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CREDIT ACCEPTANCE DECISION SUPPORT SYSTEM, A COMPARISON OF SAW, TOPSIS, AND SAW–TOPSIS METHODS

I Putu Eka Sudarsana

Universitas Pendidikan Ganesha, Banjar Tegal, Singaraja, Kabupaten Buleleng, Bali 81116, Indonesia

E-mail: eka.sudarsana@poltekelbajo.ac.id

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ABSTRACT

This study aims to compare the three methods of Decision Support Systems in assessing/recommending the provision of business credit at the Karya Sejahtera Cooperative. The three methods are: Simple Additive Weighting (SAW), Technique for Order by Similarity to Ideal Solution (TOPSIS), and a combination of the SAW and TOPSIS methods using five criteria, namely: Guarantee, Income, Loan Application Form, Business Establishment Permit, Land Building Tax. In addition to comparing methods, method testing was also carried out. It aims to find the most appropriate/relevant method in conducting the assessment. The test method uses the mean average precision technique which tests the accuracy of the debtor ranking. The comparison between the SAW, TOPSIS, and SAW-TOPSIS methods was tested using the mean average precision technique which shows that based on the test results of each method, the SAW - TOPSIS method is the method with the best accuracy when using the top 10 data rankings with a value of 83.7%. With a MAP test rating of 66%, the TOPSIS technique is the method with the second best accuracy when using the top 10 ranking data. In testing utilizing the MAP methodology, the SAW method had the third best accuracy when using the top 10 ranking data, with a value of 54.3%. The MAP test findings suggest that future research methods can include many methods for comparing outcomes, and the results of the calculation analysis can be further developed by adding data and being evaluated using other testing procedures to obtain different results.

1. Introduction

Poverty is a major issue that emerging countries face when compared to developed countries. Due to a lack of job opportunities, there is a high rate of unemployment, which raises the poverty rate. As a result, it is vital to increase employment and foster entrepreneurship. Funds is a vital component of being an entrepreneur, and one way to supply capital to an entrepreneur is through business loans. Credit has an impact on the economy of a country; credit distribution can enhance development in numerous sectors; working capital credit can expand businesses, resulting in a rise in labor demand. Credit is used not only to provide money for the community's businesses, but also to meet their daily necessities.

The Karya Sejahtera Savings and Loan Cooperative has been operating in Batunya Village, Baturiti District, Tabanan, since 2012. This cooperative concentrates on giving business loans to its members; to date, the cooperative's credits have been extended to thousands of people. The form of credit used is time-based credit, which has short, medium, and long-term payback periods. Cooperatives frequently face dangers during this time, such as not receiving advance payments, numerous arrears, or payment delays owing to various consumer causes.

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Most organizations conduct a credit analysis as part of the credit application process to establish the borrower's ability to repay the credit by gathering information, evidence, and verification. The accuracy ofthe data and information influences the choice to award creditworthiness; therefore, verification is required to verify the authenticity of the data and conformance with the facts that can assist the company in determining who is authorized to obtain credit. Because the procedure is done manually, agencies cannot eliminate the possibility of human error, such as inaccuracies in computing each debtor's ranking value. At this time, a computerized system for decision making has emerged, one of which is a decision support system (DSS) to help the organization make the best credit decision possible. To acquire the optimal conclusion in the DSS, a decision-making approach (Na'am, 2017) must be used to limit the chance of errors and shorten the decision-making time (Mubarok et al., 2019). Decision support systems will improve decision-making capabilities in data processing; they will assist in making decisions to address problems, particularly complicated and unstructured problems; they will deliver solutions more quickly, and the results will be reliable.

There are numerous approaches in the decision support system, one of which is simple additive weighting and the strategy for ordering by similarity to the ideal answer. The simplest and most extensively used Multi Attribute Decision Making (MADM) method is Simple Additive Weighting (SAW)(Seyedmohammadi et al., 2018). This approach is also the simplest to implement due to its simple algorithm. The weighted addition technique (Ifo Wahyu Pratama, 2018) is another name for the SAW method. The TOPSIS approach is frequently used to handle practical decision-making problems involving multiple factors. The TOPSIS technique has the following advantages: it is basic and easy to grasp, it is computationally efficient, and it can quantify the relative performance of decision options in a simple mathematical form (Muzakkir, 2017). TOPSIS is a strategy for assisting the optimal decision-making process in solving practical choice issues (Yasdomi & Amelia Chandra, 2017), as well as for mathematically measuring the criteria of each option alternative (El Allaki et al., 2019).

This study compares the accuracy of three methods, namely simple additive weighting (SAW), Technique for Order by Similarity to Ideal Solution (TOPSIS), and a combination of SAW – TOPSIS methods, which will be implemented in a decision support system for creditworthiness, and will compare the accuracy of the three methods.

2. Research Methods

2.1 Stages of Research

At the Karya Sejahtera Cooperative, this research began with direct observations and the identification of issues with the credit distribution process. This literature study is used as reference material in doing research and linking them together, and it is gathered from books, journals, papers, and e-books. In addition, conducting interviews with the Cooperative's Chairman to learn about all of the data that will be used and the criteria that have been used previously.

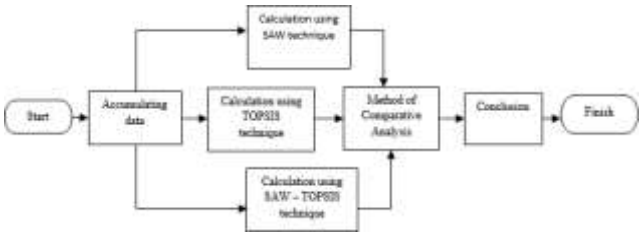

Figure 1. Research Stages Flowchart

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2.2 Research data

This study used data from 50 debtors who asked for loan at the Karya Sejahtera Farmer Cooperative for the October 2020 period. The calculation analysis will then be processed with a decision support system utilizing the SAW, TOPSIS, and SAW-TOPSIS approaches, and the three methods will be examined using the mean average precision (MAP) technique using 50 credit applicant data.

2.3 Simple Additive Weighting (SAW) Method

The SAW technique is a weighted addition method whose core principle is to obtain the weighted sum of the performance ratings for each alternative on all criteria (Hendartie, 2017).

From various angles, a variety of score functions for interval-valued evaluation are proposed to identify outcomes (Seyedmohammadi et al., 2018). The steps in the calculation process using the Simple Additive Weighting (SAW) method include determining alternative credit eligibility, determining the value of each alternative, determining a decision matrix based on criteria, normalizing the matrix based on equations that are adjusted to the type of attribute, and normalizing the matrix based on equations that are adjusted to the type of attribute (Roszkowska & Kacprzak, 2016). The final result is generated through the ranking procedure, which consists of adding the normalized matrix multiplication with the weight vector and selecting the biggest value as the best alternative as a solution.

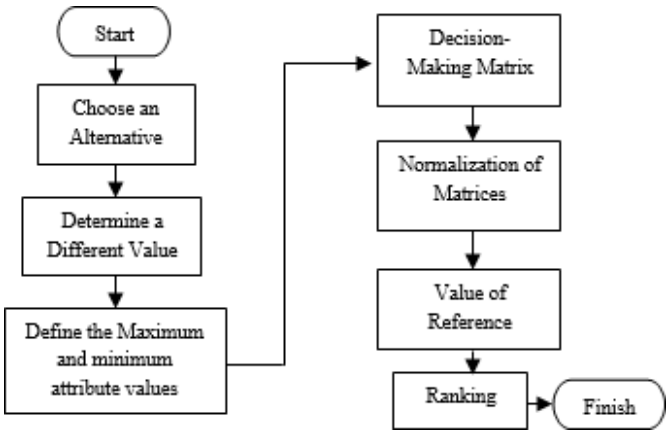

Figure 2 Simple Additive Weighting (SAW) Method Flowchart

2.4 Tehcnique for Order by Similarity to Ideal Solution (TOPSIS) Method

The Technique for Order by Resemblance to Ideal Solution (TOPSIS) approach is a decision-making strategy based on the similarity of ideal solutions (Azhari et al., 2018). The phases of the calculation using the Technique for Order by Similarity to Ideal Solution (TOPSIS) technique include identifying the value of each criterion, creating a choice matrix, normalizing the matrix (Ezhilarasan & Vijayalakshmi, 2020), determining the positive ideal solution metric and negative ideal solution matrix, determining the distance between values each alternative with a positive and negative ideal solution matrix, and finally, determining the end result of the calculation process is to In the discipline of multiple criterion decision analysis (MCDA), the TOPSIS approach is also known as the ranking method (El Allaki et al., 2019).

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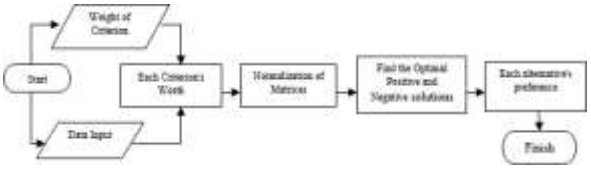

Figure 3 Tehcnique for Order by Similarity to Ideal Solution (TOPSIS) Method Flowchart

2.5 Simple Additive Weighting (SAW) – Technique for Order by Similarity to Ideal Solution (TOPSIS) Method

Using the SAW approach for weighing and the TOPSIS method for ranking, the SAW - TOPSIS combination method tries to find an accurate solution (Hendartie, 2017). Determine alternative creditworthiness, determine the value of the alternative, determine the min and max attributes, determine the decision matrix and matrix normalization, determine the value of the positive ideal solution and the negative ideal solution, determine the alternative distance, and finally determine the preference value for the next ranking procedure (Ramadiani et al., 2019).

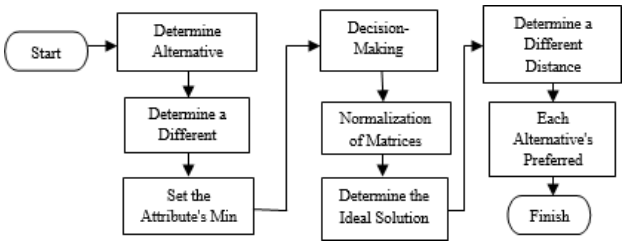

Figure 4 Simple Additive Weighting (SAW) – Technique for Order by Similarity to Ideal Solution (TOPSIS) Method Flowchart

2.6 Choosing Criteria and Sub-Criterion

The following are five criteria for decision making that will be put into a decision support system in this study: 1) Use a value range to ensure conditions are met, 2) Income requirements based on a range of values, 3) Criteria for a loan application form with complete and incomplete sub-criteria, 4) Criteria for a business establishment permit with complete and incomplete sub-criteria, 5) Debtor guarantee tax criteria with sub-criteria paid off, and not paid off.

TABLE 1
CRITERIA FOR ASSURANCE

No	Criteria for Vulnerable Value Guarantee	Information	Weight
1.	1 – 9.999.999	Very little	1
2.	10.000.000 – 49.000.000	Little	2
3.	50.000.000 – 69.999.999	Rather Good	3
4.	70.000.000 – 99.999.999	Good	4
5.	>= 100.000.000	Excellent	5

TABLE 2
INCOME REQUIREMENTS

No	Income Criteria with Vulnerable Value	Information	Weight
1.	1 – 5.999.999	Very little	1
2.	6.000.000 – 10.000.000	Little	2
3.	11.000.000 – 15.999.999	Rather Good	3
4.	16.000.000 – 20.999.999	Good	4
5.	>= 21.000.000	Excellent	5

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TABLE 3
CRITERIA FOR THE APPLICATION FORM

No	Criteria for the Application Form	Information	Weight
1.	Incomplete	Very little	1
2.	Complete	Excellent	5

TABLE 4
PERMIT CRITERIA FOR BUSINESS ESTABLISHMENTS

No	Permit Criteria for Business Establishments	Information	Weight
1.	Incomplete	Very little	1
2.	Complete	Excellent	5

TABLE 5
ENSURE TAX CRITERIA

No	Ensure Tax Criteria	Information	Weight
1.	Incomplete	Very little	1
2.	Complete	Excellent	5

2.7 Weighting of Criteria

The results of interviews with the credit analysis team and the chairman of the Karya Sejahtera Farmer Cooperative in accordance with the SOP that has been running in the Cooperative so far establish the process of weighting the value of each criterion and sub-criteria. If these weighted values are totaled together for the weighting of the criteria, the result must be 100%.

TABLE 6
WEIGHTED CRITERIA SCORE

No	Criteria	Weight
1.	Criteria for Vulnerable Value Guarantee	30%
2.	Income Criteria with Vulnerable Value	25%
3.	Criteria for the Application Form	15%
4.	Permit Criteria for Business Establishments	15%
5.	Ensure Tax Criteria	15%

2.8 Mean Average Precision

Mean Average Precision (MAP) is one of the approaches used to evaluate a system's effectiveness by measuring the effectiveness of an information retrieval system. The Mean Average Precision (MAP), which gives a single measure of quality across recall levels, is a popular standard among the TREC community (Jiang et al., 2019). MAP is demonstrated to have outstanding discrimination and stability based on all known system evaluation methods. Average Precision is the average precision value produced for the top document when each relevant document is retrieved for single information needs, and this value is then averaged according to the needed information (Suka Parwita & Winarko, 2015). The arithmetic mean of the mean precision scores for the specific information criteria is the MAP score for the test collection. This has the effect of weighting each needed piece of information in the final reported quantity at the same time, even if many papers are relevant to some queries but few to others (Luijendijk et al., 2018).

The Mean Average Precision (MAP) approach was used to test the strategies in this study. In the test, a sample of the 15 best debtors ranked 1 to 15 was selected from the calculation results of the SAW, TOPSIS, and a combination of the SAW – TOPSIS method, as well as the 15 best debtors ranked 1 to 15 according to the Tani Karya Sejahtera Cooperative's Chair and staff of Accountants/credit analysis. This MAP test is used to determine the method's accuracy or success in predicting ranks. The higher the MAP value, the more successful or appropriate the ranking provided by the calculating procedure with the ranking decided by the Higher Education Leader.

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3. Result and Discussion

The results of the decision-making calculation process using a decision support system using the SAW, TOPSIS, and a combination of SAW-TOPSIS methods will be described in this section, and the method will be tested using the Mean Average Precision (MAP) technique to determine the accuracy of each method in the following section.

3.1 Results of the SAW Method Calculation

The simple additive weighting (SAW) approach is used to calculate 50 debtor data from the Tani Karya Sejahtera Cooperative for the October 2020 period, which is given an alternate code from A1 to A50, with the calculation procedure using the Tani Karya Sejahtera Cooperative's Decision Support System. Table 7 shows the top 15 rankings/recommendations by the decision support system using the SAW approach, as well as the findings and description of the calculations using the SAW method.

TABLE 7
IN THE TOP 15 OF 50 DATA SETS

No	Kode Debitur	Nilai
1.	A49	0,92
2.	A36	0,88
3.	A28	0,77
4.	A1	0,74
5.	A26	0,74
6.	A3	0,71
7.	A10	0,71
8.	A16	0,70
9.	A19	0,70
10.	A41	0,69
11.	A44	0,69
12.	A46	0,67
13.	A47	0,65
14.	A20	0,65
15.	A7	0,60

3.2 The TOPSIS Method Calculation Results

The Technique for Order by Similarity to Ideal Solution (TOPSIS) method is used to calculate up to 50 debtor data from the Karya Sejahtera Tani Cooperative for the October 2020 period, with an alternative code ranging from A1 to A50, using a Decision Support System implemented at the Tani Karya Sejahtera Cooperative. Table 8 Ranking the Top 15 of the 50 TOPSIS data, which provides the top 15 rankings/recommended by the decision support system using the TOPSIS method, contains the findings and discussion of computations using the TOPSIS method.

TABLE 8
TOPSIS 50 DATA RANKING IN THE TOP 15

No	Kode Debitur	Nilai
1.	A49	0,7458
2.	A36	0,6650
3.	A28	0,6162
4.	A26	0,5811
5.	A1	0,5741
6.	A10	0,5614
7.	A16	0,5537
8.	A19	0,5537
9.	A46	0,5537
10.	A20	0,5537
11.	A3	0,5485
12.	A41	0,5485
13.	A44	0,5485

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No	Kode Debitur	Nilai
14.	A47	0,5485
15.	A7	0,5223

3.3 The SAW – TOPSIS Combination Method Calculation Results

The calculation using the Simple Additive Weighting (SAW) - Technique for Order by Similarity to Ideal Solution (TOPSIS) combination method uses 50 data from Tani Karya Sejahtera Cooperative debtors for the October 2020 period, given alternative codes from A1 to A50, with the calculation process using the Decision Support System. Table 9 Ranking the Top 15 of 50 SAW - TOPSIS data illustrates the top 15 rankings/recommended by the decision support system using the TOPSIS approach, as well as the results and discussion of computations using the TOPSIS method.

TABLE 9
SAW - TOPSIS RANKS IN THE TOP 15 OF 50 DATA

No	Kode Debitur	Nilai
1.	A49	0,8306
2.	A28	0,6845
3.	A36	0,6578
4.	A1	0,5980
5.	A26	0,5778
6.	A3	0,5709
7.	A10	0,5689
8.	A16	0,5579
9.	A19	0,5496
10.	A41	0,5413
11.	A44	0,5309
12.	A46	0,5219
13.	A47	0,5189
14.	A20	0,5099
15.	A35	0,5070

3.4 Mean Average Precision Method Testing

The method test analysis results are a summary of the test results for each method that has been tested using the Mean Average Precision (MAP) technique, which assesses the level of accuracy of each method based on the results of the rankings. Table 10 shows the findings of the method testing study. Mean Average Precision Results of Analyst Testing Methods.

TABLE 10
RESULTS OF ANALYST TESTING METHOD USING MEAN AVERAGE PRECISION

Metode Yang Diuji	10 Data Ranking Teratas	15 Data Ranking Teratas
SAW	54,3%	52,1%
TOPSIS	66%	51,8%
SAW - TOPSIS	83,7%	76,9%

The SAW – TOPSIS approach has the best accuracy when using the top 10 ranking data, with a value of 83.7 percent, according to the test results of each method using the Mean Average Precision (MAP) technique. These results were acquired because the SAW – TOPSIS combination approach had the highest match in the debtor ranking/ranking, with the SAW – TOPSIS method determining 6 ranks that matched the results of the Tani Karya Cooperative Chairman's ranking/ranking utilizing the 10 ranking data taken. Rank 1, rank 2, rank 3, rank 5, and rank 8 are all prosperous. Furthermore, in testing utilizing the MAP methodology, the SAW method has the third best accuracy when using the top 10 ranking data, with a value of 54.3 percent. Because of the top 10 ranking data, the SAW approach was successful in finding four rankings that matched the results of the Karya Sejahtera Farmer Cooperative's Chairperson's rankings, namely rank 1, rank 5, rank 8,

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and rank 10. With a MAP test value of 66 percent, the TOPSIS technique is the method with the second best accuracy when using the top 10 ranking data. Because of the top 10 ranking data, the TOPSIS approach was successful in finding three rankings that matched the results of the Karya Sejahtera Tani Cooperative's Chairperson's ranks, namely ranking 1, ranking 6, and ranking 14. The ranking position and number of ratings that match the results of the calculating method and the ranking decided by the Chairman of the Karya Sejahtera Farmer Cooperative determine the final results in the testing process when utilizing the Mean Average Precision (MAP) approach.

3.5 Implementation of a Decision Support System

The credit acceptance decision support system implementation consists of many menus, including a master data menu with a submenu of criteria and debtors, and a calculation menu, which includes a calculation section for each method as shown in Figure 1 Menu of Master Data (Criteria & Weights), Figure 2 Master Data for Menus (Debtor), and Figure 3 3 Methods of Menu Calculation.

Figure 1 Menu of Master Data (Criteria & Weights)

Figure 2 Master Data for Menus (Debtor)

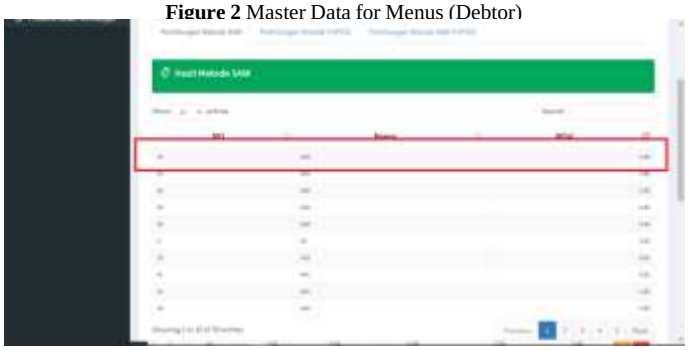

Figure 3 Methods of Menu Calculation

4. Conclusion

The SAW, TOPSIS, and SAW – TOPSIS methods were successfully implemented, as evidenced by a comparison of the SAW, TOPSIS, and SAW-TOPSIS methods tested using the mean average precision technique, which shows that, based on the test results of each method, the SAW – TOPSIS method has the best accuracy when using the top 10 ranking data, with an accuracy of 83.7 percent. With a MAP test value of 66 percent, the TOPSIS technique is the method with the second best accuracy when using the top 10 ranking data. In testing utilizing the MAP methodology, the SAW method had the third best accuracy when using the top 10 ranking data, with a value of 54.3 percent.

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