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Implementation of Simple Additive Weighting (SAW) Method for Selecting Securities Company

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Abstract—A securities company has a purpose as an intermediary for stock trading between investors and the stock company to be purchased. Securities companies must be listed on the Indonesia Stock Exchange and supervised by the Financial Services Authority. The limited information that potential investors can receive regarding the criteria for selecting securities companies causes potential investors to have difficulty comparing each company. And no system supports decisions in this election. Based on the research, obtained eight assessment criteria in the selection of securities companies, as well as determining the weight of each criterion by calculating the Likert scale and determining the cost or benefit attribute for each criterion, as follows: initial deposit fee (15%) cost, transaction fee (12%) cost, stock recommendation fee (12%) cost, registration process time (12%) cost, support application rating (12%) benefit, company establishment (9%) benefit, customer service response (15%) cost, and features (15%) benefits. In this study, the authors use five alternatives. The calculation process results in a ranking, and the top-ranking is a highly recommended alternative based on existing criteria and weights. Then a website-based decision support system is made with the SAW method, which can assist in selecting securities companies based on the desired criteria and weights. Users can also view information on the value of each criterion given by each securities company.

Keywords: Securities Company; Stock Investments; Decision Support System; Simple Additive Weighting

1. INTRODUCTION

Investment is asset management that has the aim of making a profit in the future. Stock Investment is one type of Investment. Stock Investment is made by investing a certain amount of capital in a company[1]. Then investors will benefit from the sales process and dividends distributed by the company. When investing in shares, Investors cannot invest directly on the Indonesian Stock Exchange without intermediaries. However, they must go through a broker known as a Securities Company, which is listed on the Indonesia Stock Exchange and supervised by the Financial Services Authority. Based on the Indonesia Central Securities Depository (KSEI) data, there are 107 securities companies listed on the Indonesia Stock Exchange, and in the city of Palembang, there are 12 securities companies. At this time, no system helps in the selection of securities companies, so they only choose based on recommendations and carelessly without considering the existing criteria. Then, the information obtained by potential investors in comparing each company is still limited. Such as initial deposit fees, transaction fees, share recommendation fees, registration process time, supporting application ratings, company establishment, customer service response, and availability. So that potential investors find it difficult to compare companies.

Based on this, a system will be designed that has a purpose to help potential investors choose a suitable and appropriate company using the Simple Additive Weighting method. A decision support system is a system that aims to support decisions from management in analytical work that was previously unstructured and did not have definite assessment criteria. A decision support system that can help decisions can assist in supporting existing decisions without replacing the role of decision-makers. The purpose of making the system is to find a specific goal or target[2].

The Simple Additive Weighting method is one of the methods used in a decision support system. This method is a weighted addition method. In this method, the criteria, sub-criteria, weights, and alternatives to be calculated are determined. The normalization process (X) is carried out, the final result obtained is a ranking for all existing alternatives data[3]. Then, the Simple Additive Weighting method is more suitable if the data presented is quantitative[4].

Currently, there are no journals on the selection of securities companies, but there are journals in line with this research. The following journal discusses something similar to this research, namely the Investment Company Support System using the Exponential Comparison Method[5], discussing the selection of investment companies using five criteria, namely currency, number of deposits, tenor, interest withdrawal, annual deposit interest rate. In this study, the criteria are still minimal, and the selection of investment companies is comprehensive and does not focus on selecting investment companies or securities for stock selection. The final result of this research is a program that aims to assist in the investment company's decision-making process. In the journal entitled Decision Support System for Hotel Selection in Palembang City With the Simple Additive Weighting (SAW) Method [6], there is a process of finding the best hotel with the criteria and alternatives given. One of the criteria used is facilities. There are a lot of facility criteria data, so the authors of the journal use a table of facility compatibility levels that are useful for simplifying the calculation of the facilities provided. Therefore, in this research on the selection of securities companies, the authors use a table of match levels on the feature criteria, which aims to make it easier to calculate the feature value for each company.

Based on the information above, the author proposes a new design and system in the selection of securities companies, which can assist prospective stock investors in selecting the appropriate securities companies based on the



desired criteria quickly and accurately and provide information related to securities companies to potential investors using the Simple Additive Weighting Method.

2. RESEARCH METHODOLOGY

2.1 System Development Method

The system development method in a decision support system has 4 phases[7][6]. The following is an explanation of each phase:

- a. Intelligence Phase: identification of existing problems in the selection of securities companies.
- b. 1. At this stage, the author conducts a process of observing the stock community, asking questions with several investors, and looking for literature related to research. Then the results obtained, strengthened by finding respondents to fill out the questionnaire from one of the questionnaire questions that asked whether respondents experienced problems in choosing a securities company, as many as 53.5 or 115 of 215 respondents had difficulty comparing each company and lack of information related to what should be the difference in this selection.
2. Then, collect supporting data related to the selection of securities companies and data on criteria, sub-criteria, weights, alternatives, and others used as benchmarks in selecting securities companies.
- c. Design Phase: In the design phase, the author performs a logic design. The author performs the problem modeling process, then defines and describes it based on predetermined criteria and alternatives. Determining solutions, designing and developing alternatives, actions to be taken, selecting values and weights from other options, and selecting methods to be used. Then the process modeling design uses Data Flow Diagrams, Entity Relationship Diagrams for data modeling.
- d. Choice Phase: At this stage, the right design is selected based on the previous problems. If the solution is acceptable in this last phase, then proceed with implementation decision solutions in the real world.
- e. Implementation Phase: The implementation phase is carried out on the system.
- f. That has been designed to see the obstacles that arise when the system is used. The faster it is repaired, the system performance will increase and can be reused.

2.2 Simple Additive Weighting Method

The system development method implemented in selecting this securities company is the Simple Additive Weighting method, more commonly referred to as the weighted summation method. In this method, look for the weighted sum of the performance ratings on alternatives on all attributes. This SAW method can assist in decision-making and produce the most significant value as the best alternative based on the criteria and weights given. The advantage of this method is that it saves time because the calculation process is short and straightforward. In the Simple Additive Weighting method, there are attributes, namely, benefits and costs. The difference between these two criteria is in the selection of criteria when taking[4]. The greater the value in these criteria, the better the cost criteria are. The smaller the value in these criteria, the better.

The following are the steps for the Simple Additive Weighting method[6], [8]–[13]:

1. Determine the criteria to be used in decision-making (C_i).
2. Determine the suitability rating of each alternative on each criterion.
3. Make a decision matrix based on the criteria (C_i),
4. Normalize the matrix based on the equation adjusted to the type of attribute (profit attribute or cost attribute) to obtain a normalized matrix R.
5. The ranking process is the addition of multiplication
3. normalized matrix R with weight vector to get the most significant value (Best alternative)

3. RESULT AND DISCUSSION

3.1 Analysis of Simple Additive Weighting Method

The following are some steps and the calculation of the Simple Additive Weighting method in this study[14]:

a) Determine criteria and sub-criteria

The criteria were obtained based on references, literature studies, interviews and reinforced by questionnaires from 215 respondents. The criteria that have been determined can be seen in table 1

Table 1. Criteria

No	Criteria	Initial	Type
1	Initial deposit fee	C1	Cost
2	Transaction fee	C2	Cost
3	Stock recommendation fee	C3	Cost

No	Criteria	Initial	Type
4	Registration Process time	C4	Cost
5	Supporting application ratings	C5	Benefit
6	Company establishment	C6	Benefit
7	Customer Service response	C7	Cost
8	Features	C8	Benefit

The following sub-criteria are specified.

Initial deposit fee. These subcriteria can be seen in table 2

Table 2. Sub-criteria initial deposit fee

Initial deposit fee	Weight
> Rp. 7.999.999	5
Rp. 6.000.000 – Rp.7.999.999	4
Rp. 4.000.000 – Rp. 5.999.999	3
Rp. 2.000.000 – Rp. 3.999.999	2
<Rp. 2.000.000	1

Transaction fee. These subcriteria can be seen in table 3

Table 3. Sub-criteria transaction fee

Transaction fee	Weight
>0.19% dan 0.29%	5
0.18% dan 0.28%	4
0.17% dan 0.27%	3
0.16% dan 0.26%	2
0.15% dan 0.25%	1

Stock recommendation fee. These subcriteria can be seen in table 4

Table 4. Sub-criteria stock recommendation fee

Stock recommendation fee	Weight
>Rp.39.999	5
Rp.30.000 – Rp. 39.999	4
Rp. 20.000 – Rp. 29.999	3
Rp. 10.000 – Rp. 19.999	2
<Rp. 10.000	1

Registration Process Time. These subcriteria can be seen in table 5

Table 5. Sub-criteria registration process time

Registration Process time	Weight
>10 day	5
8 day - 10 day	4
5 day -7 day	3
2 day – 4 day	2
<2 day	1

Supporting application rating. These subcriteria can be seen in table 6

Table 6. Sub-criteria supporting application rating

Supporting application ratings	Weight
5.0 - 4.2	5
4.1 - 3.4	4
3.3 – 2.6	3
2.5 – 1.8	2
1.7 – 1	1

Company establishment. These subcriteria can be seen in table 7

Table 7. Sub-criteria company establishment

Company establishment	Weight
>34 year	5

Company establishment	Weight
26 year – 34 year	4
17 yes – 25 year	3
8 year – 16 year	2
< 8 year	1

Customer Service Response. This subcriteria can be seen in table 8

Tabel 8. Sub-criteria customer service response

Customer Service response	Weight
>2 hour	5
1,6 hour – 2 hour	4
1 hour – 1,5 hour	3
0.5 hour – 1 hour	2
< 0.5 hour	1

Features

The author concludes that each securities company offers 31 features. Here prospective investors will choose the desired feature. The selected element will be divided by the total available features. Then, the value obtained from the specified attributes is a maximum of 1 (one) if all components are selected and 0 if no element is selected. The following 31 features can be seen in table 9.

Tabel 9. Features

1	Orderbook	16	Chart Comparison
2	Orderbook detail	17	Buy/sell order
3	Stock order	18	Portfolio list
4	Watch list	19	Trade list
5	Trade watch	20	Market Summary
6	Broker ranking	21	Client Info
7	Stock ranking	22	Cash position
8	Stock trade summary	23	Historical
9	Broker trade summary	24	Running trade
10	Currency	25	IDX Index
11	Commodities	26	Automatic order
12	Global indices	27	Education content
13	Future indices	28	Foreign transaction
14	News&research	29	Margin trading
15	Chart	30	Fitur analysis

Then the weight criteria are given a value of 1-5: The following table matches the level of suitability can be seen in table 10[6].

Tabel 10. Reaches the level of suitability

Reaches the level of suitability	Weight
0.81 – 1	5
0.61 – 0.8	4
0.41 – 0.6	3
0.21 – 0.4	2
0 – 0.2	1

b) Determine the weight of the criteria

In determining the weight for each criterion attribute. It is done with a questionnaire. Then the questionnaire data is calculated using a Likert scale and adjusted to the percentage of values in table 11.

Table 11. Value Percentage

Score	Information	Weight
0% - 19.99%	Very unimportant	1
20% - 39.99%	Not important	2
40% - 59.99%	Enough or neutral	3
60% - 79.99%	Important	4
80% - 100%	Very Important	5

Based on the calculation of the weight of the criteria using a Likert scale, the percentages and weights obtained are as follows, which can be seen in table 12:

Table 12. The weight of the criteria

No	Criteria	Initials	Weight	%
1	Initial deposit fee	C1	5	15%
2	Transaction fee	C2	4	12%
3	Stock recommendation fee	C3	4	12%
4	Registration Process time	C4	4	12%
5	Supporting application ratings	C5	4	12%
6	Company establishment	C6	3	9%
7	Customer Service response	C7	5	15%
8	Features	C8	5	15%

c) Determine the alternative value (W)

$$W = \{0.15; 0.12; 0.12; 0.12; 0.12; 0.09; 0.15; 0.15\}$$

d) Determine the value of the criteria match rating

This study uses four alternative securities companies in South Sumatra. A1 = BNI Securities, A2 = Mirae Asset Securities, A3 = RHB Securities, A4 = Valbury Securities. Data can be seen in table 13.

Table 13. The value of the criteria match rating

Alter Native	Criteria C1	C2	C3	C4	C5	C6	C7	C8
A1	Rp. 1000.000	0.17%, 0.27%	Rp. 0	5	3.4	25	2.5	1-20, 23, 26, 29
A2	Rp. 10.000.000	0.15%, 0.25%	Rp. 0	14	3.8	26	0.5	1-4, 6-9, 14-18, 23, 25-30
A3	Rp. 100.000	0.15%, 0.25%	Rp. 0	3	4	30	1	3-6, 9-21, 23, 28, 29
A4	Rp. 5000.000	0.18%, 0.28%	Rp.0	3	4.6	20	0.5	1, 3, 4, 6-10, 14, 18, 19, 20, 29, 30

then, convert the data to values, as in table 14.

Table 14. Convert data to value

Alternatives	Criteria							
	C1	C2	C3	C4	C5	C6	C7	C8
A1	1	3	1	3	4	3	5	4
A2	5	1	1	5	3	4	2	4
A3	1	1	1	2	4	4	3	4
A4	3	4	1	2	5	3	2	3

e) Determine the decision matrix and normalization.

The following is the formula used, as in formula 1:

$$R_{ij} = \begin{cases} \frac{x_{ij}}{\text{Max}x_{ij}} & \text{If } j \text{ is a benefits attribute} \\ \frac{\text{Min}x_{ij}}{x_{ij}} & \text{If } j \text{ is a cost attribute} \end{cases} \quad (1)$$

When R_{ij} is the normalized value of the performance rating, X_{ij} is the attribute owned, and $\text{Max } X_{ij}$ is the most considerable value for each criterion. $\text{Min } X_{ij}$ is the smallest value for each criterion[15][16].

In the following, the R matrix that has been obtained from the previous data:

1.00	0.33	1.00	0.67	0.80	0.75	0.40	1.00
0.20	1.00	1.00	0.40	0.60	1.00	1.00	1.00
1.00	1.00	1.00	1.00	0.80	1.00	0.67	1.00
0.33	0.25	1.00	1.00	1.00	0.75	1.00	0.75

Next, this is the detailed calculation of the matrix R, which can be seen in table 15.

Table 15. Details of matrix R

$$R_{1,1} = \frac{\text{Min}(1,5,1,3)}{1} = \frac{1}{1} = 1.00 \qquad R_{2,1} = \frac{\text{Min}(1,5,1,3)}{5} = \frac{1}{5} = 0.20$$

$$R_{1,2} = \frac{\text{Min}(3,1,1,4)}{3} = \frac{1}{3} = 0.33 \qquad R_{2,2} = \frac{\text{Min}(3,1,1,4)}{1} = \frac{1}{1} = 1.00$$

$$\begin{aligned}
 R_{1,3} &= \frac{\text{Min}(1,1,1,1)}{1} = \frac{1}{1} = 1.00 & R_{2,3} &= \frac{\text{Min}(1,1,1,1)}{1} = \frac{1}{1} = 1.00 \\
 R_{1,4} &= \frac{\text{Min}(3,5,2,2)}{3} = \frac{2}{3} = 0.67 & R_{2,4} &= \frac{\text{Min}(3,5,2,2)}{5} = \frac{2}{5} = 0.40 \\
 R_{1,5} &= \frac{\text{Max}(4,3,4,5)}{3} = \frac{3}{5} = 0.80 & R_{2,5} &= \frac{\text{Max}(4,3,4,5)}{3} = \frac{3}{5} = 0.60 \\
 R_{1,6} &= \frac{\text{Max}(3,4,4,3)}{3} = \frac{3}{4} = 0.75 & R_{2,6} &= \frac{\text{Max}(3,4,4,3)}{4} = \frac{4}{4} = 1.00 \\
 R_{1,7} &= \frac{\text{Min}(5,2,3,2)}{5} = \frac{2}{5} = 0.40 & R_{2,7} &= \frac{\text{Min}(5,2,3,2)}{2} = \frac{2}{2} = 1.00 \\
 R_{1,8} &= \frac{\text{Max}(4,4,3,4)}{4} = \frac{4}{4} = 1.00 & R_{2,8} &= \frac{\text{Max}(4,4,3,4)}{4} = \frac{4}{4} = 1.00 \\
 R_{3,1} &= \frac{\text{Min}(1,5,1,3)}{1} = \frac{1}{1} = 1.00 & R_{4,1} &= \frac{\text{Min}(1,5,1,3)}{3} = \frac{1}{3} = 0.33 \\
 R_{3,2} &= \frac{\text{Min}(3,1,1,4)}{1} = \frac{1}{1} = 1.00 & R_{4,2} &= \frac{\text{Min}(3,1,1,4)}{4} = \frac{1}{4} = 0.25 \\
 R_{3,3} &= \frac{\text{Min}(1,1,1,1)}{1} = \frac{1}{1} = 1.00 & R_{4,3} &= \frac{\text{Min}(1,1,1,1)}{1} = \frac{1}{1} = 1.00 \\
 R_{3,4} &= \frac{\text{Min}(3,5,2,2)}{2} = \frac{2}{2} = 1.00 & R_{4,4} &= \frac{\text{Min}(3,5,2,2)}{2} = \frac{2}{2} = 1.00 \\
 R_{3,5} &= \frac{\text{Max}(4,3,4,5)}{4} = \frac{4}{5} = 0.80 & R_{4,5} &= \frac{\text{Max}(4,3,4,5)}{5} = \frac{5}{5} = 1.00 \\
 R_{3,6} &= \frac{\text{Max}(3,4,4,3)}{4} = \frac{4}{4} = 1.00 & R_{4,6} &= \frac{\text{Max}(3,4,4,3)}{3} = \frac{3}{4} = 0.75 \\
 R_{3,7} &= \frac{\text{Min}(5,2,3,2)}{3} = \frac{2}{3} = 0.67 & R_{4,7} &= \frac{\text{Min}(5,2,3,2)}{2} = \frac{2}{2} = 1.00 \\
 R_{3,8} &= \frac{\text{Max}(4,4,3,4)}{4} = \frac{3}{4} = 1.00 & R_{4,8} &= \frac{\text{Max}(4,4,3,4)}{4} = \frac{3}{4} = 0.75
 \end{aligned}$$

f) Ranking

The ranking process is carried out using the formula 2:

$$V_i = \sum_{j=1}^n W_j R_{ij} \quad (2)$$

1
Based on the above formula, V_i is the ranking for each alternative, and W_j is the weighted value for each criterion [17].

$$V1 = (1.00 \times 0.15) + (0.33 \times 0.12) + (1.00 \times 0.12) + (0.67 \times 0.12) + (0.80 \times 0.12) + (0.75 \times 0.09) + (0.40 \times 0.15) + (1.00 \times 0.15) = 0.764$$

$$V2 = (0.20 \times 0.15) + (1.00 \times 0.12) + (1.00 \times 0.12) + (0.40 \times 0.12) + (0.60 \times 0.12) + (1.00 \times 0.09) + (1.00 \times 0.15) + (1.00 \times 0.15) = 0.780$$

$$V3 = (1.00 \times 0.15) + (1.00 \times 0.12) + (1.00 \times 0.12) + (1.00 \times 0.12) + (0.80 \times 0.12) + (1.00 \times 0.09) + (0.67 \times 0.15) + (1.00 \times 0.15) = 0.946$$

$$V4 = (0.33 \times 0.15) + (0.25 \times 0.12) + (1.00 \times 0.12) + (1.00 \times 0.12) + (1.00 \times 0.12) + (0.75 \times 0.09) + (1.00 \times 0.15) + (0.75 \times 0.15) = 0.770$$

The final results and ranking of the calculations that have been carried out can be seen in table 16.

1
Tabel 16. Ranking

Ranking	Alternatives	Nilai
1	V3	0.946
2	V2	0.780
3	V4	0.770
4	V1	0.764

3.2 Context Diagram

1
The following is a context diagram of the system created in figure 1.

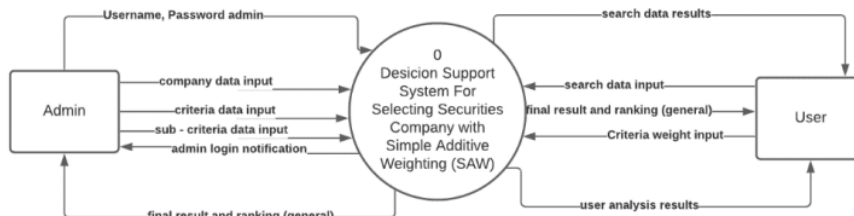


Figure 1. Context diagram

An easy way to create layouts is to use this guide directly. In this context diagram, the data flow is described where the admin will log in with a username and password and get a notification if the login is successful. The admin will input company data, input criteria data, and input sub-criteria. Later, when the system does the calculation, the admin will get the final and ranking of the calculated securities firms. Then on the user entity, the user can search for securities companies according to the criteria selected by the user and can also input criteria weights and obtain recommendations for securities companies according to the inputted consequences. The user will also get offers for securities companies based on value data input based on The results of this study will be inputted by the admin.

3.3 Database Schema

The database schema of this system can be seen in Figure 2.

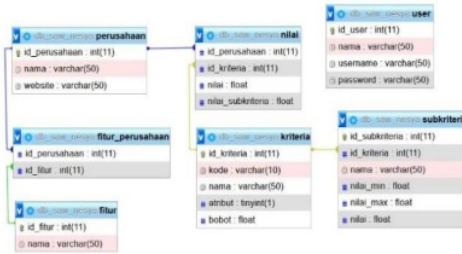


Figure 2. Database schema

3.4 Interface

The following is the result of making a decision support system for selecting a securities company.

a) Administrator

The following in Figure 3 is the main view of the administrator, where the admin must first log in to access the features.



Figure 3. Login

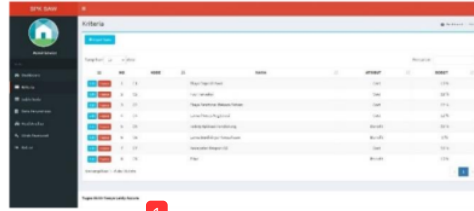
After successfully logging in, give one of the views on the administrator menu, namely the ranking results from the data that has been inputted, as shown in Figure 4. Here are some menus in the admin:

1. Homepage
2. Managing criteria data
3. Managing sub-criteria data
4. Managing company data
5. Viewing analysis results
6. Changing passwords.



Figure 4. Analysis result

In Figure 5, it is one of the views that contain the input, edit, delete processes. In this view, the user can perform the CRUD process on company data, criteria data, and sub-criteria data.



Kriteria	Berat
Keuntungan	0,3
Risiko	0,2
Reputasi	0,2
Stabilitas	0,2
Liquidity	0,1

1
Figure 5. Criteria data**b) User**

On the user page, there are features: home, company data information, search for companies by selecting the desired criteria and searching based on the desired weight, and analysis results. Figure 6 and Figure 7 are the display where the user performs the search process for securities companies.



Figure 6. Search for companies 1



Figure 7. Search for companies 2

4. CONCLUSION

Based on the previously submitted results, a decision support system is made that helps potential investors choose securities companies based on recommendations from administrators or searching with self-determined criteria and weights. This system also provides information for each standard in the securities company, so users can easily see the value of each existing measure. In the application of this decision support system, the Simple Additive weighting method is more suitable to be used in the application of this system. After all, the data presented is quantitative, so the implementation is faster and more precise and following the data presented in this research. It is recommended that this decision support system be developed further to be used more widely in Indonesia, not only in South Sumatra. Then the system should constantly be updated so that the information and data presented is always up-to-date. The system can be used by organizations/forums/ communities and individuals or companies that need a decision supporter in providing recommendations for existing securities companies. This decision support system aims to provide advice that supports the decision maker's decision without replacing the decision. Each user determines the decision of which securities company to choose. The website's appearance looks simple, making it easier for users to use the system.

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