Application of Fuzzy Multy Attribute Decision-Making Method in Decision-Making System for Determining The Provision of Achievement Scholarship in SMPN 1 Simpati

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Abstract. This study aims to predict students who are entitled to receive scholarships, the results of this study can be used to accept decisions for scholarship recipients by looking at the report cards, the method used in this study uses the FMADM method, in predicting the results obtained, receiving scholarships by looking at several suggestions such as average grades, parents' income, siblings, parents' answers. The results of FMADM calculations have actual taking values, so these values can be used to make decisions as to who is eligible to receive a scholarship.

1. Introduction
In determining the acceptance of scholarships in general, he has used computer assistance, but his use has not been optimal. This results in ineffective scholarship data processing, especially in terms of time and the number of iterations of the process that can actually be streamlined. Therefore, it is necessary to have a system that supports the process of determining scholarship recipients, to shorten the selection time and improve the quality of decisions in determining scholarship recipients.

The selection process as to who is entitled to receive scholarships at SMPN 1 SIMPATI is still an obstacle, especially in the decision-making system that is less effective and efficient. This is because there is no objective method and a good computer system to decide quickly based on existing data who is entitled to receive the scholarship.

Many schools usually rely on informal methods of solving problems. Belief in tradition causes the parties to take the same decision as to the previous decision on the same problem or opportunity, ask for advice from the authorities and make decisions based on the advice of an expert or someone of a higher level so that the results of the decision have an impact on the scholarship recipients especially students who excel or are unable to cause inequality and social inequality.
2. Methods

2.1. Fuzzy Multiple Attribute Decision Making (FMADM)

Fuzzy Multiple Attribute Decision Making (FMADM) is a method used to get more optimal alternatives from several choices by having certain criteria. The most important point of FMADM is to find out the weight value for each attribute, then proceed with the ranking process which will choose several alternatives that have been given. There are 3 approaches to get the value of attribute weights, namely the subjective approach, the objective approach, and the integrated approach between subjective and objective. Each approach has weaknesses and strengths. In the subjective approach, the weight value is determined based on the subjectivity of the decision-maker, so that the factors in the alternative ranking process can be determined freely. And in the process of an objective approach, the weight value is mathematically calculated so heed the subjectivity of the commission decision makers [1].

The FMADM method is a method that can be used to determine which high schools will be visited and carry out promotions to introduce universities. The SAW method is part of the FMADM method used by Khasanah, Permanasari, and Kusumawardani in their research to choose the primary choice in secondary schools. The results show a high degree of accuracy of around 90% compared to reality [2].

In a decision support system, the method (FMADM) is very often used to find alternatives with certain criteria. The most important point of the FMADM method is to determine the weight value for each attribute, then proceed to rank each alternative. In essence, there are three approaches to get the value of attribute weights, namely the subjective approach, the objective approach and the combination of subjective and objective approaches. In the subjective approach stage, the weight value is obtained based on the decision maker’s preference so that several factors in the alternative ranking process can be freely determined. Whereas in an objective approach, the weight value is calculated mathematically not involving decision makers [3].

2.2. Interest Rating and Criteria of Criteria Match

a. Rating Interests

| Criteria C | C1 | C2 | C3 | C4 |
|------------|----|----|----|----|
| Match rating | ST | ST | C  | C  |

b. Rule Match

| The student (sample) | Rating Match |
|----------------------|--------------|
|                      | C1 | C2 | C3 | C4 |
| Student-1            | B  | SK | B  | B  |
| Student-2            | B  | B  | SB | SB |
| Student-3            | SB | C  | K  | K  |
| Student-9            | SB | B  | B  | B  |
| Student-10           | SB | SK | K  | SK |
2.3. Fuzzy Multiple Attribute Decision-Making analysis

FMADM is one method that can help decision makers in making decisions on several alternative objects that must be taken through several criteria. Alternative decisions from criteria to criteria that contain uncertainty. Usually, the judgments given by decision-makers are carried out qualitatively and represented linguistically. Then the values of \( y, q, z \) are calculated by the equation:

\[
y_1 \left( \frac{1}{k} \sum_{t=1}^{k} (0_{ik} A_i) \right)
\]

(1)

\[
Q_1 \left( \frac{1}{k} \sum_{t=1}^{k} (P_{ik} B_i) \right)
\]

(2)

\[
Z_1 \left( \frac{1}{k} \sum_{t=1}^{k} (Q_{ik} C_i) \right)
\]

(3)

\[i = a, b, c, ..., n\]

(4)

In Fuzzy Multiple Attribute Decision-Making (FMADM). The first thing to do is to determine alternative decisions. The alternatives that will be produced are:

a. Linguistic variables that present the importance weight a for each criterion, are: T (importance) \( W = (SR, R, C, T, ST) \) with SR = Very Low, R = Low, C = Enough, T = High, ST = Very High, each of which is represented by a triangular fuzzy number as follows:

\[
SR = (0, 0, 0.25)
\]

\[
R = (0, 0.25, 0.5)
\]

\[
C = (0.25, 0.5, 0.75)
\]

\[
T = (0.5, 0.75, 1)
\]

\[
ST = (0.75, 1, 1)
\]

b. Degree of the suitability of the decision with the decision criteria are: T (compatibility) \( S = SK, K, C, B, SB \) with SK = Very Less, K = Less, C = Enough, B = Good, and SB = Very Good, each of which is represented by the fuzzy triangle numbers as follows[6]:

\[
SK = (0, 0, 0.25)
\]

\[
K = (0, 0.25, 0.5)
\]

\[
C = (0.25, 0.5, 0.75)
\]

\[
B = (0.5, 0.75, 1)
\]

\[
SB = (0.75, 1, 1)
\]

c. A hierarchical process is a form of model that provides opportunities for individuals or groups to discuss ideas and propose problems by making their own assumptions and obtaining the desired problem-solving. In assigning numerical weights, this study proposes the scale preference by the Saaty Scale. [4]

Hierarchy a structure can be seen in the figure 1.

d. Average report cards

The average report card can be seen in table 3.

e. Criteria for Total Parent Income

The criteria for total parent income can be seen in table 4.

f. Criteria of Number of Siblings

The criteria for total parent income can be seen in table 5.
Figure 1. Determination of scholarship

Table 3. Semester Criteria Weight

| No | Average Value | Value |
|----|---------------|-------|
| 1. | Value ≤ 60    | 0     |
| 2. | 60 – 65       | 0.25  |
| 3. | 65 – 70       | 0.50  |
| 4. | 70 – 75       | 0.75  |
|    | Average ≥ 7.50| 1     |

Table 4. Weight Criteria for Total Parent Income

| Parent Income | Value |
|---------------|-------|
| × ≥ Rp 4.000.000 | 0     |
| Rp 3.000.000 ≤ × ≤ Rp 4.000.000 | 0.25  |
| Rp 2.000.000 ≤ × ≤ Rp 3.000.000 | 0.5   |
| Rp 1.000.000 ≤ × ≤ Rp 2.000.000 | 0.75  |
| × ≤ Rp 1.000.000 | 1     |

Table 5. Weight of Criteria Siblings

| Siblings | Value |
|----------|-------|
| 1        | 0     |
| 2        | 0.25  |
| 3        | 0.5   |
| 4        | 0.75  |
| ≥ 5      | 1     |

2.4. Fuzzy Logic
Part of Artificial Intelligence, which is a discussion that can make a computer capable of proving human intelligence so that it is expected to be able to do things done by humans requiring artificial intelligence. In other words, fuzzy logic has a function to "integrate" human intelligence to be able to do something and implement it into devices, for example, robots, vehicles, household appliances, and others.[5].
2.5. Research Phase
The research phase to be carried out is as follows. By the needs in this study, the research steps carried out are as follows:

1. Determine several criteria and weight values for each criterion, for each student who will receive a scholarship.
2. Make variables in the form of fuzzy numbers.
3. Make a list of students who will receive scholarships based on criteria.
4. Calculate the average grade of students.
5. Calculating the income of parents under Rp. 4,000,000 will be included in the category.
6. How many brothers and sisters do students have?
7. Calculate how much the dependents of parents in making a living.

2.6. Decision Support System (DSS)
According to Keen, you Scan Morton: "Decision Support Systems are the merging of individual intelligence resources with the ability of components to improve decision quality. Decision Support Systems are also computer-based information for management decision-making that resolves semi-structural problems.

From the explanation above, it can be interpreted that the decision support system is not a decision-making tool, but a system that helps in decision making by completing information from data that has been processed correctly and used to make decisions about problems more quickly and accurately. So this system is not intended to replace decision making in the decision making process [6].

Decision Support System is a system that has the ability to provide communication skills for problems with semi-structured and unstructured conditions. This system is used to assist in decision making in semi-structured and unstructured situations, therefore no one will know exactly how the decision process should be made [7].

3. Results and Discussion
The output generated from this study is a single alternative that has the highest value compared to other alternative values. In this study, the results are taken from the highest alternative to the lowest alternative. The final results released by the program will come from the value of each criterion because each criterion has a different value. The alternative order that will be displayed starts from the highest alternative to the lowest alternative, the alternative in question is the student.

3.1. Fuzzy Match Index For Each Alternative
By substituting a fuzzy equatorial number into each linguistic variable a fuzzy match value is obtained. Can be seen in Table 6.

3.2. Integral Total Value of Each Alternative
By substituting a fuzzy match index, a total integral value will be obtained for optimal alternative selection. Can be seen in Table 7.

3.3. Decision Analysis Results
From the results of the decision analysis, it was found that each alternative scholarship had a weight value. Among them: From the results of the analysis, students who have a weight value \( \geq 0.75 \) will be entitled to receive scholarships, and students who have a weight value \( \geq 0.60 \)
Table 6. Match Indices for each alternative

| The student (sample) | Rating Match | Match Fuzzy Value |
|----------------------|--------------|-------------------|
|                      | C1  C2  C3  C4 | Index             |
| Student-1            | B    SK  B    B | 0.1562 0.375 0.6875 |
| Student-2            | B    B    SB  SB  | 0.28125 0.625 0.875 |
| Student-3            | SB   C    K    K  | 0.1875 0.4375 0.6250 |
| Student-4            | B    K    SB  C  | 0.1562 0.4375 0.7031 |
| Student-9            | SB   B    B    B | 0.2964 0.625 0.875 |
| Student-10           | SB   SK  K    SK | —         —         |

Table 7. Total Value of Each Alternative

| The student (sample) | Integral Total Value |
|----------------------|-----------------------|
|                      | \( \alpha = 0 \) | \( \alpha = 0.5 \) | \( \alpha = 1 \) |
| Student-1            | 0.2656 0.3984 0.5313 |
| Student-2            | 0.4315 0.6016 0.7500 |
| Student-3            | 0.3125 0.4219 0.5313 |
| Student-4            | 0.2969 0.4336 0.5703 |
| Student-9            | 0.4609 0.6054 0.75   |
| Student-10           | 0.2109 0.2890 0.3671 |

will be considered, while students who have a weight value < 0.60 are not entitled to receive a scholarship. Can be seen in Table 8.

Table 8. Results of Scholarship Analysis

| No | Average Value | Value     |
|----|---------------|-----------|
| Student-1 | 0.56 | Do not accept |
| Student-2 | 0.87 | Receive     |
| Student-3 | 0.57 | Do not accept |
| Student-4 | 0.62 | Do not accept |
| Student-9 | 0.81 | Receive     |
| Student-10 | 0.31 | Do not accept |

4. Conclusion

The FMADM model can be used to predict who is entitled to receive a scholarship at SMPN 1 Simpapti based on the average student report card grades, number of parents, number of people, and parental responsibilities. From 10 children to get scholarship 2 children to get the scholarship and 3 children to get the scholarship. Based on data analysis, the author uses the FMADM
method to predict which students are eligible for scholarships at SMPN 1 Simpati. Therefore, readers are expected to try other methods to predict who are students who are entitled to get a scholarship, so they can use which method is the best and most appropriate to use references.

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