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Analysis University of Surakarta KIP Scholarship Recipients Using the Fuzzy MADM Method and C-45

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Abstract: The impact of the Covid-19 pandemic has forced the economic activity of the Indonesian population to decline drastically, which has an impact on the education funding process. Given these problems, it is necessary to develop a Decision-Making System to assist the selection process for KIP admissions for students who meet the requirements. The purpose of this research is that the provision of KIP can be right on target. For decision making, three stages are used with the method used, the first stage is the C-45 method for student priority decision making, the second stage is the Fuzzy MADM method, and the third stage is ranking according to the total quota. which is determined. The initial selection used the C-45 method with the variables of GPA, parents' income, achievements, parental dependents, and cases. The results of the C4.5 calculation show that the first priority is parental dependents with a Gain value of 0.007822696, followed by a GPA with a Gain value of -0.130011482, the third priority is Parents' Income with a Gain value of -0.702657067 and the last priority is an achievement. The results of the calculation are continued with Fuzzy MADM resulting in 5 rules used to determine student priorities (can) or not. The results achieved from 140 students who applied were accepted by 135 students who passed the initial stage, and out of 135 rankings, 70 students were determined to receive scholarships from the Government with the highest calculation score of 21 and the lowest of 14.4.

Keywords: C-45, Fuzzy MADM, KIP, Ranking, Covid-19

INTRODUCTION

The COVID-19 pandemic and large-scale social restrictions have forced the economic activity of the Indonesian population to stagnate, which has an impact on the education financing process. This makes some people hope for assistance from the government to cover some of the gaps in their daily spending. one of them is through the Smart Indonesia Card. The provision of aid funds under these conditions must make the process of distributing aid right on target. Given this problem, the development of a Decision-Making System (SPK) is expected to help the selection process for KIP (Smart Indonesia Card) admissions on target for students who deserve it.

Provision of grants by the Government through universities (Data et al., 2020) with these conditions must make the process of distributing aid on target. Decision Support Systems have been widely used in the application of decision making, for decision making in education (Fiarni, Sipayung, & Tumundo, 2019)(Fitri, Pradnyana, & Darmawiguna, 2018)(Guo & Zhao, 2017), industry (Haning & Tahili, 2018)(Hoga Saragih, Murni Marbun, 2015), and for various other fields (Kahraman, Onar, & Oztaysi, 2015; Kahraman, Öztayşi, & Çevik Onar, 2016; Kamila & Helma, 2019; Komsiyah, Wongso, & Pratiwi, 2019; Kurniawan et al., 2019).

For this reason, it is necessary to make a decision-making system so that the distribution of KIP (Smart Indonesia Card) is truly on target. With the aim that the receipt of KIP assistance can be right on target. To register KIP recipients must meet the specified criteria, the main criterion in this study is the possibility of students completing their studies (passing). To make decisions in predicting the probability of student graduation using the C4.5 Algorithm, the results are then processed using the Fuzzy MADM method to determine KIP recipients. from the specified quota is taken.

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LITERATURE REVIEW

In determining the recipients of KIP assistance, the decision-making system is applied by various methods such as in research (Sugiyarti et al., 2018; Susilowati, Suyono, & Andewi, 2017; Syahputra, Sutrisno, & Gultom, 2020). The Fuzzy MADM method was used to determine preferences for weight gain as in the study (Syahputra et al., 2020)(Hoga Saragih, Murni Marbun, 2015). In a study conducted by (Syahputra et al., 2020) Fuzzy MADM was used to minimize deviations caused by uncertain and unclear linguistic values that often occur in ambiguous data arising from qualitative judgments of decision makers. The use of the C-Means method in decision making is used to carry out the unsupervised modeling process and is one method of grouping data with system partitions. Research conducted by (Data et al., 2020) research using the C-Means method for decision making BPNT recipients for residents who are unable to produce an accuracy rate of 90%. Research using the Topsis method was carried out(Satria, 2014)which was used in decision making in the selection of project development tenders, the results obtained were the winner of the tender with the calculation results according to manual calculations. While the use of the C-45 as done algorithm (Asidik, Kusrini, & Henderi, 2018) is used in making decisions to choose majors according to their field of interest, the results are 79.03% appropriate and 61.11% repeat. In the study (Asidik et al., 2018)(Aji Setiawan & Akbar, 2019) the C-45 algorithm was used for decision making in employee recruitment, the results were 33% not recommended and 77% recommended.

In this study to register KIP recipients must meet the specified criteria, the main criterion in this study is the possibility of students completing their studies (passing). To make decisions in predicting the possibility of student graduation using the C4.5 algorithm, the results are then processed using the Fuzzy MADM method to determine KIP recipients who qualify as KIP recipients will be ranked according to the integral value and taken based on the specified quota amount..

1. METHOD

The research stages are shown in accordance with Fig.1.

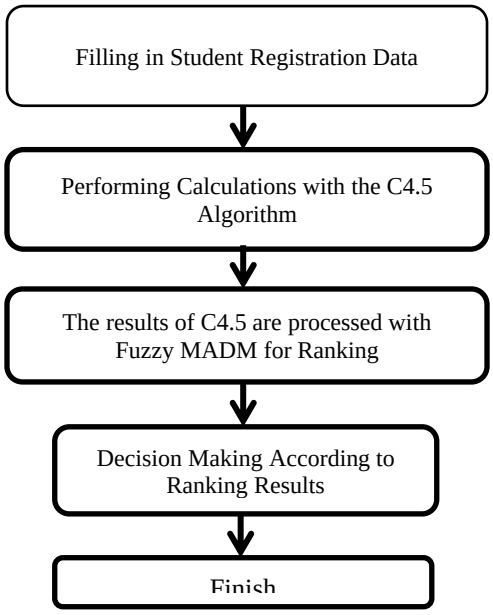

Fig. 1Research methods

1. *Filling in Student Registration Data*

The process of inputting student data who registers for the KIP (Smart Indonesia Card) provided by the government for students affected by Covid-19. The inputted data is in the form of GPA data, Parental Income, Achievement (yes or no), Number of Parent Dependents, and Student Activities (Active or Not).

2. *Performing Calculations with the C4.5 Algorithm*

Enter the data used to register KIP. The data entered was calculated using the C-45 method. The next step is to choose the attribute that produces the best node. The best size is calculated using Entropy, with the formula shown in equation (1), (Data et al., 2020; Fitri et al., 2018)

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

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S is the set of cases, k is the number of partitions S, pj is the probability obtained by the Number (Yes) divided by the Total Cases

The next step is to select attributes using Gain Ratio, with the formula shown in equation (2), (Data et al., 2020; Fitri et al., 2018)

$$gainratio(a) = \frac{gain(a)}{split(a)} \quad (2)$$

Where a = attribute, gain (a) = gain information on attribute a, Split (a) = split information on attribute a.

Example calculation for selecting the best attribute using Gain Ratio. From the gain ratio of 1 obtained a tree as shown in Fig. 2.

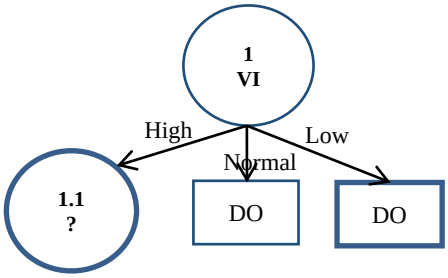

Fig. 2Gain Ratio decision tree 1

The attribute with the highest Gain Ratio value is selected as the test attribute for that node. With Gain is Gain Information. This approach applies normalization to the acquisition of information using what is referred to as discrete information. Split Info expresses entropy or potential information by equation (3).

$$SplitInfo(S,A) = -\sum_{i=1}^{n} \frac{S_i}{S} log_2 \frac{S_i}{S} \quad (3)$$

Where: S = sample space (data) used for training, A = attribute, S_i = number of samples for attribute i.

Gain information is done to get the prediction rule to be used, with equation (4)

$$Gain(A) = Entropi(S) - \sum_{i=1}^{k} \frac{|S_i|}{|S|} xEntropi(S_i) \quad (4)$$

3. The results of C4.5 are processed with Fuzzy MADM for Ranking

After obtaining the priority results from the C4.5 calculation, it is continued with calculations using Fuzzy MADM to predict students who are indeed entitled to KIP. To evaluate the fuzzy set, performed 3 steps as follows:

a. Select a set of ratings for the weight of the criteria, and the degree of correspondence of each alternative with the criteria. In this study, a triangular membership function was chosen, which can then be described as in Fig 3. With the equation as in equation (5) (Hoga Saragih, Murni Marbun, 2015)

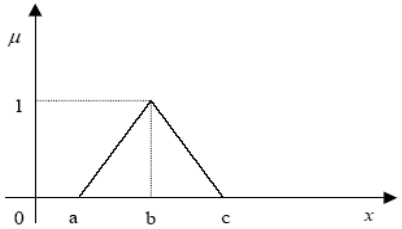

Fig. 3*Triangular fuzzy number membership function*

$$\mu(x) = \begin{cases} \frac{(x-a)}{(b-a)} ; a \le x \le b \\ \frac{(x-c)}{(b-c)} ; b \le x \le c \\ 0 ; x \le a \; or \; x \ge c \end{cases} \quad (5)$$

Suppose W_t is the weight for the criteria C_t, and Sit is the fuzzy rating for the degree of compatibility of the decision alternative A_i with the criteria C_t, and F_i is the fuzzy fit index of the alternative A_i which

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represents the degree of suitability of the decision alternatives obtained from the results of the aggregation of S_{it} and W_t, with i = 1, 2, 3, ... k and t = 1, 2, ... n.

b. Evaluate the weights of the criteria, and the degree of compatibility of each alternative with the criteria

c. Aggregating the weights of the criteria and the degree of compatibility of each alternative with the criteria. To aggregate the weights of the criteria and the degree of compatibility of each alternative with the criteria, several aggregation methods can be used, such as: mean, max, min, median, and mixed operators. If to aggregate the decision results using the mean method, and the operators and are operators used for fuzzy multiplication and addition, then F_i can be formulated as:

$$F_i = \left(\frac{1}{k}\right)[(S_{1k} \otimes W_1) \otimes (S_{2k} \otimes W_2) \otimes \ldots \otimes (S_{ik} \otimes W_k)]$$

Next, by substituting Sit and Wt with triangular fuzzy numbers that have been determined, namely: $S_{it} = (o_{it}, p_{it}, q_{it})$,and $W_t = (a_t, b_t, c_t)$, then F_i $can\ be\ approached\ as\ F_i = (Y_i, Q_i, Z_i)$with, formula

$$Y_i = (\frac{1}{k}) \sum_{t=1}^{k} (o_{it} a_i)$$

$$Q_i = (\frac{1}{k}) \sum_{t=1}^{k} (p_{it} b_i)$$

$$Z_i = (\frac{1}{k}) \sum_{t=1}^{k} (q_{it} c_i)$$

Where i = 1, 2,3, …n

4. Ranking

In this step there are 2 activities that must be done, namely:

1) Prioritizing decision alternatives based on the aggregation results. The priority of the aggregation results is needed in the framework of the decision alternative ranking process. Because the aggregation results are represented using triangular fuzzy numbers, a ranking method is needed for these fuzzy numbers. One of the ranking methods that can be used is the total integral value method. Suppose G is a triangular fuzzy number, G = (a, b, c), then the total integral value can be formulated as follows:

$$I^{\alpha}(G) = (\frac{1}{2})(\alpha c + b + (1 - \alpha)a)$$

The value of is an index of optimism that represents the degree of optimism for decision makers (0 1). If is greater, it indicates that the degree of optimism is greater

2) Choose the decision alternative with the highest priority as the optimal alternative. If t = 1 ... n, and there are several fuzzy numbers G_t, the greater the value of Iα (G_t) means that it shows the greatest match of the decision alternatives for the decision criteria, and the largest Iα (G_t) value is the goal. So it can be determined that the best alternative chosen is the one that has the largest Iα (G_t) value

5. KIP Recipient

The purpose of the decision of this problem is the selection of students who have a predetermined quota ranking.

2. RESULT

The data used in the study was 140 student data which were previously not included in the criteria for scholarship recipients, but due to the conditions affected by covid, it affected the financial condition of students

. The weight distribution is shown in Table 1;

TABLE 1 DISTRIBUTION OF WEIGHTS

NO	LEVELS OF IMPORTANCE	VALUE WEIGHT
1	Very High	5
2	High	4
3	Enough	3
4	Low	2

For the criteria, provisions are made as shown in Table 2;

TABLE 2 ATTRIBUTES USED

NO	NAME CRITERIA	ATRIBUT

*name of corresponding author

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1	Case	Benefit
2	Parental Dependence	Cost
3		Benefit
4	GPA score	Benefit
5	Parents' Income	Cost

Based on the weight distribution, which is shown in Table 1, then the criteria data are made as shown in Table 3;

TABLE 3 DETERMINATION OF CRITERIA

No	Atribut	Range	Category	Score
1	GPA score	2,75 - 3,0 (poin)	Enough	3
2	GPA score	3,1 - 3,5(poin)	High	4
3	GPA score	3,6 - 4,0 (poin)	Very High	5
4	Parents' Income	Rp. 3.000.000,00 - < Rp. 4.000.000,00	High	4
5	Parents' Income	Rp. 1.000.000,00 - < Rp. 2.000.000,00	Low	2
6	Parents' Income	Rp. 4.000.000,00 -< Rp. 5.000.000,00	Very High	5
7	Achievement	there is	Very High	5
8	Achievement	there is not any	Low	2
9	Parental Dependence	1	Enough	3
10	Parental Dependence	3	Very High	5
11	Parental Dependence	2	High	4

From the results of the calculation of C4.5 based on predetermined criteria, the results are obtained, as shown in Table 4.

TABLE 4 ENTROPY CALCULATION RESULT

Total Cases	Sum(Aktive)	Sum(Not Active)	Entropi
140	27	113	0,707410265

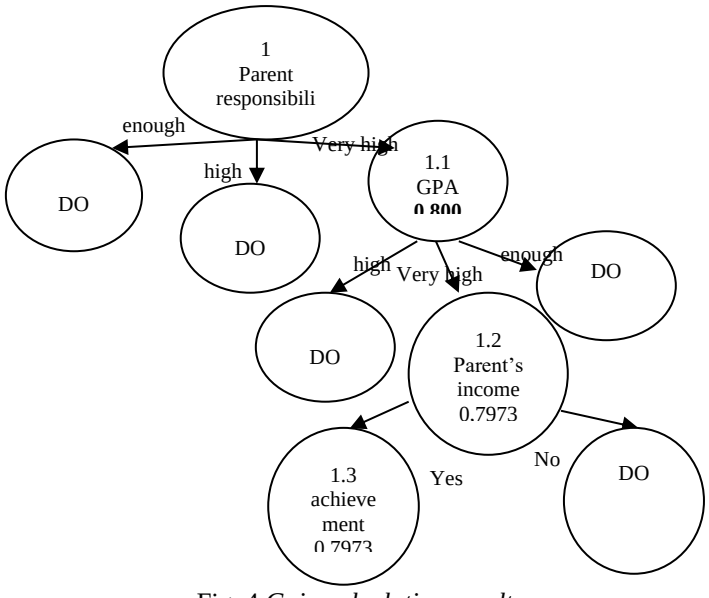

Fig. 4 *Gain calculation result*

The calculation results obtained results with priority in the form of a decision tree shown in Fig 4.
After the priority results are obtained, followed by ranking using Fuzzy MADM, the results are shown in Fig. 5.

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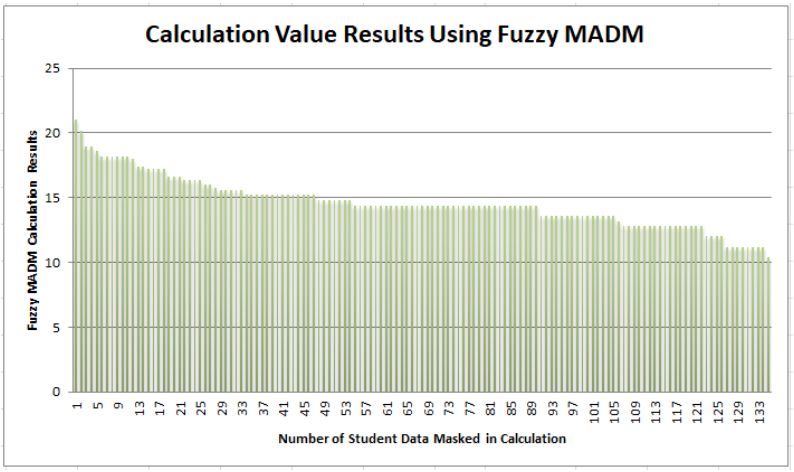

Fig. 5 *Fuxzzy MADM calculation result*

DISCUSSIONS

The results that have been achieved are in the form of data collection of students from the field of student affairs as many as 140 student data outside students who have been determined by scholarship recipients from the Government. From the results of calculations using C4.5, the priority order is obtained based on student activity, with an entropy value of 0.70741, the highest gain is obtained on the number of dependents of parents, followed by the GPA value, and then on the income of parents, finally determined by student achievement.

The calculation is used to determine the calculation using Fuzzy MADM, the results of the calculation have been obtained from 140 students who registered were accepted by 135 students who passed the initial stage, and from 135 ranks, 70 students were determined to receive scholarships from the Government with the highest calculation value of 21 and the lowest 14.4

3. CONCLUSION

From the calculation results, conclusions can be drawn, with 5 rules used to determine priority students (can) or not. The results that have been achieved from 140 students who apply, which can be accepted 135 students who pass in the early stages, 5 students can not be accepted. From the 135 grades that were accepted, 70 students were determined to receive scholarships from the Government with the highest calculation score of 21 and the lowest being 14.4 in accordance with the predetermined quota.

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