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Application of TOPSIS as a DSS in the Selection of Home Improvement Grant Recipients

Aryo Bagus Kusumadewa Tutuko [a,1,*] , Maulana Syarief Hidayatullah [a,2] , Ulla Delfana Rosiani [a,3]

[a] D-4 Information Engineering Polinema, Jl.Sukarno-Hatta 9 , Malang 65141, Indonesia
[1] aryobagus@gmail.com; [2] maulana11syarief@gmail.com; [3] rosiani@polinema.ac.id
*corresponding author

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ELECTRE
SAW
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ABSTRACT

This study aims to compare the TOPSIS method with the SAW and ELECTRE methods which have been presented in previous research in making decisions on home improvement grant recipients. This research utilizes data and findings from prior studies concerning the selection process for recipients of home renovation assistance, employing the SAW and ELECTRE methodologies. Using the TOPSIS method obtained results that have significant differences. The TOPSIS method provides positive and negative ideal solutions, this is more detailed in supporting the decision-making process. By displaying the web-based TOPSIS method, it is hoped that users with an interest in decision-making can access it more easily. The results indicate that the positive ideal solution may symbolize an ideal housing state, such as a well-maintained house, while the negative ideal solution may represent a subpar housing condition.

1. Introduction

Decision Support System (DSS) is a system used to assist decision making by providing information, analysis, and other tools. Several DSS methods include SAW (Simple Additive Weighting), ELECTRE (Elimination and Choice Expressing Reality), Analytic Hierarchy Process (AHP), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations), Fuzzy Logic, Genetic Algorithm and Bayesian Networks. The choice of an appropriate DSS method depends on the nature of the decision-making problem, available data, the decision maker's preferences, and the specific context of the decision to be taken.

A method may be more appropriate to be applied in one case than another method. This study wants to analyze decision making in the selection of residential repair grants that have been studied in previous studies using SAW and ELECTRE [1]. The analysis in question is to do a recalculation using the TOPSIS method. The purpose of this study was to compare the results obtained with the SAW method. ELECTRE, and TOPSIS to provide a better alternative, as well as presenting TOPSIS calculations on the web to make it easier for users. The SAW method is a simple and popular decision-making method. This method uses an absolute approach by giving weight to each relevant criterion in decision making. Each alternative is assessed based on the rating given to each criterion, then the weight of the criteria is multiplied by the rating. Next, the total score for each alternative is calculated by adding up the results of the multiplication of the weights and ratings. The alternative with the highest score will be chosen as the best solution [2]–[7]. Meanwhile the ELECTRE method is a decision-making method that uses an outranking approach. This method focuses on relative comparisons between alternatives based on specified criteria. In this method, a preference matrix is built to compare each pair of alternatives and identify the dominant and non-dominant alternatives. This preference matrix reflects the level of preference or level of compatibility between alternatives based on the specified criteria. Alternative ranking is determined based on dominance and non-dominance between these alternatives [8]–[10].

In the case of recipients of house renovation assistance, the application of the SAW method is to apply several relevant criteria in evaluating the current condition of the house to determine, such as roof leaks, structural damage, material wear, and others. Each criterion is given a weight based on its importance. Then, each house is rated on each criterion using a predetermined scale or rating. The weight of the criteria is multiplied by the rating assigned to each house for each criterion, and the total score is calculated by adding up the multiplication results. The house with the highest total score will be selected as a recipient of home renovation assistance. The ELECTRE method in the case of beneficiaries of home renovation assistance, the decision maker will determine the relevant criteria in evaluating the current condition of the house. For example, possible criteria include roof leaks, structural damage, wear and tear of materials, etc. Each criterion is given a weight based on its importance. Then, the preference matrix is built by comparing each pair of alternatives on each criterion. This preference matrix will show the level of preference between alternatives based on relative comparisons. The ELECTRE method will generate an alternative ranking based on dominance and non-dominance between these alternatives, with the alternative with the highest dominance getting the highest rating and being selected as the recipient of home renovation assistance.

TOPSIS is used to select the best alternative from a set of alternatives by comparing the relative distances of each alternative to the ideal solution [11]. TOPSIS calculates the distance between each alternative and the positive and negative ideal solutions, and then assigns a rating based on the proximity to the positive ideal solution. TOPSIS has an intuitive approach method that is relatively easy to understand and apply. The basic concept of TOPSIS focuses on relative comparisons between alternatives and ideal solutions, which are easily understood by decision makers [12]. TOPSIS takes into account positive and negative ideal solutions. Apply both the positive ideal solution (which has the maximum value) and the negative ideal solution (which has the minimum value) in its calculations. This helps in evaluating alternatives holistically, resulting in a more comprehensive and accurate ranking [13]. TOPSIS is quite sensitive to differences in preferences, taking into account differences in preferences between alternatives and ideal solutions using a geometric approach. In this case, TOPSIS emphasizes the alternative that has the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution, which makes it possible to distinguish the more desirable alternative [11]. TOPSIS is capable of handling different scales and complex attributes, including numeric, categorical, or even attributes with uncertainties represented by fuzzy values. By paying attention to the right weight, TOPSIS can provide consistent and comprehensive results [14] . The TOPSIS method produces alternative rankings, which makes it easier for decision makers to choose the best alternative based on these ratings. Thus, TOPSIS provides clear information and can be used as a guide in making decisions. If decision makers want to compare alternatives (applicants for assistance) based on their proximity to the positive ideal solution and their distance from the negative ideal solution, the TOPSIS method can be a good choice [12].

The objective of this study is to compare the results obtained from SAW to the TOPSIS method. From this study it is expected to answer the problem of choosing who is entitled to receive home renovation assistance. In this case, the positive ideal solution could represent a desired housing condition (e.g., the house is in good condition) and the negative ideal solution could represent a bad housing condition. The TOPSIS method will provide a rating based on the proximity of each house to the desired ideal conditions, with the closest alternative getting the highest rating. After the calculation is done, it is presented on the web which can be accessed by the user easily.

2. Method

In providing comparisons between decision-making methods, this study uses data and results from previous research on the Decision to Select Recipients of Home Renovation Assistance Using the SAW and ELECTRE Methods [1]. From the available data, further analysis was carried out using the TOPSIS method.

The steps of the analysis carried out are

a. Build a normalized decision matrix

$$R_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad \text{with } i = 1,2,3, \ldots m; \text{ and } j = 1,2,3 \ldots . n \qquad (1)$$

Information :
R_{ij} = normalized matrix result
X_{ij} = decision result matrix

b. Building normalized decision matrix weights

$$Y_{ij} = w_{ij}.r_{ij} \quad \text{with } i = 1,2,3, \ldots m; \text{ and } j = 1,2,3, \ldots n \qquad (2)$$

Information :
Y_{ij} = weighted normalization result
r_{ij} = matrix normalization result
w_{ij} = weight of the criterion score

c. Determine the ideal solution matrix and negative ideal solution matrix. The positive ideal solution (A^+) is calculated based on:

$$A^+ = (y^+, y_2^+, y_3^+, \ldots .., y_n^+) \qquad (3)$$

Negative ideal solution (A^-) is calculated based on:

$$A^- = (y^-, y_2^-, y_3^-, \ldots .., y_n^-) \qquad (4)$$

d. Determine the distance between the values of each alternative with the positive ideal solution matrix and negative ideal matrix. The distance between the alternative Ai and the positive ideal solution is formulated as:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_i^+)^2}, i = 1,2,3, \ldots m \qquad (5)$$

The distance between the alternative Ai and the negative ideal solution is formulated as:

$$D_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_i^-)^2}, i = 1,2,3, \ldots m \qquad (6)$$

e. Determine the preference value for each alternative. The closeness of each alternative to the ideal solution is calculated based on the formula:

$$V = \frac{Di^-}{Di^- + Di^+}, i = 1,2,3, \ldots m \qquad (7)$$

Information :
V = preference value

The preference value for each alternative is the final result of the TOPSIS method calculation, the higher the value, the alternative is the desired alternative.

3. Results and Discussion

Application of the TOPSIS Method

a. The flow of the algorithm in TOPSIS is in this research can be described in the following series of processes fig 1.

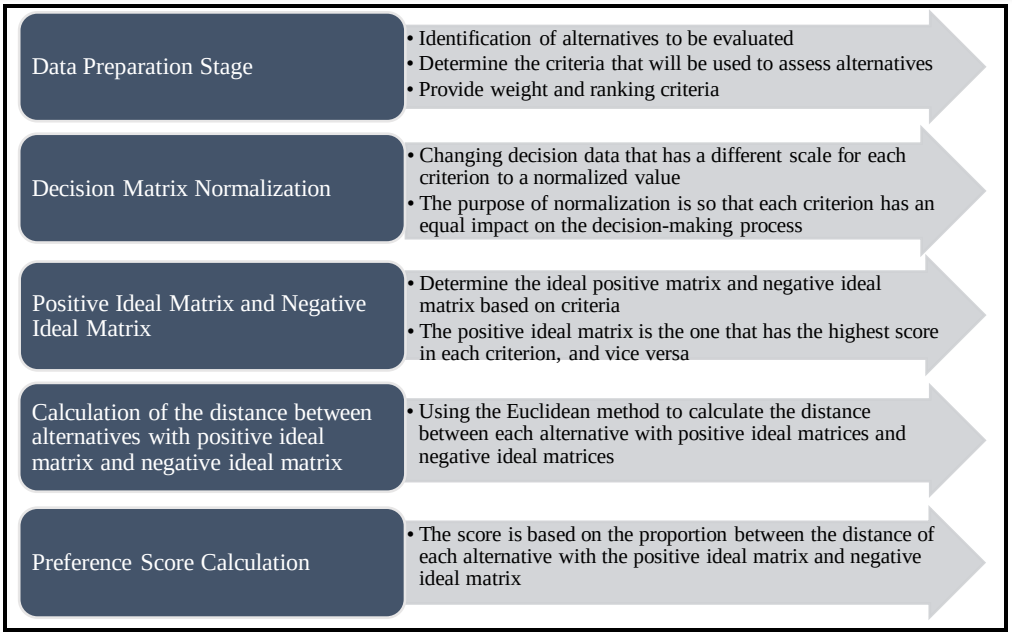

Fig.1. Research Process

b. Criteria data

This section presents a table that describes the criteria used in the decision-making process and gives weight to each bar. The weight of the criteria that have been determined includes in Table 1. For each criterion, each type is also explained.

Table 1. Weight and Criteria

Criteria	Code	Weight	Type
Foundation	C1	3	benefits
Sloop condition	C2	5	cost
Column / Pole Condition	C3	5	cost
Beam Condition	C4	5	cost
Roof Structure Condition	C5	5	benefits
Window/Light Hole	C6	5	cost
Ventilation	C7	5	cost
Bathroom Condition	C8	5	cost
Source of Drinking Water	C9	3	cost
Roof Cover Condition	C10	4	benefits
Wall Condition	C11	3	benefits
Floor Condition	C12	3	benefits

Source: data processed 2023

c. Alternative data

The results of collecting data on recipients of renovation assistance can be seen in Table 2. This table presents the decision data that will be evaluated. Table 2 shows the scores of each alternative against each predetermined criterion.

Table 2. Criteria and Alternatives

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101A	3	4	5	4	3	4	5	5	4	4	4	4
101B	4	3	3	4	4	4	3	3	4	4	4	5
101C	4	3	3	5	5	5	5	3	4	5	5	4
101D	5	5	4	5	4	5	4	4	3	4	4	4
101E	3	3	3	5	3	3	4	4	4	3	4	3
101F	4	5	3	5	4	4	4	4	3	3	4	3
101G	5	5	4	5	4	4	4	5	4	5	5	4
101H	5	5	4	5	4	5	5	5	4	5	4	5
101I	4	4	3	3	3	4	4	4	3	3	3	3
101J	4	3	3	3	4	4	4	3	3	3	3	5
101K	5	5	5	5	5	5	5	5	3	4	5	5
101L	4	3	3	5	4	4	4	5	3	4	3	4
101M	3	3	4	4	5	3	4	4	3	4	3	4
101N	4	4	4	4	3	3	3	5	3	3	3	3
101O	3	3	3	4	4	4	4	5	4	4	3	4
101P	3	3	3	4	3	4	4	5	4	4	3	4
101Q	4	3	3	4	3	3	3	5	3	3	3	3
101r	5	5	4	4	5	5	5	5	4	5	5	5
101S	4	4	3	3	4	4	5	3	3	4	3	4
101T	5	5	5	5	5	5	5	5	4	5	5	5
101U	3	3	3	3	4	4	5	5	4	3	4	4
101V	4	4	4	4	3	3	3	4	3	4	4	4
101W	4	4	3	4	3	3	3	5	3	3	3	3
101X	4	4	4	4	3	3	3	4	3	3	3	4
101Y	4	4	3	3	4	4	4	3	3	4	4	4
101Z	3	3	3	3	4	4	4	4	3	5	4	3
101AA	4	4	4	4	3	5	5	5	3	3	4	3
101AB	5	5	5	5	4	4	4	5	4	3	5	4
101AC	4	4	4	4	3	3	3	4	3	3	3	4
101AD	4	4	4	4	4	4	4	5	4	4	4	5
101AE	4	4	3	3	4	4	4	4	3	4	3	3
101AF	4	4	4	4	4	3	3	5	4	4	4	4
101AG	3	3	3	3	4	5	5	5	4	4	3	5
101AH	3	3	3	3	4	4	4	4	3	4	4	3
101AI	4	4	4	3	3	4	4	5	4	3	4	5
101AJ	4	4	4	3	3	4	4	5	4	3	4	5
101AK	3	3	3	3	4	4	4	4	4	3	3	4
Type	Benefits	cost	cost	cost	Benefits	cost	cost	cost	cost	Benefits	Benefits	Benefits

Source: Data processed 2023

d. Build a normalized decision matrix

After converting alternative data, then determine the normalization of decisions using the equation. To make the calculation easier to do, the sigma value of the decision matrix is first calculated, then divided by the decision matrix value according to the sequence. In Table 3 it can be seen the results of the calculation of the decision matrix normalization

$$RA1 = \frac{3}{\sqrt{\begin{matrix}9+16+19+25+9+16+25+25+16+16+25+16+\\16+25+16+9+16+9+9+16+25+16+25+9+16+\\16+16+16+9+16+25+16+16+16+16+9+9+16+16+9\end{matrix}}}$$

$$= \frac{3}{\sqrt{585}}$$

$$= \frac{3}{24.18677} = 0.1240347346$$

Table 3. Decision Matrix Normalization

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101A	0.12403 47346	0.1681 325407	0.2247 332875	0.1635 72164	0.1283 881478	0.1631 634033	0.1998 401917	0.1841 773672	0.1867 040112	0.1719 734322	0.1719 734322	0.1616 904167
101B	0.16537 96461	0.1260 994055	0.1348 399725	0.1635 72164	0.1711 84197	0.1631 634033	0.1199 04115	0.1105 064203	0.1867 040112	0.1719 734322	0.1719 734322	0.2021 130209
101C	0.16537 96461	0.1260 994055	0.1348 399725	0.2044 65205	0.2139 802463	0.2039 542541	0.1998 401917	0.1105 064203	0.1867 040112	0.2149 667902	0.2149 667902	0.1616 904167
101D	0.20672 45576	0.2101 656759	0.1797 8663	0.2044 65205	0.1711 84197	0.2039 542541	0.1598 721534	0.1473 418937	0.1400 280084	0.1719 734322	0.1719 734322	0.1616 904167
101E	0.12403 47346	0.1260 994055	0.1348 399725	0.2044 65205	0.1283 881478	0.1223 725525	0.1598 721534	0.1473 418937	0.1867 040112	0.1289 800741	0.1719 734322	0.1212 678125
101F	0.16537 96461	0.2101 656759	0.1348 399725	0.2044 65205	0.1711 84197	0.1631 634033	0.1598 721534	0.1473 418937	0.1400 280084	0.1289 800741	0.1719 734322	0.1212 678125
101G	0.20672 45576	0.2101 656759	0.1797 8663	0.2044 65205	0.1711 84197	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.2149 667902	0.2149 667902	0.1616 904167
101H	0.20672 45576	0.2101 656759	0.1797 8663	0.2044 65205	0.1711 84197	0.2039 542541	0.1998 401917	0.1841 773672	0.1867 040112	0.2149 667902	0.1719 734322	0.2021 130209
101I	0.16537 96461	0.1681 325407	0.1348 399725	0.1226 79123	0.1283 881478	0.1631 634033	0.1598 721534	0.1473 418937	0.1400 280084	0.1289 800741	0.1289 800741	0.1212 678125
101J	0.16537 96461	0.1260 994055	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1598 721534	0.1105 064203	0.1400 280084	0.1289 800741	0.1289 800741	0.2021 130209
101K	0.20672 45576	0.2101 656759	0.2247 332875	0.2044 65205	0.2139 802463	0.2039 542541	0.1998 401917	0.1841 773672	0.1400 280084	0.1719 734322	0.2149 667902	0.2021 130209
101L	0.16537 96461	0.1260 994055	0.1348 399725	0.2044 65205	0.1711 84197	0.1631 634033	0.1598 721534	0.1841 773672	0.1400 280084	0.1719 734322	0.1289 800741	0.1616 904167
101M	0.12403 47346	0.1260 994055	0.1797 8663	0.1635 72164	0.2139 802463	0.1223 725525	0.1598 721534	0.1473 418937	0.1400 280084	0.1719 734322	0.1289 800741	0.1616 904167
101N	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1283 881478	0.1223 725525	0.1199 04115	0.1841 773672	0.1400 280084	0.1289 800741	0.1289 800741	0.1212 678125

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101O	0.12403 47346	0.1260 994055	0.1348 399725	0.1635 72164	0.1711 84197	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.1719 734322	0.1289 800741	0.1616 904167
101P	0.12403 47346	0.1260 994055	0.1348 399725	0.1635 72164	0.1283 881478	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.1719 734322	0.1289 800741	0.1616 904167
101Q	0.16537 96461	0.1260 994055	0.1348 399725	0.1635 72164	0.1283 881478	0.1223 725525	0.1199 04115	0.1841 773672	0.1400 280084	0.1289 800741	0.1289 800741	0.1212 678125
101r	0.20672 45576	0.2101 656759	0.1797 8663	0.1635 72164	0.2139 802463	0.2039 542541	0.1998 401917	0.1841 773672	0.1867 040112	0.2149 667902	0.2149 667902	0.2021 130209
101S	0.16537 96461	0.1681 325407	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1998 401917	0.1105 064203	0.1400 280084	0.1719 734322	0.1289 800741	0.1616 904167
101T	0.20672 45576	0.2101 656759	0.2247 332875	0.2044 65205	0.2139 802463	0.2039 542541	0.1998 401917	0.1841 773672	0.1867 040112	0.2149 667902	0.2149 667902	0.2021 130209
101U	0.12403 47346	0.1260 994055	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1998 401917	0.1841 773672	0.1867 040112	0.1289 800741	0.1719 734322	0.1616 904167
101V	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1283 881478	0.1223 725525	0.1199 04115	0.1473 418937	0.1400 280084	0.1719 734322	0.1719 734322	0.1616 904167
101W	0.16537 96461	0.1681 325407	0.1348 399725	0.1635 72164	0.1283 881478	0.1223 725525	0.1199 04115	0.1841 773672	0.1400 280084	0.1289 800741	0.1289 800741	0.1212 678125
101X	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1283 881478	0.1223 725525	0.1199 04115	0.1473 418937	0.1400 280084	0.1289 800741	0.1289 800741	0.1616 904167
101Y	0.16537 96461	0.1681 325407	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1598 721534	0.1105 064203	0.1400 280084	0.1719 734322	0.1719 734322	0.1616 904167
101Z	0.12403 47346	0.1260 994055	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1598 721534	0.1473 418937	0.1400 280084	0.2149 667902	0.1719 734322	0.1212 678125
101AA	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1283 881478	0.2039 542541	0.1998 401917	0.1841 773672	0.1400 280084	0.1289 800741	0.1719 734322	0.1212 678125
101AB	0.20672 45576	0.2101 656759	0.2247 332875	0.2044 65205	0.1711 84197	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.1289 800741	0.2149 667902	0.1616 904167
101AC	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1283 881478	0.1223 725525	0.1199 04115	0.1473 418937	0.1400 280084	0.1289 800741	0.1289 800741	0.1616 904167
101AD	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1711 84197	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.1719 734322	0.1719 734322	0.2021 130209
101AE	0.16537 96461	0.1681 325407	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1598 721534	0.1473 418937	0.1400 280084	0.1719 734322	0.1289 800741	0.1212 678125
101AF	0.16537 96461	0.1681 325407	0.1797 8663	0.1635 72164	0.1711 84197	0.1223 725525	0.1199 04115	0.1841 773672	0.1867 040112	0.1719 734322	0.1719 734322	0.1616 904167
101AG	0.12403 47346	0.1260 994055	0.1348 399725	0.1226 79123	0.1711 84197	0.2039 542541	0.1998 401917	0.1841 773672	0.1867 040112	0.1719 734322	0.1289 800741	0.2021 130209
101AH	0.12403 47346	0.1260 994055	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1598 721534	0.1473 418937	0.1400 280084	0.1719 734322	0.1719 734322	0.1212 678125

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101AI	0.16537 96461	0.1681 325407	0.1797 8663	0.1226 79123	0.1283 881478	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.1289 800741	0.1719 734322	0.2021 130209
101AJ	0.16537 96461	0.1681 325407	0.1797 8663	0.1226 79123	0.1283 881478	0.1631 634033	0.1598 721534	0.1841 773672	0.1867 040112	0.1289 800741	0.1719 734322	0.2021 130209
101AK	0.12403 47346	0.1260 994055	0.1348 399725	0.1226 79123	0.1711 84197	0.1631 634033	0.1598 721534	0.1473 418937	0.1867 040112	0.1289 800741	0.1289 800741	0.1616 904167

Table 3 shows the stages of changing decision data with a different scale on each criterion into normalized values.

e. Building normalized decision matrix weights

At this stage the results of the normalization of the decision matrix are multiplied by the weight of the criteria that have been determined according to the rows and columns as shown in Table 4. After determining the weighted normalization, then we can determine the negative and positive ideal solutions.

$$YA1 = 3 * 0.1240347346$$
$$= 0.37210\ 42038$$

Table 4. Decision Matrix Weight Normalization

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101A	0.3721 042038	0.6725 301627	1.1236 66437	0.6542 886561	0.3851 644433	0.6526 536132	0.9992 009587	0.9208 868359	0.7468 160448	0.6878 937286	0.6878 937286	0.6467 616668
101B	0.6615 185845	0.3782 982165	0.4045 199175	0.6542 886561	0.6847 36788	0.6526 536132	0.3597 123451	0.3315 192609	0.7468 160448	0.6878 937286	0.6878 937286	1.0105 65104
101C	0.6615 185845	0.3782 982165	0.4045 199175	1.0223 26025	1.0699 01231	1.0197 71271	0.9992 009587	0.3315 192609	0.7468 160448	1.0748 33951	1.0748 33951	0.6467 616668
101D	1.0336 22788	1.0508 28379	0.7191 4652	1.0223 26025	0.6847 36788	1.0197 71271	0.6394 886136	0.5893 675749	0.4200 840252	0.6878 937286	0.6878 937286	0.6467 616668
101E	0.3721 042038	0.3782 982165	0.4045 199175	1.0223 26025	0.3851 644433	0.3671 176574	0.6394 886136	0.5893 675749	0.7468 160448	0.3869 402224	0.6878 937286	0.3638 034376
101F	0.6615 185845	1.0508 28379	0.4045 199175	1.0223 26025	0.6847 36788	0.6526 536132	0.6394 886136	0.5893 675749	0.4200 840252	0.3869 402224	0.6878 937286	0.3638 034376
101G	1.0336 22788	1.0508 28379	0.7191 4652	1.0223 26025	0.6847 36788	0.6526 536132	0.6394 886136	0.9208 868359	0.7468 160448	1.0748 33951	1.0748 33951	0.6467 616668
101H	1.0336 22788	1.0508 28379	0.7191 4652	1.0223 26025	0.6847 36788	1.0197 71271	0.9992 009587	0.9208 868359	0.7468 160448	1.0748 33951	0.6878 937286	1.0105 65104
101I	0.6615 185845	0.6725 301627	0.4045 199175	0.3680 37369	0.3851 644433	0.6526 536132	0.6394 886136	0.5893 675749	0.4200 840252	0.3869 402224	0.3869 402224	0.3638 034376
101J	0.6615 185845	0.3782 982165	0.4045 199175	0.3680 37369	0.6847 36788	0.6526 536132	0.6394 886136	0.3315 192609	0.4200 840252	0.3869 402224	0.3869 402224	1.0105 65104
101K	1.0336 22788	1.0508 28379	1.1236 66437	1.0223 26025	1.0699 01231	1.0197 71271	0.9992 009587	0.9208 868359	0.4200 840252	0.6878 937286	1.0748 33951	1.0105 65104

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101L	0.6615185845	0.3782982165	0.4045199175	1.022326025	0.684736788	0.6526536132	0.6394886136	0.9208868359	0.4200840252	0.6878937286	0.3869402224	0.6467616668
101M	0.3721042038	0.3782982165	0.71914652	0.6542886561	1.069901231	0.3671176574	0.6394886136	0.5893675749	0.4200840252	0.6878937286	0.3869402224	0.6467616668
101N	0.6615185845	0.6725301627	0.71914652	0.6542886561	0.3851644433	0.3671176574	0.3597123451	0.9208868359	0.4200840252	0.3869402224	0.3869402224	0.3638034376
101O	0.3721042038	0.3782982165	0.4045199175	0.6542886561	0.684736788	0.6526536132	0.6394886136	0.9208868359	0.7468160448	0.6878937286	0.3869402224	0.6467616668
101P	0.3721042038	0.3782982165	0.4045199175	0.6542886561	0.3851644433	0.6526536132	0.6394886136	0.9208868359	0.7468160448	0.6878937286	0.3869402224	0.6467616668
101Q	0.6615185845	0.3782982165	0.4045199175	0.6542886561	0.3851644433	0.3671176574	0.3597123451	0.9208868359	0.4200840252	0.3869402224	0.3869402224	0.3638034376
101r	1.033622788	1.050828379	0.71914652	0.6542886561	1.069901231	1.019771271	0.9992009587	0.9208868359	0.7468160448	1.074833951	1.074833951	1.010565104
101S	0.6615185845	0.6725301627	0.4045199175	0.368037369	0.684736788	0.6526536132	0.9992009587	0.3315192609	0.4200840252	0.6878937286	0.3869402224	0.6467616668
101T	1.033622788	1.050828379	1.123666437	1.022326025	1.069901231	1.019771271	0.9992009587	0.9208868359	0.7468160448	1.074833951	1.074833951	1.010565104
101U	0.3721042038	0.3782982165	0.4045199175	0.368037369	0.684736788	0.6526536132	0.9992009587	0.9208868359	0.7468160448	0.3869402224	0.6878937286	0.6467616668
101V	0.6615185845	0.6725301627	0.71914652	0.6542886561	0.3851644433	0.3671176574	0.3597123451	0.5893675749	0.4200840252	0.6878937286	0.6878937286	0.6467616668
101W	0.6615185845	0.6725301627	0.4045199175	0.6542886561	0.3851644433	0.3671176574	0.3597123451	0.9208868359	0.4200840252	0.3869402224	0.3869402224	0.3638034376
101X	0.6615185845	0.6725301627	0.71914652	0.6542886561	0.3851644433	0.3671176574	0.3597123451	0.5893675749	0.4200840252	0.3869402224	0.3869402224	0.6467616668
101Y	0.6615185845	0.6725301627	0.4045199175	0.368037369	0.684736788	0.6526536132	0.6394886136	0.3315192609	0.4200840252	0.6878937286	0.6878937286	0.6467616668
101Z	0.3721042038	0.3782982165	0.4045199175	0.368037369	0.684736788	0.6526536132	0.6394886136	0.5893675749	0.4200840252	1.074833951	0.6878937286	0.3638034376
101AA	0.6615185845	0.6725301627	0.71914652	0.6542886561	0.3851644433	1.019771271	0.9992009587	0.9208868359	0.4200840252	0.3869402224	0.6878937286	0.3638034376
101AB	1.033622788	1.050828379	1.123666437	1.022326025	0.684736788	0.6526536132	0.6394886136	0.9208868359	0.7468160448	0.3869402224	1.074833951	0.6467616668
101AC	0.6615185845	0.6725301627	0.71914652	0.6542886561	0.3851644433	0.3671176574	0.3597123451	0.5893675749	0.4200840252	0.3869402224	0.3869402224	0.6467616668
101AD	0.6615185845	0.6725301627	0.71914652	0.6542886561	0.684736788	0.6526536132	0.6394886136	0.9208868359	0.7468160448	0.6878937286	0.6878937286	1.010565104
101AE	0.6615185845	0.6725301627	0.4045199175	0.368037369	0.684736788	0.6526536132	0.6394886136	0.5893675749	0.4200840252	0.6878937286	0.3869402224	0.3638034376

Alternative	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
101AF	0.6615185845	0.6725301627	0.7191 4652	0.6542886561	0.6847 36788	0.3671176574	0.3597123451	0.9208868359	0.7468160448	0.6878937286	0.6878937286	0.6467616668
101AG	0.3721042038	0.3782982165	0.4045199175	0.3680 37369	0.6847 36788	1.0197 71271	0.9992009587	0.9208868359	0.7468160448	0.6878937286	0.3869402224	1.0105 65104
101AH	0.3721042038	0.3782982165	0.4045199175	0.3680 37369	0.6847 36788	0.6526536132	0.6394886136	0.5893675749	0.4200840252	0.6878937286	0.6878937286	0.3638034376
101AI	0.6615185845	0.6725301627	0.7191 4652	0.3680 37369	0.3851644433	0.6526536132	0.6394886136	0.9208868359	0.7468160448	0.3869402224	0.6878937286	1.0105 65104
101AJ	0.6615185845	0.6725301627	0.7191 4652	0.3680 37369	0.3851644433	0.6526536132	0.6394886136	0.9208868359	0.7468160448	0.3869402224	0.6878937286	1.0105 65104
101AK	0.3721042038	0.3782982165	0.4045199175	0.3680 37369	0.6847 36788	0.6526536132	0.6394886136	0.5893675749	0.7468160448	0.3869402224	0.3869402224	0.6467616668

Source: Data processed 2023

Through Table 4, we know the calculation of each criterion's normalized weight; this ensures that the total weight of all criteria is 1 or 100%.

f. Determine the ideal solution matrix and negative ideal solution matrix

In determining this solution matrix, it is done by finding the largest value and the smallest value in each column by looking at the equation. The final results of determining negative and positive ideal solutions can be seen in Table 5 and Table 6.

$A^{+}C1 = 1.033622788$
$A^{-}C1 = 0.3721042038$

Table 5. Positive Ideal Solutions

	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
A^{+}	1.033622788	0.37829 82165	0.40451 99175	0.3680 37369	1.0699 01231	0.36711 76574	0.35971 23451	0.33151 92609	0.42008 40252	1.0748 33951	1.0748 33951	1.0105 65104

Data Source processed, 2023

Table 5 shows the best ideal score for each criterion; the perfect solution or the best alternative in decision-making can be seen in the table.

Table 6. Negative Ideal Solutions

	Criteria											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
A^{-}	0.3721042038	1.0508 28379	1.1236 66437	1.0223 26025	0.38516 44433	1.0197 71271	0.99920 09587	0.92088 68359	0.74681 60448	0.38694 02224	0.38694 02224	0.36380 34376

Data Source processed, 2023

Table 6 describes the worst alternative of all the criteria to be avoided or excluded in the decision-making process.

g. Determine the distance between the values of each alternative with the positive ideal solution matrix and negative ideal matrix.

After determining the negative and positive matrices, then determine the distance between these values using the equation. The results of calculations to determine the distance between positive and negative ideal solution values can be seen in Table 7 and Table 8.

$$DA^{+} = \sqrt{2.96854}$$
$$= 1.7229446$$
$$DA^{-} = \sqrt{2.76895}$$
$$= 0.821308593$$

Table 7 shows the Positive Ideal Solution Matrix, a series of results from calculating weights and criteria to identifying positive ideal solutions for each criterion to get the best ideal score. Table 8 is obtained from the same calculation pattern as Table 7 but at the worst ideal score which must be avoided in the decision-making process. This matrix will evaluate how bad each negative ideal solution alternative is.

Table 7. Positive Ideal Solution Matrix

Positive	Mark
A1	1.7229446
A2	0.9254636958
A3	1.280845175
A4	1.459536802
A5	1.620894953
A6	1.560357689
A7	1.36894063
A8	1.602019078
A9	1.511583924
A10	1.180260265
A11	1.652132405
A12	1.40617921
A13	1.232302929
A14	1.608377599
A15	1.42726495
A16	1.535447185
A17	1.54961807
A18	1.386447581
A19	1.272452574
A20	1.63907674
A21	1.511891651
A22	1.17179875
A23	1.577304219
A24	1.421288993
A25	0.9823388315
A26	1.174850276
A27	1.760200522
A28	1.662942587
A29	1.421288993
A30	1.211476078
A31	1.280975445
A32	1.200092366
A33	1.580471253
A34	1.236930033
A35	1.424683247
A36	1.424683247
A37	1.413418586

Table 8. Negative Ideal Solution Matrix

Negative	Mark
A1	0.8213085933
A2	1.664015082
A3	1.701736981
A4	1.139407732
A5	1.313505341
A6	1.12342164
A7	1.407698853
A8	1.293467525
A9	1.285675996
A10	1.645491843
A11	1.412549669
A12	1.297895736
A13	1.47067878
A14	1.211451333
A15	1.27650709
A16	1.240857268
A17	1.459567389
A18	1.603201607
A19	1.421759781
A20	1.507039324
A21	1.338924762
A22	1.355998059
A23	1.349499791
A24	1.287472218
A25	1.497119521
A26	1.591195697
A27	0.8504615915
A28	1.159647323
A29	1.287472218
A30	1.216271642
A31	1.353986473
A32	1.30836367
A33	1.412862144
A34	1.466041942
A35	1.261603046
A36	1.261603046
A37	1.393357276

Data Source processed, 2023

h. Determine the preference value for each alternative

The final stage of the calculation process using the TOPSIS method is to determine the preference value by dividing the distance between the negative solutions and the difference between the distances between the positive solutions. In Table 9 it can be seen the results and comparison of the TOPSIS and SAW methods. It appears that there is a significant difference in choosing the TOPSIS method in determining the selection of residential repair grants that have been previously studied using the SAW method [1] .

$$VA1 = \frac{0.821308593}{0.821308593 + 1.7229446}$$
$$= 0.1852$$

Table 9. Ranking Results

Alternative	TOPSIS		SAW	
	Preference	rank	Results	ranking
A1	0.1852	37	35,3	36
A2	0.7639	1	44.75	1
A3	0.6408	5	43.05	5
A4	0.378	30	38,25	30
A5	0.398	28	39,15	23
A6	0.3422	30	38,25	32
A7	0.5136	14	38,9	25
A8	0.3934	27	37,4	34
A9	0.4213	25	39,4	22
A10	0.6597	2	44,1	2
A11	0.4201	24	38,2	33
A12	0.4599	16	40,3	14
A13	0.5872	4	42,2	8
A14	0.3612	22	38.65	27
A15	0.4451	17	39,7	21
A16	0.4443	18	38,7	26
A17	0.4704	14	41.15	11
A18	0.5714	8	39.75	20
A19	0.5568	8	42,3	7
A20	0.6597	2	38,25	30
A21	0.4409	14	40	16
A22	0.5723	6	41,4	9
A23	0.4226	13	39,9	19
A24	0.4496	10	40	16
A25	0.7005	1	43.65	3
A26	0.6504	1	43.25	4
A27	0.1902	11	35,25	37
A28	0.3256	10	36.55	35
A29	0.4496	8	40	16
A30	0.4999	6	39	24
A31	0.5295	5	41,2	10
A32	0.5419	4	40,9	12
A33	0.4445	5	40.05	15
A34	0.587	1	42.45	6
A35	0.587	1	38.45	28

A36	0.587	1	38.45	28
A37	0.4939	1	40,9	13

Data Source processed, 2023

Table 9 shows that there are different rankings or priority orders from the TOPSIS and SAW methods. This can happen because of differences in the calculation of alternative rankings and differences in priority. Different ranking of alternatives and emphasis on each criterion leads to inconsistent results showing different weighting and normalization effects in the two methods.

4. Conclusion

In the case of the decision making of beneficiaries of house renovation assistance based on the criteria for the current condition of the house, the more appropriate method depends on the preferences and specific characteristics of the decision maker. However, in this context, the TOPSIS or SAW method may be more suitable than the ELECTRE method. The TOPSIS method is suitable if the decision maker wants to compare alternatives (assistance seekers) based on their proximity to the positive ideal solution and their distance from the negative ideal solution, the TOPSIS method can be a good choice. In this case, the positive ideal solution could represent a desired housing condition (eg, the house is in good condition) and the negative ideal solution could represent a bad housing condition. The TOPSIS method will provide a rating based on the proximity of each house to the desired ideal conditions, with the closest alternative getting the highest rating.

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