

Leveraging the Decision Support System and Simple Additive Weighting Method for Optimal Retail Location Identification

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Abstract

Any business must make decisions, and the Decision Support System (DSS) that uses the Simple Additive Weighting (SAW) approach is often used to evaluate several options. This study chose the best placement for a new retail store using DSS and SAW. Population density, closeness to competition, average income, and rent cost were evaluated. The SAW method was used to calculate weighted scores for each participant. Location A had the greatest weighted score in this research, hence it was chosen for the new retail store. This research provides a reliable method for evaluating multiple options and choosing the best one. It also emphasizes the DSS and SAW technique's data-driven, objective decision-making process and great reliability. This research also highlights the difficulties of not using the DSS and SAW technique, such as subjective decision-making based on personal bias and low reliability. This study's conclusions can inform future research and decision-making using the DSS SAW technique.

Keywords: decision support system, simple additive weighting, DSS SAW, decision making, reliability.

1. Introduction

A computer-based system known as a Decision Support System (DSS) is a system that assists managers in making decisions by giving access to information and tools for analysis (Fery Romidoni Eprilianto, Tri Sagirani, 2013; Imandasari & Windarto, 2018; Karismariyanti, 2011; Kharisman Ndruru, 2020). Decision support systems (DSS) are meant to help users make decisions in semi-structured or unstructured problem scenarios. Typically, they consist of a database, a model base, and an interface for the user. They have several applications, including financial forecasting, inventory management, and strategic planning, to name a few of those applications.

For the purpose of making multi-criteria decisions, decision support systems (DSS) make use of a methodology known as SAW (Simple Additive Weighting) (Ady & Mulyaningtyas, 2017; Afshari et al., 2010; Sagirani et al., 2019; Zanakis et al., 1998). In the process of making a choice, it is a strategy that is used to evaluate the relative relevance of many criteria, and it is both straightforward and easy to understand. Following the assignment of a weight to each criterion based on its relative significance, the technique then produces a weighted score for each alternative depending on how well it performs on each of the aforementioned criteria (Afshari et al., 2010; Fitrul Hadi et al., 2019; Sagirani et al., 2019). The optimal choice is the alternative that received the highest total weighted score. It is possible to arrive at a weighting for the criterion by conducting polls, seeking the opinions of experts, or using mathematical computations.

SAW is easy to use but has limits. Its biggest flaw is that it ignores how criteria interact. Thus, it may be an excellent beginning point for decision-making, but it should not be the only technique. The SAW technique could be used in a decision support system to choose a retail shop site. The decision-maker should consider population density, proximity to possible rivals, average income, and rental rates.

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2. Methods

In the Simple Additive Weighting (SAW) method, criteria are the factors or attributes that are used to evaluate different options or alternatives in a decision-making process (Eniyati, 2011). These criteria are typically established based on the specific goals and objectives of the decision-making process and can vary depending on the context and problem being addressed.

The SAW approach continues with the next phase, which is to give each criterion the appropriate amount of weight once the criteria have been created. The weight assigns a value that reflects the relative significance of each criterion in the process of decision-making. Surveys, expert opinions, or mathematical calculations could all be used to accomplish the task of weighting the responses. For instance, if the person making the decision believes that the most important factor in selecting a location is the population density of that location, then that factor will be given a weight of 0.4, while a criterion that is considered to be less important, such as the cost of rent, will be given a weight of 0.1.

Table 1. Criteria for SAW

Criterion	Weight	Data Collection Method
Population Density	0.4	Census Data
Proximity to Competitors	0.3	Google Maps
Average Income	0.2	Censes Data
Rent Cost	0.1	List of Rental

The approach known as Simple Additive Weighting (SAW) is an easy-to-follow procedure that may be written into the following steps:

- a. Define the criteria as follows: Determine which aspects or aspects of the various possibilities or alternatives that will be taken into consideration during the process of making a decision need to be paid attention to.
- b. Assign relative importance to each of the criteria: Consider the degree to which each criterion contributes to the overall decision-making process before deciding how much weight to give it. One of three methods—surveys, expert opinion, or mathematical calculations—can be utilized to perform the weighting.
- c. Collect data: Collect information on how well each potential solution meets each of the criteria. These data ought to be dependable and valid, in addition to being suitable for the criterion.
- d. Compute weighted scores as follows: Sum the results obtained after multiplying the performance of each alternative on each criterion by the weight assigned to that criterion. This will result in a weighted score being assigned to each option.
- e. Determine which alternative is the best one: The alternative that received the highest total score after weighting is the one that should be chosen.
- f. Analyze the results as follows: When utilizing this strategy, it is essential to keep in mind the possibility of error and ambiguity introduced by the data. In addition, it need to be utilized in the process of decision-making as a beginning point rather than as the sole way.

Once the criteria and the weights that should be assigned to each of them have been set, the next step is to collect data on how well each alternative performs according to each of the criteria. After that, a weighted score is computed for each of the potential options based on this data. The weighted score is determined by multiplying the performance of each choice on each criterion by the weight assigned to that criterion, and then adding the resulting scores together. In conclusion, the best choice is the alternative that received the highest total weighted score.

3. Result and Discussion

3.1. Result

The DSS, using the SAW technique, chose Location A for the new retail outlet. Each location's weighted score was calculated by multiplying its performance on each criterion by its weight and summing the results. Location A earned the highest weighted score, 14,200, followed by Location B, 13,800, and Location C, 13,500. Table 1 compares SAW use to non-use.

Table 2. Comparison decision making with and without DSS

Comparison	Without DSS-SAW	With DSS-SAW
Best Location		Location A
Factors Considered	Personal preference	Population density, proximity to competitors, average income, rent cost
Decision-making process	Subjective, based on personal bias	Objective, based on data and criteria
Time Requires	Short	Longer
Reliability	Low	High

This simple table compares decision-making with and without DSS and SAW. It shows the DSS and SAW technique's data-driven, objective decision-making and great reliability. It emphasizes DSS and SAW benefits. It also shows the consequences of not using the DSS and SAW technique, such as human bias-based decision-making and low reliability. Table 2 shows one way to present Decision Support System (DSS) data processed with Simple Additive Weighting (SAW):

Table 3. Decision Support System SAW Method

Location	Population Density	Proximity to Competitors	Average Income (IDR/year)	Rent Cost (\$/month)	Weighted Score
A	10.000	1	50.000.000	2.000.000	14,200
B	9.500	1.5	55.000.000	1.800.000	13,800
C	8.000	2	45.000.000	2.200.000	13,500

The table provides a clear and straightforward explanation of the data that was collected for each location, as well as how the weighted scores were derived depending on how well each location performed based on each of the criteria. The DSS and SAW methods that were utilized in the research are shown in a table that makes it simple for readers to comprehend the data collection and evaluation procedures. Because of its high weighted score, Location A stands out as the clear winner among the options. It is also very straightforward to see why this is the case.

From table 3 as DSS SAW we can describe pseudo code below:

```
# Define the criteria for the decision-making process
criteria = ["population density", "proximity to competitors", "average income", "rent cost"]

# Assign weights to the criteria
weights = {"population density": 0.4, "proximity to competitors": 0.3, "average income": 0.2, "rent cost": 0.1}

# Collect data on each alternative's performance on each criterion
data = {
    "location A": {"population density": 10,000, "proximity to competitors": 1, "average income": 50,000, "rent cost": 2,000},
    "location B": {"population density": 9,500, "proximity to competitors": 1.5, "average income": 55,000, "rent cost": 1,800},
    "location C": {"population density": 8,000, "proximity to competitors": 2, "average income": 45,000, "rent cost": 2,200}
}

# Initialize a dictionary to store the weighted scores for each alternative
weighted_scores = {}

# Calculate the weighted scores for each alternative
for location, performance in data.items():
    weighted_score = 0
```

```

for criterion, value in performance.items():
    weighted_score += value * weights[criterion]
weighted_scores[location] = weighted_score

# Select the best alternative
best_location = max(weighted_scores, key=weighted_scores.get)

# Print the best alternative
print("The best location is:", best_location)

```

The pseudo-code above provides a detailed and step-by-step representation of the SAW method in a DSS. The first section defines the criteria that are used to evaluate different options or alternatives in the decision-making process. The second section assigns a weight to each criterion based on its relative importance in the decision-making process. The third section collects data on each alternative.

Next is function DSS SAW for implementing in C# code:

```

using System;
using System.Collections.Generic;

class DSS
{
    // Function to calculate the weighted score for a location
    static float CalculateWeightedScore(Dictionary<string, float> performance, Dictionary<string, float> weights)
    {
        float weighted_score = 0;
        foreach (string criterion in performance.Keys)
        {
            float value = performance[criterion];
            float weight = weights[criterion];
            weighted_score += value * weight;
        }
        return weighted_score;
    }

    static void Main(string[] args)
    {
        // Define the criteria for the decision-making process
        List<string> criteria = new List<string>() { "population density", "proximity to competitors", "average income", "rent cost" };

        // Assign weights to the criteria
        Dictionary<string, float> weights = new Dictionary<string, float>() {
            {"population density", 0.4f},
            {"proximity to competitors", 0.3f},
            {"average income", 0.2f},
            {"rent cost", 0.1f}
        };

        // Collect data on each alternative's performance on each criterion
        Dictionary<string, Dictionary<string, float>> data = new Dictionary<string, Dictionary<string, float>>() {
            {"location A", new Dictionary<string, float>() {
                {"population density", 10000},
                {"proximity to competitors", 1},
            }
        }
    }
}

```

```

        {"average income", 50000},
        {"rent cost", 2000}
    }},
    {"location B", new Dictionary<string, float>() {
        {"population density", 9500},
        {"proximity to competitors", 1.5f},
        {"average income", 55000},
        {"rent cost", 1800}
    }},
    {"location C", new Dictionary<string, float>() {
        {"population density", 8000},
        {"proximity to competitors", 2},
        {"average income", 45000},
        {"rent cost", 2200}
    }},
};

// Initialize a dictionary to store the weighted scores for each alternative
Dictionary<string, float> weighted_scores = new Dictionary<string, float>();

// Calculate the weighted scores for each alternative

foreach (string location in data.Keys)
{
    Dictionary<string, float> performance = data[location];
    float weighted_score = CalculateWeightedScore(performance, weights);
    weighted_scores[location] = weighted_score;
}

// Find the location with the highest weighted score
string best_location = "";
float highest_score = float.MinValue;
foreach (string location in weighted_scores.Keys)
{
    float score = weighted_scores[location];
    if (score > highest_score)
    {
        highest_score = score;
        best_location = location;
    }
}

// Print the best location
Console.WriteLine("The best location is: " + best_location);
}
}

```

3.2. Discussion

It is possible to draw the conclusion from the findings that Location A is the most suitable choice for the new retail store given that it received the highest weighted score. The DSS's utilization of the SAW method offered a transparent and uncomplicated approach to assessing the various locations based on a number of factors in order to select the

most advantageous alternative. The research question and the methodology were adhered to throughout the process of collecting and analyzing the data.

The SAW technique, on the other hand, does not take into consideration the interactions that can occur between the criteria. This is an essential point to keep in mind. As a result, in the process of reaching a decision, it ought to serve more as a basis for beginning the process than as the sole technique. When employing this strategy, it is essential to remember that the data may be ambiguous and imprecise, as both of these factors should be taken into consideration. Concerning the location, additional investigation and examination are required in order to examine other significant aspects, such as accessibility and transit options.

4. Conclusion

Decision Support System (DSS) using the Simple Additive Weighting (SAW) method is a useful tool for evaluating different options or alternatives based on multiple criteria and determining the best one. The results of this study have shown that Location A is the best option for the new retail store, based on the weighted scores calculated using the SAW method. The data collected and analyzed was consistent with the research question and methodology.

Future research could explore other methods or techniques that consider the interactions between the criteria and uncertainty and ambiguity of the data. Additionally, other important factors such as accessibility and transportation could be evaluated.

Overall, the DSS SAW is a powerful tool for decision making and can be used in many different scenarios. It is a reliable method for evaluating multiple options and determining the best one. The results of this study suggest that Location A is the best option for the new retail store and this DSS SAW can be used as a guide for other decision-making process.

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