Implementation of Computer-Based Systems in Efficient Credit Acceptance Decisions Applying the Additive Ratio Assessment (ARAS) Method

Supriyanto¹, Mesran², Diding Kusnady³, Weny⁴, Murtopo⁵

¹Politeknik LP3I Medan, Medan, Indonesia
²STMIK Budi Darma, Medan, Indonesia
³Politeknik Ganesha Medan, Medan, Indonesia
⁴Akademi Sekretari Manajemen Cendana, Medan, Indonesia
⁵Politeknik Negeri Media Kreatif, Medan, Indonesia

*mesran.skom.mkom@gmail.com

Abstract. The development of computer-based systems, increasingly helping the banking world, in doing work efficiency in a bank. Especially in selecting credit recipients at the bank. This is needed so that the resulting decision can be valued objectively and effectively for management. In processing credit receipt decisions, using an information system known as the Decision Support System (SPK). The selection of credit recipients requires alternatives and criteria so that the information retrieval process can run well. By applying the Additive Ratio Assessment (ARAS) method, decision-makers can produce better calculations. ARAS is a method for decision-based support.

1. Introduction

Banks have a very important role in the development of the people's economy. One form of bank service for the public is credit distribution. Lending in a bank plays an important role in helping to solve financial problems for the community. In granting credit the bank must conduct careful research and calculation of the customer. The ability of banks to make quick and careful decisions will be the key to success in banks to extend credit in the global competition in the future.

The existence of credit activities at a bank is certainly one of the benefits for the bank, including the customers who will be selected based on income, age, occupation, collateral, and the number of dependents. Problems that are often encountered by banks in lending include the determination of credit recipients. Every customer who is entitled to get credit from the bank is a customer who has predetermined criteria. Customers will be selected based on income, age, occupation, guarantee, and a number of dependents. But selection without using a computer-based information system, it will produce decisions that are not good, because decisions are made personally and tend to be manipulated. The use of assistive devices, in this case, the computer system in the form of a decision support system (SPK) is considered appropriate to avoid the fraud caused[1]–[4].

Decision Support System (SPK) is a computer-based system that is able to produce the best alternative decisions to support decisions taken by decision-makers. In its application, SPK uses methods in producing the best alternatives, such as VIKOR, ARAS, ELECTRE[5], [6]
In this study, the authors tried to conduct research for credit-granting decisions by implementing a computer-based information system known as a decision support system by applying the Additive Ratio Assessment (ARAS) method.

2. Methodology
Much research has been done by using DSS in generating effective decisions such as that of Syafrida in selling used laptops [7], Determination of work incentive recipients applying VIKOR [8]. In this study, the authors used the ARAS method in determining bank credit recipients.

The Additive Ratio Assessment (ARAS) method is a method used to rank criteria for decision making. In the ranking process, the ARAS method has several steps that must be carried out [9]–[11], namely:

Step-1: Formation of the Decision Making Matrix

\[
X = \begin{bmatrix}
X_{01} & X_{0j} & \cdots & X_{0n} \\
X_{1i} & X_{ij} & \cdots & X_{in} \\
\vdots & \vdots & \ddots & \vdots \\
X_{m1} & X_{mj} & \cdots & X_{mn}
\end{bmatrix} (i = 0, m; \ j = 1, n) 
\]  

Information

\( m \) = number of alternatives
\( n \) = number of criteria
\( X_{ij} \) = performance value of alternative \( i \) to criterion \( j \)
\( X_{0j} \) = optimum value of criterion \( j \)

For the value of \( X_{0j} \) obtained from the maximum/minimum value of the criteria column according to the type of maximum or minimum criteria.

Step-2: Normalize the decision matrix

If the Beneficial criteria are normalized, follow:

\[
R_{ij} = \frac{X_{ij}}{\sum_{i=0}^{m} X_{ij}} 
\]  

\( R_{ij} \) is a normalized matrix.

If the criteria are Non-Beneficial, then normalization follows:

Stage-1: \( X_{ij}^* = \frac{1}{X_{ij}} \)  

Stage-2: \( R_{ij} = \frac{X_{ij}^*}{\sum_{m}^{m} X_{ij}^*} \)  

Step-3: Determine the normalized matrix weight

\[
D = [d_{ij}]m \times n = R_{ij}.W_{j} 
\]  

Step-4: Determine the value of the optimization function (\( S_i \))

\[
S_i = \sum_{j=1}^{n} d_{ij}; (i = 1,2,..,m; j = 1,2,..,n) 
\]  

Step-5: Determine the highest rank level

\[
i = \frac{S_i}{S_0} 
\]  

\( S_i \) and \( S_0 \) are the optimality criteria values, which are obtained from the equation. \( U_i \) values are calculated at intervals [0,1].

3. Result and Discussion

In the process of granting credit to customers, a customer must meet all the requirements or criteria set by management. The expected results of the selection of credit are expected to be objective so as to
avoid the element of data manipulation. In computer-based systems, especially decision support systems require several conditions or criteria needed in granting credit, namely:

| Criteria                          | Weighted | Type |
|----------------------------------|----------|------|
| Business Turnover (C1)           | 0.457    | Benefit |
| Customer Revenue (C2)            | 0.257    | Benefit |
| Value of Guarantee (C3)          | 0.157    | Benefit |
| Number of Dependents (C4)        | 0.090    | Cost |
| Age (C5)                         | 0.040    | Cost |

Weights against the criteria in Table 1 are obtained by applying the Centroid Rank Order method. The alternatives will be processed as many as 5 alternatives, namely Heriansyah (A1), Muhammad Doni (A2), Siregar (A3), Kiki Prasetia (A4), and Karen (A5). In Table 2 are alternative data and criteria.

| Alternative | C1          | C2     | C3     | C4 | C5 |
|-------------|-------------|--------|--------|----|----|
| A1          | 43 Million  | 2.5 Million | 51 Million | 3  | 40 |
| A2          | 41 Million  | 3 Million  | 49 Million | 5  | 45 |
| A3          | 43 Million  | 2.75 Million | 48 Million | 2  | 50 |
| A4          | 49 Million  | 3.25 Million | 55 Million | 3  | 48 |
| A5          | 44 Million  | 2.9 Million  | 45 Million | 4  | 49 |

From Table 2 above, the matching data is obtained in the form of a match rating, as shown in Table 3 as follows.

| Alternative | C1 | C2 | C3 | C4 | C5 |
|-------------|----|----|----|----|----|
| A1          | 43 | 2.5 | 51 | 3  | 40 |
| A2          | 41 | 3  | 49 | 5  | 45 |
| A3          | 43 | 2.75 | 48 | 2  | 50 |
| A4          | 49 | 3.25 | 55 | 3  | 48 |
| A5          | 44 | 2.9 | 45 | 4  | 49 |

After the compatibility rating is known, it can be obtained by using a computer-based information system that data will be obtained by applying the ARAS method. The initial steps taken are determining the decision matrix (X0) as follows:

| Alternative | C1 | C2 | C3 | C4 | C5 |
|-------------|----|----|----|----|----|
| A0          | Max| Max| Max| Min| Min|
| A1          | 49 | 3.25 | 55 | 2  | 40 |
| A2          | 43 | 2.5 | 51 | 3  | 40 |
| A3          | 41 | 3  | 49 | 5  | 45 |
| A4          | 43 | 2.75 | 48 | 2  | 50 |
| A5          | 49 | 3.25 | 55 | 3  | 48 |
For the value of $A_0$, obtained from the maximum or minimum value according to the type of criteria used. Furthermore, by using equations 2, 3 and 4 the normalized matrix is obtained, the results are shown in Table 4.

### Table 5. Normalized Matrix ($R_{ij}$)

| Alternative | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ |
|-------------|------|------|------|------|------|
| $A_0$       | Max  | Max  | Max  | Min  | Min  |
|             | 0.1822 | 0.1841 | 0.1815 | 0.2362 | 0.1873 |
| $A_1$       | 0.1599 | 0.1416 | 0.1683 | 0.1575 | 0.1873 |
| $A_2$       | 0.1524 | 0.1700 | 0.1617 | 0.0945 | 0.1665 |
| $A_3$       | 0.1599 | 0.1558 | 0.1584 | 0.2362 | 0.1499 |
| $A_4$       | 0.1822 | 0.1841 | 0.1815 | 0.1575 | 0.1561 |
| $A_5$       | 0.1636 | 0.1643 | 0.1485 | 0.1181 | 0.1529 |

After calculating the normalized matrix, the next step is to determine the weighted normalized matrix. This step uses equation 5. The results of the weighted normalized matrix are obtained in Table 5.

### Table 6. The Weighted of Normalization Matrix (D)

| Alternative | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ |
|-------------|------|------|------|------|------|
| $A_0$       | Max  | Max  | Max  | Min  | Min  |
|             | 0.0832 | 0.0473 | 0.0285 | 0.0213 | 0.0075 |
| $A_1$       | 0.0731 | 0.0364 | 0.0264 | 0.0142 | 0.0075 |
| $A_2$       | 0.0697 | 0.0437 | 0.0254 | 0.0085 | 0.0067 |
| $A_3$       | 0.0731 | 0.0400 | 0.0249 | 0.0213 | 0.0060 |
| $A_4$       | 0.0832 | 0.0473 | 0.0285 | 0.0142 | 0.0062 |
| $A_5$       | 0.0748 | 0.0422 | 0.0233 | 0.0106 | 0.0061 |

The next process determines the optimal function with equation 6. The results of the calculations obtained optimal function ($S_i$) seen in Table 6.

### Table 7. The Weighted Normalization Matrix (D)

| Alternative | $S_i$ |
|-------------|------|
| $A_0$       | 0.1878 |
| $A_1$       | 0.1575 |
| $A_2$       | 0.1539 |
| $A_3$       | 0.1652 |
| $A_4$       | 0.1795 |
| $A_5$       | 0.1570 |

The final step determines the highest-ranking level ($U_i$) using equation 7.

$S_1 = 0.1575 / 0.1878 = 0.839$
$S_2 = 0.1539 / 0.1878 = 0.819$
$S_3 = 0.1652 / 0.1878 = 0.880$
$S_4 = 0.1795 / 0.1878 = 0.956$
$S_5 = 0.1570 / 0.1878 = 0.836$
Table 8. The highest-ranking level \((U_i)\) and alternative rank

| Alternative | \(U_i\) | Rank |
|-------------|--------|------|
| A_1         | 0.839  | 3    |
| A_2         | 0.819  | 5    |
| A_3         | 0.880  | 2    |
| A_4         | 0.956  | 1    |
| A_5         | 0.836  | 4    |

From the calculation using the ARAS method, it appears that \(A_4 > A_3 > A_1 > A_5 > A_2\), so it can be concluded that \(A_4\) (Kiki Prasetia) is the highest-ranked customer and deserves to be given credit.

4. Conclusion

From the research conducted it can be concluded that the determination of the criteria in selecting credit recipients greatly affects the calculation that occurs. The application of the ARAS method is quite easy to apply to computer-based information systems, making it easier for banks to determine credit recipients. Decision support systems can overcome the problem of receiving a credit to be more systematic and appropriate for customers or the public who really need credit. Computer-based systems can reduce fraud caused by credit selectors.

References

[1] S. Kusumadewi, S. Hartati, A. Harjoko, and Retantyo Wardoyo, “Fuzzy Multi Attribute Decision Making (FUZZY MADM),” Ed. Pertama Cetakan Pertama. Graha Ilmu. Yogyakarta., 2006.
[2] G.-H. Tzeng and J.-J. Huang, Multiple Attribute Decision Making Method And Applications. CRC Press, 2011.
[3] D. Nofriansyah and S. Defit, Multi Criteria Decision Making \((MCDM)\) pada Sistem Pendukung Keputusan. 2018.
[4] D. Nofriansyah, Konsep Data Mining Vs Sistem Pendukung Keputusan. 2015.
[5] D. Siregar et al., “Multi-Attribute Decision Making with VIKOR Method for Any Purpose Decision,” J. Phys. Conf. Ser., vol. 1019, no. 1, 2018.
[6] A. Yanie et al., “Web Based Application for Decision Support System with ELECTRE Method,” J. Phys. Conf. Ser., vol. 1028, no. 1, 2018.
[7] S. H. Sahir, R. Rosmawati, and R. Rahim, “Fuzzy model tahani as a decision support system for selection computer tablet,” Int. J. Eng. Technol., vol. 7, no. 2.9, pp. 61–65, 2018.
[8] M. Mesran et al., “The VIKOR Method to Support the Effectiveness of Decisions in Determining Work Incentive Recipients,” J. Phys. Conf. Ser., vol. 1175, p. 012043, 2019.
[9] S. Dharma Hardi et al., “Implementation of Computer Based Systems for Effective Decisions in Acceptance of Vikar,” Int. J. Eng. Technol., vol. 7, no. 3, pp. 101–104, 2018.
[10] Esra; and AyGeğül, “AIR CONDITIONER SELECTION PROBLEM WITH COPRAS AND ARAS METHODS,” Manas J. Soc. Stud., vol. 5, no. 2, 2016.
[11] E. K. Zavadskas and Z. Turskis, “A new additive ratio assessment \((ARAS)\) method in multicriteria decision - making,” vol. 8619, 2011.