The Implementation of Simple Additive Weighting (SAW) Method in Decision Support System for the Best School Selection in Jambi

IOP Conf. Series: Journal of Physics: Conf. Series **1338** (2019) 012054 doi:10.1088/1742-6596/1338/1/012054

The Implementation of Simple Additive Weighting (SAW) Method in Decision Support System for the Best School Selection in Jambi

A Ibrahim[1,a] and R A Surya[1,b]

[1]Department of Information Systems, Faculty of Computer Science, Universitas Sriwijaya, Indonesia

[a]aaliibrahim@unsri.com; [b]brizqiadisurya18@gmail.com

Abstract. Jambi Education Office, is a government institution located in the city of Jambi which is one of the government institutions engaged in education. It serves all existing schools in Jambi. In the process of selecting the best schools, there are many obstacles facing the educators; the condition of the building and the facilities at the school. This happens because of the number of schools located in Jambi. Therefore, not all schools will be the best schools; only those which meet the criteria will be the best school. It can be done by through the processing of decision support system using a method called Simple Additive Weighting. This system can be used to determine which schools are eligible to be the best schools in Jambi. The utilization of decision support system with Simple Additive Weighting method can determine the weight value for each attribute, then proceed with a ranking process that will select the best alternative from a number of alternatives. In this case, the intended alternative is the right ones to become the best schools based on the specified criteria.

1. Introduction

The Education Office of Jambi has a program to select the best schools that become pilot schools. The selected schools are ultimately projected to become references and laboratories for other schools in learning, school management, and community participation, so the schools are at all times ready to be visited and researched by the other schools in Jambi. The selection of the best schools by the Education Department of Jambi is still done manually. The obstacles faced by the Education Office of Jambi City to select the best schools is that there are many criteria that must be checked from the big number of public and private schools that exist in Jambi. The best selection of schools by the Education Department of Education of Jambi City is still done manually. The school data is sent to the assessor team to check the completeness of the file then the completed file is selected and then sent to the District Education Office according to the field that handles it. After the school was selected, the field survey is accompanied by the Head of Department. It takes a long time to proceed and it costs a lot to survey the schools. One solution is using a decision support system. This system is used as a process to get a quicker and more accurate decision. Decision support system combines the capabilities of a computer in interactive services with the processing or manipulation of data or models that utilize unstructured settlement rules [1, 2].

2. Materials and Methods

2.1 Decision Support System

The main purpose of developing DSS is to support decision makers in the decision-making process in order to handle complex problem environment. DSS has been applied in a various research area of applications as discussed by Power [3]. This section explains the overview of DSS technology in terms of its definition and categories. DSS definition is evolving from theory to practice as well as the improvement of various supporting technologies such as minicomputers and user-friendly software applications. There is no standard and universal definition of DSS as different people with different background have different views on DSS [4].

The term DSS initially coined by Gorry and Scott-Morton [5] in the Sloan Management Review article. They claimed DSS focus to support semi-structured and unstructured decisions. Since then, a growing amount of studies in terms of interpreting DSS have been discussed and argued. Donovan [6] extended DSS as the systems with the capability to deal with complex problems by providing information and necessary analysis. Another definition of DSS is defined as "computer-based to support decision making rather than to increase transaction processing and record keeping" [7]. Despite different varieties of early definitions that have been proposed, there is an acceptable understanding that DSS is a system supported by computer technology in which capable to provide decision analysis for an ill-structured problem.

Keen [8] argued that the previous definition of DSS is for a specific application. He redefined the term DSS as a completed system comes out through dynamic interactions between users, designers, and systems, analysis models as well as support for technology availability. Turban and Watkins [9] classified DSS as an interactive computer-based system which employs decision rules, models and database.

2.2 System Addictive Weighting (SAW)

Simple Additive Weighting (SAW) is a multi-attribute procedure based on the concept of a weighted summation. The system will look for a weighted summation of rating the performance of each alternative on all alternative criteria. The highest score will be the best alternative and it will be recommended. This method can be used to support Geographic Information System with overlay operations [11].

Simple Additive Weighting (SAW) is one of the methods used to solve multi-attribute decision problems. The usefulness of the basic concept of the SAW method is to find the number of weighted performance ratings for each alternative on all attributes [10]. SAW requires a process of normalizing the decision matrix (X) to a scale that can be compared with all of the ratings of existing alternatives.

$$r_{ij} = \frac{r_{ij}}{Max\left(x_{ij}\right)} \tag{1}$$

$$r_{ij} = \frac{r_{ij}}{Max\left(x_{ij}\right)} \tag{2}$$

If *j* is an attribute of benefit then use formula number one. If the attribute j is cost then use formula number two:

$$w = \frac{c_1}{c_1 + \ldots + c_n} \times 100\% \tag{3}$$

$$V_i = \sum_j^n -1 = 1 w_j r_{ij} \tag{4}$$

3. Results and Discussion

3.1 General description

This system was built for the selection of the best schools in Jambi using Simple Additive Weighting method as the calculation method in determining the best school. The web-based system is used to make decisions. This system provides information about the school's address and the accreditation of the school the future students need before they enter the school.

3.2 Simple Additive Weighting Calculation

Table 1. Criteria Name

Criteria Name	Type
School Achievement	Cost
School Environment	Benefit
School Accreditation	Cost
Implementation of the Curriculum	Benefit
Availability of Extracurricular Activities	Benefit

Weighting criteria in the SAW method are determined by the decision makers, in other words, policymakers must decide the weight preference in advance for each criterion. In this analysis the weight criteria is divided into five options for each criterion:

Table 2. School Achievement Criteria

Criteria	Weight	Value
School Achievements	International	4
	National	3
	Province	2
	District	1
	Nothing	0

Table 3. School Environment Criteria

Criteria	Weight	Value
School Environment	Very clean	2
	Clean	1
	Not clean	0

Table 4. School Accreditation Criteria

Criteria	Weight	Value
School Accreditation	A	3
	B	2
	C	1
	D	0

Table 5. Implementation of Curriculum Criteria

Criteria	Weight	Value
Implementation of Curriculum	Yes	1
	No	0

Table 6. Availability of extracurricular criteria

Criteria	Weight	Value
Availability of Extracurricular Activities	Yes	1
	No	0

The testing was performed using the following four alternatives:

1. The first alternative (A1)
2. The second alternative (A2)
3. The third alternative (A3)
4. The fourth alternative (A4)

Based on the above alternatives, the researchers made the following table preference value as the test data:

Table 7. Alternative Values

Alternates	C1	C2	C3	C4	C5
A1	4	2	4	2	2
A2	2	3	3	2	1
A3	2	3	3	1	2
A4	4	1	3	1	1

Next is to determine the value of the preference given to the decision makers value, W = (5, 4, 3, 2, 1), and the process of calculating normalization matrix according to the formula.

$$r_{ij} = \left\{ \frac{x_{ij}}{Max_{ij}} \right\} \text{ dan } r_{ij} = \left\{ \frac{Minx_{ij}}{x_{ij}} \right\}$$

Here is the calculation of the above equation:

$$r_{11} = \frac{\min\{4;2;2;4\}}{4} = \frac{2}{4} = 0,5$$

$$r_{21} = \frac{\min\{4;2;2;4\}}{2} = \frac{2}{2} = 1$$

$$r_{31} = \frac{\min\{4;2;2;4\}}{2} = \frac{2}{2} = 1$$

$$r_{41} = \frac{\min\{4;2;2;4\}}{4} = \frac{2}{4} = 0,5$$

$$r_{12} = \frac{2}{\max\{2;3;31\}} = \frac{2}{3} = 0,66$$

$$r_{22} = \frac{3}{\max\{2;3;31\}} = \frac{3}{3} = 1$$

$$r_{32} = \frac{3}{\max\{2;3;31\}} = \frac{3}{3} = 1$$

$$r_{42} = \frac{1}{\max\{2;3;31\}} = \frac{1}{3} = 0,33$$

$$r_{13} = \frac{Min\{4;3;3;3\}}{4} = \frac{3}{4} = 0,75$$

$$r_{23} = \frac{Min\{4;3;3;3\}}{3} = \frac{3}{3} = 1$$

$$r_{33} = \frac{Min\{4;3;3;3\}}{3} = \frac{3}{3} = 1$$

$$r_{43} = \frac{Min\{4;3;3;3\}}{4} = \frac{3}{4} = 0,75$$

$$r_{14} = \frac{2}{\max\{2;2;1;1\}} = \frac{2}{2} = 1$$

$$r_{24} = \frac{2}{\max\{2;2;1;1\}} = \frac{2}{2} = 1$$

$$r_{34} = \frac{2}{\max\{2;2;1;1\}} = \frac{1}{2} = 0,5$$

$$r_{44} = \frac{2}{\max\{2;2;1;1\}} = \frac{1}{2} = 0,5$$

$$r_{15} = \frac{2}{\max\{2;1;2;1\}} = \frac{2}{2} = 1$$

$$r_{25} = \frac{2}{\max\{2;1;2;1\}} = \frac{1}{2} = 0,5$$

$$r_{35} = \frac{2}{\max\{2;1;2;1\}} = \frac{2}{2} = 1$$

$$r_{45} = \frac{2}{\max\{2;1;2;1\}} = \frac{1}{2} = 0,5$$

After doing the whole calculation of the values above, the result matrix is as follows:

$$R = \begin{bmatrix} 0,5 & 0,6 & 0,75 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0,5 \\ 1 & 1 & 1 & 0,5 & 1 \\ 0,5 & 0,3 & 1 & 0,5 & 0,5 \end{bmatrix}$$

Next is the process of calculating preference (V) by using the following equation:

$$V_i = \sum_{j=1}^{n} w_i r_{ij}$$

$$V_1 = (5)(0,5) + (4)(0,6) + (3)(0,75) + (2)(1) + (1)(1) = 2,5 + 2,4 + 2,25 + 2 + 1 = 10,15$$

$$V_2 = (5)(1) + (4)(1) + (3)(1) + (2)(1) + (1)(0,5) = 5 + 4 + 3 + 2 + 0,5 = 14,5$$

$$V_3 = (5)(1) + (4)(1) + (3)(1) + (2)(0,5) + (1)(1) = 5 + 4 + 3 + 1 + 1 = 14$$

$$V_4 = (5)(0,5) + (4)(0,3) + (3)(1) + (2)(0,5) + (1)(0,5) = 2,5 + 1,2 + 3 + 1 + 1 = 8,2$$

Larger V value indicates that the alternative V_2 is the best alternative, in other words, V_2 is the best alternative decision using Simple Additive Weighting method.

Ranking results are obtained. The alternatives are then sorted from the largest value to the lowest so that participants know which has higher priority. Thus a successive alternative is obtained based on the gained ranking, namely Participant 2, Participant 3, Participant 4, and Participant 1. This proves again that V2 is the best alternative decision using SAW.

4.Conclusion

1. The system built is a decision support system of the best schools by Jambi City Education Office using SAW web-based method. It enables the process of choosing the best school easier.
2. The system can simplify the processing of the best schools selection data and can produce information about the best school selection.
3. Based on the analysis we have done, we conclude that decision support system using Simple Additive Weighting is capable of displaying results from weighting and calculation based on criteria very easily and efficiently. For testing with different case, it can be done quickly and easily because it is a simple calculation.
4. The system was built to find out what the school lacks of so that it can improve the existing system in the school.

References

[1] Conejar R J and Kim H 2014 A medical decision support system (DSS) for ubiquitous healthcare diagnosis system *International Journal of Software Engineering and Its Applications* **8** 10 pp 237–244

[2] Mohemad R, Hamdan A R, Othman Z A and Noor N M M 2010 Decision support systems (dss) in construction tendering processes *Int. J Comput Sci Issues* **7** 2 pp 35–45

[3] Power D J A Brief History of Decision Support Systems *DSS Resources COM*, URL: https://dssresources.com/history/dsshistory.html (visited on 05/07/2018)

[4] Khodashahri N G Sarabi M M H 2013 Decision Support Systems Singaporean Journal Of Business Economics, and Management Studies **1** 6 pp 95-102

[5] Gorry G A and Morton M S S 1971 A framework for management information systems *Sloan Manage Rev*. **13** 1 pp 49–61

[6] Donovan J J 1976 Database System Decision Support Approach to Management ACM *Transaction on Database Systems* **1** 4 pp 344–369

[7] Information M 2014 Development patterns for decision support *Steven Alter Abstract* **2** 3 pp 33–42
[8] Kee P G W 1980 Adaptive Design For Decision Support System ACM *Transaction on Database Systems* **12** 1-2 pp 15-25
[9] Turban, E L and Watkins P R 1985 Integrating expert systems and decision support systems. *MIS Quarterly* **10** 2 pp 121-136
[10] Khairul S M and Siahaan A P U 2016 Decision Support System in Selecting The Appropriate Laptop Using Simple Additive Weighting December IJRTER **2** 12 pp 215-222
[11] Malczewski J 1999 *GIS and Multicriteria Decision Analysis* (Canada: John Wiley and Sons)