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Combination of Decision Tree and K-Means Clustering Methods for Decision Making of BLT Recipients in the Covid-19 Period

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Abstract

The economic conditions during the Covid-19 outbreak had an impact on society globally. The number of people who have experienced layoffs has an impact on the economic conditions of the family. The economic impact that helps the community encourages the government to increase efforts to increase social assistance in the form of BLT. However, the distribution of BLT was not right on target, there were still many people who really could not afford not to receive BLT, while those who were still able to get BLT assistance. Therefore, it is important in this study to use a combination of the K-Means Cluster and Decision Tree methods to be used in BLT recipient decision making, with the aim of increasing BLT recipients as expected. The calculation results were obtained using a combination of the K-Means Cluster and Decision Tree methods referring to the criteria for the community who has the right to receive data with an error level of -2,48%< from error tolerance 6,84%.

Keywords: BLT; Decision Tree; K-Means Clustering; Covid-19

INTRODUCTION

The Covid-19 pandemic that is currently occurring globally has had a negative impact in various fields, including the economic sector(DPR-RI, n.d.). The imposition of restrictions on community activities in various regions in accordance with the instructions of the minister (Mendagri, n.d.), the Governor (P. Jateng, 2020) and the Mayor (Semarang, 2019)(B. H. S. P. Jateng, n.d.), made economic activity not smooth and many companies had to increase costs. expenditures for swab tests for employees, especially those in charge of marketing out of town. This causes extra expenses for the company, which causes the company to make a decision to reduce employees (Syahrial, 2020). The reduction in employees has an impact on the increase in the number of people who have an impact on the poor. However, of the many employees who have been dismissed, of course, not all are included in the BLT group (Kementerian Perencanaan Pembangunan Nasional, 2020), this it is important to conduct an analysis for decision making for people who deserve BLT.

Currently, the procedure for selection of BLT acceptance is still starting and being recorded through the RT, which at the time of conducting the selection it is still deemed less subjective. For this reason, it is still necessary to do a weighted ranking and decision making is done using a method that is closer to the linguistic element.

Several methods of decision-making have been used to provide assistance to poor people. In the research that has been conducted (Rahmona, Ningrum, & Ransi, 2016) using the AHP method for BLT decision making in Sembuli Village, Abeli District, Kendari City, the criteria used are 5 criteria, namely income, dependence, education, age, housing conditions, The number of households included in the test was 15 households. The results of the research showed that the AHP system method could be used to determine BLT recipients based on the order of the best recipients.

Research conducted by (Satria, 2014) used the TOPSIS method for Poor Student Aid, the data used was 15, the result of the calculation of the highest order at a value of 0.68065066. The TOPSIS method in research that has been carried out (Wuluanningrum, Kom, Pamungkas, & Kom, 2017) is to determine the recipient of Raskin for poor families in Sukowiyono village. The criteria used are 6 criteria, namely the number of family members, productive family members, the number of children, children attending school, electrical power, and building area. The data tested were 5 families of potential recipients. The preference results show the Sahri family with a preference value of 0.90298, Supari (0.63302), Pujianto (0.49731), and Suwarno (0.43453). Similar research to the TOPSIS method is also used for decision making in determining BLT recipients and livable houses for poor people as has been done (Enok Tuti Alawiah, 2019) and (Nanda, Pitiasari, & Kusmawati, 2019).

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In further research, the integration of the AHP-TOPSIS method was carried out (Maulana & Hidayat, 2018) which was carried out in Situbondo, in his research it had 6 criteria as a priority to get accuracy and the TOPSIS method was used as a preference for ranking. The data used in the training as many as 10 and 30 produced the highest accuracy value, namely 80%.

Decision making using the SAW method is also used for BLT as is done (Anwar Saputra, Tejawati, & Masnawati, 2017) and (Fadhliaziz & Sarjono, 2019). Similar research conducted by (Nugroho & Hamzah, 2019), (Reza, Arifin, & Marisa, 2017) and (Sembiring, Fauzi, Khalifah, Khotimah, & Rubiati, 2020). From several studies have been carried out in the majority decision making using the AHP, Topsis, and SAW methods. For that in this study using the K-Means Clustering method in weighting and for decision making used the Decision TreeSeveral decision-making methods that have been carried out previously to provide assistance to poor people using the AHP method have been implemented (Maulana & Hidayat, 2018; Rahmona et al., 2016; Satria, 2014; Teguh Sri Pamungkas, Agus Susilo Nugroho, Ichsan Wasiso, Tri Anggoro, 2020). The Topsis method is also widely used for decision making in determining BLT recipients and livable houses for poor people as has been done (Enok Tuti Alawiah, 2019; Nanda et al., 2019; Sumardin, 2014; Wuluanningrum et al., 2017). Decision making using the SAW method is also used for BLT as is done (Anwar Saputra et al., 2017; Fadhliaziz & Sarjono, 2019; Nugroho & Hamzah, 2019; Reza et al., 2017; Sembiring et al., 2020; Soares, 2013; Suryani, N. kairani, 2019; Wiwin Wijayanti, Kustanto, 2017; Yuliawati, Informasi, Program, & Additive, 2015). From several studies that have been carried out in the majority decision making using the AHP, Topsis and SAW methods. For that in this study using the K-Means Clustering method in weighting and for decision making used the Decision Tree.

LITERATURE REVIEW

Literature Review

The government's concern during the Covid-19 pandemic greatly impacted the economy of the community, one of which was through BLT. However, in its realization, the distribution of BLT is still deemed not on target (Wiwin Wijayanti, Kustanto, 2017), the results of the selection conducted through RT are not fully objective so that calculations are needed to rank with the decision-making method as has been done (Sembiring et al., 2020) which in his research used the SAW (Simple Additive Weighting) method. The results obtained in this study the highest score entitled to receive social assistance is 1.525, namely 5%, 1.425 which is 15%, and 1.375 namely 35%. Those who do not have the right to receive a value <1.375, namely 45%. The SAW method is also used in research (Fadhliaziz & Sarjono, 2019) wherein their research the SAW method is used for decision making for the community through PKH (Family Hope Program).

In the research conducted (Teguh Sri Pamungkas, Agus Susilo Nugroho, Ichsan Wasiso, Tri Anggoro, 2020) the AHP method is used as decision-making for people who are entitled to BLT. Calculations carried out resulted in the eigenvector value for weighting on the criteria for homeownership of 0.231035138, age with a criterion weight of 0.081077616, number of dependents with a criterion weight of 0.190359096, education with a criterion weight of 0.045273898, work with a criterion weight of 0.058111736 and monthly income with a criteria weight of 0.394142515. Based on these results, the maximum Eigenvalue is 6.418778937. Search for Consistency Index based on maximum eigen where the result of the consistency index (CI) is 0.083755787, the result of calculating the Consistency Ratio (CR) with a value of 0.06754499 so the results are stated to be consistent. Based on the functional testing of the system, the functions in the system have gone according to plan. The system has shown the same results as manual calculations based on manual testing so that it has fairly accurate results.

From the research that has been conducted by previous researchers, testing has not been carried out using the K-Means Clustering method in weighting and for decision making using the Decision Tree, for this reason in this study in making decisions for BLT fund recipients, a combination of the K-Means Clustering and Decision Tree methods is used.

Poor Population Criteria Approach

A Study on Determining the Criteria for the Poor has been carried out (Sosial, 2013) to determine the characteristics of the community that characterizes poverty conceptually (basic needs approach/poverty line). From the 2000 SPKPM results, 7 variables were deemed feasible and operational for determining poor households. The seven variables are:

1. Income (total income per month)

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2. Expenditure (percentage of expenditure)
3. Asset ownership
4. Residence status
5. Number of family dependents
6. Patterns of life
7. Number of family members of productive age

The criteria for poor households in Central Java BPS include:

1. The floor area of a residential building is less than eight square meters per person
2. Types of floors of residential buildings made of cheap soil/bamboo/wood
3. Types of living walls made of bamboo/thatch / low quality wood / walls without plaster
4. Do not have defecation facilities / together with other households,
5. Household lighting sources do not use electricity
1. 6.Sources of drinking water come from wells / unprotected springs/rivers/rainwater,
6. The fuel for daily cooking is firewood/charcoal / kerosene
7. Only consume meat / milk / chicken once a week
8. Only buy one new set of clothes a year
9. Only able to eat one / two times a day
10. Unable to pay for medical expenses at the polyclinic
11. Highest education of the head of household: not attending school / not completing SD / only SD
12. Farmers with a land area of 0.5 hectares, or farm laborers, fishermen, construction workers, plantation workers, or other jobs with an income below IDR 600,000 per month
13. Do not have savings/items that are easy to sell with a value of <= IDR 500,000, such as motorbikes, whether credit or non-credit, gold, livestock, motor boats and other capital goods

Decision Tree Method

Decision tree or CART (Classification and Regression Tree) is a flow chart shaped like a tree structure, each internal node states a test of an attribute, each branch states the output of the test and the leaf node states the classes or class distribution (urendra M. Gupta, 2018). The CART method is a combination of two tree species, namely the classification tree and the regression tree. The decision tree is used to classify a sample of data whose class is not yet known into existing classes. The first data test node is through the root node and the last is through the leaf node which will conclude the class prediction for the data. The data attribute must be categorical data, if it is continuous then the attribute must be discretized first. Fig. 1. shows the decision tree structure.

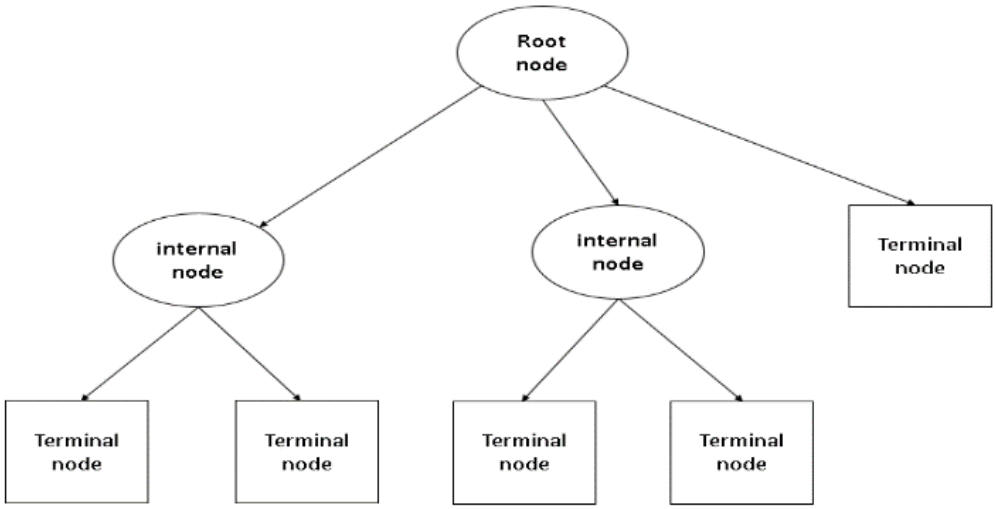

Fig. 1 The decision tree structure

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For calculations the following formula is used:

1. Entrophy

   To calculate entrophy, equation (1) is used:

$$\boldsymbol{Entropi\ (S) = \sum_{j=1}^{k} -p_j \log_2 p_j} \qquad (1)$$

   Entropi(S) = 0, if all the examples in S are in the same class

   Entropi(S) = 1, if the number of positive samples and the number of negative samples in S are the same

   0<Entropi(S)<1, if the number of positive and negative samples in S are not the same.

   Dimana : S is the set (dataset) of cases, k is the number of partitions S, p_j is the probability obtained from Sum (Active) divided by Total cases..

2. Gain

   To calculate Gain, the equation is used (2):

$$Gain(A) = Entropi(S) - \sum_{i=1}^{k} \frac{|S_i|}{|S|} x Entropi(S_i) \qquad (2)$$

   Where S= space (data) sample used for training., A = attribute. | S_i | = number of samples for the value of V, | S | = the number of all sample data, Entropy (S_i) = entropy for samples that have a value of i.

K-Means Cluster

K-means clustering is used to partition existing data into one or more clusters (Wyatt & Taylor, 2008). Group or cluster is a classification of objects based on the attributes/features of the object into K (cluster/partition). K is a positive number that represents the number of groups/clusters/partitions of the object. Data partitioning is done by finding the minimum distance value between the data and the centroid value that has been set either randomly or with the Initial Set of Centroids, to determine the centroid value based on successive K objects. The centroid is the arithmetic average of an object from all points in the object.

METHOD

The stages of the research are shown in accordance with Fig. 2:

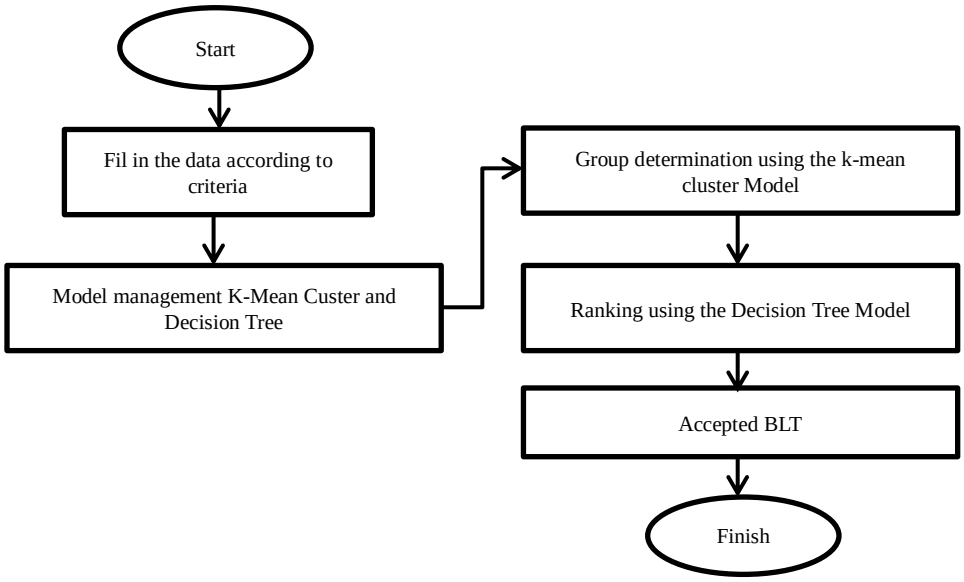

Fig. 2 Research methods

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Fill In The Data According To Criteria

a. The criteria used to define groups are:
   1) Income (Total income per month)
   2) Expenditure (percentage of expenditure)
   3) Asset ownership
   4) Residence status
b. The criteria used for ranking are:
   1) Number of family dependents
   2) Patterns of life
   3) Number of family members of productive age:

Model Management K-Mean Custer and Decision Tree

To determine new data for people who received BLT, based on data on employees who were laid off, the existing data can be seen in Table 1, it is used to form a decision tree with attributes such as residence status (value 20 for lease residence status, 40 for hitchhiking status, and 80 for residence status. residence status), Value for the level of importance of family life patterns in the range of 0-100 (very good for the level of interest ≥ 85, good for the level of interest ≥ 75, sufficient for the level of interest ≥ 65, poor for the level of interest ≥ 55 and Very bad for the importance level ≥0). The variables used in this criterion are Income (Total Income/month) (K1), Expenses (Presentation of Expenses) (K2), Asset Ownership (K3), Residence (K4).

Table 1

Data BLT registrant

NO	Candidate Data	K1: Income (Total income / month)	K2: Expenditures (Expense Presentation)	K3: Asset Ownership	K4: Residence
1	Karni	2.500.000	2.200.000	17.000.000	Rent
2	Wartoyo	1.500.000	1.700.000	12.000.000	Rent
3	Santosa	1.500.000	1.400.000	10.000.000	Ride
4	Joko Santosa	1.300.000	1.000.000	9.000.000	Rent
5	Poniman	500.000	750.000	5.500.000	Ride
6	Marsidi	1.500.000	1.300.000	9.000.000	Private property
7	Nur Muslimin	1.500.000	1.100.000	10.000.000	Private property
8	Firmansyah	600.000	800.000	6.500.000	Rent
9	Junadi	1.500.000	1.800.000	14.500.000	Rent
10	Marsidi	600.000	900.000	5.000.000	Rent
11	Martoyo	900.000	750.000	8.500.000	Rent
12	Sugeng Widodo	900.000	1.200.000	12.000.000	Ride
13	Suyanto	1.500.000	1.700.000	12.500.000	Ride
14	Sunarto	1.500.000	2.000.000	10.000.000	Rent
15	Kasiman	2.000.000	2.300.000	15.000.000	Ride
16	Ngatino	1.000.000	800.000	5.000.000	Ride
17	Mardi	600.000	900.000	4.500.000	Ride
18	Kasiman	600.000	600.000	5.000.000	Private property
19	Bambang	2.500.000	2.400.000	10.000.000	Private property
20	Tukino	1.800.000	1.700.000	9.000.000	Rent

For the weight of the criteria can be seen in Table 2:

Table 2

Criteria weight

Lifestyle	Number of Family Members of Productive Age	Number of family dependents
3	5	2

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The measure of the feasibility level is used to classify the level of feasibility based on the value of monthly income. The level of eligibility can be different every year, influenced by economic conditions each year. The range of values for the eligibility level of potential BLT recipients to the monthly income of parents and children of productive age can be seen in Table 3 :

Table 3
Classification of the level of eligibility based on the value of monthly income

Value Range	Eligibility Level
< 1.000.000	Very Worth it
1.000.000 - 1.200.000	Worth it
1.200.000 - 1.500.000	Decent enough
1.500.000 - 2.000.000	Less feasible
>2.000.000	Not feasible

Group Determination Using The K-mean Cluster Model

Data is partitioned as many as 3 partitions, then the stages are as follows:

a. K = 3, (K = Number of Clusters)
b. Default centroid (10, 80, 6) for partition 0, centroid (6, 40, 3) for partition 1 and centroid (4, 60, 3) for partition 2
c. Then the calculation of Euclidean Distance. The result of the calculation of the minimum distance A is:

$$D(p,c)_0 = \sqrt{(2-10)^2 + (60-80)^2 + (2-6)^2} = 21{,}9089$$

$$D(p,c)_1 = \sqrt{(2-6)^2 + (60-40)^2 + (2-3)^2} = 20{,}42058$$

$$D(p,c)_2 = \sqrt{(2-4)^2 + (60-60)^2 + (2-3)^2} = 2{,}236068$$

Calculations are performed for all data

d. Partition calculation results are taken from the minimum distance, with the formula:

$$c_i = min + \frac{(i-1) * (max - min)}{n} + \frac{(max - min)}{2 * n}$$

The results of the calculation are: C1 = 3,333333, C2 = 6, C3 = 8,666667
So that the calculation results can be seen in Table 4:

Table 4
The result of the calculation Centroid

Class	Average	Centroid	Average-centroid
1	3	3,333333	-0,333333333
2	4,666667	6	-1,333333333
3	7,857143	8,666667	-0,80952381
		error tolerance	-2,476190476

The result of the error tolerance = -2,476190476 < from error tolerance 6,84

e. After the data is partitioned, then the centroid value must be recalculated to determine the new minimum distance. Classify data again based on the minimum distance
f. If no data is moved to a different cluster, iteration stops until the final centroid value, the final result can be seen in Table 5:

Table 5
Result Distance with Class

Distance With Class				
	1	2	3	
Value	3	4,666667	7,857143	Class
10	7	5,333333	-2,14286	2
9	6	4,333333	-1,14286	2
8	5	3,333333	0,142857	3

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8	5	-3,33333	-0,14286	1
7	4	-2,33333	0,857143	1
7	4	2,333333	0,857143	3
6	3	1,333333	-1,85714	3
5	2	0,333333	-2,85714	3
5	2	-0,33333	2,857143	2
5	2	-0,33333	2,857143	1
5	2	-0,33333	2,857143	1
4	1	-0,66667	3,857143	3
4	1	-0,66667	3,857143	3
4	1	-0,66667	3,857143	2
3	0	1,666667	4,857143	1
3	0	1,666667	4,857143	2
3	0	1,666667	4,857143	1
3	0	-1,66667	4,857143	2
3	0	1,666667	4,857143	1
2	1	2,666667	5,857143	2

Ranking using the Decision Tree Model

The number of people who will be accepted is 18 people. From the grouping process, one group was deemed very feasible, namely cluster 3 with 6 potential BLT recipients. Because the number of people in cluster 3 has not fulfilled the number of people needed, another cluster that is most feasible will be selected after cluster 3, namely cluster 2. Likewise, if there is still no food, it will be taken from cluster 1.

Entropy results for a total of 14 cases of data consisting of 7 data from class 1 and 7 data from class 2, the calculation results are obtained:

Entropy (S) = (- (7/14) x log2 (7/14) + (- (7/14) x log2 (7/14)) = 1

The value of Gain is obtained from the calculation: K1: Income (Total income / month) = 0.5454, K2: Expenditures (Expense Presentation) = 0.177873214, K3: Asset Ownership =, 078814503, K4: Residence = 0.062898894. Since the largest gain value is Gain (K1), the attribute "K1" becomes the root node.

From the calculation results, the order is carried out and the final results can be seen in:

Table 6
Recipient Data BLT

NO	K-Mean Clustering Result			Decision Tree Results		Residents Who Received BLT	
	Cluster 1	Cluster 2	Cluster 3	Selected alternative		No	Name
1	Firmansyah	Ngatino	Firmansyah	No	Name	**Cluster 3**	
2	Suyanto	Kasiman	Suyanto	1	Sunarto	1	Firmansyah
3	Marsidi	Junadi	Marsidi	2	Kasiman	2	Suyanto
4	Poniman	Tukino	Poniman	3	Junadi	3	Marsidi
5	Wartoyo	Marsidi	Wartoyo	4	Sugeng Widodo	4	Poniman
6	Nur Muslimin	Sunarto	Nur Muslimin	5	Mardi	5	Wartoyo
		Karni		6	Kasiman	6	Nur Muslimin
				7	Santosa	**Decision Tree**	
				8	Ngatino	1	Sunarto
				9	Tukino	2	Kasiman
				10	Martoyo	3	Junadi
				11	Karni	4	Sugeng Widodo
				12	Joko Santosa	5	Mardi
						6	Kasiman
						7	Santosa
						8	Ngatino
						9	Tukino
						10	Martoyo
						11	Karni
						12	Joko Santosa

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RESULT

From the research results, the K-Means Clustering calculation results obtained the value of C1 = 3.333333, C2 = 6, C3 = 8.666667 with the error level obtained of -2.476190476 <from error tolerance 6.84. The result of Decision Tree calculation shows that the entropy value = 1. The value of Gain is obtained from the calculation: K1: Income (Total income / month) = 0.5454, K2: Expenditures (Expense Presentation) = 0.177873214, K3: Asset Ownership =, 078814503, K4: Residence = 0.062898894. The results of the 20 candidates who registered for BLT, there were 2 candidates who were not eligible to receive BLT with criteria for their own house, criteria for a bad lifestyle, and an eligibility level based on inadequate income.

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