find the strength of the attributes with respect to the decision for association rule $x \rightarrow D$ where x is the inserted values in the table and D is the decision.
Step 6: Compute the ratio $x \cup D/\ n(x)$.
Step 7: Find the most influential features of chikungunya virus infection.
Step 8: We make the appropriate decision regarding patients infected with chikungunya virus.

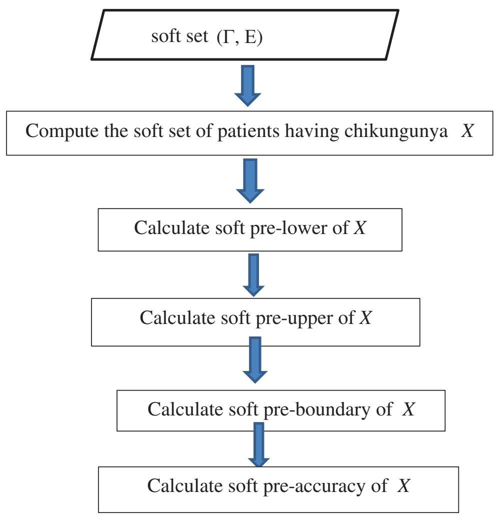

Figure 1: Framework of the proposed method

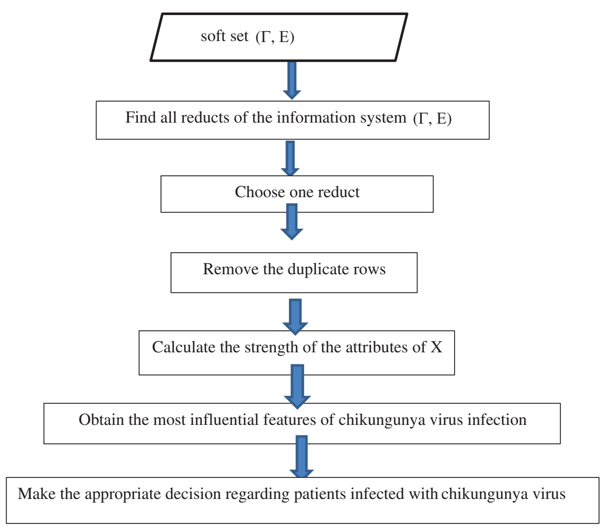

Figure 2: Framework of the result of the proposed method

4 Chikungunya Medical Application

Here we explore the problem of chikungunya, a disease that has been spread by Aedes mosquitoes that carry a virus that infects humans. CHIKV epidemics have occurred recently, linked to serious diseases. It generates a high temperature as well as significant joint discomfort. Muscle discomfort, headaches, and nausea are some of the other symptoms. The first signs and symptoms are similar to those of dengue fever. It typically does not endanger one's life. However, joint discomfort might linger for a long time. It might take months for you to fully heal. In most cases, the patient develops lifetime immunity to infection, making re-infection extremely unlikely. The illness has expanded throughout Africa and Asia in recent decades, particularly the subcontinent of India. Observe the table below, which contains information on 8-patients.

The following is a description of a set-valued information system in Table 1:

Table 1: The information system of 8-patients having Chikungunya as a soft set

Patients	Features (E)				Chikungunya
	δ_1	δ_2	δ_3	δ_4	d
m_1	0	1	0	0	1
m_2	1	0	0	1	0
m_3	1	0	0	1	1
m_4	0	0	0	0	0
m_5	0	1	1	0	0
m_6	1	1	0	1	1
m_7	1	0	1	0	0
m_8	1	1	0	1	1

$H = \{m_1, m_2, m_3, m_4, m_5, m_6, m_7, m_8\}$ of 8-patients, $E = \{\delta_1 =$ Nausea, $\delta_2 =$ Headache, $\delta_3 =$ Joint pain, $\delta_4 =$ Temperature$\}$ be a set of parameters which illustrate symptoms for patients. Consider the soft set (Γ, E), where $(\Gamma, \mathrm{E}) = \{(\delta_1, \{m_2, m_3, m_6, m_7, m_8\}), (\delta_2, \{m_1, m_5, m_6, m_8\}), (\delta_3, \{m_5, m_7\}), (\delta_4, \{m_2, m_3, m_6, m_8\})\}$ which describes having chikungunya and having not chikungunya as in the following Table 1.

Let $Y = \{m_2, m_4, m_5, m_7\}$ is the set of patients having not Chikungunya, the lower and the upper of this set are by our method is $\mathrm{B}_{-S}(Y) = \{m_2, m_5, m_7\}$, $\mathrm{B}^{-s}(Y) = \mathrm{H}$ and the boundary $BND(Y) = \{m_1, m_3, m_4, m_6, m_8\}$ and the accuracy is $\mu_A(Y) = 3/8$ since the patients $\{m_2, m_4, m_5, m_7\}$ having not Chikungunya or $\{m_1, m_3, m_6, m_8\}$ are the patients having Chikungunya, since the boundary region $\{m_1, m_3, m_4, m_6, m_8\}$, hence the patients m_1, m_3, m_4, m_6 and m_8 cannot be categorized in a unique way in view of the current state of knowledge. The patients m_1, m_5 and m_7 have indications that allow us to categorize them as chikungunya patients with precision. We can consider the indications which enable us to categorize them with confidence as Chikungunya, joint pain, Nausea, headache and temperature as the conditions we consider Chikungunya because not all condition features in a data system are required to describe features before generating judgment rules. It is possible that the judgment features rely on only a subset of condition features. Thus, we are interested in identifying this subset, which is provided by the core where $H = \{m_1, m_2, m_3, m_4, m_5, m_6, m_7, m_8\}$. Then, the reduct of these problems are $\{\delta_1, \delta_2, \delta_4\}$ and $\{\delta_1, \delta_3, \delta_4\}$.

5 Rule Generation

In this section, the rules will be generated depending on the reduct. and core as in Table 1, since the reduct sets are $\{\delta_1, \delta_3, \delta_4\}$ and $\{\delta_2, \delta_3, \delta_4\}$ also, the core sets are δ_3, and δ_4. We can find the strength of the attributes with respect to the decision for an association rule $x \rightarrow D$ which is the ration of number of the problems that contains x . From Table 1, we calculate the strength of the attributes $\{\delta_1, \delta_2, \delta_4\}$ as follows:

$(\delta_1 = 0) \rightarrow D = 1$ the strength of this particular rule is revealed to be 33%

$(\delta_1 = 1) \rightarrow D = 0$ the strength of this particular rule is revealed to be 20%

$(\delta_1 = 1) \rightarrow D = 1$ the strength of this particular rule is revealed to be 60%

$(\delta_1 = 0) \rightarrow D = 0$ the strength of this particular rule is revealed to be 67%

Similarly, the strength of rule δ_2 can be found as follows: $(\delta_2 = 1) \rightarrow D = 1$ the strength of this particular rule is revealed to be 75%.

$(\delta_2 = 0) \rightarrow D = 0$ the strength of this particular rule is revealed to be 75%

$(\delta_2 = 0) \rightarrow D = 1$ the strength of this particular rule is revealed to be 25%

$(\delta_2 = 1) \rightarrow D = 0$ the strength of this particular rule is revealed to be 25%

Similarly, the strength of rule δ_3 can be found as follows:

$(\delta_3 = 0) \rightarrow D = 1$ the strength of this particular rule is revealed to be 67%

$(\delta_3 = 0) \rightarrow D = 0$ the strength of this particular rule is revealed to be 33%

$(\delta_3 = 1) \rightarrow D = 0$ the strength of this particular rule is revealed to be 100%

Finally, we can find the strength of rules δ_4 as follows:

$(\delta_4 = 0) \rightarrow D = 1$ the strength of this particular rule is revealed to be 25%

$(\delta_4 = 1) \rightarrow D = 0$ the strength of this particular rule is revealed to be 25%

$(\delta_4 = 1) \rightarrow D = 1$ the strength of this particular rule is revealed to be 75%

$(\delta_4 = 0) \rightarrow D = 0$ the strength of this particular rule is revealed to be 100%

Then, from the above calculations we find that the attributes δ_3 and δ_4 are more affected than by Chikungunya from the other attributes because the strength of the rules for the attributes are maximum then from Table 1, the reduct sets are $\{\delta_2, \delta_3, \delta_4\}$, $\{\delta_1, \delta_3, \delta_4\}$ and the core is $\{\delta_3, \delta_4\}$ we can be reduced to the Table 2. We note that, IND $(E) \neq$ IND $(E - \{\delta_3\})$, ..., then δ_3, and δ_4 are indispensable. Also, we get δ_1 removed then we obtain IND $(E) =$ IND $(E - \{\delta_1\})$, and superfluous are $\delta_{1,}$ δ_2.

Core attributes one removal with MATLAB program [22]. Next, we get Remove Themes as the next Table 2.

From this Table 2, we find the core of this table in such a method remains consistent if we delete the value $\delta_4 = 0$. We find there are two decision values 1 and 0; this means that the based-on attribute δ_4 and we cannot make a unique decision. Thus, the values cannot be deleted. Similarly, if we delete $\delta_3 = 0$ we find there are two decision values 1 and 0. Based on attribute δ_3, we cannot make a unique decision; thus, the values cannot be deleted, as in the following Table 3.

Table 2: The reduction of the same rows

Patients	Features (E)		Chikungunya
	δ_3	δ_4	d
m_1	0	0	1
m_2	0	1	1
m_3	0	1	0
m_4	0	0	0
m_5	1	0	0

Table 3: The core of whole data

Patients	Features (E)		Chikungunya
	δ_3	δ_4	d
m_1	0	$*$	1
m_2	0	$*$	1
m_3	0	1	0
m_4	$*$	0	0
m_5	$*$	0	0

Thus, Table 3 shows that the core of the whole Table 1 This enables us to reduce to Table 3 by merging duplicate rows. We can eliminate the identical rows and get the following Table 4.

Table 4: The core of whole data

Patients	Features (E)		Chikungunya
	δ_3	δ_4	d
m_1	0	$*$	1
m_2	0	1	0
m_3	$*$	0	0

Table 4 gives us the decision rules based on the reduction as follows: if $(\delta_1 = 0)$ then $D = 1(\delta_3 = 0)$ and $\delta_4 = 1$ then $D = 0$ and if $(\delta_4 = 0)$ then $D = 0$. From our approach, determining the most important attribute based on the strength of this application can be used in many fields of knowledge discovery data mining.

6 Conclusion

In this article, we introduce the characteristics of the approach soft pre-rough set approximation and its decision making. We have introduced a new definition of this approach namely, soft pre-rough equality, soft pre-rough inclusion, soft pre-lower, soft pre-upper belong, soft pre-dense, soft pre-nowhere dense, soft pre-residual, soft pre-external lower and soft pre-internal upper and we also study some of their properties. We used our novel approach to identify the most important trait on the basis of its strength, which is an important method for analytical approach and decision making for any real-life problems. Also, we made a medical application to illustrate our method. This application can be used on any number of patients, any life problem and comment on the decision. Finally, the applicable technique is applied to a case study of a topological concept development strategy from the perspective of chikungunya virus in nature to validate the proposed method, as well as some comparison evaluations. We have explained our method with two algorithms and how to apply it using MATLAB. In reality, our suggestion is helpful in solving any future real-life problems. In the future, we shall extend the proposed methods to a variety of other concepts, such as the fuzzy set and fuzzy rough set.

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