

# Implementation of The AHP And MOORA Methods For Admission Selection of Stmik Lecturers Syaikh Zainuddin NW

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## Abstract

STMIK Syaikh Zainuddin NW Anjani always strives to improve quality or internal quality sustainably as a strategy to be able to compete with other universities. The institution itself realizes that to achieve educational goals and maintain the quality of education and produce good outputs, it requires commitment, strategies, appropriate methods and adequate human resources in the process of achieving it. One way to improve the quality of a university is to select teaching staff or lecturers because the quality of lecturers will greatly determine the high and low quality of a university. Based on the problems that arise, a decision support system is needed that can handle the influence relationship between parameters for the selection process for lecturer acceptance. In this study, the Analytical Hierarchy Process (AHP) method and the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method were used to determine alternative priorities for prospective lecturers. The AHP method is used to determine the weight of the criteria, sub-criteria and scoring data, while the MOORA method is used to calculate the final score and ranking.

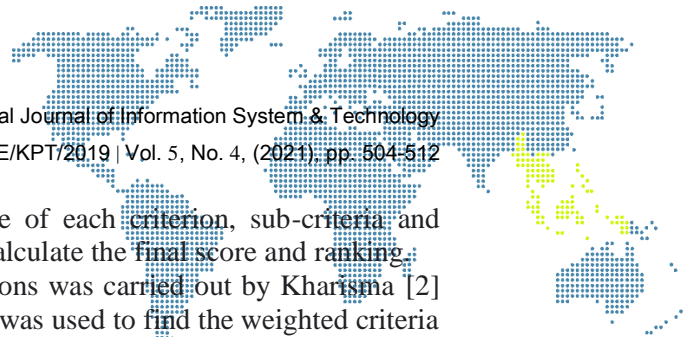
**Keywords:** Decision Support System, AHP, MOORA, Lecture Admission

## 1. Introduction

STMIK Syaikh Zainuddin NW Anjani is a private university that was established on June 12, 2006. In realizing the vision and mission of STMIK SZ NW Anjani always strives to improve the quality or internal quality on an ongoing basis as an institutional strategy to be able to compete with other universities. The institution itself realizes that to achieve educational goals and maintain the quality of education and produce good outputs, it requires commitment, strategies, appropriate methods and adequate human resources in the process of achieving it. One way to improve the quality of a university is to select teaching staff or lecturers because the quality of lecturers will greatly determine the high and low quality of a university. The selection process for lecturer admissions at STMIK SZ NW Anjani is still done conventionally, wherein determining the prospective lecturers to be accepted, the assessment process is based on the results of the tests followed by prospective lecturers with an assessment weight (0-100). Therefore, in this study, the addition of parameters in the selection process for lecturer admissions was carried out, adding parameters to the selection process aimed at getting prospective lecturers according to the needs of the institution.

To carry out the assessment process, a decision support system (DSS) is needed to assist decision-makers in making decisions, as well as to increase the effectiveness of decision making. DSS is usually built to support a solution to a problem or evaluate an opportunity [1].

The methods used in this research are the AHP (Analytical Hierarchy Process) and the MOORA (Multi-Objective Optimization On The Basis Of Ratio Analysis) method. The



AHP method is used to calculate the weight value of each criterion, sub-criteria and scoring data, while the MOORA method is used to calculate the final score and ranking. Research related to the selection of lecturer admissions was carried out by Kharisma [2] using the AHP and SAW methods, the AHP method was used to find the weighted criteria and the SAW method was used to calculate the final score. Different things were done in research conducted by Anike[2] developing a decision support system for sorting outstanding employees using the AHP method, the AHP method was used to calculate the weight of the criteria and also calculate the final score. Another study was conducted by Sinaga [3] a decision support system for the selection of the best employees using the MOORA method, in this study the value of each criterion and sub-criteria have been determined by the decision-maker and the MOORA method is used to calculate the final score and ranking.

The AHP method in this study was chosen because it has advantages in determining the weights and hierarchy of criteria [5] while the MOORA method was chosen because it has a degree of flexibility and ease of understanding in separating the subjective part of an evaluation process into decision weight criteria with several decision-making attributes [6].

## 2. Research Methodology

### 2.1. System Description

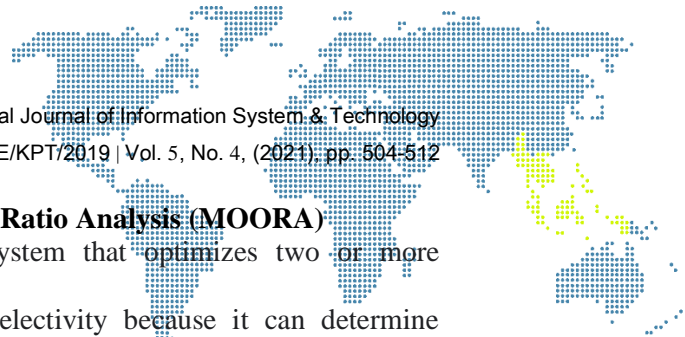
The methods used in this decision support system are AHP and MOORA methods. The AHP method is used to help determine the parameter weights that will be used in calculating the final value to be more effective, besides the AHP method also helps to find qualitative input values (text), namely by scoring the data, in this system the data whose input is in the form of text is the latest educational data[7]. The MOORA method is used to calculate the final score and ranking.

### 2.2. Analytical Hierarchy Process (AHP)

The AHP method is a multi-criteria decision-making model that can help humans think patterns where systemic processes can optimize logical factors, knowledge, emotions and feelings. The AHP method is a way to solve complex or unstructured problems in sub-problems, then arrange them into a hierarchical form [8][9]. The steps for the AHP method [10][11].

- a) Determine the types of criteria
- b) Arrange these criteria in the form of a paired matrix.
- c) Sum the values of each column in the matrix
- d) Dividing each column value by the number of column matrices to obtain Matrix normalization
- e) Calculates the priority value of the criteria with the formula for adding up the row matrix of the results of step 4 and the results are divided by the number of criteria.
- f) Test the consistency of each paired matrix with the formula for each paired matrix element in step 2 multiplied by the priority value of the criteria. The results of each row are added up, then the results with each criterion are  $\lambda_1, \lambda_2, \lambda_3, \dots, \lambda_n$ .
- g) Calculating the Consistency Index (CI) with the formula:  
$$CI = (\lambda_{maks} - n) / (n - 1) \quad (1)$$
- h) Calculate the consistency ratio, with the formula:  
$$CR = CI / RI \quad (2)$$

If  $CR < 0.1$ , then the value of pairwise comparisons in the criteria matrix given is consistency. If  $CR > 0.1$ , then the value of pairwise comparisons in the given criteria matrix is inconsistent. So if there is no consistency, then filling in the values in the paired matrix on the criteria elements must be repeated.
- i) The final result is a global priority as the value used by decision making based on the highest value



### 2.3. Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA)

The MOORA method is a multi-objective system that optimizes two or more conflicting attributes simultaneously [12][13].

The MOORA method has a good level of selectivity because it can determine conflicting criteria, namely benefits and costs [14] [15].

The method for solving the MOORA method can be described as follows:

- a. Determine the criterion value of each alternative
- b. Making a decision matrix

$$X = \begin{bmatrix} x_{i1} & x_{i2} & \dots & x_{in} \\ x_{j1} & x_{j2} & \dots & x_{jn} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \tag{3}$$

Description :

$i = 1, 2, 3, \dots, n$  is the serial number of criteria

$j = 1, 2, 3, \dots, m$  is an alternative sequence number

$X$  = Decision Matrix

- c. normalization matrix

$$X_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{j=1}^m x_{ij}^2}} \tag{4}$$

Description :

$X_{ij}$  = alternative response  $j$  on criterion  $i$

$I = 1, 2, 3, \dots, n$  is the serial number of criteria

$J = 1, 2, 3, \dots, m$  is an alternative sequence number

$X^*_{ij}$  = alternative normalization matrix  $j$  on criterion  $i$

- d. Calculating optimization value

If the criteria for each alternative are not given weight. Then the formula

$$y_j^* = \sum_{j=1}^g W_j X_{ij}^* - \sum_{j=g+1}^n W_j X_{ij}^* \tag{5}$$

Description :

$I = 1, 2, \dots, g$  criteria with status maximized

$J = g+1, g+2, \dots, n$  criteria with maximized/minimized status

$W_j$  = weight to  $j$

$Y_j$  = the value of the assessment has been normalized alternative  $I$  against all criteria

### 3. Result and Discussion

The data that will be tested on the system is the selection data for prospective lecturers at STMIK SZ NW Anjani. The data tested on the system can be seen in table 1.

**Table 1.** Tested Data

Nama	K1	K2				K3
		SK1	SK2	SK3	SK4	
<u>Khaerunnazi</u>	S2 Linear	65	68	93	56	3,55
<u>Muhammad Azmi</u>	S2 Linear	70	70	84	52	3,56
<u>Muhammad Khaerul Faridi</u>	S2 Linear	65	65	84	56	3,68
<u>Yudi Sutaryana</u>	S2 Linear	68	75	90	60	3,81
<u>Zulkamaen</u>	S2 Linear	66	70	88	55	3,57
<u>Muhammad Alfar Habib</u>	S2 Linear	60	65	92	54	3,43
<u>Ahmad Fathoni</u>	S2 Non Linear	68	60	82	60	3,26
<u>Irwan</u>	S2 Non Linear	70	65	80	52	3,39



Description :

K1 : Last education  
 K2 : Test  
 K3 : IPK

SK1: TPA  
 SK2 : English  
 SK3 : Interview  
 SK4 : Microteaching

### 3.1. Calculations Using the AHP Method

The calculation process using the AHP method includes the provision of pairwise comparisons where the comparison value is obtained from the head of the selection committee, the calculation of the weight of the criteria, the calculation of the sub-criteria and the scoring of the text data.

a) Criteria Weight Calculation

The calculation of the pairwise comparison matrix can be seen in table 2.

**Table 2.** Pairwise Comparison Matrix

	Last education	Test	IPK
Last education	1	2	3
Test	0,5	1	2
IPK	0,333	0,5	1
Jumlah	1,833	3,5	6

After performing a pairwise comparison matrix and calculating the number of each column, then normalizing the matrix, and calculating the value of the criteria weights. The results of the normalization of the matrix can be seen in table 3 and the results of the calculation of the value of the criteria weights can be seen 4.

**Table 3.** Matrix Normalization

	Last education	Test	IPK
Last education	0.545455	0.571429	0.5
Test	0.272727	0.285714	0.33
IPK	0.181818	0.142857	0.17

**Table 4.** Results of Calculation of Criteria Weight

	Last education	Test	IPK	weight of the criteria
Last education	0.545455	0.571429	0.5	0,539
Test	0.272727	0.285714	0.33	0,296
IPK	0.181818	0.142857	0.17	0,163

After getting the weight of each criterion, then calculate the maximum lamda

$$\lambda_{maks} = ((1 + 0,5 + 0,333) \times 0,593) + ((2 + 1 + 0,0,5) \times 0,593) + ((3 + 2 + 1) \times 0,163) = 3,009$$

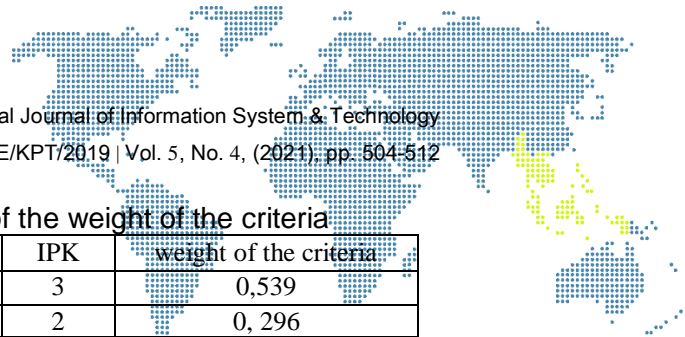
Calculate the Consistency Index (CI) value according to equation 1.

$$CI = \frac{3,009 - 3}{3 - 1} = 0,004$$

Calculate Consistency Ratio (CR) according to equation 2.

$$CR = \frac{0,004}{0,58} = 0,007 < 0,1$$

Then the value of the pairwise comparison matrix is consistent. Because CR Value < 0.1. The results of the calculation of the weight of the criteria using the AHP method as a whole can be seen in table 5.



**Table 5.** The results of the calculation of the weight of the criteria

	Last education	Test	IPK	weight of the criteria
Last education	1	2	3	0,539
Test	0,5	1	2	0,296
IPK	0,333	0,5	1	0,163
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	$\lambda_{maks}$			3,009
	CI			0,004
	RI			0,58
	CR			0,007

b) Calculation of Sub-criteria Weight and Scoring Data text

The calculation of the sub-criteria weights can be seen in table 6 and the scoring text data can be seen in table 7.

**Table 6.** The results of the calculation of the sub-criteria weight

	TPA	English	Interview	Microteaching	sub-criteria weight
TPA	1	2	3	3	0,453
English	0,5	1	2	2	0,261
Interview	0,333	0,5	1	2	0,167
Microteaching	0,333	0,5	0,4	1	0,118
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	$\lambda_{maks}$				4,059
	CI				0,019
	RI				0,9
	CR				0,022

**Table 7.** Scoring Data text

	S2 linear	S2 non linear	Weight
S2 linear	1	2	0.667
S2 non linear	0.5	1	0.333
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	$\lambda_{maks}$	2	
	CI	0	
	CR	0	

### 3.2. Calculation of test criteria and final scores using the MOORA Method

a) Calculating scores for Test criteria

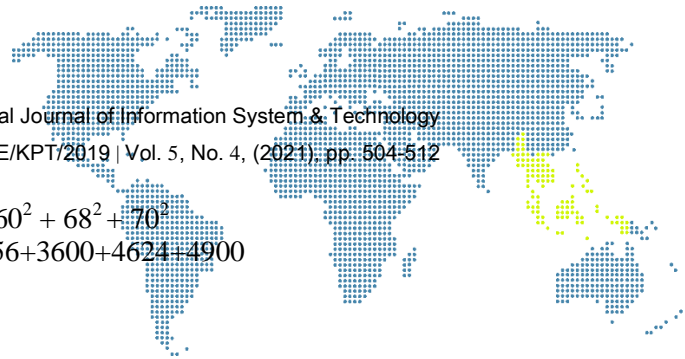
Calculate the value of the test criteria based on the data on each sub-criteria.

Determine the decision matrix X based on the sub-criteria data.

$$X = \begin{pmatrix} 65 & 68 & 93 & 56 \\ 70 & 70 & 84 & 52 \\ 65 & 65 & 84 & 56 \\ 68 & 75 & 90 & 60 \\ 66 & 70 & 88 & 55 \\ 60 & 65 & 92 & 54 \\ 68 & 60 & 82 & 60 \\ 70 & 65 & 80 & 52 \end{pmatrix}$$

Apply the equation 4 to the matrix to normalize it.





$$\begin{aligned}
 SK1 &= \text{square root of } 65^2 + 70^2 + 65^2 + 68^2 + 66^2 + 60^2 + 68^2 + 70^2 \\
 &= \text{square root of } 4225 + 4900 + 4225 + 4624 + 4356 + 3600 + 4624 + 4900 \\
 &= \text{square root of } 35454 = 188,292
 \end{aligned}$$

$$\begin{aligned}
 A_{11} &= 65 / 188,292 = 0.345 \\
 A_{21} &= 70 / 188,292 = 0.372 \\
 A_{31} &= 65 / 188,292 = 0.345 \\
 A_{41} &= 68 / 188,292 = 0.361 \\
 A_{51} &= 66 / 188,292 = 0.351 \\
 A_{61} &= 60 / 188,292 = 0.319 \\
 A_{71} &= 68 / 188,292 = 0.361 \\
 A_{81} &= 70 / 188,292 = 0.372
 \end{aligned}$$

The same steps are carried out to obtain the normalization matrices of SK 2, SK 3 and SK 4. The normalization results of the X matrix are as follows.

$$X_{ij} = \begin{pmatrix} 0.345 & 0.357 & 0.379 & 0.355 \\ 0.372 & 0.367 & 0.342 & 0.330 \\ 0.345 & 0.341 & 0.342 & 0.355 \\ 0.361 & 0.394 & 0.367 & 0.381 \\ 0.351 & 0.367 & 0.359 & 0.349 \\ 0.319 & 0.341 & 0.375 & 0.343 \\ 0.361 & 0.315 & 0.334 & 0.381 \\ 0.372 & 0.341 & 0.326 & 0.330 \end{pmatrix}$$

Calculating the value of the criteria based on the normalization of the Matrix based on equation 5.

$$Y_1 = (0,345 * 0,453) + (0,341 * 0,261) + (0,342 * 0,167) + (0,355 * 0,118) = \mathbf{0,339}$$

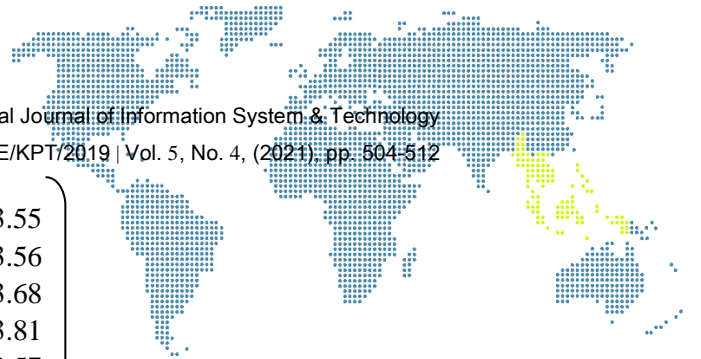
In the same way, count to Y8, so that the results for the test criteria values for each alternative are obtained in table 8.

**Table 8.** Value of test criteria

Alternative	Test Criteria
A1	0.339
A2	0.344
A3	0.329
A4	0.355
A5	0.339
A6	0.321
A7	0.332
A8	0.335

b) Calculating Final Score and Ranking

Determine the decision matrix based on the alternative values on each of the criteria used in the selection of lecturer admissions.



$$X = \begin{pmatrix} 0.667 & 0.339 & 3.55 \\ 0.667 & 0.344 & 3.56 \\ 0.667 & 0.329 & 3.68 \\ 0.667 & 0.355 & 3.81 \\ 0.667 & 0.339 & 3.57 \\ 0.667 & 0.321 & 3.43 \\ 0.333 & 0.332 & 3.26 \\ 0.333 & 0.335 & 3.39 \end{pmatrix}$$

Normalize the decision matrix based on equation 4. The results of the normalization of the decision matrix are as follows.

$$X_{ij} = \begin{pmatrix} 0.392 & 0.355 & 0.355 \\ 0.392 & 0.361 & 0.356 \\ 0.392 & 0.345 & 0.368 \\ 0.392 & 0.372 & 0.381 \\ 0.392 & 0.356 & 0.357 \\ 0.392 & 0.337 & 0.343 \\ 0.196 & 0.349 & 0.326 \\ 0.196 & 0.352 & 0.339 \end{pmatrix}$$

The next step is to calculate the final value based on equation 5. The results of the final value calculation can be seen in table 9 and the ranking results can be seen in table 10.

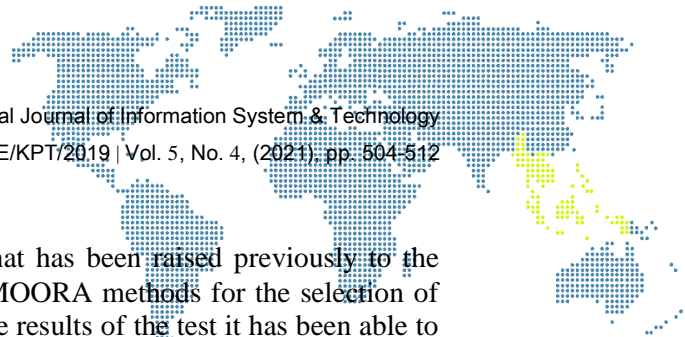
**Table 9. Final Value**

Alternative	Final score
A1	0.375
A2	0.377
A3	0.374
A4	0.385
A5	0.376
A6	0.368
A7	0.263
A8	0.266

**Table 10. Ranking Results**

Alternative	Final score	Rangking
A4	0.385	1
A2	0.377	2
A5	0.376	3
A1	0.375	4
A3	0.374	5
A6	0.368	6
A8	0.266	7
A7	0.263	8

Based on the results of the calculation of the selection of lecturers using the AHP and MOORA methods, the 4th alternative (A4) has the highest value compared to other alternatives.



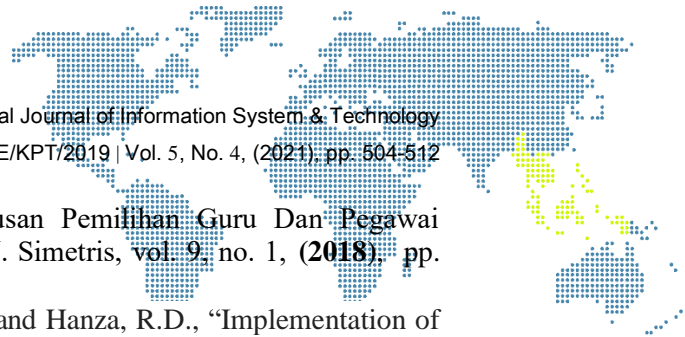
#### 4. Conclusion

From the description of the entire description that has been raised previously to the discussion of the implementation of the AHP and MOORA methods for the selection of lecturer admissions, it can be concluded that from the results of the test it has been able to run correctly so that this system can be used by the chairman of the selection committee for acceptance of lecturers as a basis for making decisions in determining prospective lecturers. which will be accepted.

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