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Additive Ratio Assessment (ARAS) Method for Selecting English Course Branch Locations

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Abstract. The research was conducted to overcome the problem of selecting a location for the opening of a new branch of the Murni Sadar English Course. The increasing need for the community to learn English has made Murni Sadar English Course to expand and open a branch of English courses in a new location. This problem is overcome by designing a support system that functions to help facilitate the selection of new branch locations. This DSS is designed using the Additive Ratio Assessment (ARAS) method using 5 criteria: population density level, access to locations, crowd level, rental costs, and population income. From the results of this study it is concluded that the ARAS method is very appropriate to be used as a tool in decision support where the best alternative location is Patuan_Anggi_Street with an alternative value of 0.1778.

1. Introduction

In today's all-digital era, everyone is increasingly required to master various abilities along with the times. One of them is the ability of English. It is no secret that the era of globalization requires people to be able to speak English. This is because English is an international language that can connect people from different countries to communicate without being constrained by not understanding. Besides, speaking English is a skill that is urgently needed and sought after by many companies. Because by having employees who are fluent in English, the company can have people who can be relied on for cooperation needs with foreign companies.

Naturally, in the end, many people who are not yet able to speak English look for an English course so they can increase their knowledge of English. This is why many English language courses have started to emerge. Taking English courses is beneficial for getting English language guidance and can increase self-confidence to learn to communicate in English. Learning can be done anywhere. However, when taking courses, we will focus more because the main goal is learning.

Realizing the public's need for English knowledge, Murni Sadar English Course in Pematangsiantar City intends to open branches in several locations in Pematangsiantar city. However, determining this branch opening's location is still challenging to determine because of many factors that need to be considered. Therefore, to overcome the problem of choosing a location for opening a branch of the course business, a decision support system was designed to help facilitate the Murni Sadar English Course in determining the location of the new branch to be opened.
Currently, computer-based technology has been widely used to make work easier [1]–[4]. Likewise, in decision making, Decision Support Systems (DSS) have been widely implemented to make it easier for management to make decisions [5]–[8]. DSS has various methods that have been applied in various fields of life, both in the areas of education, economy and business, offices, and so on [9]–[12], [13]–[15]. Therefore, to assist Murni Sadar English Course in selecting branch openings locations in new locations, a decision support system was designed. This decision support system was built using the Additive Ratio Assessment (ARAS) method. The ARAS method is now widely used in various fields to help facilitate decision-making. By designing a decision support system using the ARAS method, choosing a location for the opening of an English course branch at Murni Sadar English Course can be done easily and quickly.

2. Methodology

Data processing with the Additive Ratio Assessment (ARAS) method involves criteria and weights in the calculation process to obtain the best alternative. The criteria used to consist of Population Density Level, Access to Locations, Crowd Level, Rental Costs, and Population Income.

![Research Framework](image)

**Table 1. Site Selection Criteria**

| Criteria | Information                  |
|----------|------------------------------|
| C1       | Population Density Level     |
| C2       | Access to Locations          |
| C3       | Crowd Level                  |
| C4       | Rental Costs                 |
| C5       | Population Income            |

**Table 2. Weight Value**

| Weight | Value |
|--------|-------|
| Very Low | 1     |
| Low    | 2     |
| Moderate | 3     |
| High   | 4     |
| Very High | 5     |

Data processing with the ARAS method involves criteria and weights in the calculation process to obtain the best alternative. The criteria used to consist of Population Density Level, Access to Locations, Crowd Level, Rental Costs, and Population Income.

**Table 3. Alternative Location and Value of Each Criteria**

| Alternative          | Score each Criteria |
|----------------------|---------------------|
|                      | C1  | C2  | C3  | C4  | C5  |
| Kartini_Street       | 3   | 4   | 5   | 3   | 4   |
| Sriwijaya_Street     | 4   | 5   | 3   | 4   | 4   |
| Patuan_Anggi_Street  | 5   | 5   | 5   | 2   | 5   |
| Jawa_Street          | 4   | 4   | 3   | 4   | 4   |
| Toba_Street          | 4   | 4   | 3   | 3   | 5   |

| Criteria Type      | max | max | max | max | max |

Figure 1. Research Framework

Data processing in the decision support system for choosing a location for the opening of a branch course at Murni Sadar English Course with the ARAS method is carried out using data from each alternative contained in table 3. The data processed in the decision support system for choosing a location for the opening of an English course branch at Murni Sadar English Course using the ARAS method is carried out using data from each alternative as shown in table 3. Each criterion is given a weight based on the level of importance of each required criterion, which is as follows: [0.26, 0.28, 0.14, 0.17, 0.15].
3. Result and Discussion

After obtaining each alternative's value from the alternative location for the opening of a new branch by the Murni Sadar English Course, the Decision Making Matrix (DDM) is normalized for all the criteria. The normalization results are obtained as below:

\[
X = \begin{bmatrix}
0.2 & 0.1852 & 0.2083 & 0.2 & 0.1852 \\
0.12 & 0.1481 & 0.2083 & 0.15 & 0.1481 \\
0.16 & 0.1852 & 0.125 & 0.2 & 0.1481 \\
0.2 & 0.1852 & 0.2083 & 0.1 & 0.1852 \\
0.16 & 0.1481 & 0.125 & 0.2 & 0.1481 \\
\end{bmatrix}
\]

The next step is to determine the normalized weight by multiplying the normalized matrix with the criteria weights in the following way.

\[
D_{01} = X_{01} \times W_1 = 0.2 \times 0.26 = 0.052 \\
D_{11} = X_{11} \times W_1 = 0.12 \times 0.26 = 0.0312 \\
D_{21} = X_{21} \times W_1 = 0.16 \times 0.26 = 0.0416 \\
D_{31} = X_{31} \times W_1 = 0.2 \times 0.26 = 0.052 \\
D_{41} = X_{41} \times W_1 = 0.16 \times 0.26 = 0.0416 \\
D_{51} = X_{51} \times W_1 = 0.16 \times 0.26 = 0.0416 \\
D_{02} = X_{02} \times W_2 = 0.1852 \times 0.28 = 0.0519 \\
D_{12} = X_{12} \times W_2 = 0.1481 \times 0.28 = 0.0415 \\
D_{22} = X_{22} \times W_2 = 0.1852 \times 0.28 = 0.0519 \\
D_{32} = X_{32} \times W_2 = 0.1852 \times 0.28 = 0.0519 \\
D_{42} = X_{42} \times W_2 = 0.1481 \times 0.28 = 0.0415 \\
D_{52} = X_{52} \times W_2 = 0.1481 \times 0.28 = 0.0415 \\
D_{03} = X_{03} \times W_3 = 0.2083 \times 0.14 = 0.0292 \\
D_{13} = X_{13} \times W_3 = 0.2083 \times 0.14 = 0.0292 \\
D_{23} = X_{23} \times W_3 = 0.125 \times 0.14 = 0.0175 \\
D_{33} = X_{33} \times W_3 = 0.2083 \times 0.14 = 0.0292 \\
D_{43} = X_{43} \times W_3 = 0.125 \times 0.14 = 0.0175 \\
D_{53} = X_{53} \times W_3 = 0.125 \times 0.14 = 0.0175 \\
D_{04} = X_{04} \times W_4 = 0.2 \times 0.17 = 0.034 \\
D_{14} = X_{14} \times W_4 = 0.15 \times 0.17 = 0.0255 \\
D_{24} = X_{24} \times W_4 = 0.2 \times 0.17 = 0.034 \\
D_{34} = X_{34} \times W_4 = 0.1 \times 0.17 = 0.017 \\
D_{44} = X_{44} \times W_4 = 0.2 \times 0.17 = 0.034 \\
D_{54} = X_{54} \times W_4 = 0.15 \times 0.17 = 0.0255 \\
D_{05} = X_{05} \times W_5 = 0.1852 \times 0.15 = 0.0278 \\
D_{15} = X_{15} \times W_5 = 0.1481 \times 0.15 = 0.0222 \\
D_{25} = X_{25} \times W_5 = 0.1481 \times 0.15 = 0.0222 \\
D_{35} = X_{35} \times W_5 = 0.1852 \times 0.15 = 0.0278 \\
D_{45} = X_{45} \times W_5 = 0.1481 \times 0.15 = 0.0222 \\
D_{55} = X_{55} \times W_5 = 0.1852 \times 0.15 = 0.0278
\]

From the above calculations, the following matrix can be obtained:
The next stage is carried out by determining the optimum function's value by adding up the criterion values for each alternative of the multiplication matrix with the weight from the previous step.

\[
\begin{align*}
S_0 &= 0.052 + 0.0519 + 0.0292 + 0.034 + 0.0278 = 0.1948 \\
S_1 &= 0.0312 + 0.0451 + 0.0292 + 0.0255 + 0.0222 = 0.1496 \\
S_2 &= 0.0416 + 0.0519 + 0.0175 + 0.034 + 0.0222 = 0.1672 \\
S_3 &= 0.052 + 0.0519 + 0.0292 + 0.017 + 0.0278 = 0.1778 \\
S_4 &= 0.0416 + 0.0415 + 0.0175 + 0.034 + 0.0222 = 0.1568 \\
S_5 &= 0.0416 + 0.0415 + 0.0175 + 0.0255 + 0.0278 = 0.1539
\end{align*}
\]

The results of the ranking level table for each alternative can be obtained from the above calculations, such as the data in table 4.

| Alternative       | C1    | C2    | C3    | C4    | C5    | K      |
|-------------------|-------|-------|-------|-------|-------|--------|
| A0                | 0.052 | 0.0519| 0.0292| 0.034 | 0.0278| 0.1948 |
| Kartini_Street    | 0.0312| 0.0415| 0.0292| 0.0255| 0.0222| 0.1496 |
| Sriwijaya_Street  | 0.0416| 0.0519| 0.0175| 0.034 | 0.0222| 0.1672 |
| Patuan_Anggi_Street| 0.052 | 0.0519| 0.0292| 0.017 | 0.0278| 0.1778 |
| Jawa_Street       | 0.0416| 0.0415| 0.0175| 0.034 | 0.0222| 0.1568 |
| Toba_Street       | 0.0416| 0.0415| 0.0175| 0.0255| 0.0278| 0.1539 |

So from the calculation of each alternative, where the value of each alternative is divided by A0 to produce a Utility value which will be used as a ranking level to select the best new branch locations from several criteria with the highest results.

![Ranking Results Graph](image)

From the calculations and ranking in figure 2 above, it can be seen that in selecting the best new Branch Location for Murni Sadar English Course must meet the criteria by getting the highest score. The best location is the alternative, namely Patuan_Anggi_Street.
4. Conclusion

Based on the results of the Decision Support System's application for choosing a new branch location for Murni Sadar English Course, it can be concluded that selecting a location for selecting a new branch of the English course business can be done easily and quickly. Decision Support System (DSS) location selection for this new branch is carried out using the Additive Ratio Assessment (ARAS) method, which consists of 5 criteria: Population Density Level, Access to Locations, Crowd Level, Rental Costs, and Population Income.

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