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Research article

A multi-attribute group decision-making algorithm based on soft intervals that considers the priority rankings of group members on attributes of objects, along with some applications

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Abstract: There are a considerable number of studies involving soft sets, the most significant ones focusing on decision-making. In this study, we have developed decision-making algorithms using soft intervals on soft sets, which accounted for the priority order of individuals in situations where multiple people were involved. Soft sets can be considered as a parameterized family of subsets of the universal set; for this reason, soft sets provide an effective tool for evaluating the multiple attributes of objects in decision-making problems. In this study, the parameter set of the soft set was used for the attributes of the objects, while the universal set of the soft set was used for the objects being selected. A soft interval can be considered as a soft set that includes all parameterized subsets of the universal set within the specified boundaries determined by the order on the soft set. In this study, soft intervals were generated from the orderings on a soft set which were based on the users rankings of object attributes. The first algorithm enabled us to obtain the choice object based on the ranking of decision makers with equal influence on the decision, while the second algorithm achieved this for rankings of those with different influences. Both of these seeked to find the most appropriate object by considering the priority rankings of users in scenarios where a joint decision was required and the optimal decision objects were subsequently ranked. The novelty of the proposed algorithm lied in utilizing the new theory of soft sets to select the most suitable object for a group from multi-attribute objects, considering each member's ranking of attributes of objects.

Keywords: soft set; soft set relation; decision-making; multi-attribute group decision-making
Mathematics Subject Classification: 06A99, 91B06

1. Introduction

Soft set theory was proposed by Molodtsov [23] in 1999. This very novel theory has wide-ranging applications, so it has captured interest of many researchers. Maji et al. [22] defined various operators on soft set and obtained several significant results about them. In their early work, Babitha and Sunil [7] provided a definition for soft set relation and, subsequently, they presented the concept the partially ordered soft set [8]. By using orderings on soft sets, soft intervals were introduced by Yaylalı et al. [33]. Researches on soft sets have not been limited to the concept of relations but have found applications in various areas of mathematics, such as algebra [2] and topology [1, 11]. Moreover, studies on soft sets have led to the development of hybrid structures to expand their areas of application, such as fuzzy soft sets [20] and soft rough sets [14].

Furthermore, soft set theory is a mathematical tool which can be used for the decision-making problems that include uncertainty and vagueness. Maji et al. [21] illustrated the application of soft set theory in decision-making problems by using examples and highlighted the usability of soft sets in decision support systems. Çağman and Enginoğlu [10] introduced a matrix representation of a soft set, which enhanced the potential for rich computer applications; they also used soft sets in decision-making problems. Many researchers studied decision-making based on soft set theory like Kong et al. [17] and Zhang [37]. For this , Khamened and Kılıçman [36] analyzed multi-attribute decision-making systems based on the soft set theory systematically. Also, recent studies have shown that research on decision-making by using soft set theory is progressing quickly. For example, studies [3,4] focused on decision-making methods in medical applications, study [12] used the graph representation of soft set relations, and study [13] applied bipolar soft sets to decision-making. Additionally, study [16] used effective vague soft sets, study [19] provided a survey on decision-making methods, study [24] utilized cubic bipolar neutrosophic soft sets, and study [34] proposed a decision-making method with a computer application. In addition, if we examine recent studies on decision-making using soft sets, it becomes evident that all of them focus solely on evaluating whether the object meets the desired attributes. Moreover, there have been numerous studies addressing uncertainty in decision-making problems, risk assessment, or fuzzy sets, such as [18, 29, 35]. Additionally, some studies on achieving group consensus in decision-making include a reliability-driven large group consensus decision-making (LGCDM) approach proposed in [31] using the hesitant fuzzy linguistic terms set (HFLTS), as well as a dual-mechanism designed to model opinion dynamics and facilitate consensus building through trust exploration and leadership incubation in [32]. A multi-criteria decision-making method only for a single user without priority ranking of the user by using upper and lower energies based on neutrosophic soft sets was given in [9], and Sezgin and Çam [26] introduced a group decision-making approach by using soft theta product without priority ranking of users focused on evaluating whether the object meets the desired attributes. Musa and Asaad [25] introduced a decision-making procedure which uses Bipolar M-paramterized N soft sets, where they tried to integrate dual sides of humans in decision-making processes, but again without using priorities of users. Another approach for decision-making was given by Sezgin and Şenyiğit [27] which used soft star product by eliminating the parameters that the users did not want, and, similarly, Sezgin et al. [28] gave another decision-making method by using soft gamma-product. Al-Shargi et al. [5] presented a decision-making method by using possibility neutrosophic soft expert sets. Atagün and Kamacı [6] showed that emerged decompositions, which they presented in the same article, were useful to solve decision-making problems, but they still consider only whether the object fulfills the required attributes in multi-criteria decision-making. In addition to all this, Gifu [15] claimed that soft set methodologies can be effectively utilized in improving healthcare decision-making and patient outcomes. From the time soft sets were introduced until today, as shown in previous studies, it has become a practical theory for real-world decision-making applications. However, it has been observed that prior studies lack decision-making methods that consider multiple users and their priority rankings. Based on earlier research, it is clear that aligning the attributes of decision objects that are compatible with user preferences is an essential topic. For this reason, user preference information has started to be applied to studies in more detail. In this study, a method is proposed to solve decision-making problems involving multi-attribute objects and multiple users. Unlike earlier approaches that only examined whether objects met the desired or undesired attributes, this method also considers the priority ranking of these attributes based on user preferences.

The motivation for including user prioritization in decision-making processes within multi-attribute objects arises from the need to accurately reflect user preferences. Including prioritization of different users based on their own values makes the decision-making process more specific, so that the results are more closely aligned with users' expectations and needs. In earlier studies, assessments were made without considering the priority rankings of the decision-makers. Our study aims to address this significant deficiency. The key feature of our work is the proposed algorithms' capability to determine the most appropriate decision object for a group by considering the priority rankings of each decision-maker, as well as their varying influences in the decision-making process. An algorithm that takes into account only one user priority ranking by using the soft set was given in [34]; in this paper, that method is extended for a group of people. In this study, we have developed decision-making algorithms using soft intervals which account for the priority order of individuals separately in situations where multiple people are involved. These methods seek to find the most appropriate object when there are several objects to choose from when satisfying several attributes, by considering the priority rankings in scenarios where a joint decision is required and the optimal decision objects are subsequently ranked.

2. Materials and methods

To simplify and clarify the technical terms used in this study, some basic definitions are given in this section.

Definition 1. *[23] Let Υ be an initial universe and E' be a set of parameters. Let $\mathcal{P}(\Upsilon)$ be the set of all subsets of Υ and E be a subset of E'. A pair (Γ, E) is called a soft set over Υ where $\Gamma : E \longrightarrow \mathcal{P}(\Upsilon)$ is a set-valued function.*

In simpler terms, a soft set over Υ is a parametrized family of subsets of the universe Υ. $\Gamma(\psi)$ can be regarded as the set of ψ-approximate elements of the soft set (Γ, E).

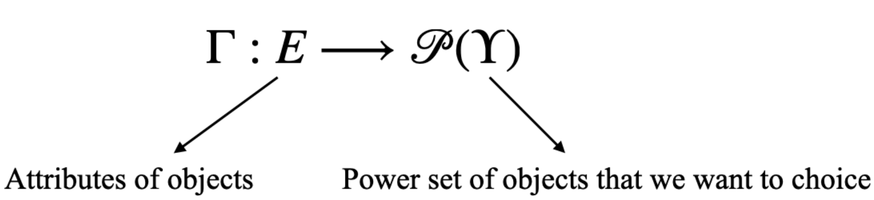

Figure 1. The representation of soft set in this study.

As described above, soft sets are highly flexible in choosing the parameter and the universal sets, which makes them widely used by researchers to solve decision-making problems. In this paper, the universal set of the soft set is made up of the objects intended for selection and the parameter set formed by attributes of objects. In this way, we can classify objects according to their attributes.

Definition 2. *[7] Let* (Γ_1, E_1) *and* (Γ_2, E_2) *be two soft sets over a common universe* Υ*.*

$(\Gamma_1, E_1) \times (\Gamma_2, E_2) = (\Gamma, E_1 \times E_2)$ is called the cartesian product of (Γ_1, E_1) and (Γ_2, E_2), where $(\psi, \psi') \in E_1 \times E_2, \Gamma : E_1 \times E_2 \to \mathcal{P}(\Upsilon \times \Upsilon)$ and $\Gamma(\psi, \psi') = \Gamma_1(\psi) \times \Gamma_2(\psi')$, i.e., $\Gamma(\psi, \psi') = \{(\upsilon_i, \upsilon_j) | \upsilon_i \in \Gamma_1(\psi), \upsilon_j \in \Gamma_2(\psi')\}$.

$\prec$ is called a soft set relation from (Γ_1, E_1) to (Γ_2, E_2), which is a soft subset of $(\Gamma_1, E_1) \times (\Gamma_2, E_2)$. In other words, a soft set relation $\prec$ from (Γ_1, E_1) to (Γ_2, E_2) is of the form $\prec = (\Gamma_\prec, S)$, where for all $(\psi, \psi') \in S$, $S \subset E_1 \times E_2$ and $\Gamma_\prec(\psi, \psi') = \Gamma(\psi, \psi')$, where $(\Gamma, E_1 \times E_2) = (\Gamma_1, E_1) \times (\Gamma_2, E_2)$.

$\Gamma_\prec(\psi, \psi')$ is also denoted by $\Gamma_1(\psi) \prec \Gamma_2(\psi')$.

Definition 3. *Let* $\prec$ *be a soft set relation on* (Γ, E)*.*

1) [7] If for all $\psi \in E$, $\Gamma_\prec(\psi, \psi) \in \prec$, then $\prec$ is a reflexive soft set relation.
2) [7] If $\Gamma_\prec(\psi, \psi') \in \prec \Rightarrow \Gamma_\prec(\psi', \psi) \in \prec$, then $\prec$ is a symmetric soft set relation.
3) [7] If $\Gamma_\prec(\psi, \psi') \in \prec$, $\Gamma_1(\psi', \psi'') \in \prec \Rightarrow \Gamma_\prec(a, c) \in \prec$ for every $\psi, \psi', \psi'' \in E$, then $\prec$ is a transitive soft set relation.
4) [8] If $\Gamma_\prec(\psi, \psi') \in \prec$ and $\Gamma_\prec(\psi', \psi) \in \prec$ imply $\Gamma(\psi) = \Gamma(\psi')$, then $\prec$ is an antisymmetric soft set relation.
5) [33] If for no $\psi \in E$, $\Gamma_\prec(\psi, \psi) \in \prec$ holds, then the soft set relation $\prec$ is called nonreflexive.

Definition 4. *[8] A reflexive, antisymmetric, and transitive binary soft set relation* $\prec$ *on* (Γ, E) *is called a partial ordering of* (Γ, E) *and the triple* $(\Gamma, E, \prec)$ *is called a partially ordered soft set.*

Definition 5. *[33] Let* $\prec$ *be a soft set relation on* (Γ, E)*, then restriction of a soft set relation* $\prec$ *to a soft subset* (Γ', E') *is defined by:*

$$\Gamma'(\psi) \prec_{(\Gamma', E')} \Gamma'(\psi') :\Leftrightarrow \Gamma(\psi) \prec \Gamma(\psi') \text{ for all } \psi, \psi' \in E'.$$

In [33], soft intervals were defined first for simple ordered soft sets, but also soft intervals were defined in the partially ordered soft set in [33].

Definition 6. *[33] Let* $(\Gamma, E, \prec)$ *be a partially ordered soft set.*

1) The soft open interval is a soft subset (Γ', E') of (Γ, E) where $E' = \{\psi \in E | \Gamma(\psi_i) \prec \Gamma(\psi), \Gamma(\psi) \prec \Gamma(\psi_j), \Gamma(\psi) \neq \Gamma(\psi_i), and\, \Gamma(\psi) \neq \Gamma(\psi_j)\}\}$, $\Gamma' = \Gamma|_B$, and denoted by $(\Gamma(\psi_i), \Gamma(\psi_j)) = \{\Gamma(\psi) | \Gamma(\psi_i) \prec \Gamma(\psi), \Gamma(\psi) \prec \Gamma(\psi_j), \Gamma(\psi) \neq \Gamma(\psi_i), and\, \Gamma(\psi) \neq \Gamma(\psi_j)\}$.

2) The soft half open interval is a soft subset (Γ', E') of (Γ, E) where $E' = \{\psi \in E | \Gamma(\psi_i) \prec \Gamma(\psi), \Gamma(\psi) \prec \Gamma(\psi_j), and\, \Gamma(\psi) \neq \Gamma(\psi_i)\}$, $\Gamma' = \Gamma|_{E'}$, and denoted by $(\Gamma(\psi_i), \Gamma(\psi_j)] = \{\Gamma(\psi) | \Gamma(\psi_i) \prec \Gamma(\psi) \prec \Gamma(\psi_j)\, and\, \Gamma(\psi) \neq \Gamma(\psi_i)\}$.

Or, the soft half open interval is a soft subset (Γ', E') of (Γ, E) where $E' = \{\psi \in E | \Gamma(\psi_i) \prec \Gamma(\psi), \Gamma(\psi) \prec \Gamma(\psi_j), and\, \Gamma(\psi) \neq \Gamma(\psi_j)\}$, $\Gamma' = \Gamma|_{E'}$, and denoted by $[\Gamma(\psi_i), \Gamma(\psi_j)) = \{\Gamma(\psi) | \Gamma(\psi_i) \prec \Gamma(\psi) \prec \Gamma(\psi_j)\, and\, \Gamma(\psi) \neq \Gamma(\psi_j)\}$.

3) The soft closed interval is a soft subset (Γ', E') of (Γ, E) where $E' = \{\psi \in E | \Gamma(\psi_i) \prec \Gamma(\psi)$, and $\Gamma(\psi) \prec \Gamma(\psi_j)\}$, $\Gamma' = \Gamma|_{E'}$, and denoted by $[\Gamma(\psi_i), \Gamma(\psi_j)] = \{\Gamma(\psi) | \Gamma(\psi_i) \prec \Gamma(\psi) \prec \Gamma(\psi_j)\}$.

In this paper, we use only soft closed intervals, so we simply write soft interval for soft closed interval.

Through the notion of soft set relation outlined above, the partially ordered soft set has been applied to soft sets, enabling an ordering to be generated among the parametrized family of subsets of the universe Υ of objects. The notion of the partially ordered soft set has allowed the effective utilization of the impact of users priority rankings into the decision-making process effectively. Thus, the proposed method aims to select the most suitable decision object in a scenario where users prioritize their expectations for the attributes of objects based on their preferences. In this study, the notion of soft interval, as defined above, is used to establish a decision-making method based on users' priority rankings, making it possible to observe how frequently one attribute is preferred over others and enhancing its weight in the decision-making process.

In this study, there are some terms used in the algorithms such as weight of a soft interval, interval choice value, and influence scalar. How to evaluate the weight of a soft interval is explained and detailed in both the algorithms, and how to calculate the interval choice value, which was originally defined in [37], is given in both algorithms. Additionally, the influence scalar is a constant that represents the impact ratio of decision-makers on the final decision. Its value depends on the problem and must be specified within the problem; otherwise, all users are assumed to have the same influence scalar. For example, in a company, shareholders influence the decision-making process based on their shareholding percentages.

2.1. Multi-attribute group decision-making algorithms

In this section decision-making algorithms based on soft intervals for multiple users are given. By using these methods, we aim to obtain the most suitable choice object for the users according to their priority rankings. Additionally, by using these methods, the most appropriate choice object order is going to be obtained. The first algorithm enables us to obtain the choice object based on the rankings of those with equal influence on the decision, while the second algorithm achieves this for rankings of those with varying degrees of influence.

The algorithms in this study utilize soft sets to represent multi-attribute objects that need to be selected. The parameter set in soft set corresponds to the set of attributes of the selection objects, while the universal set represents the set of selection objects, thereby simplifying the representation of selection objects using their multiple attributes. Additionally, the soft set relation has been established by considering the order of attributes that decision-makers expect in the objects. So in these methods, the soft set relation is derived based on the order on parameter set of the soft set.

2.1.1. Algorithm 1

The first algorithm is used to derive the choice object from the rankings of decision makers, who have equal influence in the decision, on the attributes. Step by step explanation of the presented algorithm is given below.

Step 1. Express the soft set: Write the soft set by using the informations.

Step 2. Obtain soft set relations: Obtain soft set relations by using the priority rankings of users. The number of soft set relations will be obtained equal to the number of users.

Step 3. Determine soft intervals: Determine the soft intervals according to the soft set relations.

Step 4. Determine weights of the soft intervals: The weights of soft intervals are calculating according to how many people's rankings include that soft interval. If a soft interval is obtained from n soft set relations, then its weight is n. For example, if a soft interval is obtained only from one soft set relation, then its weight is 1; if it is obtained from two soft set relations, then its weight is 2.

Step 5. Give the tabular representation of the soft intervals with their weights: Entries a_{ij} of the table represent weights of each soft interval for objects. Let $a_{ij} = [\kappa_{ij}^{(1)}, \kappa_{ij}^{(2)}]$ be the ith row and the jth column of the table. Let $\beta_j = [\Gamma(\psi_{\beta_{j1}}), \Gamma(\psi_{\beta_{j2}})]$ be a soft interval relating to the jth column.

If $\upsilon_i \in \Gamma(\psi_{\beta_{j1}})$ and β_j is obtained from n soft set relations, then $\kappa_{ij}^{(1)} = n$. If $\upsilon_i \notin \Gamma(\psi_{\beta_{j1}})$, then $\kappa_{ij}^{(1)} = 0$. Similarly, if $\upsilon_i \in \Gamma(\psi_{\beta_{j2}})$ and β_j is obtained from n soft set relations, then $\kappa_{ij}^{(2)} = n$. If $\upsilon_i \notin \Gamma(\psi_{\beta_{j2}})$, then $\kappa_{ij}^{(2)} = 0$.

Step 6. Evaluate interval choice values for the objects in the universal set: Interval choice value for the object υ_i is $[\kappa_i^{(1)}, \kappa_i^{(2)}]$, where $\kappa_i^{(1)} = \sum_{j=1}^{t} \kappa_{ij}^{(1)}$, $\kappa_i^{(2)} = \sum_{j=1}^{t} \kappa_{ij}^{(2)}$, and t is the number of soft intervals obtained from all soft set relations in the problem.

Step 7. Determine the choice object: Choice object is the object whose second component of the interval choice value $\kappa_i^{(2)}$ is maximum. If there is more than one object having the same maximum value for $\kappa_i^{(2)}$, then look for the maximum value for the first component of the interval choice values for these objects. Briefly find k for $\kappa_k^{(2)} = max_i \kappa_i^{(2)}$, then υ_k is the most suitable choice object. If there is more than one choice object, then find m for $\kappa_m^{(1)} = max_{\{k|\kappa_k^{(2)} = max_i \kappa_i^{(2)}\}} \kappa_i^{(1)}$, then υ_m is the most suitable choice object. If there is still more than one choice object, then any one of them cloud be the choice object. Additionally, the objects best suited for choice can be listed in order, starting from the largest interval choice values to the smallest.

Pseudo-code for the Algorithm 1 is given as follows:

Step 1. Express the soft set (Γ, E):

Input attributes of objects.

The set of attributes of objects is the parameter set of the soft set. ($E = \{\psi_1, \psi_2, ...\psi_p\}$).

Input objects.

The set of objects is the universal set of the soft set. ($\Upsilon = \{\upsilon_1, \upsilon_2, ...\upsilon_s\}$).

Step 2.

Input users' priority rankings on attributes of objects. (For $l = 1, ...r$, for the lth user, let us denote his/her priority ranking with $\prec_l$).

For $(l = 1, l <= r, l++)$

(For $(i = 1, i <= p, i++)$

(For $(j = 1, j <= p, j++)$

(If $\psi_i \prec_l \psi_j$, then $\Gamma(\psi_i) \prec_l \Gamma(\psi_j)$)))

Step 3.

For $(l = 1, l <= r, l++)$

(For $(i = 1, i <= p, i++)$
(For $(j = 1, j <= p, j++)$
(If $\Gamma(\psi_i) \prec_l \Gamma(\psi_j)$, then $[\Gamma(\psi_i), \Gamma(\psi_j)]$ is a soft interval for $\prec_l$.)))

Step 4. Let t be the total number of all different soft intervals obtained in Step 3.
For $(i = 1, i <= p, i++)$
(For $(j = 1, j <= p, j++)$
For $(k = 1, k <= t, k++)$
$(w_k = 0$
For $(l = 1, l <= r, l++)$
(If $[\Gamma(\psi_i), \Gamma(\psi_j)]$ is a soft interval for $\prec_l$, then $w_k = w_k + 1$.)
Weight of the soft interval $[\Gamma(\psi_i), \Gamma(\psi_j)]$ is w_k.)))

Step 5.
Let $a_{ij} = [\kappa_{ij}^{(1)}, \kappa_{ij}^{(2)}]$ denote the ith row and the jth column of the table. Let us denote the soft interval $[\Gamma(\psi_{\beta_{j1}}), \Gamma(\psi_{\beta_{j2}})]$ relating to the jth column with β_j and the weight of the soft interval β_j be denoted by $w_{\beta j}$.
For $(j = 1, j <= t, j++)$
(For $(i = 1, i <= s, i++)$
(If $\upsilon_i \in \Gamma(\psi_{\beta_{j1}})$ and $w_{\beta j} = n$, then $\kappa_{ij}^{(1)} = w_{\beta j}$; otherwise, $\kappa_{ij}^{(1)} = 0$.
If $\upsilon_i \in \Gamma(\psi_{\beta_{j2}})$ and $w_{\beta j} = n$, then $\kappa_{ij}^{(2)} = w_{\beta j}$; otherwise, $\kappa_{ij}^{(2)} = 0$.))

Step 6.
Let $[\kappa_i^{(1)}, \kappa_i^{(2)}]$ denote the interval choice value for the object υ_i.
$\kappa_i^{(1)} = \sum_{j=1}^{t} \kappa_{ij}^{(1)}$
$\kappa_i^{(2)} = \sum_{j=1}^{t} \kappa_{ij}^{(2)}$

Step 7.
Find k for $\kappa_k^{(2)} = max\{\kappa_1^{(2)}, \kappa_2^{(2)}, ..., \kappa_s^{(2)}\}$
If there is only one k, then choice object is υ_k,
If there is more than one k, such as $\{k_1, k_2, ...k_h\}$, then find m for $\kappa_m^{(1)} = max\{\kappa_{k_1}^{(1)}, \kappa_{k_2}^{(1)}, ..., \kappa_{k_h}^{(1)}\}$; then, υ_m is the most suitable choice object.

Moreover, the flowcharts of these steps are provided in the Appendix section.

The diagram in Figure 2 is prepared to make the algorithm steps clearer as given below.

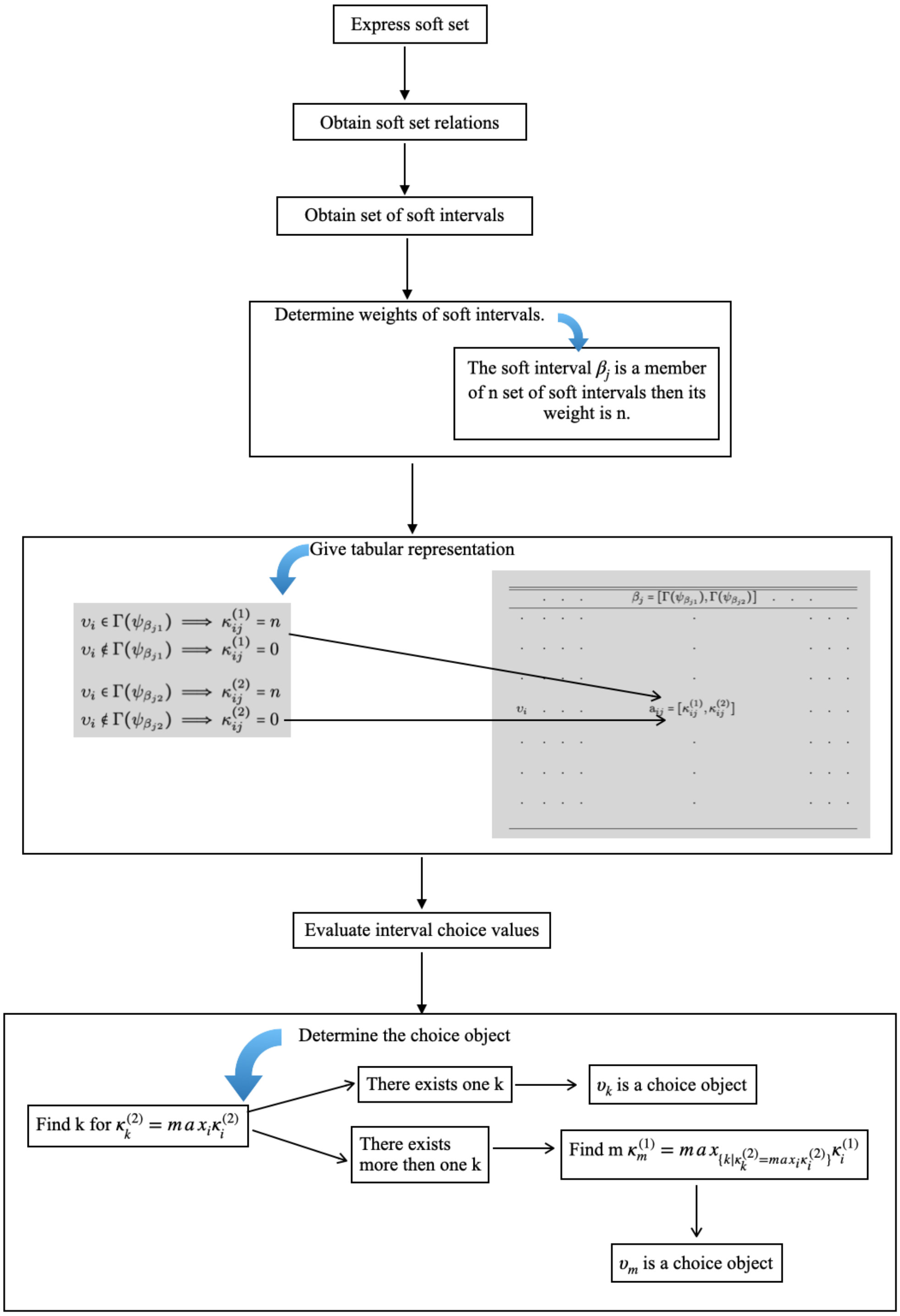

Figure 2. Diagram of the decision-making Algorithm 1.

2.1.2. Algorithm 2

In group decision-making problems, in some cases, decision makers may have more or less influence on the decision. For example, members of a company's board of directors may exert their influence on the decision in proportion to the number of shares they hold, or individuals representing a certain number of people may have influence on the decision in proportion to the communities they represent. The second algorithm is used to derive the choice object from the rankings of individuals with different levels of influences in the decision-making process. Step by step explanation of the algorithm is given below.

Step 1. Express the soft set: Write the soft set by using the informations.

Step 2. Obtain soft set relations: Obtain soft set relations by using the priority rankings of users. The number of soft set relations will be obtained equal to the number of users.

Step 3. Determine soft intervals: Determine the soft intervals according to the soft set relations.

Step 4. Determine weights of the soft intervals: The weights of soft intervals are calculating according to how many people's rankings include that soft interval and what is the influence of the decision makers whose rankings contain that soft interval. If a soft interval is obtained from n soft set relations where ith soft set relation obtained from the decision maker whose influence scalar is m_i for $i = 1, ..., n$, then its weight is $w = \sum_{i=1}^{n} m_i$. For example, if a soft interval is obtained only from two soft set relations where the first decision maker's influence scalar is 2 and the second's is 3, then its weight is 5.

Step 5. Give the tabular representation of the soft intervals with their weights: Entries a_{ij} of the table represent weights of each soft interval for objects. Let $a_{ij} = [\kappa_{ij}^{(1)}, \kappa_{ij}^{(2)}]$ be the ith row and the jth column of the table. Let $\beta_j = [\Gamma(\psi_{\beta_{j1}}), \Gamma(\psi_{\beta_{j2}})]$ be a soft interval relating to the jth column.

If $\upsilon_i \in \Gamma(\psi_{\beta_{j1}})$ and the weight of the soft interval β_j is w, then $\kappa_{ij}^{(1)} = w$. If $\upsilon_i \notin \Gamma(\psi_{\beta_{j1}})$, then $\kappa_{ij}^{(1)} = 0$. Similarly, if $\upsilon_i \in \Gamma(\psi_{\beta_{j2}})$ and the weight of the soft interval β_j is w, then $\kappa_{ij}^{(2)} = w$. If $\upsilon_i \notin \Gamma(\psi_{\beta_{j2}})$, then $\kappa_{ij}^{(2)} = 0$.

Step 6. Evaluate interval choice values for the objects in the universal set: Interval choice value for the object υ_i is $\iota_i = [\kappa_i^{(1)}, \kappa_i^{(2)}]$, where $\kappa_i^{(1)} = \sum_{j=1}^{t} \kappa_{ij}^{(1)}$, $\kappa_i^{(2)} = \sum_{j=1}^{t} \kappa_{ij}^{(2)}$, and t is the number of soft intervals obtained from all soft set relations in the problem.

Step 7. Determine the choice object: Choice object is the object whose second component of the interval choice value $\kappa_i^{(2)}$ is maximum. If there is more than one object having the same maximum value for $\kappa_i^{(2)}$, then look for the maximum value for the first component of the interval choice values for these objects. Briefly find k for $\kappa_k^{(2)} = max_i \kappa_i^{(2)}$, then υ_k is the most suitable choice object. If there is more than one choice object, then find m for $\kappa_m^{(1)} = max_{\{k|\kappa_k^{(2)}=max_i \kappa_i^{(2)}\}} \kappa_i^{(1)}$, then υ_m is the most suitable choice object. If there is still more than one choice object, then any one of them cloud be the choice object. Additionally, the objects best suited for choice can be listed in order, starting from the largest interval choice values to the smallest.

As can be seen, the first three steps of the algorithms are same. Although the same operations seem to be performed after the fourth step in both algorithms, the values obtained in these steps in Algorithm 2 differ from the Algorithm 1. Pseudo-code for Step 4 in the Algorithm 2 is different from the Algorithm 1; therefore, pseudo-code for Step 4 is given as follows for Algorithm 2.

Step 4. Let t be the total number of different soft intervals and m_l be an influence scalar of the decision maker whose priority ranking formed soft set relation $\prec_l$.

For $(i = 1, i <= p, i++)$
(For $(j = 1, j <= p, j++)$
$(w_{ij} = 0$
For $(l = 1, l <= r, l++)$
(If $[\Gamma(\psi_i), \Gamma(\psi_j)]$ is a soft interval for $\prec_l$, then weight of the soft interval $[\Gamma(\psi_i), \Gamma(\psi_j)]$ is $w_{ij} = w_{ij} + m_l$.))

The diagram of Algorithm 2 is given in Figure 3.

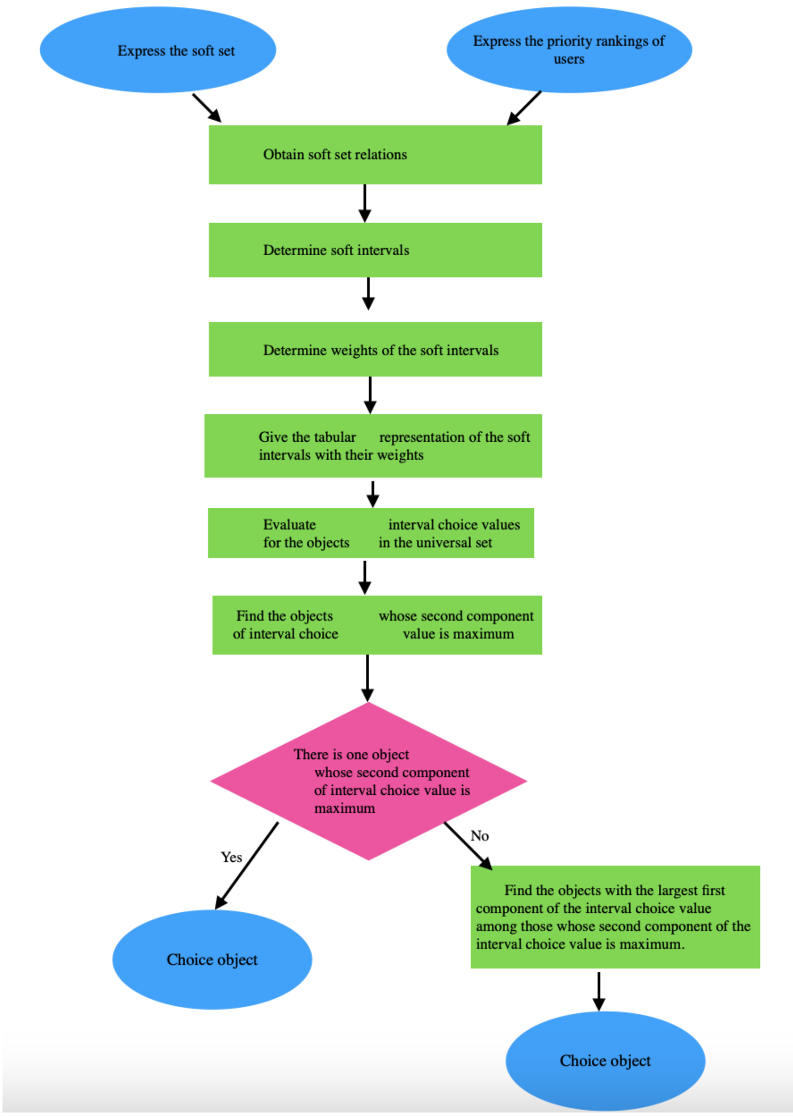

Figure 3. Diagram of the decision-making Algorithm 2.

Although both algorithms share similar steps, the first algorithm examines cases where all users have an equal influence on the decision, while the second considers scenarios where decision-makers have different levels of influence. Consequently, even though soft set relations and soft intervals are derived in the same manner in both algorithms, the differences in influence among decision-makers affect the calculations of weights of soft intervals, leading to changes in interval choice values.

2.2. Applications of the decision-making algorithms

In this section algorithms will be clarified by going through some examples. The first and the third examples are given for the first algorithm. The second and the fourth examples are given for the second algorithm.

Example 1. *In this example, the first algorithm is explained in detail by applying its steps thoroughly. It is assumed that there are two decision-makers in this example with different priority rankings.*

Step 1. Express the soft set: Let $\Upsilon = \{\upsilon_1, \upsilon_2, \upsilon_3, \upsilon_4, \upsilon_5, \upsilon_6\}$ be a universal set, and let $\Psi = \{\psi_1 =$ expensive, $\psi_2 =$ beautiful, $\psi_3 =$ wooden, $\psi_4 =$ cheap, $\psi_5 =$ in green surroundings$\}$ be the parameter set. Let a soft set (Γ, E) be defined as $\Gamma(\psi_1) = \{\upsilon_2, \upsilon_3\}$, $\Gamma(\psi_2) = \{\upsilon_2, \upsilon_3, \upsilon_5\}$, $\Gamma(\psi_3) = \{\upsilon_1, \upsilon_4\}$, $\Gamma(\psi_4) = \{\upsilon_1\}$, $\Gamma(\psi_5) = \{\upsilon_1, \upsilon_2, \upsilon_6\}$.

Step 2. Obtain soft set relations: Let the user 1 have priority ranking on attributes as beautiful, in green surroundings, cheap, expensive, and wooden, and let the user 2 have priority ranking on attributes as in green surroundings, cheap, beautiful, wooden, and expensive. To use the algorithm we need soft set relations on (Γ, E), so by using these priority rankings two soft set relations are defined as follows:

$$\begin{aligned}\prec_1 = \ &\{\Gamma(\psi_1)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_3)\times\Gamma(\psi_3), \Gamma(\psi_4)\times\Gamma(\psi_4), \Gamma(\psi_5)\times\Gamma(\psi_5),\\ &\Gamma(\psi_3)\times\Gamma(\psi_1), \Gamma(\psi_3)\times\Gamma(\psi_4), \Gamma(\psi_3)\times\Gamma(\psi_5), \Gamma(\psi_3)\times\Gamma(\psi_2), \Gamma(\psi_1)\times\Gamma(\psi_4),\\ &\Gamma(\psi_1)\times\Gamma(\psi_5), \Gamma(\psi_1)\times\Gamma(\psi_2), \Gamma(\psi_4)\times\Gamma(\psi_5), \Gamma(\psi_4)\times\Gamma(\psi_2), \Gamma(\psi_5)\times\Gamma(\psi_2)\}.\end{aligned}$$

$$\begin{aligned}\prec_2 = \ &\{\Gamma(\psi_1)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_3)\times\Gamma(\psi_3), \Gamma(\psi_4)\times\Gamma(\psi_4), \Gamma(\psi_5)\times\Gamma(\psi_5),\\ &\Gamma(\psi_1)\times\Gamma(\psi_3), \Gamma(\psi_3)\times\Gamma(\psi_4), \Gamma(\psi_3)\times\Gamma(\psi_5), \Gamma(\psi_3)\times\Gamma(\psi_2), \Gamma(\psi_1)\times\Gamma(\psi_4),\\ &\Gamma(\psi_1)\times\Gamma(\psi_5), \Gamma(\psi_1)\times\Gamma(\psi_2), \Gamma(\psi_4)\times\Gamma(\psi_5), \Gamma(\psi_2)\times\Gamma(\psi_4), \Gamma(\psi_2)\times\Gamma(\psi_5)\}.\end{aligned}$$

These soft set relations are transitive, reflexive, and antisymmetric, so they are partially ordered soft set relations.

Step 3. Determine soft intervals: For the first soft set relation, the following soft intervals are written:

$$\begin{array}{lllll}[\Gamma(\psi_1), \Gamma(\psi_1)], & [\Gamma(\psi_2), \Gamma(\psi_2)], & [\Gamma(\psi_3), \Gamma(\psi_3)], & [\Gamma(\psi_4), \Gamma(\psi_4)], & [\Gamma(\psi_5), \Gamma(\psi_5)],\\ [\Gamma(\psi_3), \Gamma(\psi_1)], & [\Gamma(\psi_3), \Gamma(\psi_4)], & [\Gamma(\psi_3), \Gamma(\psi_5)], & [\Gamma(\psi_3), \Gamma(\psi_2)], & [\Gamma(\psi_1), \Gamma(\psi_4)],\\ [\Gamma(\psi_1), \Gamma(\psi_5)], & [\Gamma(\psi_1), \Gamma(\psi_2)], & [\Gamma(\psi_4), \Gamma(\psi_5)], & [\Gamma(\psi_4), \Gamma(\psi_2)], & [\Gamma(\psi_5), \Gamma(\psi_2)].\end{array}$$

For the second soft set relation, the following soft intervals are written:

$$\begin{array}{lllll}[\Gamma(\psi_1), \Gamma(\psi_1)], & [\Gamma(\psi_2), \Gamma(\psi_2)], & [\Gamma(\psi_3), \Gamma(\psi_3)], & [\Gamma(\psi_4), \Gamma(\psi_4)], & [\Gamma(\psi_5), \Gamma(\psi_5)],\\ [\Gamma(\psi_1), \Gamma(\psi_3)], & [\Gamma(\psi_3), \Gamma(\psi_4)], & [\Gamma(\psi_3), \Gamma(\psi_5)], & [\Gamma(\psi_3), \Gamma(\psi_2)], & [\Gamma(\psi_1), \Gamma(\psi_4)],\\ [\Gamma(\psi_1), \Gamma(\psi_5)], & [\Gamma(\psi_1), \Gamma(\psi_2)], & [\Gamma(\psi_4), \Gamma(\psi_5)], & [\Gamma(\psi_2), \Gamma(e_4)], & [\Gamma(\psi_2), \Gamma(\psi_5)].\end{array}$$

We can utilize the following notations to shorten the expressions of soft intervals.

$$\begin{array}{lll}\beta_1 = [\Gamma(\psi_1), \Gamma(\psi_1)] & \beta_2 = [\Gamma(\psi_2), \Gamma(\psi_2)] & \beta_3 = [\Gamma(\psi_3), \Gamma(\psi_3)]\\ \beta_4 = [\Gamma(\psi_4), \Gamma(\psi_4)] & \beta_5 = [\Gamma(\psi_5), \Gamma(\psi_5)] & \beta_6 = [\Gamma(\psi_3), \Gamma(\psi_4)]\\ \beta_7 = [\Gamma(\psi_4), \Gamma(\psi_5)] & \beta_8 = [\Gamma(\psi_3), \Gamma(\psi_2)] & \beta_9 = [\Gamma(\psi_1), \Gamma(\psi_4)]\\ \beta_{10} = [\Gamma(\psi_1), \Gamma(\psi_5)] & \beta_{11} = [\Gamma(\psi_1), \Gamma(\psi_2)] & \beta_{12} = [\Gamma(\psi_3), \Gamma(\psi_5)]\\ \beta_{13} = [\Gamma(\psi_3), \Gamma(\psi_1)] & \beta_{14} = [\Gamma(\psi_4), \Gamma(\psi_2)] & \beta_{15} = [\Gamma(\psi_5), \Gamma(\psi_2)]\\ \beta_{16} = [\Gamma(\psi_1), \Gamma(\psi_3)] & \beta_{17} = [\Gamma(\psi_2), \Gamma(\psi_4)] & \beta_{18} = [\Gamma(\psi_2), \Gamma(\psi_5)]\end{array}$$

Step 4. Determine weights of the intervals: One can easily notice that soft intervals β_1, β_2, β_3, β_4, $\beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}$ are common for both soft set relations, but $\beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}, \beta_{18}$ are not common. Therefore, weights of soft intervals $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}$ are 2 and weights of soft intervals $\beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}, \beta_{18}$ are 1.

Step 5. Give the tabular representation of the soft intervals with their weights: Tabular representation of the soft intervals with their weights is expressed in Tables 1 and 2.

Table 1. Tabular representation of soft intervals with their weights-1.

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9
υ_1	[0,0]	[0,0]	[2,2]	[2,2]	[2,2]	[2,2]	[2,2]	[2,0]	[0,2]
υ_2	[2,2]	[2,2]	[0,0]	[0,0]	[2,2]	[0,0]	[0,2]	[0,2]	[2,0]
υ_3	[2,2]	[2,2]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[2,0]
υ_4	[0,0]	[0,0]	[2,2]	[0,0]	[0,0]	[2,0]	[0,0]	[2,0]	[0,0]
υ_5	[0,0]	[2,2]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,0]
υ_6	[0,0]	[0,0]	[0,0]	[0,0]	[2,2]	[0,0]	[0,2]	[0,0]	[0,0]

Table 2. Tabular representation of soft intervals with their weights-2.

	β_{10}	β_{11}	β_{12}	β_{13}	β_{14}	β_{15}	β_{16}	β_{17}	β_{18}
υ_1	[0,2]	[0,0]	[2,2]	[1,0]	[1,0]	[1,0]	[0,1]	[0,1]	[0,1]
υ_2	[2,2]	[2,2]	[0,2]	[0,1]	[0,1]	[1,1]	[1,0]	[1,0]	[1,1]
υ_3	[2,0]	[2,2]	[0,0]	[0,1]	[0,1]	[0,1]	[1,0]	[1,0]	[1,0]
υ_4	[0,0]	[0,0]	[2,0]	[1,0]	[0,0]	[0,0]	[0,1]	[0,0]	[0,0]
υ_5	[0,0]	[0,2]	[0,0]	[0,0]	[0,1]	[0,1]	[0,0]	[1,0]	[1,0]
υ_6	[0,2]	[0,0]	[0,2]	[0,0]	[0,0]	[1,0]	[0,0]	[0,0]	[0,1]

Step 6. Evaluate interval choice values for the objects in the universal set:

$\iota_1 = [17, 19]$, $\iota_2 = [16, 20]$, $\iota_3 = [13, 11]$, $\iota_4 = [9, 3]$, $\iota_5 = [4, 8]$, and $\iota_6 = [3, 9]$ are the interval choice values for the objects υ_i's for $i = 1, 2, 3, 4, 5, 6$, respectively.

Step 7. Determine the choice object: According to the interval choice values, choice object is υ_2.

When we use the algorithm given in [34], only for the first soft set relation choice can objects be ordered as υ_2, υ_1, υ_3, υ_5, υ_6, υ_4; only for the second soft set relation choice can objects be ordered as υ_1, υ_2, υ_6, υ_3, υ_5, υ_4. Moreover, for the algorithm given in this study choice can objects be ordered as υ_2, υ_1, υ_3, υ_6, υ_5, υ_4.

In the following Figure 4, the vertical axis is for the second component of interval choice valuesand the horizontal axis is for objects. Blue curve represents the interval choice values obtained from the first algorithm, the orange curve represents interval choice values of the first user obtained from the algorithm from [34], and similarly gray represents interval choice values of the second user obtained from the algorithm from [34]. With the help of this graph, the difference between the decision-making algorithm, which previously considered the user priority ranking but had a single decision maker making the decision, and the group decision-making presented in this paper can be seen.

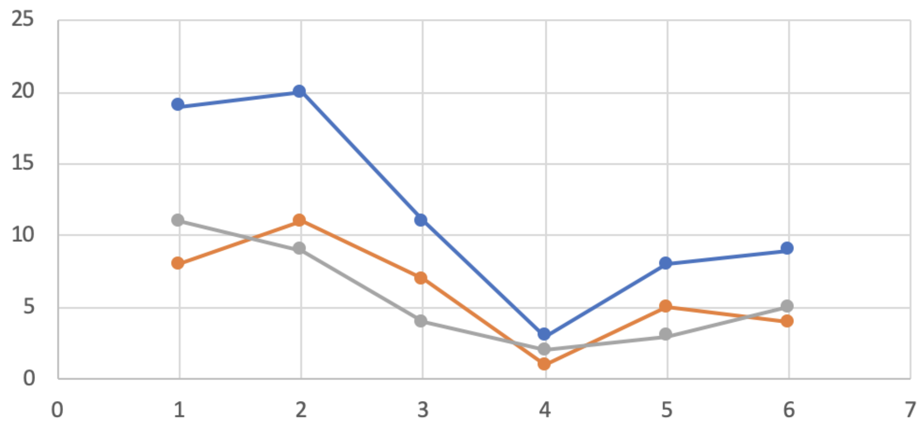

Figure 4. Interval choice values.

As seen in this example, choice object varies for users who rank the same parameters differently. Moreover, when considering all users' priority rankings simultaneously, the choice object differs from all users' choice objects, and, also, order of choice objects differs from all users' order of choice objects.

Example 2. *Let us consider same soft set and same soft set relation as in the previous Example 1, but with different influence scalar for users. For the first user influence, scalar is 1, and for the second user influence, scalar is 2.*

One can easily notice that soft intervals $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}$ are common for both soft set relations, but β_{13}, β_{14}, β_{15} are obtained from the first user, and β_{16}, β_{17}, β_{18} are obtained from the second user. Therefore, weights of $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}$ are 3, weights of $\beta_{13}, \beta_{14}, \beta_{15}$ are 1, and weights of $\beta_{16}, \beta_{17}, \beta_{18}$ are 2.

Tabular representation of the soft intervals with their weights is expressed in Tables 3 and 4. Interval choice values are written in the Table 4.

Table 3. Tabular representation of soft intervals with their weights-1.

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9
υ_1	[0,0]	[0,0]	[3,3]	[3,3]	[3,3]	[3,3]	[3,3]	[3,0]	[0,3]
υ_2	[3,3]	[3,3]	[0,0]	[0,0]	[3,3]	[0,0]	[0,3]	[0,3]	[3,0]
υ_3	[3,3]	[3,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[3,0]
υ_4	[0,0]	[0,0]	[3,3]	[0,0]	[0,0]	[3,0]	[0,0]	[3,0]	[0,0]
υ_5	[0,0]	[3,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]
υ_6	[0,0]	[0,0]	[0,0]	[0,0]	[3,3]	[0,0]	[0,3]	[0,0]	[0,0]

Table 4. Tabular representation of soft intervals with their weights-2.

	β_{10}	β_{11}	β_{12}	β_{13}	β_{14}	β_{15}	β_{16}	β_{17}	β_{18}	$[\kappa_i^{(1)}, \kappa_i^{(2)}]$
υ_1	[0,3]	[0,0]	[3,3]	[1,0]	[1,0]	[1,0]	[0,2]	[0,2]	[0,2]	[30,30]
υ_2	[3,3]	[3,3]	[0,3]	[0,1]	[0,1]	[1,1]	[2,0]	[2,0]	[2,2]	[25,29]
υ_3	[3,0]	[3,3]	[0,0]	[0,1]	[0,1]	[0,1]	[2,0]	[2,0]	[2,0]	[21,15]
υ_4	[0,0]	[0,0]	[3,0]	[1,0]	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[13,5]
υ_5	[0,0]	[0,3]	[0,0]	[0,0]	[0,1]	[0,1]	[0,0]	[2,0]	[2,0]	[7,11]
υ_6	[0,3]	[0,0]	[0,3]	[0,0]	[0,0]	[1,0]	[0,0]	[0,0]	[0,2]	[4,14]

According to the interval choice values, choice object is υ_1 and choice objects can be ordered as υ_1, υ_2, υ_3, υ_6, υ_5, υ_4, but in the Example 1, υ_2 was found as choice object. As can be seen in these two examples, even though the problems are the same, the resulting object can be different when the influence scalar of even one of the decision-makers on the decision is changed.

The following Figure 5 shows how differentiated the results from these two algorithms are, even in the same decision-making problem. The vertical axis is for the second component of interval choice values, and the horizontal axis is for objects. Blue curve represents the interval choice values obtained from the first algorithm, while the orange curve represents those obtained from the second algorithm.

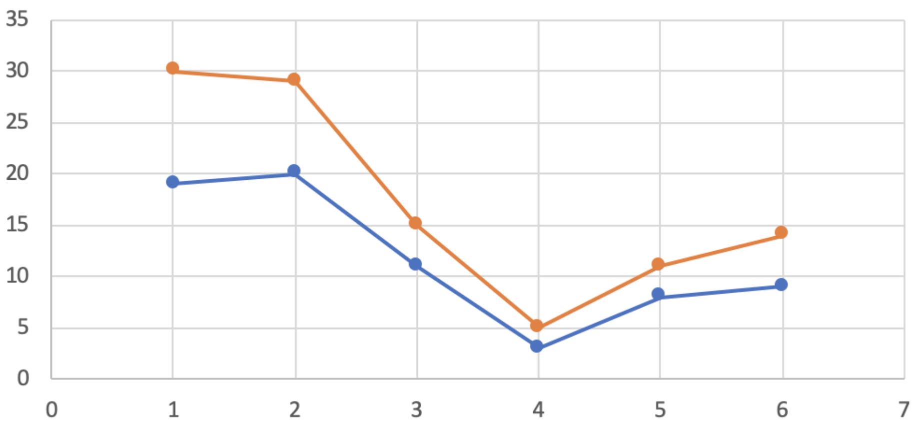

Figure 5. Interval choice values.

Example 3. *The family X, consisting of three members, wants to go on a vacation in their annual leave but they have different choices. To help them to make the most convenient travel choice, let us describe a soft set to express travel choices and their properties more explicitly. Let the universal set* $\Upsilon = \{\upsilon_1$: camping travel, υ_2 : caravan travel, υ_3 : train travel, υ_4 : cruise vacation, υ_5 : blue cruise vacation, υ_6 : vacation at 5-star hotel, υ_7 : cultural tour$\}$ *be the set of holiday choices under consideration and* $\Psi = \{\psi_1$: cheap, ψ_2 : beautiful view, ψ_3 : comfortable, ψ_4 : near sea, ψ_5 : explore new places, ψ_6 : relaxing$\}$ *be the parameter set describing the properties of holidays.*

Let a soft set (Γ, E) be defined as $\Gamma(\psi_1) = \{\upsilon_1, \upsilon_2, \upsilon_3, \upsilon_7\}$, $\Gamma(\psi_2) = \{\upsilon_1, \upsilon_2, \upsilon_4, \upsilon_5\}$, $\Gamma(\psi_3) = \{\upsilon_2, \upsilon_4, \upsilon_5, \upsilon_6\}$, $\Gamma(\psi_4) = \{\upsilon_4, \upsilon_5\}$, $\Gamma(\psi_5) = \{\upsilon_2, \upsilon_3, \upsilon_4, \upsilon_5, \upsilon_7\}$, $\Gamma(\psi_6) = \{\upsilon_1, \upsilon_5, \upsilon_6\}$.

Mr. X's priority ranking for holiday is: explore new places, near sea, beautiful view, cheap, relaxing, comfortable. Mrs. X's priority ranking for holiday is: cheap, near sea, relaxing, beautiful view, comfortable, explore new places, and child's priority ranking for holiday is: cheap, relaxing, beautiful view, comfortable, explore new places, near sea. By considering these priority rankings of Mr. X, Mrs. X, and child, three soft set relations can be obtained. These soft set relations are given as follows:

For Mr. X's priority ranking:

$$\begin{aligned} \prec_{Mr.X}= \; & \{\Gamma(\psi_1)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_3)\times\Gamma(\psi_3), \Gamma(\psi_4)\times\Gamma(\psi_4), \\ & \Gamma(\psi_5)\times\Gamma(\psi_5), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_3)\times\Gamma(\psi_1), \Gamma(\psi_3)\times\Gamma(\psi_4), \\ & \Gamma(\psi_3)\times\Gamma(\psi_5), \Gamma(\psi_3)\times\Gamma(\psi_2), \Gamma(\psi_3)\times\Gamma(\psi_6), \Gamma(\psi_1)\times\Gamma(\psi_4), \\ & \Gamma(\psi_1)\times\Gamma(\psi_5), \Gamma(\psi_1)\times\Gamma(\psi_2), \Gamma(\psi_4)\times\Gamma(\psi_5), \Gamma(\psi_6)\times\Gamma(\psi_2), \\ & \Gamma(\psi_6)\times\Gamma(\psi_1), \Gamma(\psi_6)\times\Gamma(\psi_4), \Gamma(\psi_6)\times\Gamma(\psi_5), \Gamma(\psi_2)\times\Gamma(\psi_4), \\ & \Gamma(\psi_2)\times\Gamma(\psi_5)\}. \end{aligned}$$

For Mrs. X's priority ranking:

$$\begin{aligned} \prec_{Mrs.X}= \; & \{\Gamma(\psi_1)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_3)\times\Gamma(\psi_3), \Gamma(\psi_4)\times\Gamma(\psi_4), \\ & \Gamma(\psi_5)\times\Gamma(\psi_5), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_5)\times\Gamma(\psi_3), \Gamma(\psi_5)\times\Gamma(\psi_2), \\ & \Gamma(\psi_5)\times\Gamma(\psi_6), \Gamma(\psi_5)\times\Gamma(\psi_4), \Gamma(\psi_5)\times\Gamma(\psi_1), \Gamma(\psi_3)\times\Gamma(\psi_2), \\ & \Gamma(\psi_3)\times\Gamma(\psi_6), \Gamma(\psi_3)\times\Gamma(\psi_4), \Gamma(\psi_3)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_6), \\ & \Gamma(\psi_2)\times\Gamma(\psi_4), \Gamma(\psi_2)\times\Gamma(\psi_1), \Gamma(\psi_6)\times\Gamma(\psi_4), \Gamma(\psi_6)\times\Gamma(\psi_1), \\ & \Gamma(\psi_4)\times\Gamma(\psi_1)\}. \end{aligned}$$

For child's priority ranking:

$$\begin{aligned} \prec_{child}= \; & \{\Gamma(\psi_1)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_3)\times\Gamma(\psi_3), \Gamma(\psi_4)\times\Gamma(\psi_4), \\ & \Gamma(\psi_5)\times\Gamma(\psi_5), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_4)\times\Gamma(\psi_5), \Gamma(\psi_4)\times\Gamma(\psi_3), \\ & \Gamma(\psi_4)\times\Gamma(\psi_2), \Gamma(\psi_4)\times\Gamma(\psi_6), \Gamma(\psi_4)\times\Gamma(\psi_1), \Gamma(\psi_5)\times\Gamma(\psi_3), \\ & \Gamma(\psi_5)\times\Gamma(\psi_2), \Gamma(\psi_5)\times\Gamma(\psi_6), \Gamma(\psi_5)\times\Gamma(\psi_1), \Gamma(\psi_3)\times\Gamma(\psi_2), \\ & \Gamma(\psi_3)\times\Gamma(\psi_6), \Gamma(\psi_3)\times\Gamma(\psi_1), \Gamma(\psi_2)\times\Gamma(\psi_6), \Gamma(\psi_2)\times\Gamma(\psi_1), \\ & \Gamma(\psi_6)\times\Gamma(\psi_1)\}. \end{aligned}$$

Using these three soft set relations, following soft intervals can be obtained.

Soft intervals for the soft set relation $\prec_{Mr.X}$:

$[\Gamma(\psi_1), \Gamma(\psi_1)]$, $[\Gamma(\psi_2), \Gamma(\psi_2)]$, $[\Gamma(\psi_3), \Gamma(\psi_3)]$, $[\Gamma(\psi_4), \Gamma(\psi_4)]$, $[\Gamma(\psi_5), \Gamma(\psi_5)]$, $[\Gamma(\psi_6), \Gamma(\psi_6)]$, $[\Gamma(\psi_3), \Gamma(\psi_1)]$, $[\Gamma(\psi_3), \Gamma(\psi_4)]$, $[\Gamma(\psi_3), \Gamma(\psi_5)]$, $[\Gamma(\psi_3), \Gamma(\psi_2)]$, $[\Gamma(\psi_3), \Gamma(\psi_6)]$, $[\Gamma(\psi_1), \Gamma(\psi_4)]$, $[\Gamma(\psi_1), \Gamma(\psi_5)]$, $[\Gamma(\psi_1), \Gamma(\psi_2)]$, $[\Gamma(\psi_4), \Gamma(\psi_5)]$, $[\Gamma(\psi_6), \Gamma(\psi_2)]$, $[\Gamma(\psi_6), \Gamma(\psi_1])$, $[\Gamma(\psi_6), \Gamma(\psi_4)]$, $[\Gamma(\psi_6), \Gamma(\psi_5)]$, $[\Gamma(\psi_2), \Gamma(\psi_4)]$, $[\Gamma(\psi_2), \Gamma(\psi_5)]$.

Soft intervals for the soft set relation $\prec_{Mrs.X}$:

$[\Gamma(\psi_1), \Gamma(\psi_1)]$, $[\Gamma(\psi_2), \Gamma(\psi_2)]$, $[\Gamma(\psi_3), \Gamma(\psi_3)]$, $[\Gamma(\psi_4), \Gamma(\psi_4)]$, $[\Gamma(\psi_5), \Gamma(\psi_5)]$, $[\Gamma(\psi_6), \Gamma(\psi_6)]$, $[\Gamma(\psi_5), \Gamma(\psi_3)]$, $[\Gamma(\psi_5), \Gamma(\psi_2)]$, $[\Gamma(\psi_5), \Gamma(\psi_6)]$, $[\Gamma(\psi_5), \Gamma(\psi_4)]$, $[\Gamma(\psi_5), \Gamma(\psi_1)]$, $[\Gamma(\psi_3), \Gamma(\psi_2)]$, $[\Gamma(\psi_3), \Gamma(\psi_6)]$, $[\Gamma(\psi_3), \Gamma(\psi_4)]$, $[\Gamma(\psi_3), \Gamma(\psi_1)]$, $[\Gamma(\psi_2), \Gamma(\psi_6)]$, $[\Gamma(\psi_2), \Gamma(\psi_4)]$, $[\Gamma(\psi_2), \Gamma(\psi_1)]$, $[\Gamma(\psi_6), \Gamma(\psi_4)]$, $[\Gamma(\psi_6), \Gamma(\psi_1)]$, $[\Gamma(\psi_4), \Gamma(\psi_1)]$.

Soft intervals for the soft set relation $\prec_{child}$:

$[\Gamma(\psi_1),\Gamma(\psi_1)]$, $[\Gamma(\psi_2),\Gamma(\psi_2)]$, $[\Gamma(\psi_3),\Gamma(\psi_3)]$, $[\Gamma(\psi_4),\Gamma(\psi_4)]$, $[\Gamma(\psi_5),\Gamma(\psi_5)]$,
$[\Gamma(\psi_6),\Gamma(\psi_6)]$, $[\Gamma(\psi_4),\Gamma(\psi_5)]$, $[\Gamma(\psi_4),\Gamma(\psi_3)]$, $[\Gamma(\psi_4),\Gamma(\psi_2)]$, $[\Gamma(\psi_4),\Gamma(\psi_6)]$
$[\Gamma(\psi_4),\Gamma(\psi_1)]$, $[\Gamma(\psi_5),\Gamma(\psi_3)]$, $[\Gamma(\psi_5),\Gamma(\psi_2)]$, $[\Gamma(\psi_5),\Gamma(\psi_6)]$, $[\Gamma(\psi_5),\Gamma(\psi_1)]$,
$[\Gamma(\psi_3),\Gamma(\psi_2)]$, $[\Gamma(\psi_3),\Gamma(\psi_6)]$, $[\Gamma(\psi_3),\Gamma(\psi_1)]$, $[\Gamma(\psi_2),\Gamma(\psi_6)]$, $[\Gamma(\psi_2),\Gamma(\psi_1)]$,
$[\Gamma(\psi_6),\Gamma(\psi_1)]$.

All different soft intervals are as follows:
$\beta_1 = [\Gamma(\psi_1),\Gamma(\psi_1)]$, $\beta_2 = [\Gamma(\psi_2),\Gamma(\psi_2)]$, $\beta_3 = [\Gamma(\psi_3),\Gamma(\psi_3)]$,
$\beta_4 = [\Gamma(\psi_4),\Gamma(\psi_4)]$, $\beta_5 = [\Gamma(\psi_5),\Gamma(\psi_5)]$, $\beta_6 = [\Gamma(\psi_6),\Gamma(\psi_6)]$,
$\beta_7 = [\Gamma(\psi_3),\Gamma(\psi_1)]$, $\beta_8 = [\Gamma(\psi_3),\Gamma(\psi_4)]$, $\beta_9 = [\Gamma(\psi_3),\Gamma(\psi_5)]$,
$\beta_{10} = [\Gamma(\psi_3),\Gamma(\psi_2)]$, $\beta_{11} = [\Gamma(\psi_3),\Gamma(\psi_6)]$, $\beta_{12} = [\Gamma(\psi_1),\Gamma(\psi_4)]$,
$\beta_{13} = [\Gamma(\psi_1),\Gamma(\psi_5)]$, $\beta_{14} = [\Gamma(\psi_1),\Gamma(\psi_2)]$, $\beta_{15} = [\Gamma(\psi_4),\Gamma(\psi_5)]$,
$\beta_{16} = [\Gamma(\psi_6),\Gamma(\psi_2)]$, $\beta_{17} = [\Gamma(\psi_6),\Gamma(\psi_1])$, $\beta_{18} = [\Gamma(\psi_6),\Gamma(\psi_4)]$,
$\beta_{19} = [\Gamma(\psi_6),\Gamma(\psi_5)]$, $\beta_{20} = [\Gamma(\psi_2),\Gamma(\psi_4)]$, $\beta_{21} = [\Gamma(\psi_2),\Gamma(\psi_5)]$,
$\beta_{22} = [\Gamma(\psi_5),\Gamma(\psi_3)]$, $\beta_{23} = [\Gamma(\psi_5),\Gamma(\psi_2)]$, $\beta_{24} = [\Gamma(\psi_5),\Gamma(\psi_6)]$,
$\beta_{25} = [\Gamma(\psi_5),\Gamma(\psi_1)]$, $\beta_{26} = [\Gamma(\psi_2),\Gamma(\psi_6)]$, $\beta_{27} = [\Gamma(\psi_2),\Gamma(\psi_1)]$,
$\beta_{28} = [\Gamma(\psi_4),\Gamma(\psi_1)]$, $\beta_{29} = [\Gamma(\psi_4),\Gamma(\psi_3)]$, $\beta_{30} = [\Gamma(\psi_5),\Gamma(\psi_4)]$,
$\beta_{31} = [\Gamma(\psi_4),\Gamma(\psi_2)]$, $\beta_{32} = [\Gamma(\psi_4),\Gamma(\psi_6)]$.

The weights of the soft intervals are calculated as follows in Table 5, depending on how many people's rankings include the soft interval. For example, β_1 is obtained from three soft set relations, so its weight is 3. Similarly, β_8 is derived from the soft set relations obtained from the priority rankings of Mr. and Mrs. X, so its weight is 2.

Table 5. Weights of intervals.

Weight	Soft Interval
1	$\beta_9,\beta_{12},\beta_{13},\beta_{14},\beta_{16},\beta_{19},\beta_{21},\beta_{29},\beta_{30},\beta_{31},\beta_{32}$
2	$\beta_8,\beta_{17},\beta_{18},\beta_{20},\beta_{15},\beta_{22},\beta_{23},\beta_{24},\beta_{25},\beta_{26},\beta_{27},\beta_{28}$
3	$\beta_1,\beta_2,\beta_3,\beta_4,\beta_5,\beta_6,\beta_7,\beta_{10},\beta_{11}$

The tabular representation of soft intervals with their weights is given in Tables 6–8. Let us evaluate the entry a_{57}, which is about the interval β_7 and the object υ_5, to explain calculations briefly. We need the weight of β_7, which is written in Table 5 as 3. Since $\beta_7 = [\Gamma(\psi_3),\Gamma(\psi_1)]$, $\upsilon_5 \in \Gamma(\psi_3)$, and $\upsilon_5 \notin \Gamma(\psi_1)$, then $a_{57} = [3,0]$. By making similar calculations, all entries can be found of the following Tables 6–8.

Table 6. Tabular representation of soft intervals with their weights-1.

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}
υ_1	[3,3]	[3,3]	[0,0]	[0,0]	[0,0]	[3,3]	[0,3]	[0,0]	[0,0]	[0,3]	[0,3]
υ_2	[3,3]	[3,3]	[3,3]	[0,0]	[3,3]	[0,0]	[3,3]	[2,0]	[1,1]	[3,3]	[3,0]
υ_3	[3,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,0]	[0,0]
υ_4	[0,0]	[3,3]	[3,3]	[3,3]	[3,3]	[0,0]	[3,3]	[2,2]	[1,1]	[3,3]	[3,0]
υ_5	[0,0]	[3,3]	[3,3]	[3,3]	[3,3]	[3,3]	[3,0]	[2,2]	[1,1]	[3,3]	[3,3]
υ_6	[0,0]	[0,0]	[3,3]	[0,0]	[0,0]	[3,3]	[3,0]	[2,0]	[1,0]	[3,0]	[3,3]
υ_7	[3,3]	[0,0]	[0,0]	[0,0]	[3,3]	[0,0]	[0,3]	[0,0]	[0,1]	[0,3]	[0,0]

Table 7. Tabular representation of soft intervals with their weights-2.

	β_{12}	β_{13}	β_{14}	β_{15}	β_{16}	β_{17}	β_{18}	β_{19}	β_{20}	β_{21}	β_{22}
υ_1	[1,0]	[1,0]	[1,1]	[0,0]	[1,1]	[2,2]	[2,0]	[1,0]	[2,0]	[1,0]	[0,0]
υ_2	[1,0]	[1,1]	[1,1]	[0,2]	[0,1]	[0,2]	[0,0]	[0,1]	[2,0]	[1,1]	[2,2]
υ_3	[1,0]	[1,1]	[1,0]	[0,2]	[0,0]	[0,2]	[0,0]	[0,1]	[0,0]	[0,1]	[2,0]
υ_4	[0,1]	[0,1]	[0,1]	[2,2]	[0,1]	[0,0]	[0,2]	[0,1]	[2,2]	[1,1]	[2,2]
υ_5	[0,1]	[0,1]	[0,1]	[2,2]	[1,1]	[2,0]	[2,2]	[1,1]	[2,2]	[1,1]	[2,2]
υ_6	[0,0]	[0,0]	[0,1]	[0,0]	[1,0]	[2,0]	[2,0]	[1,0]	[0,0]	[0,0]	[0,2]
υ_7	[1,0]	[1,1]	[1,0]	[0,2]	[0,0]	[0,2]	[0,0]	[0,1]	[0,0]	[0,1]	[2,0]

Table 8. Tabular representation of soft intervals with their weights-3.

	β_{23}	β_{24}	β_{25}	β_{26}	β_{27}	β_{28}	β_{29}	β_{30}	β_{31}	β_{32}	ι_i
υ_1	[0,2]	[0,2]	[0,2]	[2,2]	[2,2]	[0,2]	[0,1]	[0,0]	[0,1]	[0,1]	[25,37]
υ_2	[2,0]	[2,0]	[2,2]	[2,0]	[2,2]	[0,2]	[0,1]	[1,0]	[0,1]	[0,0]	[43,38]
υ_3	[2,0]	[2,0]	[2,2]	[0,0]	[0,2]	[0,2]	[0,0]	[1,0]	[0,0]	[0,0]	[15,17]
υ_4	[2,2]	[2,0]	[2,0]	[2,0]	[2,0]	[2,0]	[1,1]	[1,1]	[1,1]	[1,0]	[47,40]
υ_5	[2,2]	[2,2]	[2,0]	[2,2]	[2,0]	[2,0]	[1,1]	[1,1]	[1,1]	[1,1]	[56,48]
υ_6	[0,0]	[0,2]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[24,17]
υ_7	[2,0]	[2,0]	[2,2]	[0,0]	[0,2]	[0,2]	[0,0]	[1,0]	[0,0]	[0,0]	[18,25]

Interval choice values ι_i for i=1,2,...7 are calculated and written in Table 8. According to the interval choice values, the most suitable vacation for this family is υ_5, which is the blue cruise vacation. Moreover, from the algorithm given in this study, order of the appropriate vacations for the family X is υ_5 : blue cruise vacation, υ_4 : cruise vacation, υ_2 : caravan travel, υ_1 : camping travel, υ_7 : cultural tour, υ_6 : vacation at 5-star hotel, υ_3 : train travel.

The following graph (Figure 6) shows the interval choice values of vacations. Vertical axis is for the interval choice values, and the horizontal axis is for vacations.

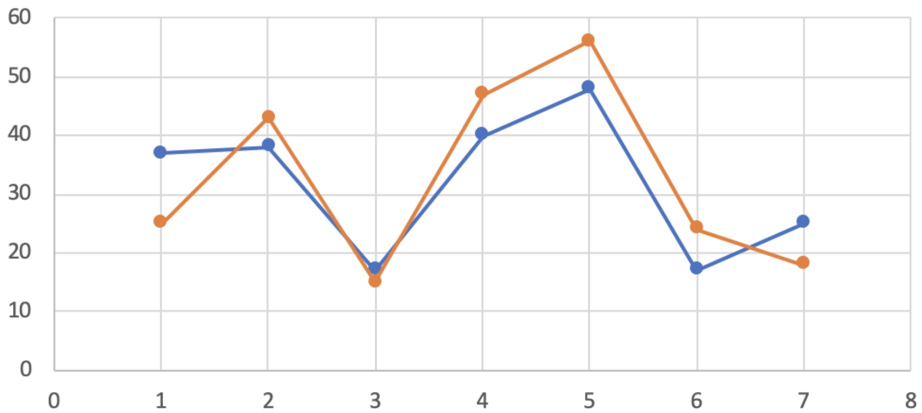

Figure 6. Interval choice values.

Blue curve represents the second component of interval choice values obtained from the first algorithm, while the orange curve represents the first component of interval choice values obtained from the first algorithm. The decision object is first identified by looking at the blue curve in this graph. For this example, the decision object is υ_5. Additionally, when ranking the suitable vacations, it can be seen from the graph that the third and sixth vacations have the same value on the blue curve. In this case, a higher value is observed on the orange curve. As a result, when comparing the third and sixth objects, the sixth should be the preferred choice.

Example 4. *The company needs to purchase a 500 cloud server with 2 CPU to run a software in the cloud, and the necessary server specifications are outlined in the following Table 9. Viewing these specifications as parameters and the servers as the universal set, this problem can be assessed within the framework of soft sets.*

Table 9. Products with attributes.

	Memory	type of storage	disk	network	bandwidth	operating system	cost per month
ς_1	2 gb	normal	100gb	1 gigabit	500mbps	ubuntu	23,23
ς_2	4 gb	ssd	100gb	1 gigabit	1 gigabit	ubuntu	42,46
ς_3	2 gb	normal	100gb	1 gigabit	500mbps	windows server	51,02
ς_4	4 gb	ssd	100gb	1 gigabit	1 gigabit	windows server	80,04
ς_5	8 gb	normal	100gb	1 gigabit	1 gigabit	ubuntu	58,92
ς_6	8 gb	ssd	100gb	1 gigabit	1 gigabit	ubuntu	65,92
ς_7	8 gb	normal	100gb	1 gigabit	1 gigabit	windows server	120,08
ς_8	8 gb	ssd	100gb	1 gigabit	1 gigabit	windows server	133,08
ς_9	4 gb	normal	100gb	1 gigabit	5mbps	ubuntu	100,5
ς_{10}	4gb	ssd	100gb	1 gigabit	5mbps	ubuntu	138,1
ς_{11}	4 gb	ssd	100gb	5 gigabit	5 gigabit	ubuntu	42,38
ς_{12}	4 gb	ssd	100gb	5 gigabit	5 gigabit	windows server	55,81
ς_{13}	3,5 gb	normal	135gb	5 gigabit	5 gigabit	windows server	131,7
ς_{14}	3,5 gb	normal	135gb	5 gigabit	5 gigabit	windows server	87,9
ς_{15}	8 gb	ssd	100gb	1 gigabit	5mbps	ubuntu	72,43
ς_{16}	8 gb	ssd	100gb	1 gigabit	5mbps	windows server	131,73
ς_{17}	8 gb	normal	100gb	1 gigabit	3 gigabit	ubuntu	86,32
ς_{18}	8 gb	normal	100gb	1 gigabit	3 gigabit	windows server	153,48

Step 1. The soft set can be written as a pair (Γ, Υ) where $\Upsilon = \{\psi_1$: memory 2 gb, ψ_2 : memory 4 gb, ψ_3 : memory 3.5 gb, ψ_4 : memory 8 gb, ψ_5 : Type of storage, normal, ψ_6 : Type of storage, ssd, ψ_7 : disk 100gb, ψ_8 : disk 135gb, ψ_9 : network 1 gigabit, ψ_{10} : network 5 gigabit, ψ_{11} : bandwidth 500mhps, ψ_{12} : bandwidth 1 gigabit, ψ_{13} : bandwidth 5 gigabit, ψ_{14} : bandwidth 5 mhps, ψ_{15} : bandwidth 3 gigabit, ψ_{16} : operating system; ubuntu, ψ_{17} : operating system; WS, ψ_{18} : cost less than 50, ψ_{19} : cost between 50 and 100, ψ_{20} : cost between 100 and 150, ψ_{21} : cost greater than 150$\}$, and

$\Gamma(\psi_1) = \{\varsigma_1, \varsigma_3\}$
$\Gamma(\psi_2) = \{\varsigma_2, \varsigma_4, \varsigma_9, \varsigma_{10}, \varsigma_{11}, \varsigma_{12}\}$
$\Gamma(\psi_3) = \{\varsigma_{13}, \varsigma_{14}\}$

$\Gamma(\psi_4) = \{\varsigma_5, \varsigma_6, \varsigma_7, \varsigma_8, \varsigma_{15}, \varsigma_{16}, \varsigma_{17}, \varsigma_{18}\}$
$\Gamma(\psi_5) = \{\varsigma_1, \varsigma_3, \varsigma_5, \varsigma_7, \varsigma_9, \varsigma_{13}, \varsigma_{14}, \varsigma_{17}, \varsigma_{18}\}$
$\Gamma(\psi_6) = \{\varsigma_2, \varsigma_4, \varsigma_6, \varsigma_8, \varsigma_{10}, \varsigma_{11}, \varsigma_{12}, \varsigma_{15}, \varsigma_{16}\}$
$\Gamma(\psi_7) = \{\varsigma_1, \varsigma_2, \varsigma_3, \varsigma_4, \varsigma_5, \varsigma_6, \varsigma_7, \varsigma_8, \varsigma_9, \varsigma_{10}, \varsigma_{11}, \varsigma_{12}, \varsigma_{15}, \varsigma_{16}, \varsigma_{17}, \varsigma_{18}\}$
$\Gamma(\psi_8) = \{\varsigma_{13}, \varsigma_{14}\}$
$\Gamma(\psi_9) = \{\varsigma_1, \varsigma_2, \varsigma_3, \varsigma_4, \varsigma_5, \varsigma_6, \varsigma_7, \varsigma_8, \varsigma_9, \varsigma_{10}, \varsigma_{15}, \varsigma_{16}, \varsigma_{17}, \varsigma_{18}\}$
$\Gamma(\psi_{10}) = \{\varsigma_{11}, \varsigma_{12}, \varsigma_{13}, \varsigma_{14}\}$
$\Gamma(\psi_{11}) = \{\varsigma_1, \varsigma_3\}$
$\Gamma(\psi_{12}) = \{\varsigma_2, \varsigma_4, \varsigma_5, \varsigma_6, \varsigma_7, \varsigma_8\}$
$\Gamma(\psi_{13}) = \{\varsigma_{11}, \varsigma_{12}, \varsigma_{13}, \varsigma_{14}, \varsigma_{17}, \varsigma_{18}\}$
$\Gamma(\psi_{14}) = \{\varsigma_9, \varsigma_{10}, \varsigma_{15}, \varsigma_{16}\}$
$\Gamma(\psi_{15}) = \{\varsigma_{17}, \varsigma_{18}\}$
$\Gamma(\psi_{16}) = \{\varsigma_1, \varsigma_2, \varsigma_4, \varsigma_5, \varsigma_9, \varsigma_{10}, \varsigma_{11}, \varsigma_{15}, \varsigma_{17}\}$
$\Gamma(\psi_{17}) = \{\varsigma_3, \varsigma_4, \varsigma_7, \varsigma_8, \varsigma_{12}, \varsigma_{13}, \varsigma_{14}, \varsigma_{16}, \varsigma_{18}\}$
$\Gamma(\psi_{18}) = \{\varsigma_1, \varsigma_2, \varsigma_{11}\}$
$\Gamma(\psi_{19}) = \{\varsigma_3, \varsigma_4, \varsigma_5, \varsigma_6, \varsigma_{12}, \varsigma_{14}, \varsigma_{15}, \varsigma_{17}\}$
$\Gamma(\psi_{20}) = \{\varsigma_7, \varsigma_8, \varsigma_9, \varsigma_{10}, \varsigma_{13}, \varsigma_{16}\}$
$\Gamma(\psi_{21}) = \{\varsigma_{18}\}$

The decision-making team comprises the Chief technology officer (CTO), information technology manager (IT manager), system and infrastructure manager, IT architect, development manager, and product owner. In this purchase, let us suppose according to the authorizations of the company, since the CTO is a senior executive, his/her influence scalar in the decision will be 3. Due to the purchase involving hardware, the influence scalar of the IT architect and system and infrastructure manager in the decision will be 2, while the influence scalar of the remaining participants will be 1.

Let priority rankings of decision makers be given as follows:

Priority ranking of CTO: $\Gamma(\psi_2)$, $\Gamma(\psi_{18})$, $\Gamma(\psi_{16})$, $\Gamma(\psi_{12})$, $\Gamma(\psi_6)$,$\Gamma(\psi_4)$, $\Gamma(\psi_{19})$.

Priority ranking of system and infrastructure manager: $\Gamma(\psi_{18})$, $\Gamma(\psi_{16})$, $\Gamma(\psi_{11})$, $\Gamma(\psi_9)$, $\Gamma(\psi_7)$, $\Gamma(\psi_5)$, $\Gamma(\psi_2)$.

Priority ranking of IT architect: $\Gamma(\psi_{20})$, $\Gamma(\psi_{13})$, $\Gamma(\psi_{10})$, $\Gamma(\psi_4)$, $\Gamma(\psi_6)$, $\Gamma(\psi_{17})$, $\Gamma(\psi_8)$.

Priority ranking of product owner: $\Gamma(\psi_{20})$, $\Gamma(\psi_{17})$,$\Gamma(\psi_{13})$, $\Gamma(\psi_{10})$, $\Gamma(\psi_8)$, $\Gamma(\psi_6)$, $\Gamma(\psi_4)$.

Priority ranking of IT manager: $\Gamma(\psi_{17})$, $\Gamma(\psi_{13})$, $\Gamma(\psi_2)$, $\Gamma(\psi_{10})$, $\Gamma(\psi_8)$, $\Gamma(\psi_4)$, $\Gamma(\psi_6)$.

Priority ranking of development manager: $\Gamma(\psi_7)$, $\Gamma(\psi_9)$, $\Gamma(\psi_{10})$, $\Gamma(\psi_{15})$, $\Gamma(\psi_2)$, $\Gamma(\psi_6)$, $\Gamma(\psi_{19})$.

Step 2. According to the priority rankings of decision makers, soft set relations can be written as follows:

$\prec_{CTO}$={ $\Gamma(\psi_2)\times\Gamma(\psi_2)$, $\Gamma(\psi_{18})\times\Gamma(\psi_{18})$, $\Gamma(\psi_{16})\times\Gamma(\psi_{16})$, $\Gamma(\psi_{12})\times\Gamma(\psi_{12})$, $\Gamma(\psi_6)\times\Gamma(\psi_6)$,$\Gamma(\psi_4)\times\Gamma(\psi_4)$, $\Gamma(\psi_{19})\times\Gamma(\psi_{19})$, $\Gamma(\psi_{19})\times\Gamma(\psi_4)$, $\Gamma(\psi_{19})\times\Gamma(\psi_6)$, $\Gamma(\psi_{19})\times\Gamma(\psi_{12})$, $\Gamma(\psi_{19})\times\Gamma(\psi_{16})$, $\Gamma(\psi_{19})\times\Gamma(\psi_{18})$, $\Gamma(\psi_{19})\times\Gamma(\psi_2)$, $\Gamma(\psi_4)\times\Gamma(\psi_6)$, $\Gamma(\psi_4)\times\Gamma(\psi_{12})$, $\Gamma(\psi_4)\times\Gamma(\psi_{16})$, $\Gamma(\psi_4)\times\Gamma(\psi_{18})$, $\Gamma(\psi_4)\times\Gamma(\psi_2)$, $\Gamma(\psi_6)\times\Gamma(\psi_{12})$, $\Gamma(\psi_6)\times\Gamma(\psi_{16})$, $\Gamma(\psi_6)\times\Gamma(\psi_{18})$, $\Gamma(\psi_6)\times\Gamma(\psi_2)$, $\Gamma(\psi_{12})\times\Gamma(\psi_{16})$, $\Gamma(\psi_{12})\times\Gamma(\psi_{18})$, $\Gamma(\psi_{12})\times\Gamma(\psi_2)$, $\Gamma(\psi_{16})\times\Gamma(\psi_{18})$, $\Gamma(\psi_{16})\times\Gamma(\psi_2)$, $\Gamma(\psi_{18})\times\Gamma(\psi_2)$}.

$\prec_{Sys.and\,inf.man.}$= $\Gamma(\psi_{18})\times\Gamma(\psi_{18})$, $\Gamma(\psi_{16})\times\Gamma(\psi_{16})$, $\Gamma(\psi_{11})\times\Gamma(\psi_{11})$, $\Gamma(\psi_9)\times\Gamma(\psi_9)$, $\Gamma(\psi_7)\times\Gamma(\psi_7)$, $\Gamma(\psi_5)\times\Gamma(\psi_5)$, $\Gamma(\psi_2)\times\Gamma(\psi_2)$, $\Gamma(\psi_2)\times\Gamma(\psi_5)$, $\Gamma(\psi_2)\times\Gamma(\psi_7)$, $\Gamma(\psi_2)\times\Gamma(\psi_9)$, $\Gamma(\psi_2)\times\Gamma(\psi_{11})$, $\Gamma(\psi_2)\times\Gamma(\psi_{16})$, $\Gamma(\psi_2)\times\Gamma(\psi_{18})$, $\Gamma(\psi_5)\times\Gamma(\psi_7)$, $\Gamma(\psi_5)\times\Gamma(\psi_9)$, $\Gamma(\psi_5)\times\Gamma(\psi_{11})$, $\Gamma(\psi_5)\times\Gamma(\psi_{16})$, $\Gamma(\psi_5)\times\Gamma(\psi_{18})$, $\Gamma(\psi_7)\times$

$\Gamma(\psi_9)$, $\Gamma(\psi_7)\times\Gamma(\psi_{11})$, $\Gamma(\psi_7)\times\Gamma(\psi_{16})$, $\Gamma(\psi_7)\times\Gamma(\psi_{18})$, $\Gamma(\psi_9)\times\Gamma(\psi_{11})$, $\Gamma(\psi_9)\times\Gamma(\psi_{16})$, $\Gamma(\psi_9)\times\Gamma(\psi_{18})$, $\Gamma(\psi_{11})\times\Gamma(\psi_{16})$, $\Gamma(\psi_{11})\times\Gamma(\psi_{18})$, $\Gamma(\psi_{16})\times\Gamma(\psi_{18})\}$.

$\prec_{ITarc.}=\{\Gamma(\psi_{20})\times\Gamma(\psi_{20}), \Gamma(\psi_{13})\times\Gamma(\psi_{13}), \Gamma(\psi_{10})\times\Gamma(\psi_{10}), \Gamma(\psi_4)\times\Gamma(\psi_4), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_{17})\times\Gamma(\psi_{17}), \Gamma(\psi_8)\times\Gamma(\psi_8), \Gamma(\psi_8)\times\Gamma(\psi_{17}), \Gamma(\psi_8)\times\Gamma(\psi_6), \Gamma(\psi_8)\times\Gamma(\psi_4), \Gamma(\psi_8)\times\Gamma(\psi_{10}), \Gamma(\psi_8)\times\Gamma(\psi_{13}), \Gamma(\psi_8)\times\Gamma(\psi_{20}), \Gamma(\psi_{17})\times\Gamma(\psi_6), \Gamma(\psi_{17})\times\Gamma(\psi_4), \Gamma(\psi_{17})\times\Gamma(\psi_{10}), \Gamma(\psi_{17})\times\Gamma(\psi_{13}), \Gamma(\psi_{17})\times\Gamma(\psi_{20}), \Gamma(\psi_6)\times\Gamma(\psi_4), \Gamma(\psi_6)\times\Gamma(\psi_{10}), \Gamma(\psi_6)\times\Gamma(\psi_{13}), \Gamma(\psi_6)\times\Gamma(\psi_{20}), \Gamma(\psi_4)\times\Gamma(\psi_{10}), \Gamma(\psi_4)\times\Gamma(\psi_{13}), \Gamma(\psi_4)\times\Gamma(\psi_{20}), \Gamma(\psi_{10})\times\Gamma(\psi_{13}), \Gamma(\psi_{10})\times\Gamma(\psi_{20}), \Gamma(\psi_{13})\times\Gamma(\psi_{20})\}$.

$\prec_{Product\,owner}=\{\Gamma(\psi_{20})\times\Gamma(\psi_{20}), \Gamma(\psi_{17})\times\Gamma(\psi_{17}), \Gamma(\psi_{13})\times\Gamma(\psi_{13}), \Gamma(\psi_{10})\times\Gamma(\psi_{10}), \Gamma(\psi_8)\times\Gamma(\psi_8), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_4)\times\Gamma(\psi_4), \Gamma(\psi_4)\times\Gamma(\psi_6), \Gamma(\psi_4)\times\Gamma(\psi_8), \Gamma(\psi_4)\times\Gamma(\psi_{10}), \Gamma(\psi_4)\times\Gamma(\psi_{13}), \Gamma(\psi_4)\times\Gamma(\psi_{17}), \Gamma(\psi_4)\times\Gamma(\psi_{20}), \Gamma(\psi_6)\times\Gamma(\psi_8), \Gamma(\psi_6)\times\Gamma(\psi_{10}), \Gamma(\psi_6)\times\Gamma(\psi_{13}), \Gamma(\psi_6)\times\Gamma(\psi_{17}), \Gamma(\psi_6)\times\Gamma(\psi_{20}), \Gamma(\psi_8)\times\Gamma(\psi_{10}), \Gamma(\psi_8)\times\Gamma(\psi_{13}), \Gamma(\psi_8)\times\Gamma(\psi_{17}), \Gamma(\psi_8)\times\Gamma(\psi_{20}), \Gamma(\psi_{10})\times\Gamma(\psi_{13}), \Gamma(\psi_{10})\times\Gamma(\psi_{17}), \Gamma(\psi_{10})\times\Gamma(\psi_{20}), \Gamma(\psi_{13})\times\Gamma(\psi_{17}), \Gamma(\psi_{13})\times\Gamma(\psi_{20}), \Gamma(\psi_{17})\times\Gamma(\psi_{20})\}$.

$\prec_{IT\,manager}=\{\Gamma(\psi_{17})\times\Gamma(\psi_{17}), \Gamma(\psi_{13})\times\Gamma(\psi_{13}), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_{10})\times\Gamma(\psi_{10}), \Gamma(\psi_8)\times\Gamma(\psi_8), \Gamma(\psi_4)\times\Gamma(\psi_4), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_6)\times\Gamma(\psi_4), \Gamma(\psi_6)\times\Gamma(\psi_8), \Gamma(\psi_6)\times\Gamma(\psi_{10}), \Gamma(\psi_6)\times\Gamma(\psi_2), \Gamma(\psi_6)\times\Gamma(\psi_{13}), \Gamma(\psi_6)\times\Gamma(\psi_{17}), \Gamma(\psi_4)\times\Gamma(\psi_8), \Gamma(\psi_4)\times\Gamma(\psi_{10}), \Gamma(\psi_4)\times\Gamma(\psi_2), \Gamma(\psi_4)\times\Gamma(\psi_{13}), \Gamma(\psi_4)\times\Gamma(\psi_{17}), \Gamma(\psi_8)\times\Gamma(\psi_{10}), \Gamma(\psi_8)\times\Gamma(\psi_2), \Gamma(\psi_8)\times\Gamma(\psi_{13}), \Gamma(\psi_8)\times\Gamma(\psi_{17}), \Gamma(\psi_{10})\times\Gamma(\psi_2), \Gamma(\psi_{10})\times\Gamma(\psi_{13}), \Gamma(\psi_{10})\times\Gamma(\psi_{17}), \Gamma(\psi_2)\times\Gamma(\psi_{13}), \Gamma(\psi_2)\times\Gamma(\psi_{17}), \Gamma(\psi_{13})\times\Gamma(\psi_{17})\}$.

$\prec_{Dev.man.}=\{\Gamma(\psi_7)\times\Gamma(\psi_7), \Gamma(\psi_9)\times\Gamma(\psi_9), \Gamma(\psi_{10})\times\Gamma(\psi_{10}), \Gamma(\psi_{15})\times\Gamma(\psi_{15}), \Gamma(\psi_2)\times\Gamma(\psi_2), \Gamma(\psi_6)\times\Gamma(\psi_6), \Gamma(\psi_{19})\times\Gamma(\psi_{19}), \Gamma(\psi_{19})\times\Gamma(\psi_6), \Gamma(\psi_{19})\times\Gamma(\psi_2), \Gamma(\psi_{19})\times\Gamma(\psi_{15}), \Gamma(\psi_{19})\times\Gamma(\psi_{10}), \Gamma(\psi_{19})\times\Gamma(\psi_2), \Gamma(\psi_{19})\times\Gamma(\psi_{13}), \Gamma(\psi_{19})\times\Gamma(\psi_{17}), \Gamma(\psi_6)\times\Gamma(\psi_2), \Gamma(\psi_6)\times\Gamma(\psi_{15}), \Gamma(\psi_6)\times\Gamma(\psi_{10}), \Gamma(\psi_6)\times\Gamma(\psi_9), \Gamma(\psi_6)\times\Gamma(\psi_7), \Gamma(\psi_2)\times\Gamma(\psi_{2-15}), \Gamma(\psi_2)\times\Gamma(\psi_{10}), \Gamma(\psi_2)\times\Gamma(\psi_9), \Gamma(\psi_2)\times\Gamma(\psi_7), \Gamma(\psi_{15})\times\Gamma(\psi_{10}), \Gamma(\psi_{15})\times\Gamma(\psi_9), \Gamma(\psi_{15})\times\Gamma(\psi_7), \Gamma(\psi_{10})\times\Gamma(\psi_9), \Gamma(\psi_{10})\times\Gamma(\psi_7), \Gamma(\psi_9)\times\Gamma(\psi_7)\}$.

Step 3. According to the soft set relations obtained from the priority rankings of decision makers, 101 soft intervals are obtained. All soft intervals are written with their weights as follows, and calculation of weights is explained in the next step.

1). $\beta_{78}=[\Gamma(\psi_8),\Gamma(\psi_2)]$, $\beta_{79}=[\Gamma(\psi_{10}),\Gamma(\psi_2)]$, $\beta_{80}=[\Gamma(\psi_2),\Gamma(\psi_{13})]$, $\beta_{81}=[\Gamma(\psi_2),\Gamma(\psi_{17})]$, $\beta_{86}=[\Gamma(\psi_{19}),\Gamma(\psi_{15})]$, $\beta_{87}=[\Gamma(\psi_{19}),\Gamma(\psi_{10})]$, $\beta_{88}=[\Gamma(\psi_{19}),\Gamma(\psi_9)]$, $\beta_{89}=[\Gamma(\psi_{19}),\Gamma(\psi_7)]$, $\beta_{90}=[\Gamma(\psi_6),\Gamma(\psi_{15})]$, $\beta_{91}=[\Gamma(\psi_6),\Gamma(\psi_9)]$, $\beta_{92}=[\Gamma(\psi_6),\Gamma(\psi_7)]$, $\beta_{93}=[\Gamma(\psi_2),\Gamma(\psi_{15})]$, $\beta_{94}=[\Gamma(\psi_2),\Gamma(\psi_{10})]$, $\beta_{95}=[\Gamma(\psi_{15}),\Gamma(\psi_{15})]$, $\beta_{96}=[\Gamma(\psi_{15}),\Gamma(\psi_{10})]$, $\beta_{97}=[\Gamma(\psi_{15}),\Gamma(\psi_9)]$, $\beta_{98}=[\Gamma(\psi_{15}),\Gamma(\psi_7)]$, $\beta_{99}=[\Gamma(\psi_{10}),\Gamma(\psi_9)]$, $\beta_{100}=[\Gamma(\psi_{10}),\Gamma(\psi_7)]$, $\beta_{101}=[\Gamma(\psi_9),\Gamma(\psi_7)]$.

2). $\beta_{29}=[\Gamma(\psi_2),\Gamma(\psi_5)]$, $\beta_{32}=[\Gamma(\psi_2),\Gamma(\psi_{11})]$, $\beta_{33}=[\Gamma(\psi_2),\Gamma(\psi_{16})]$, $\beta_{34}=[\Gamma(\psi_2),\Gamma(\psi_{18})]$, $\beta_{35}=[\Gamma(\psi_5),\Gamma(\psi_5)]$,$\beta_{36}=[\Gamma(\psi_5),\Gamma(\psi_7)]$,$\beta_{37}=[\Gamma(\psi_5),\Gamma(\psi_9)]$,$\beta_{38}=[\Gamma(\psi_5),\Gamma(\psi_{11})]$, $\beta_{39}=[\Gamma(\psi_5),\Gamma(\psi_{16})]$,$\beta_{40}=[\Gamma(\psi_5),\Gamma(\psi_{18})]$, $\beta_{42}=[\Gamma(\psi_7),\Gamma(\psi_9)]$,$\beta_{43}=[\Gamma(\psi_7),\Gamma(\psi_{11})]$,$\beta_{44}=[\Gamma(\psi_7),\Gamma(\psi_{16})]$,$\beta_{45}=[\Gamma(\psi_7),\Gamma(\psi_{18})]$,$\beta_{46}=[\Gamma(\psi_9),\Gamma(\psi_{11})]$, $\beta_{47}=[\Gamma(\psi_9),\Gamma(\psi_{16})]$, $\beta_{48}=[\Gamma(\psi_9),\Gamma(\psi_{18})]$, $\beta_{49}=[\Gamma(\psi_{11}),\Gamma(\psi_{11})]$, $\beta_{50}=[\Gamma(\psi_{11}),\Gamma(\psi_{16})]$, $\beta_{51}=[\Gamma(\psi_{11}),\Gamma(\psi_{18})]$, $\beta_{52}=[\Gamma(\psi_4),\Gamma(\psi_8)]$, $\beta_{55}=[\Gamma(\psi_4),\Gamma(\psi_{17})]$, $\beta_{57}=[\Gamma(\psi_6),\Gamma(\psi_8)]$, $\beta_{60}=[\Gamma(\psi_6),\Gamma(\psi_{17})]$, $\beta_{69}=[\Gamma(\psi_{10}),\Gamma(\psi_{17})]$, $\beta_{72}=[\Gamma(\psi_{13}),\Gamma(\psi_{17})]$, $\beta_{82}=[\Gamma(\psi_8),\Gamma(\psi_6)]$, $\beta_{83}=[\Gamma(\psi_8),\Gamma(\psi_4)]$, $\beta_{84}=[\Gamma(\psi_{17}),\Gamma(\psi_6)]$, $\beta_{85}=[\Gamma(\psi_{17}),\Gamma(\psi_{13})]$.

3). $\beta_2=[\Gamma(\psi_{19}),\Gamma(\psi_4)]$,$\beta_4=[\Gamma(\psi_{19}),\Gamma(\psi_{12})]$,$\beta_5=[\Gamma(\psi_{19}),\Gamma(\psi_{16})]$,$\beta_6=[\Gamma(\psi_{19}),\Gamma(\psi_{18})]$, $\beta_{10}=[\Gamma(\psi_{12}),\Gamma(\psi_{12})]$,$\beta_{15}=[\Gamma(\psi_4),\Gamma(\psi_{12})]$, $\beta_{16}=[\Gamma(\psi_4),\Gamma(\psi_{16})]$,$\beta_{17}=[\Gamma(\psi_4),\Gamma(\psi_{18})]$, $\beta_{19}=[\Gamma(\psi_6),\Gamma(\psi_{12})]$, $\beta_{20}=[\Gamma(\psi_6),\Gamma(\psi_{16})]$,$\beta_{21}=[\Gamma(\psi_6),\Gamma(\psi_{18})]$,$\beta_{22}=[\Gamma(\psi_9),\Gamma(\psi_9)]$,$\beta_{23}=[\Gamma(\psi_{12}),\Gamma(\psi_{16})]$,$\beta_{24}=[\Gamma(\psi_{12}),\Gamma(\psi_{18})]$,$\beta_{25}=[\Gamma(\psi_{12}),\Gamma(\psi_2)]$,$\beta_{27}=[\Gamma(\psi_{16}),\Gamma(\psi_2)]$,$\beta_{28}=[\Gamma(\psi_{18}),\Gamma(\psi_2)]$,$\beta_{30}=[\Gamma(\psi_2),\Gamma(\psi_7)]$,$\beta_{31}=[\Gamma(\psi_2),\Gamma(\psi_9)]$,$\beta_{41}=[\Gamma(\psi_7),\Gamma(\psi_7)]$, $\beta_{54}=[\Gamma(\psi_4),\Gamma(\psi_{13})]$,

$\beta_{56} = [\Gamma(\psi_4), \Gamma(\psi_{20})]$, $\beta_{61} = [\Gamma(\psi_6), \Gamma(\psi_{20})]$, $\beta_{66} = [\Gamma(\psi_8), \Gamma(\psi_{20})]$, $\beta_{70} = [\Gamma(\psi_{10}), \Gamma(\psi_{20})]$, $\beta_{73} = [\Gamma(\psi_{13}), \Gamma(\psi_{20})]$, $\beta_{75} = [\Gamma(\psi_{17}), \Gamma(\psi_{20})]$, $\beta_{76} = [\Gamma(\psi_{20}), \Gamma(\psi_{20})]$, $\beta_{77} = [\Gamma(\psi_6), \Gamma(\psi_4)]$.

4). $\beta_1 = [\Gamma(\psi_{19}), \Gamma(\psi_{19})]$, $\beta_3 = [\Gamma(\psi_{19}), \Gamma(\psi_6)]$, $\beta_7 = [\Gamma(\psi_{19}), \Gamma(\psi_2)]$,$\beta_{14} = [\Gamma(\psi_4), \Gamma(\psi_6)]$,$\beta_{18} = [\Gamma(\psi_4), \Gamma(\psi_2)]$, $\beta_{53} = [\Gamma(\psi_4), \Gamma(\psi_{10})]$, $\beta_{59} = [\Gamma(\psi_6), \Gamma(\psi_{13})]$, $\beta_{62} = [\Gamma(\psi_8), \Gamma(\psi_8)]$, $\beta_{63} = [\Gamma(\psi_8), \Gamma(\psi_{10})]$, $\beta_{64} = [\Gamma(\psi_8), \Gamma(\psi_{13})]$, $\beta_{65} = [\Gamma(\psi_8), \Gamma(\psi_{17})]$, $\beta_{68} = [\Gamma(\psi_{10}), \Gamma(\psi_{13})]$, $\beta_{71} = [\Gamma(\psi_{13}), \Gamma(\psi_{13})]$, $\beta_{74} = [\Gamma(\psi_{17}), \Gamma(\psi_{17})]$.

5). $\beta_{11} = [\Gamma(\psi_{16}), \Gamma(\psi_{16})]$, $\beta_{12} = [\Gamma(\psi_{18}), \Gamma(\psi_{18})]$, $\beta_{26} = [\Gamma(\psi_{16}), \Gamma(\psi_{18})]$, $\beta_{58} = [\Gamma(\psi_6), \Gamma(\psi_{10})]$, $\beta_{67} = [\Gamma(\psi_{10}), \Gamma(\psi_{10})]$.

6). $\beta_8 = [\Gamma(\psi_4), \Gamma(\psi_4)]$, $\beta_{13} = [\Gamma(\psi_2), \Gamma(\psi_2)]$.

7). $\beta_9 = [\Gamma(\psi_6), \Gamma(\psi_6)]$.

Step 4. Let us explain some of the previous weight calculations. For instance, to evaluate weight of $\beta_7 = [\Gamma(\psi_{19}), \Gamma(\psi_2)]$, we need to find from whose priority rankings that we obtain that soft interval. Since only CTO and development manager preferred ψ_2 to ψ_{19}, the soft interval β_7 is obtained from their soft set relations, and since influence scalar of CTO is 3 and development manager is 1 weight of β_7 is 4. Similarly, let us evaluate weight of $\beta_{26} = [\Gamma(\psi_{16}), \Gamma(\psi_{18})]$; we need to find from whose priority rankings that we obtain that soft interval. Since only CTO and system and infrastructure manager preferred ψ_{18} to ψ_{16}, the soft interval β_{26} is obtained from their soft set relations, and since influence scalar of CTO is 3 and system and infrastructure manager is 2, then weight of β_{26} is 5. Also, other weights of soft intervals are calculated similarly. The following Tables 10–16 show the calculation of the weights of soft intervals in detail. The weight of the soft interval is written in the bottom of the tables and is obtained by adding the values in the corresponding column.

Table 10. Tabular representation of the calculation of weights of soft intervals-1.

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}	β_{12}	β_{13}	β_{14}	β_{15}
CTO	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Sys. and inf. man.	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0
IT architect	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0
Product owner	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0
IT manager	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0
Dev. man.	1	0	1	0	0	0	1	0	1	0	0	0	1	0	0
Weight	4	3	4	3	3	3	4	7	8	3	5	5	7	4	3

Table 11. Tabular representation of the calculation of weights of soft intervals-2.

	β_{16}	β_{17}	β_{18}	β_{19}	β_{20}	β_{21}	β_{22}	β_{23}	β_{24}	β_{25}	β_{26}	β_{27}	β_{28}	β_{29}	β_{30}
CTO	3	3	3	3	3	3	0	3	3	3	3	3	3	0	0
Sys. and inf. man.	0	0	0	0	0	0	2	0	0	0	2	0	0	2	2
IT architect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Product owner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IT manager	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Dev. man.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Weight	3	3	4	3	3	3	3	3	3	3	5	3	3	2	3

Table 12. Tabular representation of the calculation of weights of soft intervals-3.

	β_{31}	β_{32}	β_{33}	β_{34}	β_{35}	β_{36}	β_{37}	β_{38}	β_{39}	β_{40}	β_{41}	β_{42}	β_{43}	β_{44}	β_{45}
CTO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sys. and inf. man.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IT architect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Product owner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IT manager	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dev. man.	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Weight	3	2	2	2	2	2	2	2	2	2	3	2	2	2	2

Table 13. Tabular representation of the calculation of weights of soft intervals-4.

	β_{46}	β_{47}	β_{48}	β_{49}	β_{50}	β_{51}	β_{52}	β_{53}	β_{54}	β_{55}	β_{56}	β_{57}	β_{58}	β_{59}	β_{60}
CTO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sys. and inf. man.	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0
IT architect	0	0	0	0	0	0	0	2	2	0	2	0	2	2	0
Product owner	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
IT manager	0	0	0	0	0	0	1	1	1	1	0	1	1	1	1
Dev. man.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Weight	2	2	2	2	2	2	2	4	4	2	3	2	5	4	2

Table 14. Tabular representation of the calculation of weights of soft intervals-5.

	β_{61}	β_{62}	β_{63}	β_{64}	β_{65}	β_{66}	β_{67}	β_{68}	β_{69}	β_{70}	β_{71}	β_{72}	β_{73}	β_{74}	β_{75}
CTO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sys. and inf. man.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IT architect	2	2	2	2	2	2	2	2	0	2	2	0	2	2	2
Product owner	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IT manager	0	1	1	1	1	0	1	1	1	0	1	1	0	1	0
Dev. man.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Weight	3	4	4	4	4	3	5	4	2	3	4	2	3	4	3

Table 15. Tabular representation of the calculation of weights of soft intervals-6.

	β_{76}	β_{77}	β_{78}	β_{79}	β_{80}	β_{81}	β_{82}	β_{83}	β_{84}	β_{85}	β_{86}	β_{87}	β_{88}	β_{89}	β_{90}
CTO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sys. and inf. man.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IT architect	2	2	0	0	0	0	2	2	2	2	0	0	0	0	0
Product owner	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IT manager	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Dev. man.	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Weight	3	3	1	1	1	1	2	2	2	2	1	1	3	1	1

Table 16. Tabular representation of the calculation of weights of soft intervals-7.

	β_{91}	β_{92}	β_{93}	β_{94}	β_{95}	β_{96}	β_{97}	β_{98}	β_{99}	β_{100}	β_{101}
CTO	0	0	0	0	0	0	0	0	0	0	0
Sys. and inf. man.	0	0	0	0	0	0	0	0	0	0	0
IT architect	0	0	0	0	0	0	0	0	0	0	0
Product owner	0	0	0	0	0	0	0	0	0	0	0
IT manager	0	0	0	0	0	0	0	0	0	0	0
Dev. man.	1	1	1	1	1	1	1	1	1	1	1
Weight	1	1	1	1	1	1	1	1	1	1	1

Step 5. The tabular representation of soft intervals with their weights for each object is given in the following Tables 17–25.

Table 17. Tabular representation of soft intervals with their weights-1.

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}
ς_1	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,3]	[0,0]	[0,0]	[0,0]	[0,0]	[5,5]
ς_2	[0,0]	[0,0]	[0,4]	[0,3]	[0,3]	[0,3]	[0,4]	[0,0]	[8,8]	[3,3]	[5,5]
ς_3	[4,4]	[3,0]	[4,0]	[3,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_4	[4,4]	[3,0]	[4,4]	[3,3]	[3,3]	[3,0]	[4,4]	[0,0]	[8,8]	[3,3]	[5,5]
ς_5	[4,4]	[3,3]	[4,0]	[3,3]	[3,3]	[3,0]	[4,0]	[7,7]	[0,0]	[3,3]	[0,0]
ς_6	[4,4]	[3,3]	[4,4]	[3,3]	[3,0]	[3,0]	[4,0]	[7,7]	[8,8]	[3,3]	[0,0]
ς_7	[0,0]	[0,3]	[0,0]	[0,3]	[0,0]	[0,0]	[0,0]	[7,7]	[0,0]	[3,3]	[0,0]
ς_8	[0,0]	[0,3]	[0,4]	[0,3]	[0,0]	[0,0]	[0,0]	[7,7]	[8,8]	[3,3]	[0,0]
ς_9	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]	[4,4]	[0,0]	[0,0]	[0,0]	[5,5]
ς_{10}	[0,0]	[0,0]	[0,4]	[0,0]	[0,3]	[0,0]	[0,4]	[0,0]	[8,8]	[0,0]	[5,5]
ς_{11}	[0,0]	[0,0]	[0,4]	[0,0]	[0,3]	[0,3]	[0,4]	[0,0]	[8,8]	[0,0]	[5,5]
ς_{12}	[4,4]	[3,0]	[4,4]	[3,0]	[3,0]	[3,0]	[4,4]	[0,0]	[8,8]	[0,0]	[0,0]
ς_{13}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{14}	[4,4]	[3,0]	[4,0]	[3,0]	[3,0]	[3,0]	[4,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{15}	[4,4]	[3,3]	[4,4]	[3,0]	[3,3]	[3,0]	[4,0]	[7,7]	[8,8]	[0,0]	[5,5]
ς_{16}	[0,0]	[0,3]	[0,4]	[0,0]	[0,0]	[0,0]	[0,0]	[7,7]	[8,8]	[0,0]	[0,0]
ς_{17}	[4,4]	[3,3]	[4,0]	[3,0]	[3,3]	[3,0]	[4,0]	[7,7]	[0,0]	[0,0]	[5,5]
ς_{18}	[0,0]	[0,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[7,7]	[0,0]	[0,0]	[0,0]

Table 18. Tabular representation of soft intervals with their weights-2.

	β_{12}	β_{13}	β_{14}	β_{15}	β_{16}	β_{17}	β_{18}	β_{19}	β_{20}	β_{21}	β_{22}
ς_1	[5,5]	[0,0]	[0,0]	[0,0]	[0,3]	[0,3]	[0,0]	[0,0]	[0,3]	[0,3]	[3,3]
ς_2	[5,5]	[7,7]	[0,4]	[0,3]	[0,3]	[0,3]	[0,4]	[3,3]	[3,3]	[3,3]	[3,3]
ς_3	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[3,3]
ς_4	[0,0]	[7,7]	[0,4]	[0,3]	[0,3]	[3,0]	[0,4]	[3,3]	[3,3]	[3,0]	[3,3]
ς_5	[0,0]	[0,0]	[4,0]	[3,3]	[3,3]	[3,0]	[4,0]	[0,3]	[0,3]	[0,0]	[3,3]
ς_6	[0,0]	[0,0]	[4,4]	[3,3]	[3,0]	[3,0]	[4,0]	[3,3]	[3,0]	[3,0]	[3,3]
ς_7	[0,0]	[0,0]	[4,0]	[3,3]	[3,0]	[3,0]	[4,0]	[0,3]	[0,0]	[0,0]	[3,3]
ς_8	[0,0]	[0,0]	[4,4]	[3,3]	[3,0]	[3,0]	[4,0]	[3,3]	[3,0]	[3,0]	[3,3]
ς_9	[0,0]	[7,7]	[0,0]	[0,0]	[0,3]	[0,0]	[0,4]	[0,0]	[0,3]	[0,0]	[3,3]
ς_{10}	[0,0]	[7,7]	[0,4]	[0,0]	[0,3]	[0,0]	[0,4]	[3,0]	[3,3]	[3,0]	[3,3]
ς_{11}	[5,5]	[7,7]	[0,4]	[0,0]	[0,3]	[0,3]	[0,4]	[3,0]	[3,3]	[3,3]	[0,0]
ς_{12}	[0,0]	[7,7]	[0,4]	[0,0]	[0,0]	[0,0]	[4,4]	[3,0]	[3,0]	[3,0]	[0,0]
ς_{13}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{14}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{15}	[0,0]	[0,0]	[4,4]	[3,0]	[3,3]	[3,0]	[4,0]	[3,0]	[3,3]	[3,0]	[3,3]
ς_{16}	[0,0]	[0,0]	[4,4]	[3,0]	[3,0]	[3,0]	[4,0]	[3,0]	[3,0]	[3,0]	[3,3]
ς_{17}	[0,0]	[0,0]	[4,0]	[3,0]	[3,3]	[3,0]	[4,0]	[0,0]	[0,3]	[0,0]	[3,3]
ς_{18}	[0,0]	[0,0]	[4,0]	[3,0]	[3,0]	[3,0]	[4,0]	[0,0]	[0,0]	[0,0]	[3,3]

Table 19. Tabular representation of soft intervals with their weights-3.

	β_{23}	β_{24}	β_{25}	β_{26}	β_{27}	β_{28}	β_{29}	β_{30}	β_{31}	β_{32}	β_{33}
ς_1	[0,3]	[0,3]	[0,0]	[5,5]	[3,0]	[3,0]	[0,2]	[0,3]	[0,3]	[0,2]	[0,2]
ς_2	[3,3]	[3,3]	[3,3]	[5,5]	[3,3]	[3,3]	[2,0]	[3,3]	[3,3]	[2,0]	[2,2]
ς_3	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,3]	[0,3]	[0,2]	[0,0]
ς_4	[3,3]	[3,0]	[3,3]	[5,0]	[3,3]	[0,3]	[2,0]	[3,3]	[3,3]	[2,0]	[2,2]
ς_5	[3,3]	[3,0]	[3,0]	[5,0]	[3,0]	[0,0]	[0,2]	[0,3]	[0,3]	[0,0]	[0,2]
ς_6	[3,0]	[3,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,3]	[0,0]	[0,0]
ς_7	[3,0]	[3,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,3]	[0,3]	[0,0]	[0,0]
ς_8	[3,0]	[3,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,3]	[0,0]	[0,0]
ς_9	[0,3]	[0,0]	[0,3]	[5,0]	[3,3]	[0,3]	[2,2]	[3,3]	[3,3]	[2,0]	[2,2]
ς_{10}	[0,3]	[0,0]	[0,3]	[5,0]	[3,3]	[0,3]	[2,0]	[3,3]	[3,3]	[2,0]	[2,2]
ς_{11}	[0,3]	[0,3]	[0,3]	[5,5]	[3,3]	[3,3]	[2,0]	[3,3]	[3,0]	[2,0]	[2,2]
ς_{12}	[0,0]	[0,0]	[0,3]	[0,0]	[0,0]	[0,3]	[2,0]	[3,3]	[3,0]	[2,0]	[2,0]
ς_{13}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{14}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{15}	[0,3]	[0,0]	[0,0]	[5,0]	[3,0]	[0,0]	[0,0]	[0,3]	[0,3]	[0,0]	[0,2]
ς_{16}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,3]	[0,0]	[0,0]
ς_{17}	[0,3]	[0,0]	[0,0]	[5,0]	[3,0]	[0,0]	[0,2]	[0,3]	[0,3]	[0,0]	[0,2]
ς_{18}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,3]	[0,3]	[0,0]	[0,0]

Table 20. Tabular representation of soft intervals with their weights-4.

	β_{34}	β_{35}	β_{36}	β_{37}	β_{38}	β_{39}	β_{40}	β_{41}	β_{42}	β_{43}	β_{44}
ς_1	[0,2]	[2,2]	[2,2]	[2,2]	[2,2]	[2,2]	[2,2]	[3,3]	[2,2]	[2,2]	[2,2]
ς_2	[2,2]	[0,0]	[0,2]	[0,2]	[0,0]	[0,2]	[0,2]	[3,3]	[2,2]	[2,0]	[2,2]
ς_3	[0,0]	[2,2]	[2,2]	[2,2]	[2,2]	[2,0]	[2,0]	[3,3]	[2,2]	[2,2]	[2,0]
ς_4	[2,0]	[0,0]	[0,2]	[0,2]	[0,0]	[0,2]	[0,0]	[3,3]	[2,2]	[2,0]	[2,2]
ς_5	[0,0]	[2,2]	[2,2]	[2,2]	[2,0]	[2,2]	[2,0]	[3,3]	[2,2]	[2,0]	[2,2]
ς_6	[0,0]	[0,0]	[0,2]	[0,2]	[0,0]	[0,0]	[0,0]	[3,3]	[2,2]	[2,0]	[2,0]
ς_7	[0,0]	[2,2]	[2,2]	[2,2]	[2,0]	[2,0]	[2,0]	[3,3]	[2,2]	[2,0]	[2,0]
ς_8	[0,0]	[0,0]	[0,2]	[0,2]	[0,0]	[0,0]	[0,0]	[3,3]	[2,2]	[2,0]	[2,0]
ς_9	[2,0]	[2,2]	[2,2]	[2,2]	[2,0]	[2,2]	[2,0]	[3,3]	[2,2]	[2,0]	[2,2]
ς_{10}	[2,0]	[0,0]	[0,2]	[0,2]	[0,0]	[0,2]	[0,0]	[3,3]	[2,2]	[2,0]	[2,2]
ς_{11}	[2,2]	[0,0]	[0,2]	[0,0]	[0,0]	[0,2]	[0,2]	[3,3]	[2,0]	[2,0]	[2,2]
ς_{12}	[2,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]	[3,3]	[2,0]	[2,0]	[2,0]
ς_{13}	[0,0]	[2,2]	[2,0]	[2,0]	[2,0]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{14}	[0,0]	[2,2]	[2,0]	[2,0]	[2,0]	[2,0]	[2,2]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{15}	[0,0]	[0,0]	[0,2]	[0,2]	[0,0]	[0,2]	[0,0]	[3,3]	[2,2]	[2,0]	[2,2]
ς_{16}	[0,0]	[0,0]	[0,2]	[0,2]	[0,0]	[0,0]	[0,0]	[3,3]	[2,2]	[2,0]	[2,0]
ς_{17}	[0,0]	[2,2]	[2,2]	[2,2]	[0,0]	[0,2]	[0,0]	[3,3]	[2,2]	[2,0]	[2,2]
ς_{18}	[0,0]	[2,2]	[2,2]	[2,2]	[0,0]	[0,0]	[0,0]	[3,3]	[2,2]	[2,0]	[2,0]

Table 21. Tabular representation of soft intervals with their weights-5.

	β_{45}	β_{46}	β_{47}	β_{48}	β_{49}	β_{50}	β_{51}	β_{52}	β_{53}	β_{54}	β_{55}
ς_1	[2,2]	[2,2]	[2,2]	[2,2]	[2,2]	[2,2]	[2,2]	[0,0]	[0,0]	[0,0]	[0,0]
ς_2	[2,2]	[2,0]	[2,2]	[2,2]	[0,0]	[0,2]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]
ς_3	[2,0]	[2,2]	[2,0]	[2,0]	[2,2]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[0,2]
ς_4	[2,0]	[2,0]	[2,2]	[2,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]
ς_5	[2,0]	[2,0]	[2,2]	[2,0]	[0,0]	[0,2]	[0,0]	[2,0]	[4,0]	[4,0]	[2,0]
ς_6	[2,0]	[2,0]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[2,0]	[4,0]	[4,0]	[2,0]
ς_7	[2,0]	[2,0]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[2,0]	[4,0]	[4,0]	[2,2]
ς_8	[2,0]	[2,0]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[2,0]	[4,0]	[4,0]	[2,2]
ς_9	[2,0]	[2,0]	[2,2]	[2,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{10}	[2,0]	[2,0]	[2,2]	[2,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{11}	[2,2]	[0,0]	[0,2]	[0,2]	[0,0]	[0,2]	[0,2]	[0,0]	[0,4]	[0,4]	[0,0]
ς_{12}	[2,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,4]	[0,4]	[0,2]
ς_{13}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,4]	[0,4]	[0,0]
ς_{14}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,4]	[0,4]	[0,0]
ς_{15}	[2,0]	[2,0]	[2,2]	[2,0]	[0,0]	[0,2]	[0,0]	[2,0]	[4,0]	[4,0]	[2,2]
ς_{16}	[2,0]	[2,0]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[2,0]	[4,0]	[4,0]	[2,2]
ς_{17}	[2,0]	[2,0]	[2,2]	[2,0]	[0,0]	[0,2]	[0,0]	[2,0]	[4,0]	[4,4]	[2,0]
ς_{18}	[2,0]	[2,0]	[2,0]	[2,0]	[0,0]	[0,0]	[0,0]	[2,0]	[4,0]	[4,4]	[2,2]

Table 22. Tabular representation of soft intervals with their weights-6.

	β_{56}	β_{57}	β_{58}	β_{59}	β_{60}	β_{61}	β_{62}	β_{63}	β_{64}	β_{65}	β_{66}
ς_1	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_2	[0,0]	[2,0]	[5,0]	[4,0]	[2,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_3	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,0]	[0,4]	[0,0]
ς_4	[0,0]	[2,0]	[5,0]	[4,0]	[2,2]	[3,0]	[0,0]	[0,0]	[0,0]	[0,4]	[0,0]
ς_5	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_6	[3,0]	[2,0]	[5,0]	[4,0]	[2,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_7	[3,3]	[0,0]	[0,0]	[0,0]	[0,2]	[0,3]	[0,0]	[0,0]	[0,0]	[0,4]	[0,3]
ς_8	[3,3]	[2,0]	[5,0]	[4,0]	[2,2]	[3,3]	[0,0]	[0,0]	[0,0]	[0,4]	[0,3]
ς_9	[0,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]
ς_{10}	[0,3]	[2,0]	[5,0]	[4,0]	[2,0]	[3,3]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]
ς_{11}	[0,0]	[2,0]	[5,5]	[4,4]	[2,0]	[3,0]	[0,0]	[0,4]	[0,4]	[0,0]	[0,0]
ς_{12}	[0,0]	[2,0]	[5,5]	[4,4]	[2,2]	[3,0]	[0,0]	[0,4]	[0,4]	[0,4]	[0,0]
ς_{13}	[0,3]	[0,2]	[0,5]	[0,4]	[0,2]	[0,0]	[4,4]	[4,4]	[4,4]	[4,0]	[3,3]
ς_{14}	[0,0]	[0,2]	[0,5]	[0,4]	[0,2]	[0,3]	[4,4]	[4,4]	[4,4]	[4,4]	[3,0]
ς_{15}	[3,0]	[2,0]	[5,0]	[4,0]	[2,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_{16}	[3,3]	[2,0]	[5,0]	[4,0]	[2,2]	[3,0]	[0,0]	[0,0]	[0,0]	[0,4]	[0,3]
ς_{17}	[3,0]	[0,0]	[0,0]	[0,4]	[0,0]	[0,3]	[0,0]	[0,0]	[0,4]	[0,0]	[0,0]
ς_{18}	[3,0]	[0,0]	[0,0]	[0,4]	[0,2]	[0,0]	[0,0]	[0,0]	[0,4]	[0,4]	[0,0]

Table 23. Tabular representation of soft intervals with their weights-7.

	β_{67}	β_{68}	β_{69}	β_{70}	β_{71}	β_{72}	β_{73}	β_{74}	β_{75}	β_{76}	β_{77}	β_{78}
ς_1	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]
ς_2	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[3,0]	[0,1]
ς_3	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,2]	[0,0]	[4,4]	[3,0]	[0,0]	[0,0]	[0,0]
ς_4	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[0,2]	[0,0]	[4,4]	[3,0]	[0,0]	[3,0]	[0,1]
ς_5	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]
ς_6	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[3,3]	[0,0]
ς_7	[0,0]	[0,0]	[0,2]	[0,3]	[0,0]	[0,2]	[0,3]	[4,4]	[3,3]	[3,3]	[0,3]	[0,0]
ς_8	[0,0]	[0,0]	[0,2]	[0,3]	[0,0]	[0,2]	[0,3]	[4,4]	[3,3]	[3,3]	[3,3]	[0,0]
ς_9	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]	[0,0]	[0,3]	[0,0]	[0,3]	[3,3]	[0,0]	[0,1]
ς_{10}	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]	[0,0]	[0,3]	[0,0]	[0,3]	[3,3]	[3,0]	[0,1]
ς_{11}	[5,5]	[4,4]	[2,0]	[3,0]	[4,4]	[2,0]	[3,0]	[0,0]	[0,0]	[0,0]	[3,0]	[0,1]
ς_{12}	[5,5]	[4,4]	[2,2]	[3,0]	[4,4]	[2,2]	[3,0]	[4,4]	[3,0]	[0,0]	[3,0]	[0,1]
ς_{13}	[5,5]	[4,4]	[2,2]	[3,3]	[4,4]	[2,2]	[3,3]	[4,4]	[3,3]	[3,3]	[0,0]	[1,0]
ς_{14}	[5,5]	[4,4]	[2,2]	[3,0]	[4,4]	[2,2]	[3,0]	[4,4]	[3,0]	[3,3]	[0,0]	[1,0]
ς_{15}	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[3,3]	[0,0]
ς_{16}	[0,0]	[0,0]	[0,2]	[0,3]	[0,0]	[0,2]	[0,3]	[4,4]	[3,3]	[3,3]	[3,3]	[0,0]
ς_{17}	[0,0]	[0,4]	[0,0]	[0,0]	[4,4]	[2,0]	[3,0]	[0,0]	[0,0]	[0,0]	[0,3]	[0,0]
ς_{18}	[0,0]	[0,4]	[0,2]	[0,0]	[4,4]	[2,2]	[3,0]	[4,4]	[3,0]	[0,0]	[0,3]	[0,0]

Table 24. Tabular representation of soft intervals with their weights-8.

	β_{79}	β_{80}	β_{81}	β_{82}	β_{83}	β_{84}	β_{85}	β_{86}	β_{87}	β_{88}	β_{89}	β_{90}	β_{91}
ς_1	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,0]	[0,1]
ς_2	[0,1]	[1,0]	[1,0]	[0,2]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[1,0]	[1,1]
ς_3	[0,0]	[0,0]	[0,1]	[0,0]	[0,0]	[2,0]	[2,0]	[1,0]	[1,0]	[1,1]	[1,1]	[0,0]	[0,1]
ς_4	[0,1]	[1,0]	[1,1]	[0,2]	[0,0]	[2,2]	[2,0]	[1,0]	[1,0]	[1,1]	[1,1]	[1,0]	[1,1]
ς_5	[0,0]	[0,0]	[0,0]	[0,0]	[0,2]	[0,0]	[0,0]	[1,0]	[1,0]	[1,1]	[1,1]	[0,0]	[0,1]
ς_6	[0,0]	[0,0]	[0,0]	[0,2]	[0,2]	[0,2]	[0,0]	[1,0]	[1,0]	[1,1]	[1,1]	[1,0]	[1,1]
ς_7	[0,0]	[0,0]	[0,1]	[0,0]	[0,2]	[2,0]	[2,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,0]	[0,1]
ς_8	[0,0]	[0,0]	[0,1]	[0,2]	[0,2]	[2,2]	[2,0]	[0,0]	[0,0]	[0,1]	[0,1]	[1,0]	[1,1]
ς_9	[0,1]	[1,0]	[1,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,0]	[0,1]
ς_{10}	[0,1]	[1,0]	[1,0]	[0,2]	[0,0]	[0,2]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[1,0]	[1,1]
ς_{11}	[1,1]	[1,1]	[1,0]	[0,2]	[0,0]	[0,2]	[2,2]	[0,0]	[0,1]	[0,0]	[0,1]	[1,0]	[1,1]
ς_{12}	[1,1]	[1,1]	[1,1]	[0,2]	[0,0]	[2,2]	[2,2]	[1,0]	[1,1]	[1,0]	[1,1]	[1,0]	[1,0]
ς_{13}	[1,0]	[0,1]	[0,1]	[2,0]	[2,0]	[2,0]	[2,2]	[0,0]	[0,1]	[0,0]	[0,1]	[0,0]	[0,0]
ς_{14}	[1,0]	[0,1]	[0,1]	[2,0]	[2,0]	[2,0]	[2,2]	[1,0]	[1,1]	[1,0]	[1,0]	[0,0]	[0,0]
ς_{15}	[0,0]	[0,0]	[0,0]	[0,2]	[0,2]	[0,2]	[0,0]	[1,0]	[1,0]	[1,1]	[1,0]	[1,0]	[1,0]
ς_{16}	[0,0]	[0,0]	[0,1]	[0,2]	[0,2]	[2,2]	[2,0]	[0,0]	[0,0]	[0,1]	[0,1]	[1,0]	[0,1]
ς_{17}	[0,0]	[0,1]	[0,0]	[0,0]	[0,2]	[0,0]	[0,2]	[1,1]	[1,0]	[1,1]	[1,1]	[0,1]	[0,1]
ς_{18}	[0,0]	[0,1]	[0,1]	[0,0]	[0,2]	[2,0]	[2,2]	[0,1]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]

Table 25. Tabular representation of soft intervals with their weights-9.

	β_{92}	β_{93}	β_{94}	β_{95}	β_{96}	β_{97}	β_{98}	β_{99}	β_{100}	β_{101}	$\iota_i = [\kappa_i^{(1)}, \kappa_i^{(2)}]$
ς_1	[0,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[60,99]
ς_2	[1,1]	[1,0]	[1,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[118,146]
ς_3	[0,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[73,64]
ς_4	[1,1]	[1,0]	[1,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[152,130]
ς_5	[0,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[120,84]
ς_6	[1,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[139,78]
ς_7	[0,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[98,96]
ς_8	[1,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[125,122]
ς_9	[0,1]	[1,0]	[1,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[78,103]
ς_{10}	[1,1]	[1,0]	[1,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[101,121]
ς_{11}	[1,1]	[1,0]	[1,1]	[0,0]	[0,1]	[0,0]	[0,1]	[1,0]	[1,1]	[0,1]	[124,163]
ς_{12}	[1,1]	[1,0]	[1,1]	[0,0]	[0,1]	[0,0]	[0,1]	[1,0]	[1,1]	[0,1]	[144,121]
ς_{13}	[0,0]	[0,0]	[0,1]	[0,0]	[0,1]	[0,0]	[0,0]	[1,0]	[1,0]	[0,0]	[76,86]
ς_{14}	[0,0]	[0,0]	[0,1]	[0,0]	[0,1]	[0,0]	[0,0]	[1,0]	[1,0]	[0,0]	[104,83]
ς_{15}	[1,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[140,93]
ς_{16}	[0,1]	[0,0]	[0,0]	[0,0]	[0,0]	[0,1]	[0,1]	[0,1]	[0,1]	[1,1]	[111,107]
ς_{17}	[0,1]	[0,1]	[0,0]	[1,1]	[1,0]	[1,1]	[1,1]	[0,1]	[0,1]	[1,1]	[120,107]
ς_{18}	[0,1]	[0,1]	[0,0]	[1,1]	[1,0]	[1,1]	[1,1]	[0,1]	[0,1]	[1,1]	[90,90]

Step 6. Interval choice values for objects ς_i, for $i = 1, 2, ..., 18$ are written in the last column of Table 25.

Step 7. According to the interval choice values which are written in the last column of Table 25, the most suitable cloud server is ς_{11}, which has 4 GB memory with 100 GB SSD harddisk, 5-gigabit network, and 5-gigabit bandwidth along with Ubuntu operating system, costing $42,38 per month.

The following Figure 7 shows the interval choice values of objects. Vertical axis is for the interval choice values, and the horizontal axis is for objects. Blue curve represents the second component of interval choice values obtained from the second algorithm, while the orange curve represents the first component of interval choice values obtained from the second algorithm. The decision object is first identified by looking at the blue curve in this graph. For this example, the decision object is ς_{11}. Additionally, one can rank the suitable objects by using this figure first by looking at the blue curve, then if necessary by looking at the orange curve; for instance, it can be seen from the graph that the tenth and twelfth objects have the same value on the blue curve. In such case, a higher value is observed on the orange curve. As a result, when comparing just two of them, the twelfth should be the preferred choice.

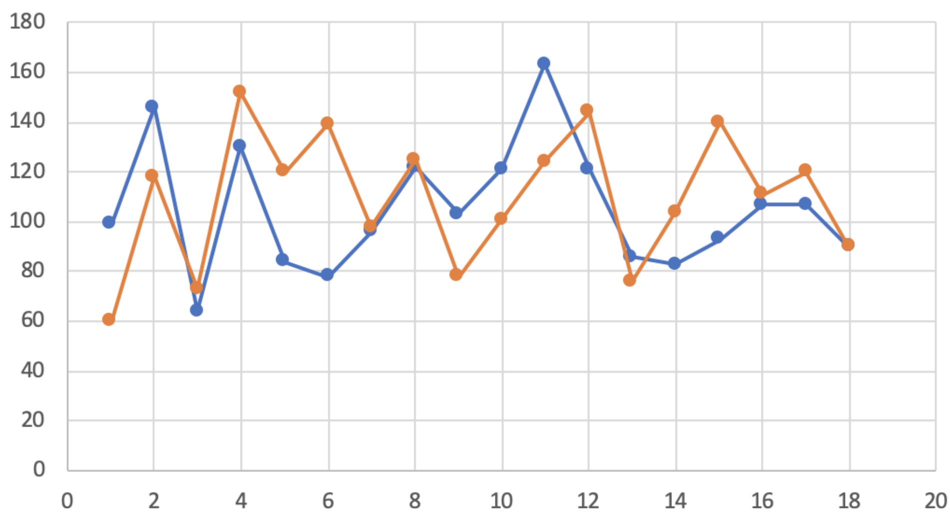

Figure 7. Interval choice values.

3. Discussion and analysis

Soft sets, by their nature, can be considered as a parameterized family of subsets of a universal set. Moreover, since parameter set and universal set in soft sets can include not only numbers but also words, objects, and many other elements, their applicability and usability in daily life are significantly high. Studies have shown that soft sets are effectively used in decision-making methods in numerous areas, including various fields such as business, healthcare, environmental sciences, and engineering. With this motivation, this study selects the most suitable decision object based on the priorities of all decision-makers regarding object attributes, which were not considered in previous studies.

Table 26 provides a detailed comparison, highlighting the applicability and limitations of decision-making methods based on the soft set theory.

Table 26. Comparison table.

Article	Year	Single/ group user	Method based on	Attributes of objects	Priority ranking of users	Weight on attributes	Different influence of users
[21]	2002	single	soft set	which attribute the user want	×	✓	×
[10]	2010	group	soft set	which attribute the user want	×	×	×
[17]	2014	single	incomplete soft set	which attribute the user want	×	×	×
[37]	2014	single	interval soft set	which attribute the user want	×	×	×
[12]	2019	single	soft set	which attribute the user want	✓	×	×
[34]	2021	single	soft interval	which attribute the user want	✓	×	×
[4]	2022	single	similarity measure	which attribute the user want	×	✓	×
[13]	2022	group	bipolar soft set	which attribute the user want	×	×	×
[5]	2023	group	similarity measure	which attribute the user want	×	×	×
[25]	2024	single	Bipolar M-parametrized N soft set	which attribute the user want	×	✓	×
[6]	2024	group	decomposition of soft set	which attribute the user want	×	×	×
[16]	2024	single	effective vague soft set	which attribute the user want	×	×	×
[24]	2024	single	similarity measure	which attribute the user want	×	×	×
[9]	2025	single	neutrosophic soft set	which attribute the user want	×	×	×
[26]	2025	group	soft theta product	which attribute the user do not want	×	×	×
[27]	2025	group	soft star product	which attribute the user do not want	×	×	×
[28]	2025	single	soft gamma product	which attribute the user want and do not want	×	×	×
proposed method		group	soft interval	which attribute the user want	✓	×	✓

In Table 26, the decision-making methods presented in the references are compared with the method proposed in this study. The articles are listed in chronological order and Table 26 is constructed based on criterias; whether the decision-maker is single or a group, the structure used in soft sets, how object attributes are evaluated, whether users' priority rankings are considered, whether weights are assigned to the attributes, and whether users have different influence in the decision-making process. According to Table 26, recent researches have investigated both group and single user decision-making. However, no prior research has introduced a decision-making method that considers multiple decision-makers' preferences for object attributes using soft sets. Moreover, while previous studies assumed that all decision-makers had the same level of influence on the decision, this study evaluates cases where their influence may differ, ensuring the selection of the most suitable decision objects. To apply the method presented in this study to previously proposed methods, it is necessary to obtain the priority ranking of object attributes from users. After the priority ranking for object attributes is obtained according to the given problem, the most suitable method from the proposed ones in this study can be easily applied.

The integration of priority rankings of users with the soft set relation to derive soft intervals may introduce complexity. This complexity arises as the number of parameters increases significantly, leading to a higher number of soft intervals. Consequently, weights of each soft interval must be calculated and interval choice values for each object must be evaluated. Even though an increasing number of parameters may lead to complexity, performing calculations through matrix representation improves result clarity and makes comparison of decision objects more efficient.

Analyzing the sensitivity of our method, we observe that changes in the parameters, whether an increase or a decrease in their number, have a direct impact on the results. For instance, in Example 1, if we delete the parameter ψ_5, then the soft intervals β_5, β_7, β_{10}, β_{12}, and β_{18} will be deleted, so interval choice values will become $\iota_1 = [11, 10]$, $\iota_2 = [11, 11]$, $\iota_3 = [10, 11]$, $\iota_4 = [7, 3]$, $\iota_5 = [3, 8]$, and $\iota_6 = [1, 0]$. Therefore, ranking of choice objects becomes υ_2, υ_3, υ_1, υ_5, υ_4, υ_6, which is different from the result obtained in Example 1. Similarly, when parameters change, the soft set changes; therefore, all results will change. Additionally, one of the previous decision-making methods given in [34] that considers user's ranking was applied in Example 1 and compared with the proposed method. As can be observed in Example 1, the method presented in this study seeks to ensure the most appropriate object selection for all users by considering the rankings of all decision-makers at the same time.

The methods proposed in this study can be effective in making decisions more systematic and fair in real-world scenarios, such as vehicle purchasing for families or companies, multi-manager or departmental decisions in recruitment processes, the selection of hospital equipment or medical devices, and the choice of housing or office spaces for families or companies.

4. Conclusions

In this study, the decision-making algorithms using soft sets with a group of decision makers and with multi-attribute objects were developed. In the first algorithm, the influence of users on the decision is considered equal, while in the second, it is assessed as different. In both algorithms, the most suitable decision object and the ranking of objects were determined according to each user's priority ranking of object attributes. This highlights that the notion of soft sets can be effective in making decisions more systematic and fair in multi-criteria, multi-user decision-making processes. Consequently, this method can offer valuable guidance in selecting the most suitable decision object for all users in real-world multi-criteria and multi-user decision-making scenarios. In this study, unlike previous studies, the decision object selection was based not only on whether the objects met the desired attributes, but also on which attributes were preferred more by the users. Similarly, in future studies on decision-making methods using soft sets, it could be investigated how adding details to the parameters or users might make the decision object more suitable. Furthermore, future studies could explore whether similar methods can be applied in hybrid models that use soft sets. Moreover, it is widely recognized that consensus is a fundamental aspect of group decision-making. Accordingly, this study aimed to harmonize the diverse perspectives of group members and reach a consensus. For this reason, by individually considering each member's preferences along with their priority rankings, the most appropriate decision object that is acceptable to all has been determined. Following this perspective, the method used in this study can be expanded on consensus research in group decision-making, including fuzzy sets, by individually analyzing each decision-maker's preferences and then integrating these evaluations. Currently, no specific software has been developed for this method. However, future studies may include the development of a dedicated implementation.

Use of Generative-AI tools declaration

The author declares he have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

The author declares no conflicts of interest in this paper.

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Appendix

Flowcharts of the steps of Algorithm 1 are given in the following Figures 8–14:

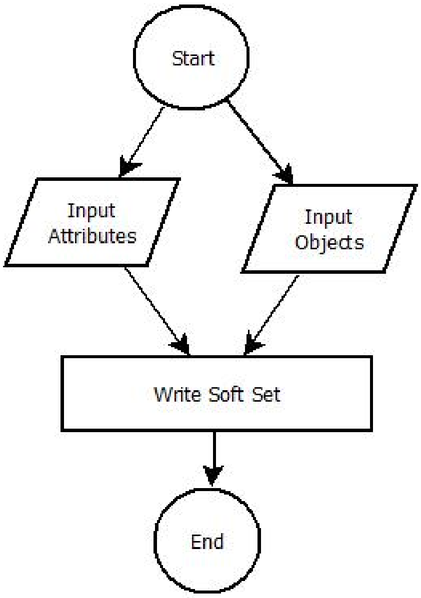

Figure 8. Flowchart of Step 1.

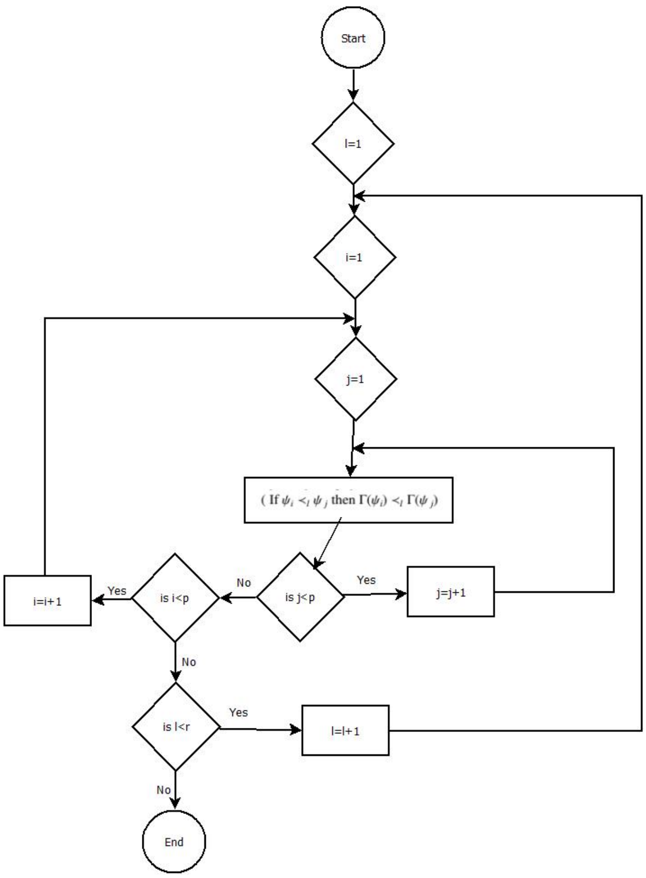

Figure 9. Flowchart of Step 2.

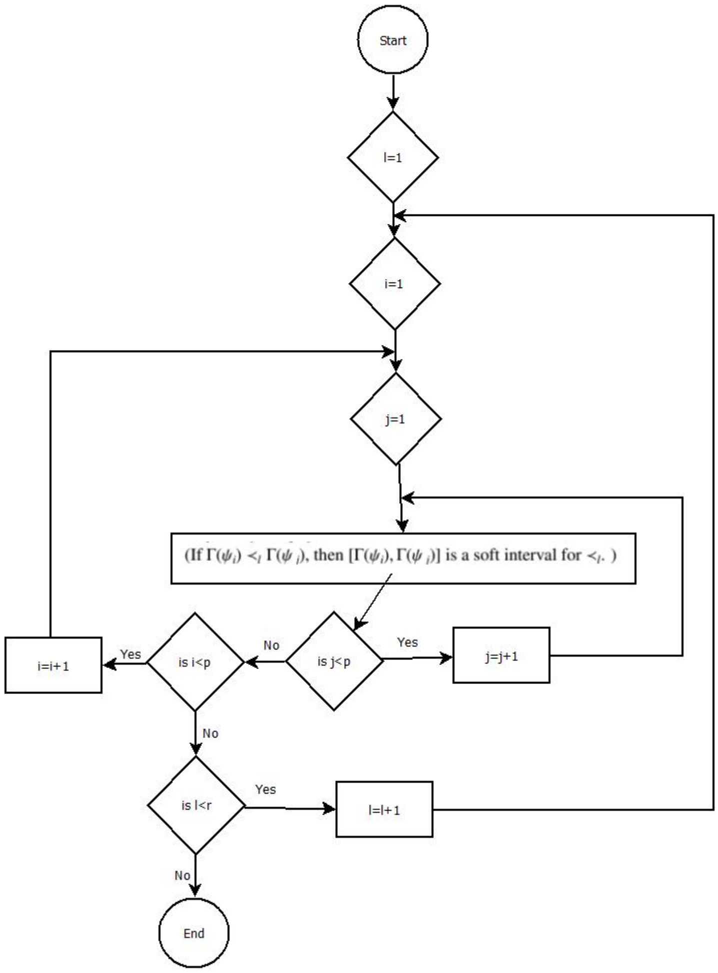

Figure 10. Flowchart of Step 3.

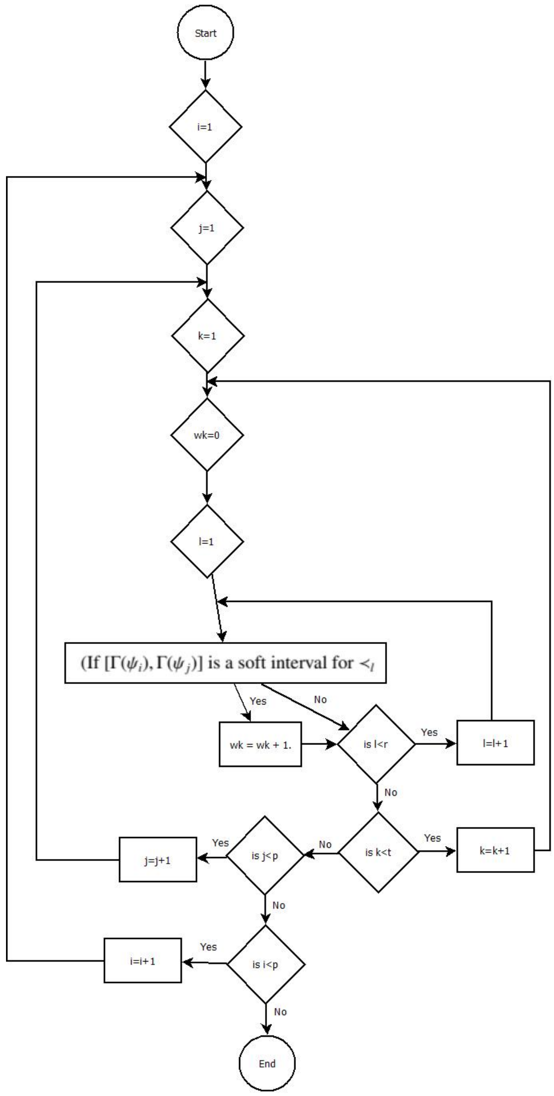

Figure 11. Flowchart of Step 4.

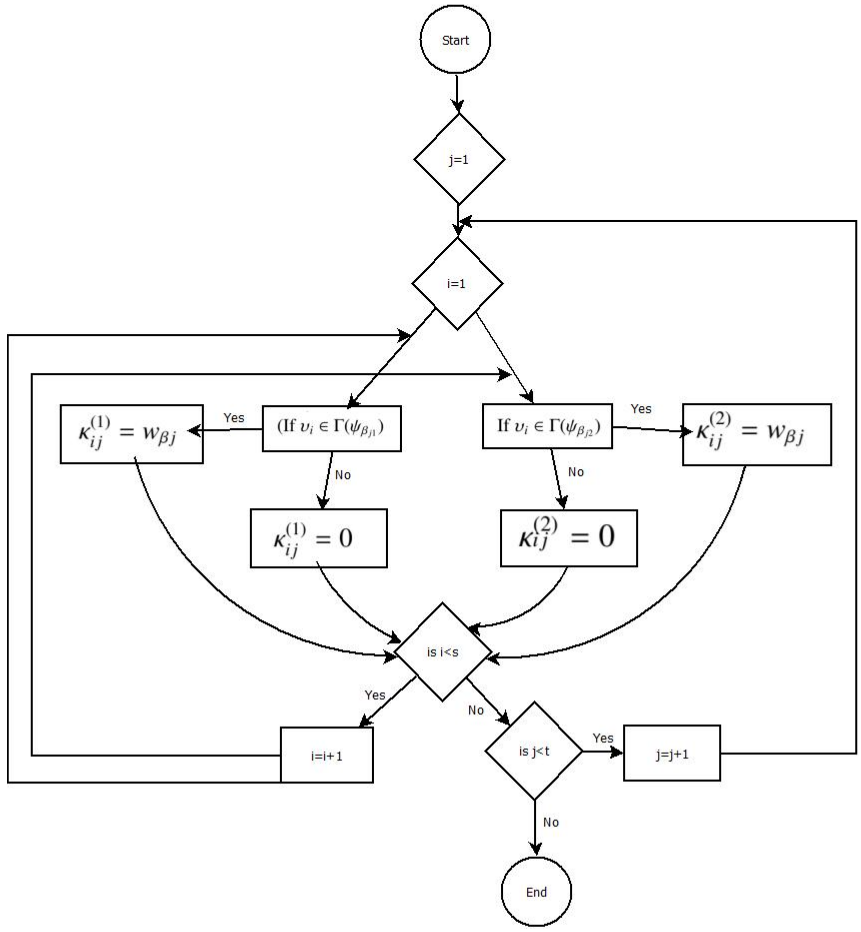

Figure 12. Flowchart of Step 5.

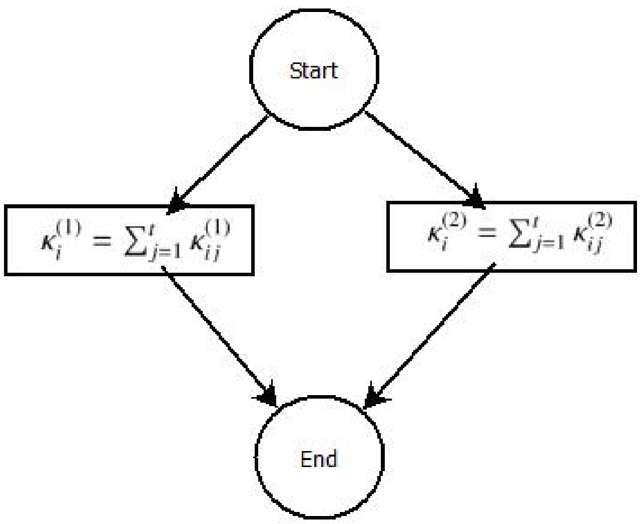

Figure 13. Flowchart of Step 6.

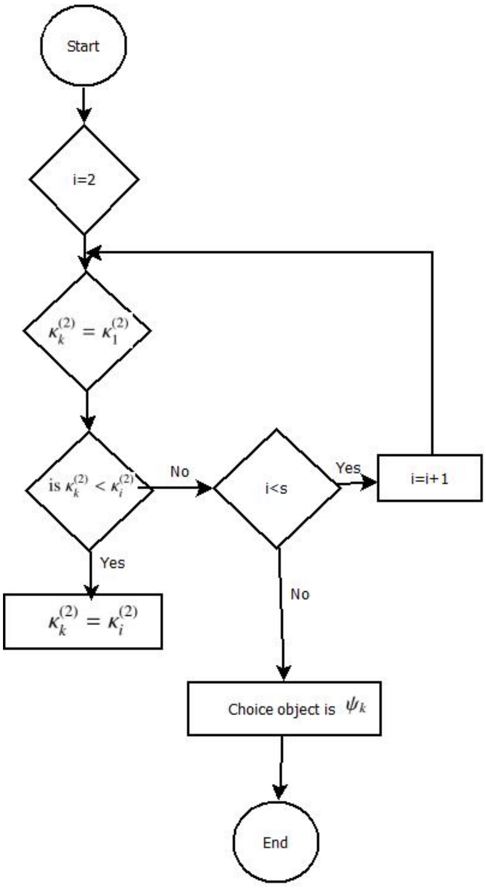

Figure 14. Flowchart of Step 7.