

Combination of Fuzzy C-Means Clustering Methods and Simple Additive Weighting in Scholarship of Decision Support Systems

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Abstract. Scholarships are educational assistance given to individuals or students with the aim of providing relief from financial costs for the continuation of the education pursued. Scholarships at SMK Auto Matsuda There are two types of scholarships which are grouped based on achievement criteria, status and family economic conditions. The decision-making system has not been objective and transparent in determining foundation scholarship recipients, this is the background of the research using a combination of two methods, namely the Method *Fuzzy C-Means* (FCM) and *Simple Additive Weighting* (SAW). The combination of the *Fuzzy C-Means* (FCM) method is used for clustering to determine the membership weights objectively based on each variable criterion, while the *Simple Additive Weighting* (SAW) method is used for the weighted addition of each alternative on all alternative criteria to find a weighted addition. with the performance appraisal of the overall highest score by taking the results of the clustering, the best alternative will be taken. provide information and consideration to anticipate in classifying prospective recipients of Foundation Education Fee Assistance Scholarships (BBP Foundation) and Learning Achievement Enhancement Scholarships (PPB Foundation). Sampel data as much as 10 student data obtained three clusters based on the average value of the determination of the scholarship then processed by Simple Additive Weighting (SAW) for the ranking of each cluster classified based on which criteria are prioritized with the greatest value at the final distance is the cluster that receives the scholarship, while The cluster with the smallest score is the cluster that is not eligible to receive a scholarship. This study aims to implement the *Simple Additive Weighting* (SAW) method and the *Fuzzy C-Means* (FCM) method by categorizing variable criteria and using weighting in the selection of participants who receive the Foundation Education Fee Assistance (BBP Foundation) scholarship and Learning Achievement Improvement (PPB Foundation) scholarship. can display the final results of prospective scholarship recipients from the greatest value (feasible) to the smallest (not feasible).

Keywords: Scholarships, Decision Support Systems, FCM, SAW.

1. INTRODUCTION

Scholarships are assistance for the ongoing education, which is given to individuals. This assistance can be obtained from government agencies, companies or foundations. Scholarships can be categorized as free gifts or gifts with work ties and are commonly referred to as official ties after the completion of the scholarship recipient's education. Students at various levels, especially Senior High School (SLTA) at the high school level in private schools have a greater chance of obtaining educational assistance in the form of scholarships provided by schools sourced from the Foundation. Especially at the Auto Matsuda Vocational School, it has 2 (two) forms of educational assistance, namely the Education Fee Scholarship (BBP Foundation) for orphaned, orphaned and orphaned students as well as for students who experience economic limitations, and Learning Achievement Scholarships (BPB Foundation) for Outstanding students at the national or regional level cover all aspects of the field, besides that there are scholarships from several companies that have collaborated with schools in the form of apprenticeship training scholarships, student exchanges or other scholarships which are routine annual programs of schools with large companies.

The variables applied in this study are the value of report cards each semester, student achievement, parental condition, productive age of household heads, number of family members who are still in school, parents' income, parental dependents, electricity bills, and BPJS contributions. This variable is taken from the data of students who registered as candidates for foundation scholarship assistance. Therefore, not all students who register can be accepted, only students who meet the criteria will receive the scholarship assistance. Considering the large number of prospective scholarship recipients and the many required criteria indicators, a decision support system is needed to help determine scholarship recipients so that they are right on target and reduce the error of the subjectivity element.

The method used in this study is to combine two methods, namely Fuzzy C-Means (FCM) and Simple Additive Weighting methods (SAW). The combination of the Fuzzy C-Means (FCM) method is used for clustering to determine the membership weights objectively based on each variable criterion, while the Simple Additive Weighting (SAW) method is used for the weighted addition of each alternative on all alternative criteria to find a weighted addition. with the performance appraisal of the overall highest score by taking the results of the clustering, the best alternative will be taken. Robbie Shugara, et al (2016) from the journal Pseudocode, Volume III Number 2, ISSN 2355-

5920 conducted a study entitled Implementation of the Fuzzy C Algorithm - Means Clustering and Simple Additive Weighting in Providing Assistance for the Quality Improvement Program for Settlement Areas (Case Study: Kelurahan / RT throughout Bengkulu City). This study succeeded in grouping RTs throughout Bengkulu City into 3 clusters using the fuzzy c-means clustering algorithm and succeeded in ranking RTs throughout Bengkulu City with algorithm simple additive weighting so as to provide recommendations in the form of a list of RT-RTs that deserve assistance with ranking values. the highest.

2. METHOD

2.1. Fuzzy C-Means (FCM)

FCM integrates the effectiveness of the C-Means algorithm to partition or group data into a number of clusters, with the ability of similar algorithms [1]. The main parts of the fuzzy C-Means algorithm (FCM) are (1) as a functional equation between clusters; (2) as a result of the clustering function accurately; and (3) for functional variable data analysis [3].

The basic concept of FCM, first is to determine the center of the cluster, which will mark the average location for each cluster. At initial conditions, the center of this cluster is still inaccurate. Each data point has a degree of membership for each cluster. How to repair the cluster center and the degree of membership of each data point repeatedly, it will be seen that the cluster center will move to the right location. This iteration is based on minimizing the objective function describing the distance from a given data point to a cluster center weighted by the degree of membership of that data point. The output from FCM is not a fuzzy inference system, but a row of cluster centers and several degrees of membership for each data point. This information can be used to build a fuzzy inference system [2].

The Fuzzy C-Means (FCM) algorithm is as follows:

Input data to be in cluster X, in the form of a matrix of size $n \times m$ (n = number of data samples, m = attributes of each data). X_{ij} = sample data i ($i = 1, 2, \dots, n$), attribute j ($j = 1, 2, \dots, m$).

1. The next step is to determine some of the inputs required in calculating fuzzy c-means, namely:
 - a. The number of clusters (c) is the number of clusters that will be formed according to clustering needs.
 - b. The exponent (w) is the exponential value.
 - c. Maximum iteration (MaxIter) is the limit of repetitions or loops. Looping will stop when the maximum iteration value has been reached.
 - d. The error smallest (ξ) is a value limit that

causes the loop to end after the expected error value is obtained.

- e. The initial objective function ($P_0 = 0$) is a function to be optimized (maximum or minimum), the value of 0 means to get the minimum value.
- f. Initial iteration ($t = 1$), iteration is a specific property of an algorithm or computer program in which a sequence or more of an algorithmic step is repeated. The initial iteration is the loop the program will start with.
- g. Generating a number *random* μ_{ik} , $i = 1, 2, \dots, n$; $k = 1; 2, \dots, c$; as the elements of the initial partition matrix U . Count the number of each column:

$$Q_i = \sum_{k=1}^n \mu_{ik}$$

Q_i is the number of each column of the random value of a matrix, the number of Q depends on the number of scoring criteria.

h. Calculate the center of the k -th cluster: V_{kj} , where $k = 1, 2, \dots, c$; and $j = 1, 2, \dots, m$

$$V_{kj} = \frac{\sum_{i=1}^n ((\mu_{ik})^w * X_{ij})}{\sum_{i=1}^n (\mu_{ik})^w}$$

V_{kj} is the center point of each *cluster*, the number of V_{kj} depends on how many *clusters* will be formed and n is the number of proposals.

- i. Compute the objective function in the iteration t , P_t

$$P_{(t)} = \sum_{i=1}^n \sum_{k=1}^c ([\sum_{j=1}^m (X_{ij} - V_{kj})] (\mu_{ik})^2)$$

$$Z = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1j} \\ \vdots & \vdots & \vdots & \vdots \\ x_{i1} & x_{i2} & \dots & x_{ij} \end{bmatrix}$$

- c. Give the preference weight value (W) by the decision maker for each of the predetermined

$$W = [W_1 \ W_2 \ W_3 \ \dots \ W_j]$$

- d. Normalizing the Z decision matrix by calculating the normalized performance rating value (r_{ij}) from the

It is a calculated iteration, if the iteration starts from 1 then at the beginning of the calculation the value of t is 1. The iteration will repeat in accordance with the provisions of the ongoing iteration. Calculate the change in partition matrix.

$$\mu_{ik(t)} = \frac{[\sum_{j=1}^m (X_{ij} - V_{kj})^2]^{-\frac{1}{w}}}{\sum_{k=1}^c [\sum_{j=1}^m (X_{ij} - V_{kj})^2]^{-\frac{1}{w}}}$$

The iteration will continue to repeat if certain values or conditions have not been reached, as for the condition is if: ($| P_t - P_{t-1} | < \xi$) or ($t > \text{MaxIter}$) then it stops where P_t is the center of the cluster iteration to t is less than the value *error* expected or if t (number of iterations) is greater than the maximum iteration. However, if the iteration is repeated with $t + 1$ it will repeat the 4th process or calculate the center of the cluster again.[2]

2.2. Simple Additive Weighting (SAW)

The SAW method is often also known as the weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. The method steps in the SAW method are [5]:

- a. Making a decision matrix Z of size $m \times n$, where $m =$ the alternative to be selected and $n =$ the criteria
- b. Give the value of x for each alternative (i) for each criterion (j) that has been determined, where, $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$ in the decision matrix Z ,

criteria.

alternative A_i in attribute C_j

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\text{MAX}_i(x_{ij})} & \text{Benefit} \\ \frac{\text{MIN}_i(x_{ij})}{x_{ij}} & \text{Cost} \end{cases}$$

with the following conditions:

- a) It is said that the profit attribute is if the attribute provides many benefits for the decision maker, while the cost attribute is an attribute that provides a lot of expenses. if the value is greater for the decision maker.
- b) If it is a profit attribute, the value (x_{ij}) of each

attribute column is divided by the value (MAX x_{ij}) of each column, while for the cost attribute, the value (MIN x_{ij}) of each attribute column is divided by the value (x_{ij}) each column.

- e. The results of the normalized performance rating value (r_{ij}) form a normalized matrix (N)

$$N = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1j} \\ \vdots & \vdots & \vdots & \vdots \\ r_{i1} & r_{i2} & \dots & r_{ij} \end{bmatrix}$$

- f. Perform the ranking process by multiplying the normalized matrix (N) with the preference weight value (W).

- g. Determining the preference value for each alternative (V_i) by adding the product of the normalized matrix (N) with the preference weight value (W).

$$V_i = \sum_{j=1}^n w_j r_{ij}$$

Value of V_i the larger one indicates that alternative A_i is the best alternative.

2.3. Combination of Fuzzy C-Means and Simple Additive Weighting

To solve the problem, it is done by combining 2 methods, namely Fuzzy C-Means Clustering and Simple Additive Weighting. The steps are as follows:

- 1. Enter the data to be clustered into an X matrix, where the matrix is $m \times n$, where m is the amount of data to be clustered and n is the attribute of each data.
Example X_{ij} = data i th ($i = 1, 2, \dots, m$), attribute to- j ($j = 1, 2, \dots, n$).
- 2. Determine:
 - a. Number of clusters = c ;

- b. Rank / weight = w ;
- c. Maximum iteration = MaxIter ;
- d. Expected error = ξ ;
- e. Initial objective function = $P_0 = 0$;
- f. Initial iteration = $t = 1$;

- 3. Generate a random number μ_{ik} (with $i = 1, 2, \dots, m$ and $k = 1, 2, \dots, c$) as the element of the initial partition matrix U, where X_{iith} is the data on the condition that the number of membership degrees (μ).
- 4. Calculate the center of the k -th cluster: V_{kj} , where $k = 1, 2, \dots, c$ and $j = 1, 2, \dots, n$.
- 5. Compute the objective function in the t -iteration.

6. Calculate the change in the degree of membership of each data in each cluster (fixing the partition U matrix).
7. Check the stop condition. If: $(| P_t - P_{t-1} | < \xi)$ or $(t > \text{MaxIter})$ then it stops; If not: $t = t + 1$, repeat step 4
8. Calculate the XB index (Xie-Beni).
9. Find the smallest XB index value from the existing cluster, the smallest value indicates that the cluster is the best cluster.
10. Data included in the best clusters will be used in the calculation process using the SAW method.
11. Make a decision matrix Z measuring $m \times n$, where m = data members from the best cluster and n = criteria.
12. Give the x value of each alternative (row) on each criterion (column) that has been determined, where, $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$ in the decision matrix Z on.
13. Give preference weight value (W) by decision maker for each criterion on.
14. Normalizing the decision matrix Z by calculating the normalized performance rating value (r_{ij}) from alternative A_i on attribute C_j .
15. The results of the normalized performance rating value (r_{ij}) form a normalized matrix (N).
16. Carry out the ranking process by multiplying the normalized matrix (N) with the preference weight value (W).
17. Determine the preference value for each alternative (V_i) by adding the product of the normalized matrix (N) with the preference weight value (W). Value of V_i the largest indicates that alternative A_i is the best alternative.

$$X = \begin{pmatrix} 1 & 5 & 2 & 4 & 4 & 1 & 1 & 0 & 0 \\ 1 & 3 & 1 & 2 & 3 & 1 & 1 & 0 & 0 \\ 1 & 5 & 2 & 5 & 3 & 1 & 1 & 0 & 0 \\ 1 & 1 & 3 & 2 & 4 & 1 & 1 & 0 & 0 \\ 1 & 5 & 1 & 2 & 3 & 2 & 3 & 0 & 0 \\ 1 & 5 & 1 & 4 & 5 & 1 & 1 & 1 & 1 \\ 2 & 5 & 2 & 2 & 3 & 2 & 2 & 0 & 0 \\ 1 & 4 & 2 & 4 & 3 & 1 & 1 & 0 & 0 \\ 1 & 2 & 1 & 2 & 4 & 1 & 1 & 0 & 0 \\ 3 & 5 & 2 & 2 & 3 & 1 & 3 & 0 & 0 \end{pmatrix}$$

In this step, generate the matrix U with components $k, i = 14; k = 2$, the value of μ_{ik} is determined

2.4. Decision Support System (DSS)

Definition of the concept of a Decision Support System (DSS) was first presented by Scott Morton in 1970 with the term *Management Decision System*. Decision support systems are interactive computer-based systems, which help decision makers to use data and various models to solve unstructured problems. The decision support system combines the intellectual resources of individuals with computer capabilities to improve decision quality [4].

3. RESULTS AND DISCUSSION

3.1. Research Results The

variable data used in this study to determine scholarship acceptance using a combination of the Fuzzy C-Means algorithm and Simple Additive The weighting of 20 prospective scholarship recipients in the clustering process where the status of parents is made 1, family income is made 2, family dependents are made as 3, father's age is made as 4, report card value is used as 5, electricity bill is made as X_i 6, dues BPJS is used as X_i 7, the number of achievements is used as X_i 8 and the level of achievement is used as X_i 9. Enter the data to be clustered into the matrix. The data entered in the matrix is data that has been weighted based on the variables required for the study as follows:

randomly .. The matrix is U used to calculate the center of the cluster in the next step.

$$U = \begin{pmatrix} 0.251 & 0.792 & 0.682 \\ 0.718 & 0.818 & 0.209 \\ 0.316 & 0.765 & 0.733 \\ 0.955 & 0.966 & 0.256 \\ 0.351 & 0.864 & 0.977 \\ 0.087 & 0.639 & 0.665 \\ 0.320 & 0.805 & 0.663 \\ 0.947 & 0.008 & 0.929 \\ 0.644 & 0.222 & 0.756 \\ 0.745 & 0.827 & 0.963 \end{pmatrix}$$

The results of the matrix U that have been formed will be used as the center of the cluster first then

used for the iteration process in calculations in the next process.

Table 1 Calculation Results of Multiplication between Column μ_i to the power of 2 with Each Column Matrix X

$(\mu_i)^2$	$(\mu_i)^2 * X_{i1}$	$(\mu_i)^2 * X_{i2}$	$(\mu_i)^2 * X_{i3}$	$(\mu_i)^2 * X_{i4}$	$(\mu_i)^2 * X_{i5}$	$(\mu_i)^2 * X_{i6}$	$(\mu_i)^2 * X_{i7}$	$(\mu_i)^2 * X_{i8}$	$(\mu_i)^2 * X_{i9}$
0.063	0.063	0.314	0.126	0.251	0.251	0.063	0.063	0.000	0.000
0.515	0.515	1.545	0.515	1.030	1.545	0.515	0.515	0.000	0.000
0.100	0.100	0.499	0.200	0.499	0.299	0.100	0.100	0.000	0.000
0.913	0.913	0.913	2.739	1.826	3.652	0.913	0.913	0.000	0.000
0.123	0.123	0.616	0.123	0.246	0.370	0.246	0.370	0.000	0.000
0.008	0.008	0.038	0.008	0.030	0.038	0.008	0.008	0.008	0.008
0.102	0.204	0.511	0.204	0.204	0.307	0.204	0.204	0.000	0.000
0.896	0.896	3.585	1.793	3.585	2.689	0.896	0.896	0.000	0.000
0.414	0.414	0.829	0.414	0.829	1.658	0.414	0.414	0.000	0.000
0.555	1.664	2.773	1.109	1.109	1.664	0.555	1.664	0.000	0.000
$\frac{\sum (\mu_i)^2 * X_{ij}}{\sum (\mu_i)^2}$	1.796	2.451	8.883	2.932	5.870	5.517	2.452	3.730	0.027
$\frac{\sum (\mu_i)^2 * X_{ij}}{\sum (\mu_i)^2}$	1.364	4.945	1.632	3.268	3.071	1.365	2.076	0.015	

Calculating the cluster center of each degree of membership value where V_{kj} is the center point of each cluster, the number of V_{kj} depends on how many

clusters which will be formed and N is the number of proposals.

Table 2 Calculation Results Clusterat

$$V = \begin{pmatrix} 1.380 & 4.244 & 1.421 & 3.082 & 3.796 & 1.025 & 1.318 & 0.211 & 0.211 \\ 1.577 & 4.378 & 1.744 & 3.126 & 3.435 & 1.073 & 1.361 & 0.071 & 0.087 \\ 1.485 & 4.361 & 1.608 & 3.046 & 3.509 & 1.062 & 1.348 & 0.046 & 0.048 \end{pmatrix}$$

Table 3 Calculation Results of Objective Functions

$\left[\sum_{j=1}^6 (x_{ij} - v_{1j})^2 \right] (\mu_{i1})^2$	$\left[\sum_{j=1}^6 (x_{ij} - v_{2j})^2 \right] (\mu_{i2})^2$	$\left[\sum_{j=1}^6 (x_{ij} - v_{3j})^2 \right] (\mu_{i3})^2$	L1+L2+L3
L1	L2	L3	
0.426107888	1.812960172	0.084964776	2.324032836
3.098398842	0.290590512	0.21522982	3.604219174
0.456959999	0.178394531	1.099482238	1.734836768
0.247637067	0.669086669	0.323522068	1.240245804
0.076509771	0.75948732	5.971433002	6.807430093
4.34913095	4.723234154	0.525156785	9.597521889
0.875108456	0.722606776	0.120648466	1.718363698
0.535587441	0.329093862	0.615065631	1.479746935
3.694255473	0.982912029	1.170462877	5.847630379
1.820401467	0.088379653	0.017398044	1.926179164
Fungsi Objective			56.6098897137938

Table 4 Partition Matrix Calculations U

$\left[\sum_{j=1}^6 (x_{ij} - v_{1j})^2 \right]$	$\left[\sum_{j=1}^6 (x_{ij} - v_{2j})^2 \right]$	$\left[\sum_{j=1}^6 (x_{ij} - v_{3j})^2 \right]$	$\sum_{k=1}^3 \left[\sum_{j=1}^6 (x_{ij} - v_{kj})^2 \right]^{-1}$
L1	L2	L3	LT = L1+L2+L3
0.316781238	0.526913989	0.426425424	1.270120651
0.224304104	0.207495178	0.240858171	0.672657453
0.145111587	0.222773801	0.192847501	0.560732889
0.059622558	0.058477602	0.067961754	0.186061914
0.19012707	0.170130281	0.161751254	0.522008605
0.14836796	0.169782339	0.164869485	0.483019784
0.385676889	0.309267203	0.294244859	0.98918895
0.285773867	0.514373477	0.515864155	1.3160115
0.119043194	0.107676479	0.129890109	0.356609782
0.192847428	0.151600531	0.153802439	0.498250399

Table 5 Calculation Result Matrics Partition U

\square_{i1}	\square_{i2}	\square_{i3}
L1/LT	L2/LT	L3/LT
0.24941	0.414853	0.335736
0.33346	0.308471	0.35807
0.258789	0.39729	0.34392
0.320445	0.314291	0.365264
0.364222	0.325915	0.309863
0.307167	0.351502	0.341331
0.389892	0.312647	0.297461
0.217151	0.390858	0.391991
0.333819	0.301945	0.364236
0.387049	0.304266	0.308685

This step is to determine the initial parameters that will be used to solve the problem with the Fuzzy C-Means algorithm. These parameters are the number of clusters ($C = 2$), power ($W = 2$), maximum iteration

(MaxIter = 50), smallest error expected ($\xi = 0,01$), initial objective function ($P_0 = 0$), and the initial iteration ($t = 1$). There are two defined clusters, namely the clusters for those who deserve to receive scholarships and the clusters for those who are not

eligible for scholarships.

The results of calculations on *fuzzy c-mens* based on clusters are names of scholarship recipients and clusters

where: C1 is highly prioritized for obtaining scholarships and C2 is not prioritized.

Ranking	Nilai V	Nama	Kelas	Status Orang Tua	Penghasilan	Tanggungan	Usia Ayah	Nilai Semester	Tagihan Listrik	Iuran BPJS
1	22.7333333333333	RIVALDI CHAN BAHTIAR	X	Yatim Piatu	>= Rp.999.999	1	>= 55	75-79	Lunas	Lunas
2	20.5666666666667	RIO ADI PRATAMA	X	Yatim	>= Rp.999.999	2	>= 55	75-79	Lunas	Menunggak 3 Bulan
2	20.5666666666667	ANGGI SETIAWAN	X	Yatim	>= Rp.999.999	2	>= 55	75-79	Lunas	Menunggak 2 Bulan
2	20.5666666666667	RIZAL KHAIRUL UMAM	XII	Yatim	>= Rp.999.999	1	>= 55	75-79	Lunas	Lunas
5	16.4333333333333	INDAR OPIYANTI	X	Piatu	>= Rp.999.999	1	50-54	75-79	Menunggak 1 Bulan	Menunggak 1 Bulan
5	16.4333333333333	RIFA NIUR SHIDIKYA	X	Lengkap	>= Rp.999.999	3	40-44	80-85	Lunas	Lunas
5	16.4333333333333	NAINA NURRAHMA SARI	X	Lengkap	>= Rp.1.000.000 - Rp.1.499.999	2	50-54	75-79	Lunas	Menunggak 1 Bulan

Figure 1 Calculation Results of the SAW Method

#	Periode	Rank	Nilai V	Nama	Status	Penghasilan	Tanggungan	Usia Ayah	Nilai Rata-rata	Tagihan Listrik	Iuran BPJS
1	1	1	22.7333	RIVALDI CHAN BAHTIAR	Yatim Piatu	>= Rp.999.999	1	>= 55	75-79	Lunas	Lunas
2	1	2	20.5667	RIO ADI PRATAMA	Yatim	>= Rp.999.999	2	>= 55	75-79	Lunas	Menunggak 3 Bulan
3	1	2	20.5667	ANGGI SETIAWAN	Yatim	>= Rp.999.999	2	>= 55	75-79	Lunas	Menunggak 2 Bulan
4	1	2	20.5667	RIZAL KHAIRUL UMAM	Yatim	>= Rp.999.999	1	>= 55	75-79	Lunas	Lunas
5	1	5	16.4333	INDAR OPIYANTI	Piatu	>= Rp.999.999	1	50-54	75-79	Menunggak 1 Bulan	Menunggak 1 Bulan
6	1	5	16.4333	RIFA NIUR SHIDIKYA	Lengkap	>= Rp.999.999	3	40-44	80-85	Lunas	Lunas
7	1	5	16.4333	NAINA NURRAHMA SARI	Lengkap	>= Rp.1.000.000 - Rp.1.499.999	2	50-54	75-79	Lunas	Menunggak 1 Bulan
8	1	8	13.0833	YUYUN SUNARSIH	Lengkap	>= Rp.999.999	1	40-44	75-79	Menunggak 1 Bulan	Menunggak 2 Bulan
9	1	8	13.0833	FEBI MUHAMAD SAPUTRA	Lengkap	>= Rp.999.999	1	50-54	>= 86	Lunas	Lunas
10	1	8	13.0833	PUTRI ANJANI	Lengkap	>= Rp.999.999	1	50-54	80-85	Lunas	Lunas

Figure 2 Results of Scholarship Recipients The

picture shows the results of the scholarship recipient's information based on the best ranking on the criteria data of each scholarship recipient, where the highest V value indicates that the alternative A_i is the best alternative.

In the figure, it shows that Rivaldi got the best ranking with a V value of 22.733 while Putri Anjani got

a V value of 13.0833, thus giving objective and on target results.

4. CONCLUSION

The *Fuzzy C-means algorithm* can be used to group the data of prospective scholarship recipients more finely by applying the degree of membership of each

element to enter the existing groups. Data testing was carried out in 4 iterations, three groups were obtained based on the average score of the determination of the scholarship, namely: The first group (1st cluster), which contains scholarship recipients who have a V value of 20,566 - 22,733; status of orphaned, orphaned and orphaned parents; have an average parent income below Rp. 1,000,000; with parents over 55 years. The second group (second cluster) contains scholarship recipients who have a V value of 16,433; have an average parent income above Rp. 1,000,000; with an average age of parents under 55 years.

Each cluster is classified based on which criteria are prioritized with the largest score in the final distance being the cluster that receives the scholarship, while the cluster with the smallest score is the cluster that is not entitled to receive the scholarship. The decision-making support system in selecting yayasana scholarship recipients is fast, objective and easy. This system can be used on various operating system platforms and browsers. The results of the recommendations are more objective because the user does not directly determine which alternatives to choose. The determination of the criteria attribute greatly affects the results of the calculation of *simple additive weighting*.

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