# A Decision Support System of Scholarship Grantee Selection Using Moora

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ABSTRACT

Scholarships are awards from an institution or an individual to someone for educational purposes. Scholarships can be given free or on conditions that prospective scholarship grantee must-have. The scholarship grantee selection process is usually with several criteria in order to get grantee who can be declared elected as scholarship grantee. The use of several criteria in the selection process requires more analysis to determine the scholarship grantee. Moora (Multi-Objective Optimization on The Base of Ratio Analysis) is one of the methods of decision support systems that can be used to assist decision-makers in making decisions. This study takes scholarship acceptance criteria as a parameter then each parameter is given a weight based on the priority of each parameter. The results of this study are to get an optimization value of each alternative then after ranking, it can be seen the ranking of scholarship grantee.



## I. Introduction

Scholarships are awards given by money or education. Scholarships can be given free or on condition [1]. Scholarship sources can be from the government, private institutions, embassies, educational institutions, or other sources. Government Regulation Number 48 of 2008 concerning education regulations, article 27 paragraph (1), government and local government regulations in accordance with their authority to provide educational assistance or scholarships to students who are parents/guardians who do not support to finance their education. Article 27 paragraph (2), which regulates the government and regional government in accordance with their authority to provide educational assistance for students who have achievements. With this goal, certain conditions such as the GPA, number of family members, etc. can be given [2], [3].

The process of receiving a scholarship if using one criterion such as a report card or GPA is not a problem to determine the eligibility of a scholarship grantee. If the selection process uses many criteria, it becomes more difficult in making decisions so more analysis is needed to determine the eligibility of grantee scholarships. To help the selection process, a decision support system is applied. One method that can be used is the Multi-Objective Optimization method in The Base of Ratio Analysis (Moora). This scholarship acceptance selection research aims to make the selection process easier so that proper scholarship grantee will be obtained with precise and more accurate results in accordance with specified criteria.

## II. Research Methodology

### *A. Decision Support System*

Decision Support System (DSS) as an interactive computer-based information system that has the ability to solve semi-structured and unstructured problems for decision making [4], [5]. DSS is needed to avoid inaccurate selection results. Application of DSS can avoid subjectivity in making decisions [6].

*B. MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) Method*

The steps in using the Moora method are [7], [8]:

1. Make a decision matrix.

$$\begin{bmatrix} X11 & X12 & \dots & X1n \\ X21 & X22 & \dots & X2n \\ \dots & \dots & \dots & \dots \\ Xm1 & Xm2 & \dots & Xmn \end{bmatrix} \quad (1)$$

2. Make a normalization matrix.

$$X^{*}ij = \frac{Xij}{\sqrt{\sum_{j=1}^{m} Xij^{2}}} \quad (2)$$

3. Create a weighted normalization matrix / optimization value

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

$$y_i = \sum_{j=1}^{g} W_j X^{*}_{ij} - \sum_{j=g+1}^{n} W_j X^{*}_{ij} \quad (4)$$

4. Create reference values.

The value $y_i$ can be positive or negative depending on the maximum total value in the decision matrix. The highest $y_i$ value is the best alternative while the lowest $y_i$ value is the worst alternative.

## III. Result and Discussion

In this study a decision support system was made for the selection of scholarship receipts using the Moora method. The process using the Moora method requires criteria that affect the participant's assessment [8]. The criteria used in this study are the number of family members, GPA, number of motorcycles, number of cars, parent's salary, average electricity payment in one month.

*A. Research Criteria*

The criteria used in this study are the number of family members, GPA, number of motorcycles, number of cars, parent's salary, average electricity payment in one month. Each of these criteria is given a weight value to determine the priority level of each criterion used. Weights and types for each criterion are used as in Table 1.

*Table 1 Criteria weight*

| Criteria | Variable | Type | Criteria Weight |
|---|---|---|---|
| Number of family members | C1 | Benefit | 20 |
| GPA | C2 | Benefit | 15 |
| Number of motorcycles | C3 | Cost | 15 |
| Number of cars | C4 | Cost | 15 |
| Parent's salary | C5 | Cost | 20 |
| Average electricity payment | C6 | Cost | 15 |

*B. Fuzzy Determination*

Fuzzy logic is usually used in decision support systems or to provide a recommendation because fuzzy values are not only binary logic (0 and 1). Fuzzy values can be expanded so that fuzzy values can be with 0-1 intervals. [9]. The values of the Fuzzy numbers used in this study are shown in Table 2.

Table 2 *Fuzzy Value*

| Grading rate | Value |
|---|---|
| Strongly agree | 6 |
| Agree | 5 |
| Little agree | 4 |
| Little disagree | 3 |
| Disagree | 2 |
| Strongly disagree | 1 |

*C. Criteria for Number of Family Members (C1)*

The number of family members is one of the criteria in this study. Fuzzy value of the criteria for the number of family members (C1) are shown in Table 3.

Table 3 *Fuzzy* value C1

| Number | Value |
|---|---|
| >=9 | 6 |
| 7-8 | 5 |
| 5-6 | 4 |
| 3-4 | 3 |
| 2 | 2 |
| 1 | 1 |

*D. Criteria for GPA (C2)*

GPA is one of the criteria in this study. Fuzzy value of the GPA criteria (C2) are shown in Table 4.

Table 4 Fuzzy *value* C2

| GPA | Value |
|---|---|
| 3.51 – 4.00 | 6 |
| 3.01 – 3.50 | 5 |
| 2.51 – 3.00 | 4 |
| 2.01 – 2.5 | 6 |
| 1.01 – 2.00 | 2 |
| 0.00 – 1.00 | 1 |

*E. Criteria for Number of Motorcycles (C3)*

The number of motorcycles is one of the criteria in this study. Fuzzy value of the number of motorcycles criteria (C3) is shown in Table 5.

Table 5 Fuzzy value C3

| Number | Value |
|---|---|
| 0 – 1 | 6 |
| 2 – 3 | 5 |
| 4 – 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| >= 8 | 1 |

*F. Criteria for number of cars (C4)*

The number of cars is one of the criteria in this study. Fuzzy value of the number of motorcycles criteria (C4) is shown in Table 6.

Table 6 Fuzzy value C4

| Number | Value |
|---|---|
| 0 | 6 |
| 1 | 5 |
| 2 | 4 |
| 3 | 3 |
| 4 | 2 |
| >=5 | 1 |

*G. Criteria for parent's salary (C5)*

Parent's salary is one of the criteria in this study. Fuzzy value from parent's salary criteria (C5) is shown in Table 7.

Table 7 Fuzzy value C5

| Number | Value |
|---|---|
| 0 – 999.999 | 6 |
| 1.000.000 – 1.999.999 | 5 |
| 2.000.000 – 2.999.999 | 4 |
| 3.000.000 – 3.999.999 | 3 |
| 4.000.000 – 4.999.999 | 2 |
| >= 5.000.000 | 1 |

*H. Criteria for electricity payment every month (C6)*

Electricity payment every month is one of the criteria in this study. Fuzzy value from the criteria for the amount of electricity payment (C6) are shown in Table 8.

Table 8 Fuzzy value C6

| Number | Value |
|---|---|
| 0 – 24.999 | 6 |
| 25.000 – 49.999 | 5 |
| 50.000 – 99.999 | 4 |
| 100.000 – 199.000 | 3 |
| 200.000 – 299.000 | 2 |
| >= 300.000 | 1 |

The data in this study were obtained from forms filled out by respondents as many as 107 students, but the amount of data presented in this study were 10 respondents or 10 alternatives. Preliminary research data are shown in Table 9. From the preliminary data then given Fuzzy value on each criterion are shown in Table 10.

Table 9 *Preliminary data*

| A | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| A1 | 3 | 3.2 | 1 | 0 | Rp 0 - Rp 999.999 | Rp 0 - Rp 24.999 |
| A2 | 4 | 3.1 | 2 | 0 | Rp 0 - Rp 999.999 | Rp 25.000 - Rp 49.999 |
| A3 | 5 | 3.1 | 1 | 0 | Rp 1.000.000 - Rp 1.999.999 | Rp 25.000 - Rp 49.999 |
| A4 | 4 | 3.3 | 1 | 0 | Rp 0 - Rp 999.999 | Rp 0 - Rp 24.999 |
| A5 | 6 | 3.4 | 1 | 0 | Rp 0 - Rp 999.999 | Rp 50.000 - Rp 99.999 |
| A6 | 4 | 3.8 | 2 | 0 | Rp 0 - Rp 999.999 | Rp 25.000 - Rp 49.999 |
| A7 | 9 | 3.7 | 1 | 0 | Rp 4.000.000 - Rp 5.000.000 | Rp 100.000 - Rp 200.000 |
| A8 | 5 | 3.2 | 4 | 0 | Rp 0 - Rp 999.999 | Rp 25.000 - Rp 49.999 |
| A9 | 6 | 3.9 | 2 | 0 | Rp 1.000.000 - Rp 1.999.999 | Rp 25.000 - Rp 49.999 |
| A10 | 5 | 3.2 | 2 | 1 | Rp 2.000.000 - Rp 2.999.999 | Rp 50.000 - Rp 99.999 |

Table 10 *Fuzzy value* for *each criterion*

| A | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| A1 | 3 | 5 | 6 | 6 | 6 | 6 |
| A2 | 3 | 5 | 5 | 6 | 6 | 5 |
| A3 | 4 | 5 | 6 | 6 | 5 | 5 |
| A4 | 3 | 5 | 6 | 6 | 6 | 6 |
| A5 | 4 | 5 | 6 | 6 | 6 | 4 |
| A6 | 3 | 6 | 5 | 6 | 6 | 5 |
| A7 | 6 | 6 | 6 | 6 | 2 | 3 |
| A8 | 4 | 5 | 4 | 6 | 6 | 5 |
| A9 | 4 | 6 | 5 | 6 | 5 | 5 |
| A10 | 4 | 5 | 5 | 5 | 4 | 4 |

*I. Normalization*

The next step is to create a normalization matrix from the fuzzy value matrix of each criterion. The normalization matrix is shown in Table 11.

Table 11 normalization matrix

| A | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| A1 | 0.73000 | 1.48610 | 2.09246 | 1.92704 | 2.12872 | 2.33353 |
| A2 | 0.73000 | 1.48610 | 1.45310 | 1.92704 | 2.12872 | 1.62051 |
| A3 | 1.29777 | 1.48610 | 2.09246 | 1.92704 | 1.47828 | 1.62051 |
| A4 | 0.73000 | 1.48610 | 2.09246 | 1.92704 | 2.12872 | 2.33353 |
| A5 | 1.29777 | 1.48610 | 2.09246 | 1.92704 | 2.12872 | 1.03713 |
| A6 | 0.73000 | 2.13998 | 1.45310 | 1.92704 | 2.12872 | 1.62051 |
| A7 | 2.91999 | 2.13998 | 2.09246 | 1.92704 | 0.23652 | 0.58338 |
| A8 | 1.29777 | 1.48610 | 0.92998 | 1.92704 | 2.12872 | 1.62051 |
| A9 | 1.29777 | 2.13998 | 1.45310 | 1.92704 | 1.47828 | 1.62051 |
| A10 | 1.29777 | 1.48610 | 1.45310 | 1.33822 | 0.94610 | 1.03713 |

Optimization values are calculated based on alternatives. Each weighting criterion has been given so that the optimization value is calculated by multiplying the value of the attribute by the weight value. The results can be seen in Table 12.

Table 12 Optimization values

| Alternative | Total |
|---|---|
| A1 | 174.7613 |
| A2 | 154.4755 |
| A3 | 162.4125 |
| A4 | 174.7613 |
| A5 | 166.6706 |
| A6 | 164.2837 |
| A7 | 164.2730 |
| A8 | 157.9842 |
| A9 | 162.6303 |
| A10 | 124.5955 |

*J. Ranking*

After the optimization value is obtained, a ranking is made based on the results of the optimization value obtained for each criterion. The ranking results are shown in Table 13.

Table 13 Ranking

| Ranking | Alternative | Total |
|---|---|---|
| 1 | A1 | 174.761 |
| 2 | A4 | 174.761 |
| 3 | A5 | 166.671 |
| 4 | A6 | 164.284 |
| 5 | A7 | 164.273 |
| 6 | A9 | 162.630 |
| 7 | A3 | 162.413 |
| 8 | A8 | 157.984 |
| 9 | A2 | 154.475 |
| 10 | A10 | 124.595 |

## IV. Conclusions

Based on the results of the study, the conclusions are:

1. Decision support systems using the Moora method can help the decision-making process using many criteria. The selection results become more effective and can reduce errors in the selection process.
2. The decision support system using the Moora method can help the selection process for scholarship acceptance. From the calculation results, it is found that A1 and A4 get the same optimization values and are ranked 1 and 2 with a value of 174,761 while ranking 10 with a value of 124,595 by A10.

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