

Decision Support System for Selecting the Best Hotel Using the Multi-Objective Optimization Method on the Basis of Simple Ration Analysis (MOOSRA)

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Abstract—Selecting the best hotel is an important decision-making process that requires careful consideration of various criteria. In this study, we use the *Multi-Objective Optimization by Simple Ratio Analysis* (MOOSRA) method to determine the most suitable hotel based on a set of predetermined criteria. The MOOSRA method is a multi-objective optimization technique that uses a simple ratio of the overall favorable and unfavorable criterion scores to avoid negative values and reduce the impact of large variations in criterion values. This study aims to develop a decision support system that helps customers choose the best hotel based on criteria. The MOOSRA method is applied to a decision matrix constructed from hotel attributes, and the overall performance score of each hotel is calculated using a simple ratio formula.

Keywords: DSS; Hotel Selection; MOOSRA Method; Best Hotel

1. INTRODUCTION

Tourism is an important part of Medan's economy. As air traffic increases, interest in changing categories also increases. The hotel has a standard sightseeing area, ideal for group travelers. Therefore, the announcement of the best hotels plays an important role in increasing the number of tourists who choose accommodation according to their needs and preferences [1].

This hotel can be distinguished from the level of hotel size or hotel building and people who choose rooms according to their economic ability and the comfort they are looking for based on the shape of each hotel room. The increasing number of facilities and tourist attractions that can be visited, hotels are one of the places needed as accommodation facilities. Hotels in the city of Medan have also grown very rapidly. The city of Medan provides so many choices of hotels spread across various locations with various hotel classes, rental prices, facilities and services. The diversity of hotels often makes it difficult for tourists to determine a hotel that suits their needs and criteria so that a Decision Support System (DSS) is needed that can help humans determine a hotel with a method [2].

Based on the description of the problem above, a proper choice is needed and the alternatives are evaluated to help determine the best hotel, namely, DSS. Decision Support System (DSS) is a system that contains information technology and artificial intelligence that helps decision making in complex situations and provides more accurate results in a systematic form and a system that helps process data to solve existing problems and get the right decision value [3].

The MOOSRA (*Multi-Objective Optimization on the basis of Ratio Analysis*) method is one of the methods in multi-criteria decision making used to optimize several competing objectives [4]. This method is used to evaluate and select the best alternative based on the ratio of various established criteria. MOOSRA is used for several reasons, namely: multi-objective handling, flexibility, use of ratios, support for complex decisions and increasing objectivity [5][6].

There are previous studies related to the MOOSRA method which is used as a reference point in identifying decision making in order to obtain precise and accurate results. Such as research conducted by Haerudin (2022) regarding the Selection of Mathematics Olympiad Participants Using the MOOSRA Method. The study discussed the Selection of Mathematics Olympiad Participants using the MOOSRA method getting the same results with final scores that are significantly different, the use of the MOOSRA method still makes the alternatives occupy the same ranking position, the difference is only the percentage of the value where the highest value obtained by the MOOSRA method is 25.38454, the method has simple stages. The MOOSRA method based on several previous studies is recognized as an alternative to making decisions that are precise and accurate [7].

In the second study entitled The Process of Research Results conducted by researchers obtained the results of the Recruitment of Non-Civil Servant Government Employees (PPNPN) at the Medan City Land Office Applying the Multi-Objective Optimization Method On the basis of simple Ratio Analysis (MOOSRA) can produce weight values and criteria where using this method can help in determining the results that have been obtained from the study above, that from the highest alternative value based on the criteria that have been set where the alternative {A8} Yuda as a Prospective Non-Civil Servant Government Employee with a result of 0.445 Using the MOOSRA Method by Azhar (2022) this study discusses the Moosra Method simplifying each step with proper consideration,

the results obtained are very accurate based on data and facts in previous research and research that has been carried out now the results obtained are the A1 e-commerce alternative or Lazada is the best e-commerce from other e-commerce with the acquisition [8].

The third study by Ahlan Ismono (2022) entitled Decision Support System for Auditor Selection Using the MOOSRA Method. Based on the results of the research and discussion presented, it can be concluded that the decision support system helps solve problems in auditor selection, by implementing the decision support system the results obtained are more objective and in accordance with the predetermined criteria. The results of the application of the MOOSRA Method obtained the results that A1 was selected as an auditor with a value of 5.60 [9].

For the fourth study by Arya Widana (2023) Decision Support System for Selecting Activity Trainers Extracurricular Using the Moosra Method, in using this method using criteria consisting of experience, achievement, academic, skills, leadership. Based on the results of the design of a decision support system for selecting extracurricular activity trainers using the MOOSRA method that has been built, it can be concluded that the use of this method can accelerate and facilitate the Faculty of Science and Technology Labuhan Batu University in selecting the best extracurricular activity trainers [10].

2. RESEARCH METHODOLOGY

2.1 Research Framework

Figure 1 below is the research framework.

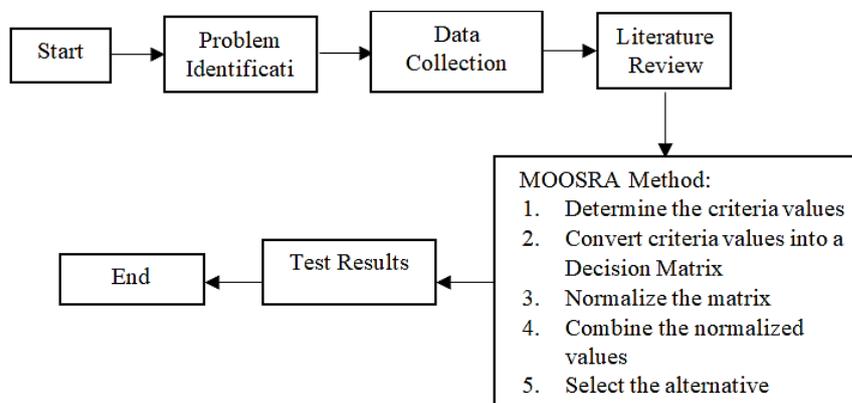


Figure 1. Research Framework

From the stages framework Work on, writer conclude contents of the discussion:

1. Identification of problems
Researchers observe existing situations, processes, or environments to identify signs of problems. This observation may include direct observation, data analysis, or information gathering.
2. Data collection
Researchers collect relevant data and information about the problem at hand. This may involve collecting statistical data, or analyzing documents, references from newspapers and the internet.
3. Literature Study
Researchers review and analyze literature or sources that are relevant and related to a particular research or study topic.
4. Method Implementation
The author implements the MOOSRA method in calculating and determining weights. This method functions to make the decision-making process more effective from each alternative and criteria that have been collected.
5. Test Results
The test result is a result that has been applied, this stage is carried out to find out whether the results obtained are appropriate or not.

2.2 Decision Support System

Decision support systems are information systems that help managers support their decisions. With DSS, managers can solve company problems, both structured and unstructured[11]. The steps involved in decision making include identifying the problem, selecting a model to solve the problem, collecting information, applying the model, evaluating data, and implementing the chosen solution [12][13].

2.3 Hotels

Hotel is a place to stay for tourists. The facilities provided in hotels vary depending on the class or star of the hotel. Hotels can range from simple bed accommodation in small rooms, to luxurious five-star hotels with large rooms

with dressing tables, refrigerators and kitchen facilities, flat-screen televisions, and hot water bathrooms. Hotels evolved from inns and taverns that provided rest and food for travelers [14]. Hotels began to flourish with the increasing ease of long-distance travel along with the development of transportation technology, namely trains and steamships during the Industrial Revolution. Hospitality and tourism are two inseparable industries. Hotels need tourists who visit tourist attractions as prospective guests who stay and provide income for the hotel. If a tourist attraction is famous and crowded with visitors, then the hotels around it will also be visited by many [15][16].

2.4 Multi-Objective Optimization Method on the basis of Simple Ratio Analysis (MOOSRA)

The MOOSRA method is one of the methods in multi-criteria decision making. This method is used to select the best alternative from a number of alternatives based on several predetermined criteria [17]. The basic principle of MOOSRA is to convert the criteria values into simple ratios and then use the ratio to calculate the final score. each alternative [18]. The following are the general steps in the MOOSRA method [19][20]:

1. Determining criteria values, criteria weights, and alternatives
2. Converting criteria values into a decision matrix. All values in each criterion are represented into a decision matrix.

$$x = \begin{bmatrix} x_{11} & x_{12} & x_{1n} \\ x_{21} & x_{22} & x_{2n} \\ x_{m1} & x_{m2} & x_{m_n} \end{bmatrix} \tag{1}$$

3. Matrix normalization. The purpose of matrix normalization is to unite each element of the matrix so that the elements in the matrix have comparable values. Matrix normalization uses the following equation:

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \tag{2}$$

4. Determination of performance score. Determination of performance score using the following equation:

$$y_i = \frac{\sum_{j=1}^g w_j x_{ij}^*}{\sum_{j=g+1}^n w_j} x_{ij}^* \tag{3}$$

$$y_i = \frac{\sum_{j=1}^g x_{ij}^*}{\sum_{j=g+1}^n x_{ij}^*} x_{ij}^* \tag{4}$$

Where g is the attribute to be maximized (benefit), n is the attribute to be minimized (cost), w_j is the weight and x^{*}_{ij} is the matrix normalization.

5. Alternative selection: The selection is determined based on the largest value from the calculation results that have been carried out.

3. RESULTS AND DISCUSSION

3.1 Determination of Criteria

By setting these criteria, the criteria used to select the best-ranked hotels are in accordance with the established regulations. The weight of the criteria data determined in this study is calculated using the *Multi-Objective Optimization Based on Simple Rational Analysis* (MOOSRA) formula presented in Table 1 [21].

Table 1. Criteria Data

Code	Criteria	Weight	Type
C1	Hotel location	0.28	Benefits
C2	Facility	0.15	Benefits
C3	Service	0.10	Benefits
C4	Security	0.06	Benefits
C5	Cleanliness	0.02	Benefits
C6	Room rental rates	0.40	Cost

Furthermore determine the weight value of interest For every criteria like on the Table 2 following.

Table 2. Values Weight Interest Criteria

Scale	Weight Criteria
Very good/Very expensive	1
Good/Expensive	0.7

Scale	Weight Criteria
Enough good/quite expensive	0.5
Not good/Cheap	0.3

3.2 Determination of Alternatives

Data alternative using data hotel sample as many as 5 hotels can seen on table 3 under This:

Table 3. Data Alternative

Code	Alternative
A1	Hotel A
A2	Hotel B
A3	Hotel C
A4	Hotel D
A5	Hotel E
A6	Hotel F
A7	Hotel G
A8	Hotel H

Next is Table 4. that is data table alternative and criteria value hotel.

Table 4. Data Alternative And Hotel Criteria Value

Alternative	C1	C2	C3	C4	C5	C6
A1	Very good	Very good	Good	Good	Very good	Very expensive
A2	Good	Pretty good	Pretty good	Good	Very good	Expensive
A3	Good	Not good	Good	Pretty good	Very good	Quite expensive
A4	Good	Very good	Good	Good	Good	Very expensive
A5	Pretty good	Not good	Good	Very good	Pretty good	Expensive
A6	Pretty good	Good	Not good	Very good	Not good	Expensive
A7	Good	Pretty good	Very good	Pretty good	Good	Cheap
A8	Not good	Very good	Good	Good	Pretty good	Very expensive

Table 5. Data Alternative And Hotel Criteria Value

Alternative	C1	C2	C3	C4	C5	C6
A1	1	1	0.7	0.7	1	1
A2	0.7	0.5	0.5	0.7	1	0.7
A3	0.7	0.3	1	0.5	1	0.5
A4	0.7	1	1	0.7	0.7	1
A5	0.5	0.3	0.7	1	0.5	0.7
A6	0.5	0.7	0.3	1	0.3	0.7
A7	0.7	0.5	1	0.5	0.7	0.3
A8	0.3	0.1	0.7	0.7	0.5	1

3.3 Application of the MOOSRA Method

After the alternative values that have been weighted are produced, the decision-making process is carried out using the method MOOSRA.

1. Creating a matrix normalization

$$R_{ij} = \begin{bmatrix} 1 & 1 & 0.7 & 0.7 & 1 & 1 \\ 0.7 & 0.5 & 0.5 & 0.7 & 1 & 0.7 \\ 0.7 & 0.3 & 1 & 0.5 & 1 & 0.5 \\ 0.7 & 1 & 1 & 0.7 & 0.7 & 1 \\ 0.5 & 0.3 & 0.7 & 1 & 0.5 & 0.7 \\ 0.5 & 0.7 & 0.3 & 1 & 0.3 & 0.7 \\ 0.7 & 0.5 & 1 & 0.5 & 0.7 & 0.3 \\ 0.3 & 1 & 0.7 & 0.7 & 0.5 & 1 \end{bmatrix}$$

2. Matrix normalization

$$C1 = \sqrt{1^2 + 0.7^2 + 0.7^2 + 0.7^2 + 0.5^2 + 0.5^2 + 0.7^2 + 0.3^2} = 3.06$$

$$C1 = \sqrt{3.06} = 1.75$$

$$C1 = 1/1.75 = 0.571$$

$$C1 = 0,7/1.75 = 0.400$$

$$C1 = 0,7/1.75 = 0.400$$

$$C1 = 0,7/1.75 = 0.400$$

$$C1 = 0.5/1.75 = 0.286$$

$$C1 = 0.5/1.75 = 0.286$$

$$C1 = 0.7/1.75 = 0.400$$

$$C1 = 0.3/1.75 = 0.171$$

$$C2 = \sqrt{1^2 + 0.5 + 0.3^2 + 1^2 + 0.3^2 + 0.7^2 + 0.5^2 + 1^2} = 4.33$$

$$C2 = \sqrt{4.33} = 2.08$$

$$C2 = 1/2.08 = 0.481$$

$$C2 = 0.5/2.08 = 0.240$$

$$C2 = 0.3/2.08 = 0.144$$

$$C2 = 1/2.08 = 0.481$$

$$C2 = 0.3/2.08 = 0.144$$

$$C2 = 0.7/2.08 = 0.337$$

$$C2 = 0.5/2.08 = 0.240$$

$$C2 = 1/2.08 = 0.481$$

$$C3 = \sqrt{0.7^2 + 0.5^2 + 1^2 + 1^2 + 0.7^2 + 0.3^2 + 1^2 + 0.7^2} = 4.02$$

$$C3 = \sqrt{4.02} = 2.00$$

$$C3 = 0.7/2.00 = 0.35$$

$$C3 = 0.5/2.00 = 0.25$$

$$C3 = 1/2.00 = 0.50$$

$$C3 = 1/2.00 = 0.50$$

$$C3 = 0.7/2.00 = 0.35$$

$$C3 = 0.3/2.00 = 0.15$$

$$C3 = 1/2.00 = 0.50$$

$$C3 = 0.7/2.00 = 0.35$$

$$C4 = \sqrt{0.7^2 + 0.7^2 + 0.5^2 + 0.7^2 + 1^2 + 1^2 + 0.5^2 + 0.7^2} = 5.67$$

$$C4 = \sqrt{5.67} = 2.38$$

$$C4 = 0.7/2.38 = 0.294$$

$$C4 = 0.7/2.38 = 0.294$$

$$C4 = 0.5/2.38 = 0.210$$

$$C4 = 0.7/2.38 = 0.294$$

$$C4 = 1/2.38 = 0.420$$

$$C4 = 1/2.38 = 0.420$$

$$C4 = 0.5/2.38 = 0.210$$

$$C4 = 0.7/2.38 = 0.294$$

$$C5 = \sqrt{1^2 + 1^2 + 1^2 + 0.7^2 + 0.5^2 + 0.3^2 + 0.7^2 + 0.5^2} = 4.57$$

$$C5 = \sqrt{4.57} = 2.14$$

$$C5 = 1/2.14 = 0.467$$

$$C5 = 1/2.14 = 0.467$$

$$C5 = 1/2.14 = 0.467$$

$$C5 = 0.7/2.14 = 0.327$$

$$C5 = 0.5/2.14 = 0.234$$

$$C5 = 0.3/2.14 = 0.140$$

$$C5 = 0.7/2.14 = 0.327$$

$$C5 = 0.5/2.14 = 0.234$$

$$C6 = \sqrt{1^2 + 0.7^2 + 0.5^2 + 1^2 + 0.7^2 + 0.7^2 + 0.3^2 + 0.1^2} = 3.81$$

$$C6 = \sqrt{3.81} = 1.95$$

$$C6 = 1/1.95 = 0.513$$

$$C6 = 0.7/1.95 = 0.359$$

$$C6 = 0.5/1.95 = 0.256$$

$$C6 = 1/1.95 = 0.513$$

$$C6 = 0.7/1.95 = 0.359$$

$$C6 = 0.7/1.95 = 0.359$$

$$C6 = 0.3/1.95 = 0.154$$

$$C6 = 1/1.95 = 0.513$$

3. After performing calculations from C1 to C5, the following matrix will be formed:

$$X_{ij} = \begin{bmatrix} 0.571 & 0.481 & 0.35 & 0.294 & 0.467 & 0.513 \\ 0.400 & 0.240 & 0.25 & 0.294 & 0.467 & 0.359 \\ 0.400 & 0.144 & 0.50 & 0.210 & 0.467 & 0.256 \\ 0.400 & 0.481 & 0.50 & 0.294 & 0.327 & 0.513 \\ 0.286 & 0.144 & 0.35 & 0.420 & 0.234 & 0.359 \\ 0.286 & 0.337 & 0.15 & 0.420 & 0.140 & 0.359 \\ 0.400 & 0.240 & 0.50 & 0.210 & 0.327 & 0.154 \\ 0.171 & 0.481 & 0.35 & 0.294 & 0.234 & 0.513 \end{bmatrix}$$

4. After the normalization value search is carried out, the next step is to search for the ranking value by multiplying the weight of each alternative value and then separating the benefit from the cost, where the benefit value that has been added up after multiplying the weight is then divided by the cost value after being multiplied by the weight as well .

$$y1 = \frac{(0.571 \cdot 0.28) + (0.481 \cdot 0.15) + (0.35 \cdot 0.10) + (0.294 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.513 \cdot 0.40)} = \frac{0.29301}{0.2052} = 1.428$$

$$y2 = \frac{(0.400 \cdot 0.28) + (0.240 \cdot 0.15) + (0.25 \cdot 0.10) + (0.294 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.359 \cdot 0.40)} = \frac{0.19998}{0.1436} = 1.392$$

$$y3 = \frac{(0.400 \cdot 0.28) + (0.144 \cdot 0.15) + (0.50 \cdot 0.10) + (0.210 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.256 \cdot 0.40)} = \frac{0.20554}{0.1024} = 2.007$$

$$y4 = \frac{(0.400 \cdot 0.28) + (0.481 \cdot 0.15) + (0.50 \cdot 0.10) + (0.294 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.513 \cdot 0.40)} = \frac{0.26113}{0.2052} = 1.273$$

$$y5 = \frac{(0.286 \cdot 0.28) + (0.144 \cdot 0.15) + (0.35 \cdot 0.10) + (0.420 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.359 \cdot 0.40)} = \frac{0.17122}{0.1436} = 1.192$$

$$y6 = \frac{(0.286 \cdot 0.28) + (0.337 \cdot 0.15) + (0.15 \cdot 0.10) + (0.420 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.359 \cdot 0.40)} = \frac{0.18017}{0.1436} = 1.255$$

$$y7 = \frac{(0.400 \cdot 0.28) + (0.240 \cdot 0.15) + (0.50 \cdot 0.10) + (0.210 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.154 \cdot 0.40)} = \frac{0.21994}{0.0616} = 3.57$$

$$y8 = \frac{(0.171 \cdot 0.28) + (0.481 \cdot 0.15) + (0.35 \cdot 0.10) + (0.294 \cdot 0.06) + (0.467 \cdot 0.02)}{(0.513 \cdot 0.40)} = \frac{0.18201}{0.2052} = 0.887$$

5. Next, calculate the value

Table 6. Search for Y Values

Alternative	C1+C2+C3+C4+C5 (Benefits)	C6 (Cost)	Y=Benefit/Cost
A1	0.29301	0.2052	1,428
A2	0.19998	0.1436	1,392
A3	0.20554	0.1024	2.007
A4	0.26113	0.2052	1.273
A5	0.17122	0.1436	1.192
A6	0.18017	0.1436	1.255
A7	0.21994	0.0616	3.57
A8	0.18201	0.2052	0.887

6. Then we will rank the calculation results.

Table 7. Ranking Results

Alternative	Y=Benefit/Cost	Ranking
A1	1,428	3
A2	1,392	4
A3	2.007	2
A4	1.273	5
A5	1.192	6
A6	1.255	7
A7	3.57	1
A8	0.887	8

4. CONCLUSION

In conclusion, this study shows that the MOOSRA method can help in determining the best hotel in Medan City based on several predetermined criteria. From the calculations that have been done, the results obtained are alternative A7 or Hotel G is the best hotel from other hotels with a value of 3.57.

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