Implementation of the Simple Additive Weighting

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Implementation of the Simple Additive Weighting (SAW) Method in the Selection of Recipients of Social Funds for Poor Families

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Abstract−Decision support system is the implementation of several decision-making theories by sciences such as operations research and management science. There are several differences, namely if in the past to find a solution to the problem at hand, iteration calculations had to be done manually or usually looked for the minimum, maximum, and optimum values, now Pc computers have offered the ability to solve the same problems in a relatively short time. In this study using the Simple Additive Weighting (SAW) method for collecting data on receipts of social assistance funds for poor families carried out by PT. Bank Negara Indonesia (Persero) Tbk. become more systematic and the right of recipients of social assistance funds is right for the people in need.

Keywords: Data Collection; Social Fund Assistance; Right on Target; Simple Additive Weighting

1. INTRODUCTION

The lack of enthusiasm for economic growth in Indonesia has made some people experience difficulties in the economy. Financial institutions, especially banks, have a very strategic role in moving the economic pattern of a country. To increase the enthusiasm of the economy, one of the activities carried out by PT. Bank Negara Indonesia (Persero) Tbk. namely social fund assistance, in order to realize the economic welfare of the underprivileged.

In data collection or data collection, there are several values that are needed so that the acceptance of financial assistance can be realized, according to the objectives and right for the people in need. Some of the data determined by the Bank in receiving assistance, namely: Income and family expenses are important for both recipients and donors to determine the eligibility of the community to receive financial assistance. Furthermore, there are several other supports such as dependents, the level of eligibility for the house, and data on the work done by the family to meet the family's adequacy. One of the problems faced by PT. Bank Negara Indonesia (Persero) Tbk, namely the ineffectiveness of the results obtained in the election of the underprivileged community. This is in addition to the data that is selected too much, also the limited budget that is owned in its distribution. For that we need the right system that can be used by PT. Bank Negara Indonesia (Persero) Tbk, to assist in the selection of the recipients of the Social Fund for Poor Families. WrongOne system that is able to solve these problems is a decision support system (DSS).

The decision support system (DSS) makes problem solving systematic and optimally using the maximum, minimum and optimum values obtained from alternative data collection provided by the author. In the application of the DSS, ranking methods are used so that the results obtained are more effective, such as the Simple Additive Weighting(SAW), WP, TOPSIS, ELECTRE methods [1], [2]. The Simple Additive Weighting (SAW) method is the right algorithm to be used in decision making with a weighted addition methodminimum to maximum number. The SAW method requires normalization of the matrix to a data from Social Fund Assistance and compared with the alternatives that have been determined [3]–[6].

Several previous studies used the Simple Additive Weighting (SAW) method which allows decision making to minimize calculations quickly and get more accurate results. Among them are research conducted by Saifullah Sitorus dkk, in 2019 about the Decision Support System for Selection of the Best Craftsmen in Making Furniture or Furniture at CV.Metro Prabot Using the Simple Additive Weighting (SAW) Method [2].

Based on the discussion above, the authors are interested in conducting research on PT. Bank Negara Indonesia (Persero) Tbk by applying the Simple Additive Weighting (SAW) method, which is later expected to provide benefits to more streamline the results in the selection of alternative calculations for candidates for Social Fund Assistance for Poor Families.

2. RESEARCH METHODOLOGY

2.1 Social Fund Assistance for Poor Families

The social assistance fund for underprivileged families is an assistance provided in the form of money from PT. Bank Negara Indonesia (Persero) Tbk. which was ordered from the Ministry of SOEs to help the economic viability of the people in need as well as the underprivileged. This assistance is selective and is not continuously received by the family. This is an important objective to protect against social loss. Social losses that usually occur in this social fund

assistance, the existence of social vulnerabilities that are borne by families, individuals or communities as a result of social inequality, political crises, economic crises, natural phenomena and several natural disasters which if there is no social assistance budget there will be life in unnatural conditions[7].

2.2 Recipients of Social Data Assistance

Recipient of social fund assistance for underprivileged families by PT. Bank Negara Indonesia (Persero) Tbk, was selected systematically and accurately and achieved the goals that have been agreed with the Ministry of SOEs and the Ministry of Finance. There are also criteria that are needed to get goals that are in accordance with the rights of recipients of social funds, namely:

1. Family income
2. Family expenses
3. Child care costs
4. House eligibility rate (Using house eligibility percentage 0-100)
5. Job data (with a value of 0-100)

From the value of the criteria above, the author calculates the eligibility of the family to be entitled or not to receive the assistance.

2.3 Decision Support System

Decision Support System or in English a decision support system (DSS) is a system that provides data management functions according to certain models, so that users of this system can choose the best decision shortcut. The decision support system is not an icon of making a decision, but only as a decision support icon. The point is that decisions taken from a problem are not the absolute result of the system[8]–[10].

2.4 Simple Additive Weighting (SAW) Method

The Simple Additive weighting (SAW) method is one of the algorithms for making a decision. SAW is also known as an algorithm with a weighted addition method. In this method a decision matrix requires a normalization process from one scale which is compared with all existing alternative ranking values[11]–[14].

Here is the formula in determining the addition to solve the problem of decision making from the SAW method, namely:

1. Prepare the Decision Matrix

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & X_{13} & . & X_{1n} \\ X_{21} & X_{22} & X_{23} & . & X_{2n} \\ X_{31} & X_{32} & X_{33} & . & X_{3n} \\ . & . & . & . & . \\ X_{mn} & X_{mn} & X_{mn} & X_{mn} & X_{mn} \end{bmatrix} \quad (1)$$

With description:

Xij = Decision Matrix
i = Row (Alternative)
j = Column (Attributes/Criteria)
m = Number of Rows/alternatives
n = number of columns/ criteria

2. Calculating the Normalized Matrix(Rij)
Calculation for the criteria of benefit (Benefit)

$$R_{ij} = \frac{X_{ij}}{MAX\ X_{ij}} \quad (2)$$

Calculation for cost criteria (cost)

$$R_{ij} = \frac{MIN\ X_{ij}}{X_{ij}} \quad (3)$$

Where:

Rij = Matrix that has been normalized
Max Xij = Highest value In column j
Min Xiji = The lowest value in the jth column
Xij = Decision matrix

3. Final stage Calculating preference (Vi)
At this stage determine the rating value of each alternative. The highest preference value indicates that Alternative i is more selected.

$$V_i = \sum_{j=1}^{n} W_j R_{ij} \quad (4)$$

Where:
Vi = Preference Value
Wj = Weight
Rij = Normalized Matrix
j = Criteria
n = Number of criteria [15]

3. RESULTS AND DISCUSSION

This activity that takes a lot of time in data collection is due to the large number of residents who respond well to aid activities for the poor, only that many people do not understand the criteria determined by the company to obtain the aid funds. The bank and the author determine the selection criteria and weights that have been collected.

In this study, the authors conducted research for the selection of recipients of Social Fund Assistance for Poor Famili. The first step that can be taken is to determine several criteria and weight values to be used in the selection, which can be seen in table 1.

Table 1. Criteria table

Criteria	Type	Weight
Family Income (C1)	Cost	30%
Family Expenditure (C2)	Benefits	20%
Dependent Costs for Children (C3)	Benefits	20%
House Eligibility Level (C4)	Benefits	15%
Employment Data (C5)	Benefits	15%

Cost are costs, and benefits are profits. What is meant by the cost here is the income of every community recorded as having the right to receive assistance, and this benefit is the right of a family to receive the aid fund.
The alternatives needed as data are 15 Family Cards as a sample in the determination, as follows:

$\mathbf{A}_1$ = Edwin Nurdiansya
$\mathbf{A}_2$ = Rahadian Rahim
$\mathbf{A}_3$ = Awaluddin Siregar
$\mathbf{A}_4$ = Muhammad Ru'yat
$\mathbf{A}_5$ = Didit Susanto
$\mathbf{A}_6$ = Agus Kiswanto
$\mathbf{A}_7$ = Ahmad Junaid
$\mathbf{A}_8$ = Sumitro Ariadi
$\mathbf{A}_9$ = Deden Hermawan
$\mathbf{A}_{10}$ = Subagio Day
$\mathbf{A}_{11}$ = Wahyu Pujo Leksono
$\mathbf{A}_{12}$ = Rusdi Effendi
$\mathbf{A}_{13}$ = Abdullah
$\mathbf{A}_{14}$ = Ari Widananto
$\mathbf{A}_{15}$ = Sutrisno

Below is a table of matches between Criteria and Alternatives.

Table 2. Alternative Value on each criterion

No	Alternative	Criteria				
		C1	C2	C3	C4	C5
1	Edwin Nurdiansyah	600,000	400,000	100,000	Well	Scavenger
2	Rahadian Rahim	720,000	500,000	130,000	Enough	Laborer
3	Awaluddin Siregar	1,400,000	1,200,000	200,000	Well	Barber
4	Muhammad Ru'yat	2,100,000	1,800,000	110,000	Well	Ojek online
5	Didit Susanto	830,000	900,000	100,000	Enough	Parking attendants
6	Agus Kiswanto	1,900,000	1,500,000	190,000	Well	Construction laborers
7	Ahmad Junaidi	500,000	550,000	120,000	Not good	Scavenger
8	Sumitro Ariadi	2,600,000	2,000,000	270,000	Well	Ojek online
9	Deden Hermawan	1,000,000	750,000	200,000	Enough	laborer

No	Alternative	Criteria				
		C1	C2	C3	C4	C5
10	Subagio Day	900,000	800,000	150,000	Enough	sweeper
11	Wahyu Pujo Leksono	900,000	750,000	200,000	Well	sweeper
12	Rusdi Effendi	1,400,000	1,200,000	180,000	Well	Construction laborers
13	Abdullah	550,000	450,000	90,000	Not good	laborer
14	Ari Widananto	2,000,000	1,500,000	150,000	Enough	Barber
15	Sutrisno	1,300,000	1,000,000	175,000	Enough	Pedicab driver

From the decision table above, the weight to be given to each criterion is = (C1:30% , C2:20% , C3:20% , C4: 15% , C5: 15%) From this criterion C1 is the cost, and C2, C3 , C4, C5 is the benefit criteria. Because from the sample data taken there are criteria that do not have values such as C4 and C5. Then the criteria must be changed so that they have weight. The determination of the weights is formed in the following table:

Table 3. House Eligibility Criteria

No	House Eligibility (C4)	Weight
1	Not good	1
2	Enough	2
3	Well	3

Table 4. Employment data

No	House Eligibility (C_5)	Weight
1	Ojek Online, barbershop	3
2	Construction Worker, Pedicab Driver	2
3	Scavengers, laborers, sweepers	1

The stages of selection of social assistance funds by applying the Simple Additive Weighting (SAW) method so that people who are entitled to receive the funds are obtained, as follows:

1. Prepare the Decision Matrix

$$Xij = \begin{bmatrix} 600.000 & 400.000 & 100.000 & 3 & 1 \\ 720.000 & 500.000 & 130.000 & 2 & 2 \\ 1.400.000 & 1.200.000 & 200.000 & 3 & 2 \\ 2.100.000 & 1.800.000 & 110.000 & 3 & 3 \\ 830.000 & 900.000 & 100.000 & 2 & 1 \\ 1.900.000 & 1.500.000 & 190.000 & 3 & 2 \\ 500.000 & 550.000 & 120.000 & 1 & 1 \\ 2.600.000 & 2.000.000 & 270.000 & 3 & 2 \\ 1.000.000 & 750.000 & 200.000 & 2 & 1 \\ 900.000 & 800.000 & 150.000 & 2 & 1 \\ 900.000 & 750.000 & 200.000 & 3 & 1 \\ 1.400.000 & 1.200.000 & 180.000 & 3 & 2 \\ 550.000 & 450.000 & 90.000 & 1 & 1 \\ 2.000.000 & 1.500.000 & 150.000 & 2 & 3 \\ 1.300.000 & 1.000.000 & 175.000 & 2 & 2 \end{bmatrix}$$

Cost/benefit 500,000 2,000,000 270,000 3 3

2. The following is the normalization of each criterion with the formula:

Criterion C1: Family Income using equation 3.

R1,1 : 500,000/600.000 = 0.83333
R2.1 : 500,000 /720,000 = 0.69444
R3.1 : 500,000/1,400,000 = 0.35714
R4.1 : 500,000/2,100,000 = 0.23809
R5,1 : 500,000/830,000 = 0.60240
R6.1 : 500,000/1,900,000 = 0.26315
R7,1 : 500,000/500,000 = 1.0000
R8,1 : 500,000/2,600,000 = 0.19230
R9,1 : 500,000/1,000,000 = 0.50000
R10.1 : 500,000/900,000 = 0.55556

R11,1 : 500,000/900,000 = 0.55556
R12.1 : 500,000/1,400,000 = 0.35714
R13,1 : 500,000/550,000 = 0.90909
R14.1 : 500,000/2,000,000 = 0.25000
R15.1 : 500,000/1,300,000 = 0.38461

Criterion C2: Family Expenditures using equation 2.
R1,2 : 400,000/2,000,000 =0.20000
R2,2 : 500,000/2,000,000 =0.25000
R3,2 : 1,200,000/2,000,000 =0.60000
R4.2 : 1,800,000/2,000,000 =0.90000
R5,2 : 900,000/2,000,000 =0.45400
R6,2 : 1,500,000/2,000,000 =0.75000
R7,2 : 550,000/2,000,000 =0.27500
R8,2 : 2,000,000/2,000,000 =1,000000
R9,2 : 750,000/2,000,000 =0.37500
R10,2 : 800,000/2,000,000 =0.40000
R11,2 : 750,000/2,000,000 =0.37500
R12,2 : 1.200.000/2.000.000 =0.60000
R13,2 : 450,000/2,000,000 =0.22555
R14,2 : 1,500,000/2,000,000 =0.75000
R15,2 : 1,000,000/2,000,000 =0.50000

Criterion C3: Dependent Costs for Children using equation 2.
R1,3 : 100,000/270,000 =0,37037
R2,3 : 130,000/270,000 =0.48148
R3,3 : 200,000/270,000 =0.74074
R4,3 : 110,000/270,000 =0.40740
R5,3 : 100,000/270,000 =0.37037
R6.3 : 190,000/270,000 =0.70370
R7,3 : 120,000/270,000 =0.44444
R8,3 : 270,000/270,000 =1.0000
R9,3 : 200,000/270,000 =0.74074
R10,3 : 150,000/270,000 =0.55556
R11,3 : 200,000/270,000 =0.74074
R12,3 : 180,000/270,000 =0.66667
R13,3 : 90,000/270,000 =0.33334
R14.3 : 150,000/270,000 =0.55556
R15.3 : 175,000/270,000 =0.64816

Criterion C4: House Feasibility Level by using equation 2.
R1.4 :3/3 =1.0000
R2.4 :2/3 =0.66667
R3,4 :3/3 =1,000000
R4,4 :3/3 =1,000000
R5,4 :2/3 =0.66667
R6.4 :3/3 =1,000000
R7,4 :1/3 =0.33333
R8,4 :3/3 =1,000000
R9,4 :2/3 =0.66667
R10,4 :2/3 =0.66667
R11.4 :3/3 =1,000000
R12.4 :3/3 =1,000000
R13,4 :1/3 =0.33333
R14.4 :2/3 =0.66667
R15.4 :2/3 =0.66667

Criterion C5: Employment Data using the equation 3.
R1.4 :1/3 =0.33333
R2.4 :2/3 =0.66667
R3,4 :2/5 =0.66667
R4,4 :3/3 =1,000000

R5,4 :1/3 =0.33333
R6.4 :2/3 =0.66667
R7,4 :1/3 =0.33333
R8,4 :2/3 =0.66667
R9,4 :1/3 =0.33333
R10,4 :1/3 =0.33333
R11.4 :1/3 =0.33333
R12.4 :2/3 =0.66667
R13,4 :1/3 =0.33333
R14.4 :3/3 =1,000000
R15.4 :2/3 =0.66667

The results obtained for the normalized matrix are:

$$Rij = \begin{bmatrix} 0{,}83333 & 0{,}20000 & 0{,}37037 & 1{,}00000 & 0{,}33333 \\ 0{,}69444 & 0{,}25000 & 0{,}48148 & 0{,}66667 & 0{,}66667 \\ 0{,}35714 & 0{,}60000 & 0{,}74074 & 1{,}00000 & 0{,}66667 \\ 0{,}23809 & 0{,}90000 & 0{,}40740 & 1{,}00000 & 1{,}00000 \\ 0{,}60240 & 0{,}45400 & 0{,}37037 & 0{,}66667 & 0{,}33333 \\ 0{,}26315 & 0{,}75000 & 0{,}70370 & 1{,}00000 & 0{,}66667 \\ 1{,}00000 & 0{,}27500 & 0{,}44444 & 0{,}33333 & 0{,}33333 \\ 0{,}19230 & 1{,}00000 & 1{,}00000 & 1{,}00000 & 0{,}66667 \\ 0{,}50000 & 0{,}37500 & 0{,}74074 & 0{,}66667 & 0{,}33333 \\ 0{,}55556 & 0{,}40000 & 0{,}55556 & 0{,}66667 & 0{,}33333 \\ 0{,}55556 & 0{,}37500 & 0{,}74074 & 1{,}00000 & 0{,}33333 \\ 0{,}35714 & 0{,}60000 & 0{,}66667 & 1{,}00000 & 0{,}66667 \\ 0{,}90909 & 0{,}22555 & 0{,}33334 & 0{,}33333 & 0{,}33333 \\ 0{,}25000 & 0{,}75000 & 0{,}55556 & 0{,}66667 & 1{,}00000 \\ 0{,}38461 & 0{,}50000 & 0{,}64816 & 0{,}66667 & 0{,}66667 \end{bmatrix}$$

3. The final step is to calculate the Preference value (Vi) using equation 4.

V1= (0.3*0.83333)+(0.2*0,20000)+(0.2*0,37037)+(0.15*1,00000)+(0.15*0,33333) =0.5640725
V2= (0.3*0.69444)+(0.2*0.25000)+(0.2*0.48148)+(0.15*0.66667)+(0.15*0.66667) =0.5546290
V3= (0.3*0.35714)+(0.2*0.60000)+(0.2*0.74074)+(0.15*1.00000)+(0.15*0.66667) =0.6252905
V4= (0.3*0,23809)+(0.2*0.90000)+(0.2*0.40740)+(0.15*1,00000)+(0.15*1,00000) =0.6329070
V5= (0.3*0.60240)+(0.2*0.45400)+(0.2*0,37037)+(0.15*0.66667)+(0.15*0.33333) =0.4955940
V6= (0.3*0,26315)+(0.2*0.75000)+(0.2*0.70370)+(0.15*1,00000)+(0.15*0.66667) =0.6196915
V7= (0.3*1.00000)+(0.2*0.27500)+(0.2*0.44444)+(0.15*0.33333)+(0.15*0.33333) =0.5438870
V8= (0.3*0,19230)+(0.2*1,00000)+(0.2*1,00000)+(0.15*1,00000)+(0.15*0.66667) =0.7076905
V9= (0.3*0.50000)+(0.2*0.37500)+(0.2*0.74074)+(0.15*0.66667)+(0.15*0.33333) =0.5231480
V10= (0.3*0.55556)+(0.2*0.40000)+(0.2*0.55556)+(0.15*0.66667)+(0.15*0.33333) =0.5077801
V11= (0.3*0.55556)+(0.2*0.37500)+(0.2*0.74074)+(0.15*1.00000)+(0.15*0.33333) =0.5898155
V12= (0.3*0.35714)+(0.2*0.60000)+(0.2*0.66667)+(0.15*1.00000)+(0.15*0.66667) =0.6104765
V13= (0.3*0.909099)+(0.2*0.22555)+(0.2*0.33334)+(0.15*0.33333)+(0.15*0.33333) =0.4845040
V14= (0.3*0.25000)+(0.2*0.75000)+(0.2*0.55556)+(0.15*0.66667)+(0.15*1,000000) =0.5861125
V15= (0.3*0,38461)+(0.2*0.50000)+(0.2*0.64816)+(0.15*0.66667)+(0.15*0.66667) =0.5450161

From the value of the preference calculation above, the final value for determining the recipients of social funds assistance is obtained for those who are entitled to it. The final value ranking can be seen from the following table:

Table 4. Rank of recipients of social assistance funds

No	Family Head Name	Preference Results	Rating
1	Edwin Nurdiansyah	0.5640725	8
2	Rahadian Rahim	0.5546290	7
3	Awaluddin Siregar	0.6252905	13
4	Muhammad Ru'yat	0.6329070	14
5	Didit Susanto	0.4955940	2
6	Agus Kuswanto	0.6196915	12
7	Ahmad Junaidi	0.5438870	5
8	Sumitro Ariadi	0.7076905	15

No	Family Head Name	Preference Results	Rating
9	Deden Hermawan	0.5231480	4
10	Subagio Day	0.5077801	3
11	Wahyu Pujo Leksono	0.5898155	10
12	Rusdi Effendi	0.6104765	11
13	Abdullah	0.4845050	1
14	Ari Widananto	0.5861125	9
15	Sutrisno	0.5450161	6

In the table above, it can be seen that the rankings listed are 5 Heads of Families who received Social Assistance funds from PT. Bank Negara Indonesia (Persero) Tbk. namely the family that has the lowest preference value as follows:

1. Abdullah = 0.4845050
2. Didit Susanto = 0.4955940
3. Subagio Day = 0.5077801
4. Deden Hermawan = 0.5231480
5. Ahmad Junaidi = 0.5438870

The names above are the people who are entitled to receive the aid funds and will soon be distributing the funds by PT. Bank Negara Indonesia (Persero) Tbk.

4. CONCLUSION

From the discussion above, it can be concluded that the calculation using Simple Additive Weighting (SAW) on the reference criteria for receiving Social Assistance Funds from PT. Bank Negara Indonesia, then selected 5 families who are entitled to receive the aid funds, namely 1. Abdullah, 2. Didit Susanto 3. Hari Subagio, 4. Deden Hermawan, 5. Ahmad Junaidi. Thus, to get families who are entitled to receive social funding assistance, implementing a decision support system with the SAW method is more effective and simple in the data processing process, so that the distribution of aid funds can be realized as soon as possible and can be used as well as possible by the recipients of the aid rights.

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