Determination of Scholarship Recipients Using Simple Additive Weighting Method

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Abstract

This paper presents Simple Additive Weighting method to determine scholarship recipients. Sharing scholarships are undertaken by several institutions to help someone who is less able or achieving during his studies. To assist the determination in determining someone who is eligible to receive a scholarship then needed a decision support system. One method that can be used for Decision Support System is by using Fuzzy MADM (Multi Attribute Decision Making). In this research will be raised a case that is looking for the best alternative based on criteria to perform calculation of FMADM method in the case. This method is chosen because it is able to select the best alternative from a number of alternatives, in this case the intended alternative is that eligible to receive scholarship based on the criteria specified. Research is done by finding the weight value for each attribute, then done the ranking process that will determine the optimal alternative, the best student.

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DETERMINATION OF SCHOLARSHIP RECIPIENTS USING SIMPLE ADDITIVE WEIGHTING METHOD

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ABSTRACT
This paper presents Simple Additive Weighting method to determine scholarship recipients. Sharing scholarships are undertaken by several institutions to help someone who is less able or achieving during his studies. To assist the determination in determining someone who is eligible to receive a scholarship then needed a decision support system. One method that can be used for Decision Support System is by using Fuzzy MADM (Multi Attribute Decision Making). In this research will be raised a case that is looking for the best alternative based on criteria to perform calculation of FMADM method in the case. This method is chosen because it is able to select the best alternative from a number of alternatives, in this case the intended alternative is that eligible to receive scholarship based on the criteria specified. Research is done by finding the weight value for each attribute, then done the ranking process that will determine the optimal alternative, the best student.

Keywords: *Criteria, FMADM, SAW, Scholarship*

1. INTRODUCTION
1.1 BACKGROUND
Along with technological developments, some human work can become easier with the help of computer technology as in the case of data processing. With the help of computer, data processed will be more effective and efficient to produce the desired information. Data is a fact that can be stored and has meaning [1].

However, all students are given the opportunity to apply for a scholarship that will determine whether or not it is determined by stakeholders in Pringsewu District. In this study discussed the provision of educational scholarship from pringsewu district. Given the limited allocation of scholarship funds granted by schools at this time in the form of Student Learning Assistance (BBM). When undertaken research on existing schools in Pringsewu District is related to decision making scholarship recipients from Pringsewu Regency has not been done efficiently and well. Stakeholders of Pringsewu District conduct file and file selection from student of scholarship recipients and at the end of the decision of students who deserve to receive scholarship based on criteria and files and subsequently the decision is submitted to school for approval and submitted to students [2].

This is felt to be less effective because of the inaccuracy of the criteria used in decision making for scholarship recipients due to the lack of testing of these criteria. To facilitate the decision making in determining the students who deserve to receive the scholarship required a decision support system that examines the criteria as one of the conditions in the acceptance of the scholarship. This criterion is tested using Fuzzy MADM (Multiple Attribute Decision Making) method. Fuzzy MADM is used to find alternatives from a number of alternatives with certain criteria. Research is done by finding the weight value for each attribute, then done the ranking process to determine the given alternatives. The process of determining scholarships with Fuzzy MADM can accelerate the ranking process, reduce errors in determining scholarship recipients, and assist the selection team in determining scholarship recipients [3].

To obtain a scholarship, there are several predefined criteria. The usual criteria are defined as the amount of parental income, the number of dependents of the parents, the number of siblings, the average value, and the percentage of student attendance (craft). To help determine a student receives a scholarship, then it can be used a Decision Support System (DSS)

by using Fuzzy Multiple model Attribute Decision Making (FMADM) which is a method used to find the optimal alternative of a number of alternatives with certain criteria [4].

1.2 FORMULATION OF THE PROBLEM
Based on the background that has been presented can be identified existing problems as follows:
1. How to make an application to determine the criteria of the Scholarship recipient in Pringsewu District?
2. How does the implementation of decision support system to determine Student using Fuzzy MADM method?

1.3 SCOPE OF PROBLEM
In order for this study's discussion not to deviate from the problems identified, restrictions are required.
Limitations of the problem include:
1. This program is created using web-based programming.
2. Database using *MySQL*.
3. The data comes from schools in Pringsewu District.
4. The criteria used in this decision support system consists of the average value of report cards, student attendance, student attitudes, extra-curricular activities followed.

1.4 RESEARCH PURPOSES
Given the problems encountered, can be determined the objectives to be achieved are:
1. Creating applications that are useful in assisting decision making in determining the students who are eligible to receive scholarships based on predetermined criteria using a web-based programming language.
2. Implement the design of decision support system that has been made to determine the scholarship recipient in Pringsewu District using Fuzzy MADM and SAW methods.

2. LITERATURE REVIEW
2.1 FMADM
The FMADM method is more development continued from MADM. MADM refers to decision-making based on selection of multiple options that each have multiple attributes and inter-attributes that conflict with each other. In decision making where a problem can not be presented properly into the value of crips, or in other words into boolean values, the application of Fuzzy logic can be a problem solving [4].
Application of fuzzy logic in MADM, hereinafter referred to as FMADM. The usual MADM method deficiencies against imprecise data, and are within the approximate range of values can be covered.

2.2 FMADM ALGORITHM
Here is the algorithm used inside solve the problem [6].
1. Provide the value of each alternative (Ai) on each criterion (Cj) that has been determined, where the value is obtained based on the value of crisp; i = 1,2, ... m and j = 1,2, ... n.
2. Gives a weight value (W) which is also obtained based on crisp value.
3. Perform normalized matrices by calculating the normalized performance rating (rij) value of the Ai alternatives in the Cj attribute based on the equations that are adjusted to the attribute type. Benefits attribute = MAXIMUM or cost / cost attribute = MINIMUM. If it is a profit meaning, the crisp (Xij) value of each attribute column is divided by the crisp MAX (MAX Xij) value of each column, while for the cost attribute, the crispMIN (MIN Xij) value of each collector is divided by the crisp (Xij) value of each column.
4. Perform the ranking process by multiplying the normalized matrix (R) with the weight value (W).
5. Determine the preference value for each alternative (Vi) by summing the product of the normalized (R) matrix with the weight value (W). A larger value of Vi indicates that Ai's alternatives are preferred.

3. RESEARCH METHODS

3.1 METHOD OF COLLECTING DATA
In the preparation of this journal the need for a particular method that will be used in collecting data obtained in the following way.

3.1.1 INTERVIEW METHOD
Interviews are conversations between researchers and informants. The researcher here hopes to get information, while the informant is someone who is assumed to have important information about an object. The interviews are conducted directly to the officials of the village apparatus, the community, and related institutions to the village governance system as well as the potentials in the village.

3.1.2 OBSERVATION METHOD
Data collection methods where the investigator makes direct observations of complex situations and is a process composed of various biological and psychological processes that emphasize observation and memory.

3.1.3 DOCUMENTATION
The term document is distinguished from the record. The definition of a record is any written statement prepared by a person or institution for the purpose of testing an event or presenting an account. The document is any written material or film, other than the record, which is not prepared due to an investigator's request.

3.2 SYSTEMS DEVELOPMENT METHOD
The data obtained is then analyzed to develop an existing system with the aim of obtaining better results. The Development Life Cycle (SDLC) system in systems engineering and software engineering is the process of creating and altering systems and the models and methodologies used to develop systems. SDLC is also the stages of work done by systems analysts and programmers in building information systems.

Figure 1. SDLC

The stages can be seen as shown below.

1. Planning (Planning)
At this stage more focus on the interpretation of needs and problem diagnoses by defining the goals and objectives of the system to be built.

2. System Analysis
In this phase, an analysis of the existing system with the method used is the method of interviewing with related parties and make observations on the condition of the village into the scope of the study. In this phase include: determining the object, studying the organization, analyzing output requirements, analyzing input requirements, evaluating system effectiveness.

3. *System Design*
In designing this system based on the needs and problems encountered in the object of research in this phase includes database design, user interface design, hardware requirements, network design, software requirements.

4. Testing (*System implementation*)
System implementation is the construction, installation, testing and delivery system into production (meaning daily operations). Implementation of the system to construct new information systems and put it into operation, then carried out testing.

5. Maintenance
Maintenance is intended for the implemented system to follow any developments and changed that occur to achieve its intended use.

4. DESIGN AND IMPLEMENTATION

4.1 THE DESIGN OF FMADM SYSTEM
In the selection of scholarship using Fuzzy Multiple Attribute Decision Making (FMADM) method with Simple Additive Weighting (SAW) method, we need criteria and weights to do the calculation so that we can get the best alternative.

4.2 CRITERIA AND WEIGHT
In FMADM method with SAW method there are criteria needed to determine who will be selected as the scholarship recipient. The criteria are as follows.

Table 1. Criteria

Criteria	Information
C1	Age
C2	Parental income amount
C3	Number of dependents people
C4	Achievement
C5	Average rating
C6	Personality

From each of these criteria will be determined the weights. The weights consist of six fuzzy numbers, very low (SR), low (R), medium (S), middle (T1), high (T2), and very high (ST) as shown in Figure 1.
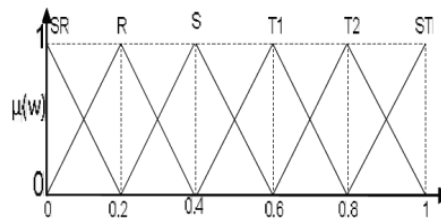

Figure 1. Fuzzy numbers for weights

From the picture above, fuzzy numbers can be converted to crisp numbers. For more details weights are formed in the table below.

Table 2. Weight

Fuzzy Numbers	Value
Very Low (SR)	0
Very Low (SR)	0.2
Medium (S)	0.4
Central (T1)	0,6
Central (T1)	0,8
Very High (ST)	1

4.3 SAMPLE CASE

Table 3. Scholarship applicants

No	Name	C1	C2	C3	C4	C5
1	Student 1	15	450,000	2	2	73
2	Student 2	17	1,000,000	5	5	83
3	Student 3	18	400,000	3	3	68

4.4 CALCULATION OF SCHOLARSHIP SELECTION
1. Provide the value of each alternative (A_i) on each criterion (C_j) that has been determined.
   a. Age (C1)

Table 4. Age

C1	Fuzzy number	Value
C1 <= 15 Years	Very Young (SM)	0.25
C1 = 16 Years	Young (M)	0.5
C1 = 17 Years	Medium (S)	0.75
C1 >= 18 Years	Old (T)	1

b. Total Income of Parents (C2)

Table 5. Total income of parents

C2	Fuzzy number	Value
C2 <= Rp. 500,000	Low (R)	0.25
C2> Rp. 500,000 - Rp. 1.500.000	Simply (C)	0.5
C2> Rp. 1,500,000 - Rp. 3,000,000	High (T)	0.75
C2> Rp. 3,000,000	Very High (ST)	1

c. Number of Dependents Brokers (C3)

Table 6. Number of dependents of parents

C3	Fuzzy number	Value
C3 = 1 child	Very Few (SS)	0
C3 = 2 children	Little (S)	0.25
C3 = 3 children	Medium (SD)	0.5
C3 = 4 children	Many (B)	0.75
C3> = 5 children	Very Many (SB)	1

d. Achievements (C4)

Table 7. Achievements

C4	Fuzzy number	Value
Talent	Very Few (SS)	0
Interest	Little (S)	0.25
Motivation	Medium (SD)	0.5
Mental	Many (B)	0.75
Parents attention	Very Many (SB)	1

e. Rate of Report (C5)

Table 8. The average value of report cards

C5	Fuzzy number	Value
C5 <= 60	Very Low (SR)	0
C5 = 61 - 70	Low (R)	0.25
C5 = 71 - 80	Simply (C)	0.5
C3= 4 children	High (T)	0.75
C5> = 91	Very High (ST)	1

f. Personality (C6)

Table 9. Personality

C5	Fuzzy number	Value
Behavior	Very Low (SR)	0
Sociability	Low (R)	0.25
Tempraments	Simply (C)	0.5
Attitude	High (T)	0.75

From Table 8. it is converted into a decision X matrix with data:

$$X = \begin{bmatrix} 0{,}25 & 0{,}25 & 0{,}25 & 0{,}25 & 0{,}5 & 0{,}25 \\ 0{,}71 & 0{,}5 & 1 & 1 & 0{,}75 & 0{,}75 \\ 1 & 0{,}25 & 0{,}5 & 0{,}5 & 0{,}25 & 0{,}75 \end{bmatrix}$$

2. Give weight value (W).

$$W = [0.4\ 1\ 0.8\ 0.4\ 0.4\ 0.4]$$

3. Normalize matrix X into matrix R based on equation (1).

$$R = \begin{bmatrix} 1 & 1 & 0{,}25 & 0{,}25 & 0{,}5 & 0{,}25 \\ 0{,}33 & 0{,}5 & 1 & 1 & 0{,}75 & 0{,}25 \\ 0{,}25 & 1 & 0{,}5 & 0{,}5 & 0{,}25 & 0{,}75 \end{bmatrix}$$

4. Perform the ranking process by using (2):

$V1 = (0.4)(1) + (1)(1) + (0.8)(0.25) + (0.4)(0.25) + (0.4)(0.5) + (0,4)(0,25) = 0.40 + 1.00 + 0.20 + 0.10 + 0.20 + 0,1 = 2,0$

$V2 = (0.4)(0.33) + (1)(0.5) + (0.8)(1) + (0.4)(1) + (0.4)(0.75) + (0,4)(0,25) = 0.13 + 0.5 + 0.8 + 0.40 + 0.30 + 0,1 = 2.23$

$V3 = (0.4)(25) + (1)(1) + (0.8)(0.5) + (0.4)(0.5) + (0.4)(0.25) + (0,4)(0,75) = 0.10 + 1.00 + 0.40 + 0.20 + 0.10 + 0,3 = 2.1$

The greatest value is on V2 so that alternative A2 (Student 2) is the chosen alternative as the best alternative.

5. CONCLUSION AND SUGGESTION
5.1 CONCLUSION
1. The built system can assist the scholarship selection team in conducting scholarship selection.
2. Fuzzy Multiple Attribute Decision Making (FMADM) method with Simple Additive Weighting (SAW) method can be applied to determine the scholarship recipient.

5.2 SUGGESTION
1. The management of fuzzy numbers is made more dynamic.
2. Scholarship criteria are made more dynamic.
3. Data entered into the program is expected to use the correct data.
4. Admin is expected to continue to perform system maintenance regularly.
5. Maintain good coordination among users in selecting scholarships.

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