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Research Article

Implementation of MOORA and MOORSA Methods in Supporting Computer Lecturer Selection Decisions

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Abstract: Computer science lecturer recruitment is a crucial process for academic institutions, requiring the assessment of multiple criteria to effectively identify the most suitable candidates. This study explores the application of Multi-Objective Optimization based on Ratio Analysis (MOORA) and its variant, Multi-Objective Optimization on the Basis of Ratio Analysis with a Subjective Attitude (MOORSA), in facilitating this complex decision-making process. The MOORA method is used to optimize several criteria related to the selection of computer science lecturers, such as Last Education, Grade Point Average, Academic Potential Test, Interview, Microteaching, Achievement, Professional Organization, Age, and Competence. Meanwhile, the MOORSA method is used to combine the optimization results of the MOORA method with the weights given by the decision maker. To assist the decision-making process, this study develops a Decision Support System (DSS) that uses the MOORA and MOORSA methodologies, as well as other widely known methods such as SAW, AHP, and TOPSIS. The MOORA method, which is known for its precision in handling several criteria, produces the highest score for A1 candidates of 0.651819. Likewise, the MOORSA method, which includes subjective preferences in its assessment, also provides the best A1 candidates with a score of 0.592177. This study increases the transparency and objectivity of the selection process, resulting in the best candidates being selected based on a comprehensive, fair, and academically qualified evaluation framework.

Keywords: Computer Department, Decision Support System, Lecturer Selection, MOORA, MOORSA

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1 Introduction

Lecturers are individuals who have high academic qualifications, such as a doctorate degree, and are responsible for teaching, conducting research, and providing guidance to students. They are the primary teachers at universities or colleges, and they are often involved in curriculum development, evaluation and other academic administration. Lecturers may also be active researchers in their field, disseminating new knowledge through scientific publications and contributing to the development of knowledge in a particular field. Computer Science lecturers are professional educators whose main task is to teach computer science studies, such as programming, data structures and software design. They are specialists in the field of computer science, and generally have at least a master's degree [21].

The need for computer instructors in higher education is rising due to the growing number of institutions that have started computer study programs. STMIK Mulia Darma is one such institution. One of the institutions in North Sumatra is STMIK Mulia Darma, which has three computer study programs open: informatics, information systems, and informatics management. These programs are presently hiring teachers. With semi-structured and unstructured situations, the Decision Support System (DSS) is a system that may solve issues and facilitate communication [7, 9, 20]. When there is uncertainty about the optimal way to make decisions in semi-structured and unstructured scenarios, these technologies are utilized to support decision-making [15, 16, 24]. In the investigation of a support system for applying the Waspas technique to choose beneficiaries of excellent student scholarships. The information technology field is now seeing fast development. Computers are one type of technology that supports information systems. Computers are a crucial tool for transforming data into usable information [2, 4, 6, 10, 17, 27]. It is anticipated that SPK's presence will enable it to aid in issue resolution and serve as a substitute for its users. A decision support system is a tool that helps with semi-structured issue resolution and communication [1, 13, 18, 19]. One technique that can support SPK's decision-making process is Multi-Objective Optimisation by Ratio Analysis (MOORA). Brauers invented the MOORA approach and used it in a multicriteria decision-making process [6]. A problem's alternative can be found with a good degree of selectivity using the MOORA approach. The practice of concurrently optimizing several competing criteria under several restrictions is known as the MOORA approach [5, 11, 12, 14, 26].

Based on earlier research, including that of Ruly Dwi Arista from 2020 on MOORA as a Decision Support System in Measuring Lecturer Performance Levels, which may be utilized as a reference in this study. The results of evaluating this Moore approach yielded M3, or 0.2144, the highest value of the alternative table computations [3]. Subsequently, rank 1 with a value of Yi = 0.464 is obtained in the research done in 2022 by Rizky Rinaldi on the analysis of the decision support system for choosing the top professors at STAI Raudhatul Akmal utilizing the MOORA approach [22]. Syahriani Syam et al.'s 2023 research examines tablet PC selection decision assistance systems utilizing the WASPAS and MOORA methodologies; the best option is shown by Results 0.439 [25]. Decision Support Systems for Determining Teaching Staff Using the MOORA Method research by Daeng Mhd El Faritsi et al. in 2022 produced a priority teacher score of 0.3835 [5]. The finest campus selection decision support system, according to research by Chandra Kusuma et al. in 2020, was designed using multi-objective optimization on the basis of ratio analysis (Moora), with a score of 2.826222296 [8].

2 Research Method

MOORA (Multi Objective Optimisation on the Basis of Ratio) and Entropy in the context of decision support systems (SDM) include research that uses entropy for criteria weighting and MOORA for best alternative recommendations. Entropy is used to ascertain the weight of each criterion, while MOORA is used to determine the position of other options. The results of this research are generally more accurate and on target in helping decision making and easy to implement.

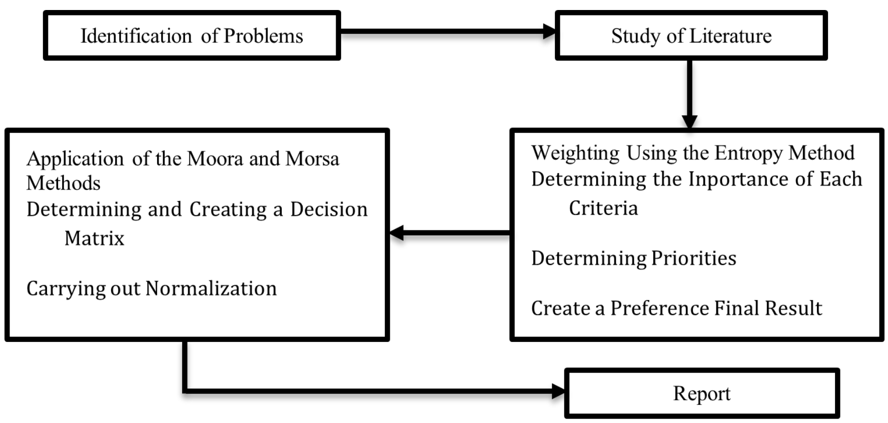

Figure 1: Research stage.

Based on Figure 1, the following are some of the steps in this research:

1. Problem Identification A process to solve a problem and also analyse data first before working on the design.
2. Literature studies This literature study is very important in research so that the author can understand the concept of the Decision Support System in detail and can find out how the MOORA method is calculated.
3. Analysis and Application First, analyse a problem in the selection of permanent lecturers, then determine the weight of the entroy criteria and it will be analysed by the MOORA method.
4. Discussion At this stage, we will apply the results of the research that has been carried out in writing the report.

2.1 Multi Objective Optimisation on the Basis of Ratio Analysis (MOORA) Method

Multi Objective Optimisation On The Basis Of Ratio Analysis, or MOORA, is a technique that is frequently applied in decision-making. This technique is popular since it requires few steps to apply, allowing researchers to answer issues rapidly. The following are the procedures for using the MOORA approach, which is also known as the Multi-Objective Optimization Rationale. It is capable of optimizing many qualities that are in conflict with one another at the same time [23].

2.1.1 Create a decision matrix from X_{11} to X_{mn}.

$$X = \begin{pmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{11} & X_{1n} \\ X_{m1} & X_{m1} & X_{mn} \end{pmatrix} \tag{1}$$

Description: X_{ij} :Decision Matrix of alternative i on criterion j
I : Alternative (Row)
j : Attributes/Criteria (Column)
n : Number of Attributes/Criteria
m : Number of Alternatives/Lines

2.1.2 Normalising the x matrix

$$X_{IJ} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m}(x_j)}} \tag{2}$$

Description: X_{ij} : Decision Matrix on alternative i against criterion j
$X * ij$: Normalisation Matrix for alternative i against criterion j ($j = 1, 2, , n$)
i : Alternative (Row)
j : Attributes/Criteria (Column)
m : Number of Alternatives / Row

2.1.3 Optimisation of attributes

$$y_i = \sum_{j-1}^{g}(x^*_{ij}) - \sum_{j=+1}^{n}(x^*_{ij}) \tag{3}$$

Description: x^*_{ij} :Normalisation Matrix on alternative i against criterion j
j :Attributes/Criteria (Columns)
Wj :Weight on alternative i on criterion j
g :Number of Attributes/Criteria (column) with benefit criteria
$g + 1$:Attributes/Criteria (column) with cost criteria
n :Number of Attributes/Criteria (column)
Yi :Optimum assessment of alternative i

If there are weights in the normalisation, the following formula can be used.

$$y_i = \sum_{j-1}^{g}(w_j x^*_{ij}) - \sum_{j=g+1}^{g}(w_j x^*_{ij}) \tag{4}$$

2.2 MOORSA (Multy–Objective Optimization on the basis Of Simple Ratio Analysis)

Daset al was the first to develop the MOOSRA method which is a method in decision support systems which in general the MOOSRA method has measurements, namely alternatives, attributes or criteria, significant coefficients on each criterion or individual weights and measures a performance related to criteria.

2.2.1 Create a decision matrix from X_{11} to X_{mn}.

$$X = \begin{pmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{11} & X_{1n} \\ X_{m1} & X_{m1} & X_{mn} \end{pmatrix} \quad (5)$$

2.2.2 Normalise the matrix x

$$X^*_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} (x^2_{ij})}} \quad (6)$$

2.2.3 Determine the preference value or final value If the importance of the weights is equal to the formula

$$Y_i = \frac{\sum_{i=1}^{g} (X^{*ij})}{\sum_{j=g+1}^{n} (X^{*ij})} \quad (7)$$

If the importance of weight is different with the formula

$$Y_i = \frac{\sum_{j=1}^{g} (wjX^{*ij})}{\sum_{j=g+1}^{n} (wjX^{*ij})} \quad (8)$$

3 Results

3.1 Analysis of Method Application

Determination of the selection of computer lecturers for STMIK Mulia Darma using the MOORA method and Entropy Weighting by determining the criteria as an assessment material that will be used and produce a ranking of the methods used. The following Table 1 contains the criteria in this assessment.
Criteria Description of Table 1:

- Last Education : Describes the Lecturer Candidate's Last Education
- Grade Point Average : GPA during college
- Academy Potential Test : Results from the Examiner

- Interview : Interview Result
- Microteaching : Result of Microteaching Practicum
- Achievement : Achievements that are owned by prospective lecturers
- Professional Organisation : Activeness of Professional Organisation
- Age : How old is the prospective lecturer
- Competence : Certificate of Competence Held

Table 1: Criteria data and score value

Code	Criteria	Skor	Type
C1	Latest Education	0.25	Benefit
C2	Achievements Index	0.30	Benefit
C3	Test of Academic Potential	0.25	Benefit
C4	Interview	0.20	Benefit
C5	Microteaching	0.20	Benefit
C6	Achievements	0.11	Cost
C7	Professional Organisation	0.20	Cost
C8	Age	0,4	Cost
C9	Competence	0,37	Cost
C9	Competence	0,37	Cost

3.2 Alternative Determination

In the decision support system, it is not only determining the criteria data, but must determine alternative data to make it easier to determine and select permanent lecturer candidates for Stmik Mulia Darma. The following is Alternative Data, a sample data of prospective lecturers who applied at STMIK Mulia Darma as many as 10 in Table 2.

Because Table 2 data uses linguistic type so that in determining the suitability twigs must change in the form of numbers by weighting first as Table 3 and Table 4. Based on the results of Table 3 and Table 4, the scoring can already be determined by determining the suitability branch so that it is obtained in Table 5 which is the result of the following suitability branch data.

3.3 Determination of MOORA Method

The steps in solving a problem and determining a good ranking are as follows:

1. Establish baseline data by creating the Decision matrix below.

$$X = \begin{pmatrix} 3 & 5 & 4 & 5 & 4 & 5 & 5 & 30 & 5 \\ 2 & 4 & 4 & 4 & 4 & 4 & 4 & 35 & 4 \\ 2 & 5 & 5 & 5 & 5 & 5 & 5 & 44 & 5 \\ 2 & 4 & 5 & 4 & 5 & 3 & 3 & 25 & 3 \\ 3 & 5 & 3 & 5 & 5 & 5 & 5 & 33 & 5 \\ 2 & 3 & 4 & 3 & 3 & 5 & 4 & 32 & 4 \\ 2 & 5 & 4 & 5 & 4 & 4 & 5 & 43 & 5 \\ 2 & 4 & 3 & 4 & 4 & 5 & 3 & 33 & 3 \\ 3 & 4 & 4 & 4 & 4 & 3 & 5 & 32 & 5 \\ 2 & 3 & 5 & 3 & 5 & 3 & 5 & 28 & 5 \end{pmatrix}$$

Table 2: Alternative data

Code	Alternatif	C1	C2	C3	C4	C5	C6	C7	C8	C9
A1	Eva Oktavia	S3	Very Good	Good	Very Good	Good	Very Good	Very Good	30	Very Good
A2	Habib Rahmant	S2	Good	Good	Good	Good	Good	Good	35	Good
A3	Harmoko Lubis	S2	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good	44	Very Good
A4	Sastra Wandi Nduru	S2	Good	Very Good	Good	Very Good	Pretty Good	Pretty Good	25	Pretty Good
A5	Sri Handayani	S3	Very Good	Pretty Good	Very Good	Very Good	Very Good	Very Good	33	Very Good
A6	Dwika Assrani	S2	Pretty Good	Good	Pretty Good	Pretty Good	Very Good	Good	32	Good
A7	Hamsiah	S2	Very Good	Good	Very Good	Good	Good	Very Good	43	Very Good
A8	Jonhariono Sihotang	S2	Good	Pretty Good	Good	Good	Very Good	Pretty Good	33	Pretty Good
A9	Mohammad Yusup	S3	Good	Good	Good	Good	Pretty Good	Very Good	32	Very Good
A10	Sari Lanovha	S2	Pretty Good	Very Good	Pretty Good	Very Good	Pretty Good	Very Good	28	Very Good

Table 3: Criteria importance weight score

Scale	Criteria score
Very Good	5
Good	4
Good Enough	3
Poor	2
Very Bad	1

2. Matrix Normalization

$$\mathrm{X}_{\mathrm{scaler}}(i) = \sqrt{\sum_{i,j=0}^{N} \mathbf{x}_j^2}, \tag{9}$$

$$\mathrm{X}_{\mathrm{normed}}(i) = \frac{\mathbf{x}}{\mathrm{X}_{\mathrm{scaler}}(i)}, \tag{10}$$

Table 4: Degree

Degree	Criteria score
S3	3
S2	2
S1	1

Table 5: Conformity rating

Code	C1	C2	C3	C4	C5	C6	C7	C8	C9
A1	3	5	4	5	4	5	5	30	5
A2	2	4	4	4	4	4	4	35	4
A3	2	5	5	5	5	5	5	44	5
A4	2	4	5	4	5	3	3	25	3
A5	3	5	3	5	5	5	5	33	5
A6	2	3	4	3	3	5	4	32	4
A7	2	5	4	5	4	4	5	43	5
A8	2	4	3	4	4	5	3	33	3
A9	3	4	4	4	4	3	5	32	5
A10	2	3	5	3	5	3	5	28	5

where $\mathrm{X}_{\mathrm{scaler}}(i)$ is the scale value for respectedly for the column i, N is the total column in the matrix, x_j is a vector in column i and row j. $\mathrm{X}_{\mathrm{normed}}(i)$ is the normalized matrix respected to the scale $\mathrm{X}_{\mathrm{scaler}}(i)$ and vector x.
After completing the normalisation calculation, the results are described in Table 6:

Table 6: Matrix normalisation results

Code	C1	C2	C3	C4	C5	C6	C7	C8	C9
A1	0.4045	0.3706	0.3049	0.3706	0.2909	0.3686	0.3535	0.2763	0.3535
A2	0.2696	0.2965	0.3049	0.2965	0.2909	0.2948	0.2828	0.3224	0.2828
A3	0.2696	0.3706	0.3812	0.3706	0.3636	0.3686	0.3535	0.4053	0.3535
A4	0.2696	0.2965	0.3812	0.2965	0.3636	0.2211	0.2121	0.2302	0.2121
A5	0.4045	0.3706	0.2287	0.3706	0.3636	0.3686	0.3535	0.3039	0.3535
A6	0.2696	0.2223	0.3049	0.2223	0.2182	0.3686	0.2828	0.2947	0.2828
A7	0.2696	0.2965	0.3049	0.3706	0.2909	0.2948	0.3535	0.3940	0.3535
A8	0.2696	0.2965	0.2287	0.2965	0.2909	0.3686	0.2121	0.3039	0.2121
A9	0.4045	0.2965	0.3049	0.2965	0.2909	0.2211	0.3535	0.2947	0.3535
A10	0.2696	0.2223	0.3812	0.2223	0.3636	0.2211	0.3535	0.2947	0.3535

3. Determining Yi Value and preference result

   $Y1 = ((0.4045 * 0,25) + (0.3706 * 0,30) + (0.3049 * 0,25) + (0.3706 * 20) + (0.2909 * 0,20) + (0.3686 * 0,11) + (0.3535 * 0,20) - (0.2763 * 0,4) + (0.3535 * 0,37)$
   $= 0,651819$
   This process is carried out up to Y1-Y10 with the results in Table 8.
   From the results obtained in Table 8. That Alternative A1 which has the highest value is 0.651819.

3.4 Implementation of the MOORSA Method

As for solving the algorithm that applies the MOOSRA method, there are 4 stages, namely as follows:

(a) Forming the decision matrix The decision matrix can be taken from the decision matrix Xij in the application section of the MOORA method above.

Table 7: Multiplication between normalization and weight (Yi Value)

	Skoring								
	Benefit	Benefit	Benefit	Benefit	Benefit	Cost	Cost	Cost	Cost
	0.25	0.30	0.25	0.20	0.20	0.11	0.20	0,4	0,37
Kode	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
A1	0.4045	0.3706	0.3049	0.3706	0.2909	0.3686	0.3535	0.2763	0.3535
A2	0.2696	0.2965	0.3049	0.2965	0.2909	0.2948	0.2828	0.3224	0.2828
A3	0.2696	0.3706	0.3812	0.3706	0.3636	0.3686	0.3535	0.4053	0.3535
A4	0.2696	0.2965	0.3812	0.2965	0.3636	0.2211	0.2121	0.2302	0.2121
A5	0.4045	0.3706	0.2287	0.3706	0.3636	0.3686	0.3535	0.3039	0.3535
A6	0.2696	0.2223	0.3049	0.2223	0.2182	0.3686	0.2828	0.2947	0.2828
A7	0.2696	0.2965	0.3049	0.3706	0.2909	0.2948	0.3535	0.3940	0.3535
A8	0.2696	0.2965	0.2287	0.2965	0.2909	0.3686	0.2121	0.3039	0.2121
A9	0.4045	0.2965	0.3049	0.2965	0.2909	0.2211	0.3535	0.2947	0.3535
A10	0.2696	0.2223	0.3812	0.2223	0.3636	0.2211	0.3535	0.2947	0.3535

Table 8: Final outcome or preference

Alternative	**Skor**	**Ranking**
A1	0,651819	1
A2	0;530783	7
A3	0,646549	2
A4	0,519680	8
A5	0,646205	3
A6	0,488369	9
A7	0,583038	5
A8	0,480292	10
A9	0,597808	4
A10	0,560598	6

(b) Apply matrix normalization The normalisation of the matrix can be taken from the Normalisation of the matrix in the section on the application of the MOORA method above.

(c) Determining the preference value or final value
$Y1 = ((0.4045*0,25)+(0.3706*0,30)+(0.3049*0,25)+(0.3706*20)+(0.2909*0,20)+(0.3686*0,11)+(0.3535*0,20)/(0.2763*0,4)+(0.3535*0,37) = 0,592177$

This process is carried out up to Y10 so as to get the results in Table 9. From the calculation results of the MOORSA method, the highest value is A1, which is 0.592177

4 Discussion

The application of the Multi-Objective Optimization based on Ratio Analysis (MOORA) and its variant, Multi-Objective Optimization based on Ratio Analysis with a Subjective Attitude (MOORSA), in the selection process of computer science lecturers. The complexity of this selection process, which involves evaluating various criteria such as academic qualifications, teaching experience, and research capabilities, necessitates a robust Decision Support System (DSS). The study demonstrates how both MOORA and MOORSA methods can be implemented to optimize the decision-making process by normalizing and weighting different criteria to derive a comprehensive ranking of candidates. The application of these methods at STMIK Mulia Darma resulted in the consistent identification of the top candidate, demonstrating the methods' reliability and effectiveness in handling multi-criteria decision-making scenarios. The research findings indicate that the highest-ranking candidate, A1, scored 0.651819 using the MOORA method and 0.592177 using the MOORSA method, showing consistency across both methods. This consistency highlights the validity of using these optimization techniques in academic staff selection, ensuring a transparent and objective evaluation process. The study concludes that the MOORA and MOORSA methods provide a structured and fair approach to decision-making, supporting educational institutions in selecting the most qualified candidates. The research underscores the potential of these methods to enhance decision support systems, making them valuable tools for academic and other professional selection processes.

Table 9: Ranking the alternatives

Alternative	Skor	Ranking
A1	0,592177	1
A2	0,487123	7
A3	0,592065	2
A4	0,486473	8
A5	0,587667	3
A6	0,443602	10
A7	0,528102	5
A8	0,450031	9
A9	,0,538902	4
A10	0,501692	6

5 Conclusion

The research concludes that the MOORA and MOORSA methods are suitable for supporting decision making in selecting computer lecturers. They provide a structured approach to evaluate various criteria, which ultimately helps in fair and effective selection of candidates. This study compares the results of using MOORA with combining MOORSA which considers subjective attitudes. Based on the results of the research conducted, it can be concluded that the Computer Lecturer Admission Decision Support System using the MOORA method and the MOOSRA method can produce different ranking value decisions from each formula, but the values are equally real and fair without any cheating. Research based on MOORA method calculations, the highest result was achieved by A1, worth 0.651819, as well as using the MOOSRA method, the highest alternative result was achieved by A1, worth 0.592177.

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