SIMPLE ADDITIVE WEIGHTING FOR MODELING DSS TO DETERMINE THE BEST COLLEGE IN PRINGSEWU

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Abstract

Continuing study to a college is a hope for prospective students. However, that is an easy problem, because that needs to be considered in choosing such as, the cost during the lecture took place, facilities, facilities and infrastructure, cooperation between universities and others. By using The Decision Support System, the calculation of all criteria can be able to determine the best college to assist prospective students in selecting and choosding the college. The Decision Support System uses the Simple Additive Weighting (SAW) method. The Decision Support Issues are basically for the selection of alternative actions enabling prospective students in choosing the college which they want, and will produce a best decision for prospective students for continuing in the best collage.

Keywords: DSS, College, Simple Additive Weighting (SAW)

1. INTRODUCTION

1.1. Background of the Problem

At this time, The Information of Technology (IT) in the world is very increase and favored by the graduate students from senior high school, to be able to continue their study in the best college. One of the efforts of educational institutions to ensure the quality of graduation and teaching and learning process is to improve the quality of lecturer's performance in teaching and learning process. The quality of educational institutions is determined by three factors, namely students, lecturers and teaching learning facilities. These three factors are interrelated and mutually supportive of one another in creating a good learning process [1]. According to RI Law NO. In 2005, lecturers are professional educators and scientists with the primary task of transforming, developing and disseminating science, technology, and the arts through education, research, and community service [2]. In addition to the elements that have been mentioned above there are other elements that are very important in the process of supporting learning in universities namely sara and infrastructure. With good facilities and infrastructure and supported with qualified lecturers qualified then the college will be qualified. To find out how the quality of universities will be in the rankings of colleges using SAW method. Therefore, many best colleges are running and prospective students are difficult to determine or choose which one the college that will be a means of seeking their knowledge. Based on the problems, the researchers used Simple Additive Weighting method, for helping prospective students in determining the best college.

1.2. Formulation of the Problem

How to determine and select a collage in Pringsewu that fit the criteria of prospective students by using Simple Additive Weighting (SAW) method?

1.3. Scope of the problem

Based on the formulation of the problem, this research would be conducted to capture prospective students in determining the appropriate college in Pringsewu. By processing the data from the desired criteria using Simple Additive Weighting (SAW), it can be an accurate decision support.

1.4. Research Purpose

The purpose of this research is to make the decision support application to determine the best college in Pringsewu by using Simple Additive Weighting (SAW) method.

1.5. Objective of the Research

The objective of this research is to make prospective students for determining the best college easily.

2. FRAME OF THEORY

2.1. The definition of Decision Support System

Decision Support System (DSS) is a system capable of providing problem solving and communications capabilities for problems with semi-structured and unstructured conditions. This system is used to assist decision making in semi-structured situations and unstructured situations, where nobody knows exactly how decisions should be made (Turban, 2005).

DSS aims to provide information, guide, provide predictions and lead to users of information in order to make better decisions. DSS is an implementation of decision-making theories that have been introduced by sciences such as operation research and science management, the difference is we would look for problem solving that we have to manually calculate iteration (usually to find the minimum, maximum, or optimum) first, now PC has offered its ability to solve the same problem in a relatively short time.

Sprague and Watson define Decision Support System (SPK) as a system that has five main characteristics (Sprague et.al, 1993):

1. Computer-based systems.
2. Used to assist decision makers.
3. To solve complicated problems that is impossible to do with manual calculations.
4. Through interactive simulation.
5. Where data and model analysis as the main component.

2.2. Fuzzy Multiple Attribute Decision Making (FMADM)

Fuzzy Multiple Attribute Decision Making (FMADM) is a method used to find the optimal alternative of a number of alternatives with certain criteria. The core of FMADM is to determine the weight value for each attribute, then proceed with the ranking process which will select the alternatives already given. Basically, there are 3 approaches to finding attribute weight value, that is subjective approach, objective approach and approach of integration between subjective & objective. Each approach has its advantages and disadvantages. In a subjective approach, the weighted value is determined by the subjectivity of the decision-makers, so that several factors in the alternative ranking process can be determined freely. Whereas in the objective approach, the weight value is calculated mathematically so that it ignores the subjectivity of the decision maker. (Kusumadewi, 2013). There are several methods that can be used to solve FMADM problems. among others :

a. Simple Additive Weighting Method (SAW);
b. Weighted Product (WP);
c. Elimination Et Choix Traduisant la Realite (ELECTRE);
d. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS);
e. Analytic Hierarchy Process (AHP)

2.3. *Simple Additive Weighting* Method

Simple Additive Weighting method is often also known as weighted summing method. The basic concept of the SAW method is to find the weighted sum of performance ratings on each alternative on all attributes. SAW method requires the process of normalizing the decision matrix (X) to a scale comparable to all existing alternative ratings.

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{\max\limits_i X_{ij}} & \text{jika } j \text{ atribut keuntungan } (benefit) \\ \\ \dfrac{\min\limits_i X_{ij}}{X_{ij}} & \text{jika } j \text{ atribut biaya } (cost) \end{cases} \tag{1}$$

Which:

r_{ij} = normalized performance rating value
x_{ij} = attribute value of each criterion
Max x_{ij} = the largest value of each criterion i
Min x_{ij} = the smallest value of each criterion i
Benefit = if the greatest value is best
Cost = if the smallest value is best

where r_{ij} is the normalized performance rating of the alternative A_i Ai on the attribute C_j; i=1,2,...,m and j=1,2,...,n. The preference value for each alternative (V_i) is given as:

$$V_i \sum_{j=1}^{n} w_j r_{ij} \tag{2}$$

Which:
V_i = rank for each alternative
w_j = weighted value of each criteria
r_{ij} = normalized performance rank values
Greater V_i values indicate that A_i alternatives are more elected.

3. RESULT AND DISCUSSION

The respondents of this research is the colleges in Pringsewu. These are the criteria needed for decision making, the criteria on the questionnaire given to the respondents, namely:
C1 = Building / study space
C2 = Re-listing fee
C3 = Development cost
C4 = Tuition fee per semester
C5 = Library
C6 = Laboratory availability
C7 = College accreditation
C8 = Linearity of educational scholarship
C9 = Percentage of alumni

After the criteria selection process through questionnaires from SMK (The Vocational Senior High School), so based on the answers questionnaire after calculating the percentage of respondents' answers were:

C1 = Building / study space
C2 = Library
C3 = Laboratory availability
C4 = College accreditation
C5 = Cost of education
C6 = Percentage of alumni

From the existing keriteria, then it made a level of importance criteria based on the value of weight that had been determined into the fuzzy ratio, the rating matches each alternative on each criteria as follows:

1. Very low (SR) = 0;
2. Low (R) = 0.2;
3. Medium (S) = 0.4;
4. Middle (T1) = 0.6;
5. Height (T2) = 0.8;
6. Very high (ST) = 1;

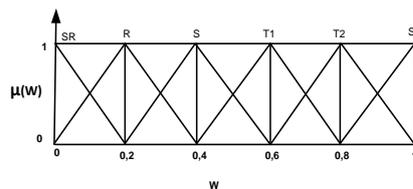The value of the weight is made in a graph to be clearer, as shown in the picture below:

Figure 1. Graph of weight

After the process of selecting criteria through questionnaires from the respondents, the criteria were chosen based on the results of the questionnaire answers after calculating the percentage of respondents' answers were :

C1 = Building / study space
C2 = Library
C3 = Laboratory availability
C4 = College accreditation
C5 = Cost of education
C6 = Percentage of alumni

Based on the criteria and sub-criteria of each alternative rating on the loyalty of predetermined criteria, then the weighting of each criterion has been converted with fuzzy numbers.

1. **Building / study space**
   The value interval of the building / study space that has been converted with fuzzy numbers below can be seen in the table below.

Table 3.1 Index Values Building / study space

Building / Study Space	Values
X = 1:40	0.25
X = 1:35	0.50

X = 1:30	0.75
X = 1:25	1.00

2. **Library**
   The library value interval that has been converted with fuzzy numbers can be seen in the table below. Assessment of the library is related to the number of titles of books available in the library.

Table 3.2 Index Value of Library

Library	Values
X < 200	0.25
X >= 200	0.50
X >= 250	0.75
X >= 300	1.00

3. **Laboratory availability**
   The interval of labor availability that has been converted with fuzzy numbers can be seen in the table below. Assessment of laboratory availability is related to the availability of laboratories in accordance with the existing study program.

Table 3.3 Laboratory Availability Index Rate

Availability of Value Laboratory	Values
X = 0	0
X = 1	0.50
X > 1	1.00

4. **Accreditation of colleges**
   The interval of accredited school values that have been converted with fuzzy numbers can be seen in table below.

Table 3.4 The value of accreditation index of colleges

Accreditation of colleges	Values
Not accredited	0.25
Accreditation C	0.50
Accreditation B	0.75
Accreditation A	1.00

5. Cost of Education in each semester
   The interval of the value of the educational linearity of the educator that has been converted to the fuzzy number can be seen in table below.

Table 3.5 Cost of Education in each semester

Cost of Education in each semester	Values
>= very expensive	0.25
>= expensive	0.50

>= affordable	0.75
100%	1.00

6. Percentage of alumni

The percentage interval of the percentage of students passing a national exam that has been converted with fuzzy numbers is seen in table below.

Table 3.6 The Value of Percentage alumni index

Percentage of alumni	Values
>= 70%	0.25
>= 80%	0.50
>= 90%	0.75
100%	1.00

Manual Calculation based on the Example of Case (Simulation)

The three colleges that would be assessed, they have the following data:

Table 3.7 Simulation of colleges' calculations

Criteria	PRIVATE COLLEGES		
	PTS 1 (A1)	PTS 2 (A2)	PTS 3 (A3)
Building / study space (C1)	1:35	1:30	1:40
Library (C2)	>=400	>=250	>=300
Laboratory availability (C3)	2	1	1
Accreditation of college (C4)	B	C	B
Education cost (C5)	100%	>=90%	>=90%
Percentage of alumni (C6)	100%	100%	100%

Based on the table above, data can be formed matrix decision X that has been converted with fuzzy numbers, as follows:

Alternative	Criteria					
	C1	C2	C3	C4	C5	C6
A1	0.50	0.75	0.50	0.75	1.00	1.00
A2	0.75	0.75	0.50	0.50	0.75	1.00
A3	0.25	1.00	0.50	0.75	0.75	1.00

Decision making gives weight, based on the level of importance of each of the required criteria as follows:

Weight Vector: W = [0.15, 0.10, 0.15, 0.20, 0.20, 0.20]

Creating the X decision matrix, it created from the match table as follows:

$$X = \begin{Bmatrix} 0.50 & 0.75 & 0.50 & 075 & 1.00 & 1.00 \\ 0.75 & 0.75 & 0.50 & 0.50 & 0.75 & 1.00 \\ 0.25 & 1.00 & 0.50 & 0.75 & 0.75 & 1.00 \end{Bmatrix}$$

The first normalization of X matrix to calculate the value of each criterion based on the criteria is assumed as the criterion of profit or cost as follows:

A1). $r_{11} = \dfrac{0.50}{Max\{0.50,0.75,0.25\}} = \dfrac{0.50}{0.75} = 0.66$

$r_{12} = \dfrac{0.75}{Max\{0.75,0.75,1.00\}} = \dfrac{0.75}{1.00} = 0.75$

$r_{13} = \dfrac{0.50}{Max\{0.50,0.50,0.50\}} = \dfrac{0.50}{0.50} = 1.00$

$r_{14} = \dfrac{0.75}{Max\{0.75,0.50,0.75\}} = \dfrac{0.75}{0.75} = 1.00$

$r_{15} = \dfrac{1.00}{Max\{1.00,0.75,0.75\}} = \dfrac{1.00}{1.00} = 1.00$

$r_{16} = \dfrac{1.00}{Max\{1.00,1.00,1.00\}} = \dfrac{1.00}{1.00} = 1.00$

A2). $r_{21} = \dfrac{0.75}{Max\{0.50,0.75,0.25\}} = \dfrac{0.75}{0.75} = 1.00$

$r_{22} = \dfrac{0.75}{Max\{0.75,0.75,1.00\}} = \dfrac{0.75}{1.00} = 0.75$

$r_{23} = \dfrac{0.50}{Max\{0.50,0.50,0.50\}} = \dfrac{0.50}{0.50} = 1.00$

$r_{24} = \dfrac{0.50}{Max\{0.75,0.50,0.75\}} = \dfrac{0.50}{0.75} = 0.66$

$r_{25} = \dfrac{0.75}{Max\{1.00,0.75,0.75\}} = \dfrac{0.75}{1.00} = 0.75$

$r_{26} = \dfrac{1.00}{Max\{1.00,1.00,1.00\}} = \dfrac{1.00}{1.00} = 1.00$

A3). $r_{31} = \dfrac{0.25}{Max\{0.50,0.75,0.25\}} = \dfrac{0.25}{0.75} = 0.33$

$r_{32} = \dfrac{1.00}{Max\{0.75,0.75,1.00\}} = \dfrac{1.00}{1.00} = 1.00$

$r_{33} = \dfrac{0.50}{Max\{0.50,0.50,0.50\}} = \dfrac{0.50}{0.50} = 1.00$

$r_{34} = \dfrac{0.75}{Max\{0.75,0.50,0.75\}} = \dfrac{0.75}{0.75} = 1.00$

$r_{35} = \dfrac{0.75}{Max\{1.00,0.75,0.75\}} = \dfrac{0.75}{1.00} = 0.75$

$r_{36} = \dfrac{1.00}{Max\{1.00,1.00,1.00\}} = \dfrac{1.00}{1.00} = 1.00$

Second, making normalization of matrix R obtained from result of normalization of matrix X as follows:

$$X = \begin{Bmatrix} 0.66 & 0.75 & 1.00 & 1.00 & 1.00 & 1.00 \\ 1.00 & 0.75 & 1.00 & 0.66 & 0.75 & 1.00 \\ 0.33 & 1.00 & 1.00 & 1.00 & 0.75 & 1.00 \end{Bmatrix}$$

Next, it will be made multiplication matrix W * R and calculate the results multiplication to obtain the best alternative by doing ranking the largest value as follows:

V_1 = (0.15*0.66)+(0.10*0.75)+ (0.15*1) + (0.20*1) + (0.20*1) + (0.20*1)
= (0.099 + 0.075 + 0.15 + 0.20 + 0.20 + 0.20)
= 0.924
V_2 = (0.15*1)+(0.10*0.75)+(0.15*1)+(0.20*0.66)+ (0.20*0.75) + (0.20*1)
= (0.15 + 0.075 + 0.15 + 0.132 + 0.15 + 0.20)
= 0.857
V_3 =(0.15*0.33)+ (0.10*1) + (0.15*1) + (0.20*1) + (0.20*0.75) + (0.20*1)
= (0.0495 + 0.10 + 0.15 + 0.20 + 0.15 + 0.20)
= 0.8495

From multiplication of matrix W * R then it got the result as follows: V_1 = 0.924, V_2 = 0.857, V_3 = 0.8495, largest value of the summation of the above matrix is V_1 so that alternative **A₁ (PTS A) is a PTS deserving the best PTS**. The criteria of colleges above, they are based on the following intervals:
0.00 – 0.33 = Worse
0.34 – 0.66 = Good
0.67 – 1.00 = Best

4.   CONCLUSIONS

From the calculation of the case examples above, it can be concluded that the colleges are eligible to be selected based on the SAW method with an affordable cost assessment, adequate facilities, and good accreditation. The SAW application for the best DSS selection modeling can make a result in a rational and optimal decision making

5.   SUGGESTIONS

This research is still very far from perfect value, the researchers suggest for further research to:
1. The application can be added another criteria.
2. The application can be developed again for an example by adding fuzzy logic so that the inappropriate data can be tolerated and the results given more accurate again.

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