

Decision Support System for PKH Assistance Recipients Promethee Method

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Abstract

The Family Hope Program (PKH) is a program providing conditional social assistance to Beneficiary Families (KPM) who are designated as PKH beneficiary families. With the current development of information technology, decision making can be assisted by using computers equipped with application programs to support the production of the required quality decisions. In selecting families who receive assistance from the Family Hope Program (PKH) using the Decision Support System using the Promethee method. Promethee is a method of determining the order (priority) in multi-criteria analysis, the result of this method is a ranking of alternatives based on the selected criteria. The decision support system application using the Promethee method can determine which disadvantaged families will receive PKH assistance with faster, more accurate and fair calculations and considerations. The results of research using this method using 5 alternatives, there are 3 alternatives with accepted status and 2 alternatives that are rejected. The accepted alternatives were Tiah, Mansyah and Mus Muliadi. Meanwhile, the alternatives that were rejected were Irmansyah and Ainun. By obtaining calculation results from a decision support system using the Promethee method, it can help and make it easier for sub-districts to determine recipients of the Family Hope Program (PKH) for underprivileged families.

Keywords: Decision Support System, *Promethee*, Criteria, Promethee Method, Family Hope Program (PKH).

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1. Introduction

Currently in Indonesia, poverty is a serious problem and must be addressed [1]. The number of poor people in Indonesia in September 2019, the Central Statistics Agency (BPS) of the Republic of Indonesia stated that the number of poor people or people whose monthly per capita expenditure was still below the poverty line in Indonesia reached 24.79 million people. This number is equivalent to 9.22% of the total population of Indonesia [2]. These statistics were then worsened by the Covid-19 pandemic, BPS stated that in March 2020 the poverty rate in Indonesia was 9.78%, which is equivalent to 26.42 million people [3].

Considering the importance of this problem, the government has made the Family Hope Program policy since 2007, namely a program providing conditional social assistance to households that meet the PKH criteria as an effort to accelerate poverty reduction [4].

The Social Protection Program, which is also known internationally as *Conditional Cash Transfers* (CCT), has proven to be quite successful in overcoming the poverty faced by these countries, especially the problem of chronic poverty. Specifically, the aim of PKH is to improve access and quality of education and health services for PKH participants, to increase the educational level of PKH participants, and to improve the health and nutritional status of PKH participants [5].

In line with the success that has been achieved and according to the observations of researchers in the Family Hope Program (PKH), there are still problems that need to be addressed, one of which is the difficulty in determining recipients of the Family Hope Program based on existing criteria [6].

Based on Minister of Social Affairs Regulation Number 1 of 2018 concerning the Family Hope Program, it was issued with the consideration of improving the quality of life for poor and vulnerable families through increasing accessibility to health, education and social welfare services. Because currently many Family Hope Programs (PKH) are considered inappropriate target, where there are still many people who should be entitled, but do not receive these assistance funds. This has the impact of subjectivity in determining participants for the Family Hope Program (PKH), especially if several prospective participants who are poor or underprivileged have a level of eligibility that is not much different. In this case, the data collection system still uses old data that has not been updated, whereas every year the population always experiences changes in social status patterns and data processing is still done manually [7].

Facing this, researchers based on their observations in Nagari Kampung Dalam wanted to create a system or application that could help make it easier for sub-district parties to determine recipients of the Family

Hope Program (PKH) for underprivileged families by building a Decision Support System [8] .

Decision Support Systems (DSS) are interactive information systems that provide information, models, and which provide model information, and manipulate the data used to help make decisions in semi-structured situations and no one knows for sure how decisions should be made [9] .

In decision making, data and information processing aims to produce alternative decisions that can be taken. SPK is an application of an information system intended only as a management tool in decision making. SPK is not intended to replace the decision-making function in making decisions, but only as a decision-making aid in carrying out tasks [10] .

In this research, a case will be raised, namely looking for the best alternative based on criteria that have been determined using the *Promethee method* . The *Promethee* method is included in the *Multi Criteria Decision Making* (MCDM) problem solving group or multiple criteria decision making which is a very important scientific discipline in decision making or a problem that has more than one criterion (multicriteria) [11] .

Promethee is a method for determining the best alternative in multicriteria analysis. The result of this method is a ranking of alternatives based on the selected criteria [12]. *Promethee* is an abbreviation of *Preference Ranking Organization Method for Enrichment Evaluation*, which is an *outranking method* that offers *users* (decision makers) a flexible and simple way to analyze multi-criteria problems (*Brans and Vincke, 1985*). The principle used is the determination of alternative priorities that have been determined based on considerations of basic rules [13] :

$$Max \{ f_1(x), f_2(x), f_3(x), \dots, f_i(x), \dots, f_k(x) | x \} \dots\dots\dots(1)$$

Where k is a number of alternative collections and f_i ($i=1, 2, \dots, k$) is the relative value/size of the criteria for each *alternative* [14].

Outranking Relationship Values in Promethee Dominance Criteria The value f is the real value of a criterion: $f : K \rightarrow R$ For each alternative $a \in K$, $f(a)$ is the evaluation of that *alternative* for a criterion. When two alternatives are compared, $a, b \in K$, the comparison of preferences must be determined. The expression of intensity (P) of preference for alternative a towards alternative b is such that [13]:

1. $P(a, b) = 0$, meaning there is no (indifferent) between a and b , or there is no preference for a over b .
2. $P(a, b) \sim 0$, means weak preference of a is better than b .
3. $P(a, b) \sim 1$, means the strong preference for a is better than b .

4. $P(a, b) = 1$, meaning the absolute preference of a is better than b

2. Research methodology

The research framework is a sequence of activities that will be carried out in a study. The research will be carried out applying the *Preference Ranking Organization Method for Enrichment Evaluation (Promethee) method* . The SAW method is used to make it easy to make flexible decisions and is widely used because of its simplicity in responding to needs in decision making, so that decisions can be made effectively and efficiently.

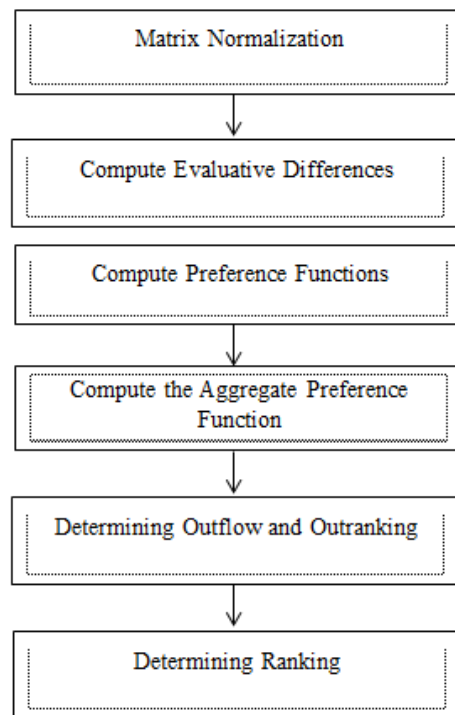


Figure 1. Research Framework

This method was developed to assist decision makers in dealing with complex situations where multiple criteria and alternatives must be assessed simultaneously. Promethee provides a structured and systematic framework for comparing alternatives based on specific preferences and criteria. Following are the steps to complete the Promethee method calculation:

1. Normalizing the decision matrix Normalization allows a more accurate comparison between alternatives by eliminating scale or unit differences that may exist in the original data. After normalization, the decision matrix will consist of scores in the range 0 to 1, which can be used for further analysis such as calculating preferences or ranking alternatives.
2. Calculate the evaluative difference of the alternative with respect to the other alternatives. This step

involves calculating the differences in criterion values between various pair-wise alternatives

3. Calculate the preference function . In this method, the preference function often produces different function values between two evaluations, so that [13]:

$$P(a, b) = P(f(a) - f(b))$$

Recommendations for Preference Functions for Application Needs. In *Promethee* six forms of criterion preference functions are presented. The six preferences are as follows [14]:

A. Usual Criteria _

$$H(d) = \begin{cases} 0 & \text{jika } d \leq 0 \\ 1 & \text{jika } d > 0 \end{cases}$$

Where :

$H(d)$ = function of the difference in criteria between alternatives

d = difference in criterion values $\{ d = f(a) - f(b) \}$

B. Quasi Criterion (*Quasi Criterion*)

$$H(d) = \begin{cases} 0 & \text{jika } d \leq q \\ 1 & \text{jika } d > q \end{cases}$$

Where :

$H(d)$ = function of the difference in criteria between alternatives

d = difference in criterion values $\{ d = f(a) - f(b) \}$

q = must be a fixed value

C. Criteria with Linear Preferences

$$H(d) = \begin{cases} 0 & \text{jika } d \leq 0 \\ \frac{d}{p} & \text{jika } 0 \leq d \leq p \\ 1 & \text{jika } d > p \end{cases}$$

Where :

$H(d)$ = function of the difference in criteria between alternatives

d = difference in criterion values $\{ d = f(a) - f(b) \}$

p = upward trend value

D. Level Criteria (Level Criterion)

$$H(d) = \begin{cases} 0 & \text{jika } d \leq q \\ 0.5 & \text{jika } q < d \leq p \\ 1 & \text{jika } d > q \end{cases}$$

Where :

$H(d)$ = function of the difference in criteria between alternatives

d = difference in criterion values $\{ d = f(a) - f(b) \}$

p = upward trend value

q = must be a fixed value

E. Criteria with Linear Preferences and Non-Different Areas

$$H(d) = \begin{cases} 0 & \text{jika } d \leq q \\ \frac{d - q}{p - q} & \text{jika } q < d \leq p \\ 1 & \text{jika } d > p \end{cases}$$

Where :

$H(d)$ = function of the difference in criteria between alternatives

d = difference in criterion values $\{ d = f(a) - f(b) \}$

p = upward trend value

q = must be a fixed value

F. Gaussian Criterion (Gaussian Criterion)

$$H(d) = \begin{cases} 0 & \text{jika } d \leq q \\ 1 - e - \frac{d^2}{2a^2} & \text{jika } d > 0 \end{cases}$$

Where :

$H(d)$ = function of the difference in criteria between alternatives

d = difference in criterion values $\{ d = f(a) - f(b) \}$

4. Calculating the aggregate preference function by considering the weights of the criteria. Join preference function.

5. Determining Outflow and Outranking is one of the important steps in comparing and ranking alternatives

6. Determining Ranking is the final step in the decision making process. After you have calculated the incoming flow and outgoing flow for each alternative, as well as the net flow inde

The PROMETHEE method is used when decision making involves various criteria that need to be measured and evaluated. This helps in handling situations where both subjective and objective preferences need to be considered in decision making.

3. Results and Discussion

3.1 Calculation of the Preference Ranking Organization Method for Enrichment Evaluation (Promethee)

Analysis of the system that will be created uses the *Promethee method* by collecting criteria data in the form of conditional social family data [16]. All required social family data is used to create a basis for criteria for determining conclusions regarding acceptance of the Family Hope Program (PKH).

The basic criteria are categories of conditions of the conditional social family [1]. Where the criteria basis is carried out by selecting conditional social family data to be able to determine the condition of families who are entitled to receive assistance [1]. Several basic criteria in this research are presented in Table 1.

No.	Criterion Name	Information	Weight	Type
1	Work	Unemployment (4) Labor (1) Self Employed (2)	20	Benefits
2	Income	<=Rp.500,000 (4) >Rp.500,000 – Rp.1,000,000 (3) >Rp.1,000,000 – Rp.1,500,000 (2) >Rp.2,000,000 (1)	20	Cost
3	The number of dependents	>=4 children (4) 3 children (3) 2 children (2) 1 or no children (1)	10	Benefits
4	Residence Status	Rental houses (4) Hitchhiking with parents (3) Own house (2)	15	Benefits
5	Water sources	River water (4) Well Water (3) Hitchhiking with neighbors (2) PDAMs (1)	15	Benefits
6	House Condition	Very Simple (4) Simple (3) Enough (2) Rich (1)	20	Benefits

To determine alternatives and criteria, researchers conducted direct interviews with employees at the Wali Nagari Kampung Dalam office. In this research there

are 5 alternative samples and six dominance criteria, which are presented in Table 2.

Alternative	Criteria					
	K1	K2	K3	K4	K5	K6
A1	4	3	4	4	2	4
A2	1	2	1	1	3	2
A3	3	3	2	4	3	3
A4	1	3	1	1	1	2
A5	1	4	1	1	1	1

At this stage, a comparison is made between one *alternative* and another *alternative*, by subtracting the value of the first *alternative* from the second *alternative*, then calculating the preference value according to the type of preference used. The preference function used to select PKH aid recipients is the level criteria preference *function*.

In this case, the nondifferentiating propensity q and the preference propensity p are determined simultaneously. If d is between the values of q and p , this means a weak preference situation ($H(d) = 0.5$).

Based on the equation above, the preference function will be searched for each criterion in selecting PKH assistance recipients as follows.

1. Job Criteria

Based on the equation above, a preference function will be sought for job criteria in selecting PKH assistance recipients which is presented in Table 3.

Alternative	A1	A2	A3	A4	A5
A1	0	0	0	0	0
A2	0.2	0	0.2	0	0
A3	0.2	0	0	0	0
A4	0.2	0	0.2	0	0
A5	0.2	0	0.2	0	0

2. Income

Based on the equation above, a preference function will be sought for the income criteria in selecting PKH assistance recipients which is presented in Table 4.

Alternative	A1	A2	A3	A4	A5
A1	0	0	0	0	0
A2	0.2	0	0.2	0	0
A3	0.2	0	0	0	0
A4	0.2	0	0.2	0	0
A5	0.2	0	0.2	0	0

3. The number of dependents

Based on the equation above, a preference function will be sought for the criteria for the number of

dependents in selecting PKH assistance recipients, which is presented in Table 5.

Table 5 . H(d) Number of Dependents

Alternativ e	A1	A2	A3	A4	A5
A1	0	0	0	0	0.1
A2	0.1	0	0.1	0.1	0.1
A3	0	0	0	0	0.1
A4	0	0	0	0	0.1
A5	0	0	0	0	0

4. Status of residence

Based on the equation above, a preference function will be sought for the residential status criteria in selecting PKH assistance recipients, which is presented in Table 6.

Table 6 . H(d) Residence Status

Alternativ e	A1	A2	A3	A4	A5
A1	0	0	0	0	0
A2	0.15	0	0.15	0	0
A3	0	0	0	0	0
A4	0.15	0	0.15	0	0
A5	0.15	0	0.15	0	0

5. Water sources

Based on the equation above, a preference function will be sought for water source criteria in selecting PKH assistance recipients, which is presented in Table 7.

Table 7 . H(d) Water Source

Alternativ e	A1	A2	A3	A4	A5
A1	0	0.15	0.15	0	0
A2	0	0	0	0	0
A3	0	0	0	0	0
A4	0.15	0.15	0.15	0	0
A5	0.15	0.15	0.15	0	0

6. House Condition

Based on the equation above, a preference function will be sought for the house condition criteria in selecting PKH assistance recipients which is presented in Table 8.

Table 8 . H(d) House Condition

Alternativ e	A1	A2	A3	A4	A5
A1	0	0	0	0	0
A2	0.2	0	0.2	0	0
A3	0.2	0	0	0	0
A4	0.2	0	0.2	0	0
A5	0.2	0.2	0.2	0.2	0

Next, calculate the leaving flow

Leaving flow is the number of curved line values that have a direction away from node a and this is the character of the outranking measurement

Determining each node in the outranking value graph is based on leaving flow

Based on the equation above, the Leaving Flow value will be looked for in selecting PKH aid recipients, presented in Table 9.

Table 9 . Leaving Flow

Alternative	Leaving Flow
A1	0.1
A2	0.475
A3	0.175
A4	0.5125
A5	0.5875

Next, calculate the entering flow

Entering flow is the number of symmetric line values that have a direction comparable to node a and this is the character of the outranking measurement

Determining each node in the graph outranking value is based on symmetrical entering flow ,

Based on the equation above, the Net Flow value will be sought in selecting PKH aid recipients, presented in Table 10.

Table 10 . Net Flow

Alternative	Net Flow
A1	-0.7125
A2	0.3125
A3	-0.525
A4	0.4375
A5	0.4875

The ranking values obtained using the Promethee process for selecting PKH aid recipients can be seen in Table 11.

Table 11 . Ranking Table

Alternativ e	A1	A2	A3	A4	A5
A1	0	0.15	0.15	0	0.1
A2	0.85	0	0.85	0.1	0.1
A3	0.6	0	0	0	0.1
A4	0.9	0.15	0.9	0	0.1
A5	0.9	0.35	0.9	0.2	0

The final results obtained using the Promethee process can be seen in Table 12 with a decision table for using Promethee for receiving PKH assistance in Table 13.

Table 12 . Table of Decisions on Accepting PKH Assistance

Alternative	Net Flow
>=0	Accepted
<0	Rejected

Table 13 . Selection Results Table

Alternative	Name	Leaving Flow	Entering Flow	Net Flow	Status
A1	Irmansyah	0.1	0.8125	- 0.7125	Rejected
A2	Tiah	0.475	0.1625	0.3125	Accepted
A3	Ainun	0.175	0.7	-0.525	Rejected
A4	Mansyah	0.5125	0.075	0.4375	Accepted
A5	Mus Muliadi	0.5875	0.1	0.4875	Rejected

Admin Login Page

The Admin login page is used by the Admin to access the system with access rights as Admin . As in Figure 2. the following :

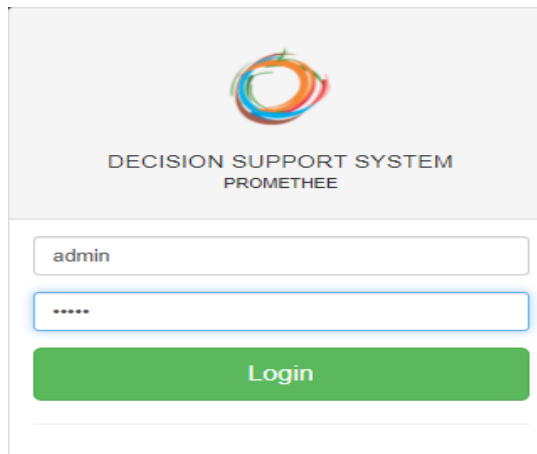


Figure 2 Admin Login Page

Criteria Data Page

The Criteria Data page displays the criteria data that has been entered. As in Figure 3. Following :

Data kriteria Penerima Bantuan

Nama	Bobot	Jenis	SubKriteria (Bobot)	Aksi
partisipasi	20	nomor	+Rp. 500.000 (4) +Rp. 500.000, and Rp. 1.000.000 (3) +Rp. 1.000.000, and Rp. 1.500.000 (2) Rp. 2.000.000 (1)	
jumlah tanggapan	10	nomor	4 anak atau lebih (4) 3 anak (3) 2 anak (2) 1 anak tidak punya anak (1) Dipernah I/2/3 (4)	
nomor ur	15	nomor	Air hangat (4) Air panas (3) Mempunyai tanggapan tanggapan (2) PISIR (1)	
partisipasi	20	nomor	pengangguran (4) anak (3) tidak ada (2) PISIR (1)	
status tempat tinggal	15	nomor	nomor nomor (3) mempunyai tanggapan tanggapan (2) rumah tidak sendiri (1)	
Kondisi Rumah	20	nomor	tergantung ketersediaan (4) tidak ada (3) tidak ada (2) tidak ada (1) bagian (1)	

Figure 3 Criteria Data Page

Prospective Aid Recipient Data Page

The Data on Prospective Aid Recipients page displays data on potential aid recipients that have been entered. As in Figure 4. Following :

Data Calon Penerima Bantuan

No	Nama	Jenis Kelamin	Alamat	Aksi
1	IRMANSYAH	Laki - Laki	Kota Bangun	
2	TIAH	Perempuan	Kota Bangun	
3	AINUN	Perempuan	Kota Bangun	
4	MANSYAH	Laki - Laki	Kota Bangun	
5	MUS MULIADI	Laki - Laki	Kota Bangun	

Figure 4 Prospective Aid Recipient Data Page

Selection Results Page

The Selection Results page displays the results of the selection of data on potential aid recipients that have been processed. As in Figure 5. the following :

Seleksi Calon Penerima Program Bantuan

Alternatif	Nama	Leaving Flow	Entering Flow	Net Flow	Status
A1	IRMANSYAH	0	0.6125	-0.6125	ditolak
A2	TIAH	0.3	0.075	0.225	diambil
A3	AINUN	0.05	0.3075	-0.3375	ditolak
A4	MANSYAH	0.35	0	0.35	diambil
A5	MUS MULIADI	0.4	0.025	0.375	diambil

Figure 5 Selection Results Page

4. Conclusion

A decision-making system using the Promethee method can help determine which families are entitled to become recipients of Poor Family Assistance Funds (PKH). The decision-making system using the PROMETHEE method is an effective tool in determining families who are entitled to receive Poor Family Assistance Funds (PKH). By identifying and measuring relevant criteria, as well as taking into account the preferences of decision makers, these methods enable more precise ranking and selection of alternatives. This allows PKH program administrators to run the program more efficiently and fairly, ensuring that assistance is provided to families who need it as appropriate.

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