Implementation of EDAS Method in the Selection of the Best Students with ROC Weighting

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Abstract

This study aims to provide recommendations for the best students to be selected using the EDAS method and ROC weighting, so as to help schools in decision making. The EDAS method requires a lot of input, and preference must be precise in the determination of the weight of the criteria. To fix the problem of weighting criteria in the EDAS method, the Centroid Rank Order (ROC) method is used. ROC is a simple method used to assign weight values to each criterion used. The results of this study provide recommendations for the best students to be selected using the EDAS method and ROC weighting, so as to help schools in decision making. The application of the EDAS method in the selection of exemplary student candidates resulted in exemplary prospective students obtained on behalf of Hadi Santoso with a final score of 0.70885 and obtained 1st rank. The results of these recommendations can help the school determine the selection of the best students by applying the EDAS method and ROC weighting.

Keywords: *Decision Making; EDAS; ROC; Student; Weighting*

1. Introduction

Students are children who sit at the table studying elementary and junior high school strata, high school and above. These students learn to gain knowledge and to achieve an understanding of the knowledge that has been obtained in the world of education. The best students are students who have succeeded in achieving an achievement in both academic and non-academic fields that are pursued at school so that they should be proud. Students are students who sit at the table studying elementary and junior high school strata, high school and above.

The selection of the best students at the end of each semester is determined based on the results of assessments in learning or activities outside learning for one semester. The selection is made by the homeroom teacher for each level which will result in some of the best student recommendations.

The school will choose to determine the best students based on recommendations given by the homeroom teacher. The school still has difficulty in determining the best students based on existing recommendations.

Based on the existing problems in determining the best students, a decision support system (DSS) approach is needed in determining the best students. DSS is one part of an information system that can help to improve decision-making effectiveness in semi-structured and unstructured situations where no one knows exactly how decisions should be made by decision makers [1, 2]. DSS aims to provide information, guide, provide predictions, and direct solution options to information users in order to make better decisions. DSS is the application of information systems intended only as management tools in decision making. DSS is designed to generate various alternatives offered to decision makers in carrying out their duties [3]. DSS unites the capabilities of computers in interactive services to their users with the process of processing or manipulating data that utilizes unstructured models or rules so as to produce situational decision alternatives [4, 5]. One of the methods used in decision making is the Evaluation Method based on Distance from Average Solution (EDAS).

The EDAS method is one of the multi-criteria decision-making methods based on the highest Appraisal Score (AS) assessment score to get the best choice from all alternatives. The basic principle of the EDAS method is to use two measures of distance, namely Positive Distance from Average (PDA) and Negative Distance from Average (NDA). The alternative that has the highest PDA value and the lowest NDA value will be the best alternative. EDAS requires a lot of input, and preference must be precise in the determination of the weight of the criteria. To fix the problem of weighting criteria in the EDAS method, the Centroid Rank Order (ROC) method is used. ROC is a simple method used to assign a weight value to each criterion used. ROC is carried out by giving weight to each criterion according to the ranking which is assessed based on priority level [7, 8, 9, 10].

Research related to the EDAS method and ROC weighting carried out provides very accurate and selective results on a decision [11]. The Evaluation Based On Distance From Average Solution or EDAS method of Centroid Rank Order (ROC) weighting can obtain the best final value and weight value results without any fraud in it in accordance with alternative data [12]. The combination of the ROC method and generating weight values on specific criteria and the EDAS method produces the best preference accordingly [13]. Optimization of the function of the decision support system by implementing the EDAS method and ROC weighting method can produce an accurate and reliable decision [14]. The difference between this research and previous research is that in this study, in determining the quantitative scale, a certain value range is used, and this value will be chosen by the decision maker to determine the value of pairwise comparisons between criteria. Because the EDAS weighting method depends on a quantitative scale of comparison between criteria. In addition, this study uses criteria including Average Report Card Value, Value of Attendance, Organization, Achievement, Personality Values.

The purpose of this study is to provide recommendations for the best students to be selected using the EDAS method and ROC weighting, so as to help the school in decision making. It is hoped that the results of this study will be an effective decision solution in determining the best students in school.

2. Methods

The research stage is a structural activity carried out in this study this stage includes planning activities in identifying existing problems [15, 16, 17, 18]. So that the results of the planning produce a solution to the problems found [19]. The stages of research carried out can be seen in Figure 1 below.

Based on the stages of research above, some of the activities or activities carried out in this study will be explained in the following steps.

1. Identify the Problem

   The first stage carried out in this study is the identification of problems by conducting
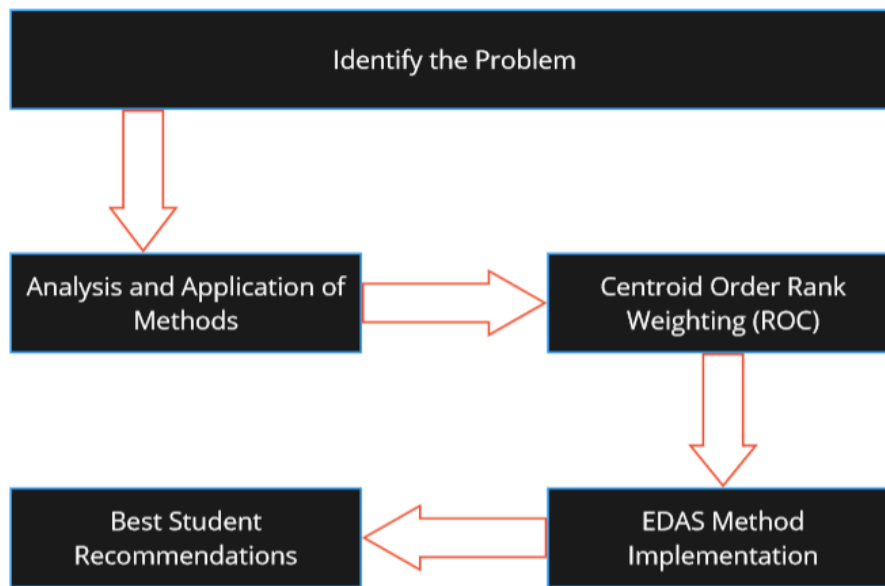
Figure 1. Stages of Research

interviews with the school in the process of determining and assessing the best students that occur in the school. The problem that occurs in determining the best students is that there is no decision model used in determining the best students. This is the highlight and challenge of researchers in making a computerized system in determining the best students.

2. Analysis and Application of Method

   The next stage determines the decision support system model using the Evaluation Based on Distance from Average Solution (EDAS) method for selecting the best students and weighting the Centroid Rank Order (ROC) to determine the weight of the criteria used.

3. Centroid Order Rank (ROC) Weighting

   The next stage is weighting the ROC in determining the weight of the criteria used in selecting the best students. The stages in ROC weighting use the following equation.

$$w_k = \frac{1}{2} \sum_{i=1}^{k} (\frac{1}{k}) \tag{1}$$

   Information:

   w : criteria weighting value

   k : number of criteria

   i : alternative value

4. EDAS Method Implementation

   The EDAS method was developed by Mehdi Keshavarz-Ghorabaee in 2015, this EDAS method aims to analyze problems by using the calculation of negative ideal distances and positive ideal distances from the average in order to create a real and real ranking value or final value. The following are the steps for calculating EDAS in determining the final value as follows.

   (a) Create a decision matrix

       The first step in this method is to convert the assessment results by making a decision matrix, the decision matrix equation can be seen with the following formula

$$\begin{bmatrix} x_{i1} & \cdots & x_{in} \\ x_{m1} & \ddots & x_{mn} \end{bmatrix} \tag{2}$$

(b) Determine the average result of alternatives

The second step determines the average result of alternatives using the following formula.

$$AV_j = \frac{\sum_{i=1}^{n} X_{ij}}{n} \tag{3}$$

(c) Calculates the average value of positive and negative distances

The third step calculates the average value of positive and negative distances. Criteria with the type of benefit, the following equation applies.

$$PDA_{ij} = \frac{max\left(0, (X_{ij} - AV_j)\right)}{AV_j} \tag{4}$$

$$NDA_{ij} = \frac{max\left(0, (AV_j - X_{ij})\right)}{AV_j} \tag{5}$$

Criteria with the type of cost, the following equation applies.

$$PDA_{ij} = \frac{max\left(0, (AV_j - X_{ij})\right)}{AV_j} \tag{6}$$

$$NDA_{ij} = \frac{max\left(0, (X_{ij} - AV_j)\right)}{AV_j} \tag{7}$$

(d) Calculates positive and negative distance values

The fourth step calculates positive and negative distance values using the following equation.

$$SP_i = \sum_{j=1}^{m} w_j \times PDA_{ij} \tag{8}$$

$$SN_i = \sum_{j=1}^{m} w_j \times NDA_{ij} \tag{9}$$

(e) Normalization of positive and negative distance weights

The fifth step normalizes positive and negative distance weights using the following equation.

$$NSP_i = \frac{SP_i}{max\left(SP_i\right)} \tag{10}$$

$$NSN_i = \frac{SN_i}{max\left(SN_i\right)} \tag{11}$$

(f) Final scoring

The final step calculates the final scoring using the following equation

$$AS_i = \frac{1}{2}\left(NSP_i + NSN_i\right) \tag{12}$$

5. Best Student Recommendations

The last stage is the finalization stage of selecting exemplary students, namely ranking the optimization results of the EDAS method, in this stage the ranking is assessed based on the highest value of the existing alternative optimization results

The criteria used in selecting the best students can be seen in Table 1 below.

Table 1. Best Student Assessment Criteria

Criteria Name	Type of Criteria
Average Report Card Value (C1)	Benefit
Value of Attendance (C2)	Benefit
Organization (C3))	Cost
Achievement (C4)	Benefit
Personality Values (C5)	Cost

3.   Result and Discussion

The results of the collection of needs based on interviews and discussions with the school obtained 8 (eight) candidates for the best student candidates for class X who will be used in selecting the best students. The results of data obtained from schools can be seen in Table 2 below.

Table 2. Best Student Candidate Assessment Data

Student Name	C1	C2	C3	C4	C5
(A1) Rahmat Julianto	4	5	3	4	5
(A2) Putri Amanda Sari	4	5	4	3	4
(A3) Bambang Supriyadi	5	4	3	4	5
(A4) Hendra Gunawan	4	4	3	5	5
(A5) Hadi Santoso	3	5	4	4	4
(A6) Silvia Agustina	4	5	4	4	3
(A7) Hilda Sitorus	5	4	4	4	3
(A8) Hendrik Yudistira	4	3	5	5	3

The calculation process in determining the best students using the EDAS method and ROC weighting consists of several stages. The following are the stages and explanations in the selection of the best students.

3.1.   ROC Method Implementation

Based on the criteria data table, there is no weight value, so the ROC method is needed to get the weight value from the existing criteria. w1 is the weight for the Average report card value criterion, w2 is the weight for the value of attendance criterion, w3 is the weight for the organization criterion, w4 is the weight for the achievement criterion, and w5 is the weight for the personality values criterion. Calculation of the value of the criterion weight using equation (1).

$W_1 = \frac{1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0.456$

$W_2 = \frac{0 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0.256$

$W_3 = \frac{0 + 0 + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0.156$

$W_4 = \frac{0 + 0 + 0 + \frac{1}{4} + \frac{1}{5}}{5} = 0.09$

$W_5 = \frac{0 + 0 + 0 + 0 + \frac{1}{5}}{5} = 0.04$

3.2.   EDAS Method Implementation

After the data needed to produce a solution is complete, then the next stage is the processing of existing data with the EDAS method, here are the stages of the EDAS method in selecting the best students.

1. Create a decision matrix

Based on the candidate assessment data shown in table 2, the first stage is to make a decision matrix using equation (2). The rows in the matrix show the alternatives, and the columns in the matrix show the criteria. The results of the decision matrix can be seen below.

$$X=\begin{bmatrix} 4 & 5 & 3 & 4 & 5 \\ 4 & 5 & 4 & 3 & 4 \\ 5 & 4 & 3 & 4 & 5 \\ 5 & 4 & 3 & 5 & 5 \\ 3 & 5 & 4 & 4 & 4 \\ 4 & 5 & 4 & 4 & 3 \\ 5 & 4 & 4 & 4 & 3 \\ 4 & 3 & 5 & 5 & 3 \end{bmatrix}$$

2. Determine the average result of alternatives

The second step is to determine the average solution (AV) according to predetermined criteria. Determination of the average solution using equation (3). The result of calculating the AV value is as follows.

$AV_1 = \frac{4+4+5+4+3+4+5+4}{8} = \frac{33}{8} = 4.125$

$AV_2 = \frac{5+5+4+4+5+5+4+3}{8} = \frac{35}{8} = 4.375$

$AV_3 = \frac{3+4+3+3+4+4+4+5}{8} = \frac{30}{8} = 3.75$

$AV_4 = \frac{4+3+4+5+4+4+4+5}{8} = \frac{38}{8} = 4.125$

$AV_5 = \frac{5+4+5+5+4+3+3+3}{8} = \frac{32}{8} = 4$

3. Calculates the average value of positive and negative distances

The next step calculates the positive distance (PDA) and negative distance (NDA) from the average solution (AV). For benefit-type criteria, PDA values use equation (4) and NDA uses equation (5), while cost-type criteria PDA values use equation (6) and NDA uses equation (7). The results of calculating the PDA and NDA values can be seen below.

Benefit type criteria for average report card value (C1):

$PDA_{11} = \frac{max(0,(X_{11}-AV_1))}{AV_1} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$

$PDA_{12} = \frac{max(0,(X_{12}-AV_1))}{AV_1} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$

$PDA_{13} = \frac{max(0,(X_{13}-AV_1))}{AV_1} = \frac{max(0,(5-4.125))}{4.125} = \frac{0.875}{4.125} = 0.21$

$PDA_{14} = \frac{max(0,(X_{14}-AV_1))}{AV_1} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$

$PDA_{15} = \frac{max(0,(X_{15}-AV_1))}{AV_1} = \frac{max(0,(3-4.125))}{4.125} = \frac{0}{4.125} = 0$

$PDA_{16} = \frac{max(0,(X_{16}-AV_1))}{AV_1} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$

$PDA_{17} = \frac{max(0,(X_{17}-AV_1))}{AV_1} = \frac{max(0,(5-4.125))}{4.125} = \frac{0.875}{4.125} = 0.21$

$PDA_{18} = \frac{max(0,(X_{18}-AV_1))}{AV_1} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$

$NDA_{11} = \frac{max(0,(AV_1-X_{11}))}{AV_{1j}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$

$NDA_{12} = \frac{max(0,(AV_1-X_{12}))}{AV_{1j}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$

$NDA_{13} = \frac{max(0,(AV_1-X_{13}))}{AV_{1j}} = \frac{max(0,(4.125-5))}{4.125} = \frac{0}{4.125} = 0$

$NDA_{14} = \frac{max(0,(AV_1-X_{14}))}{AV_{1j}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$

$NDA_{15} = \frac{max(0,(AV_1-X_{15}))}{AV_{1j}} = \frac{max(0,(4.125-3))}{4.125} = \frac{1.375}{4.125} = 0.33$

$NDA_{16} = \frac{max(0,(AV_1-X_{16}))}{AV_{1j}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$

$NDA_{17} = \frac{max(0,(AV_1-X_{17}))}{AV_{1j}} = \frac{max(0,(4.125-5))}{4.125} = \frac{0}{4.125} = 0$

$NDA_{18} = \frac{max(0,(AV_1-X_{18}))}{AV_{1j}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$

$$\text{PDA}_{21} = \frac{max(0,(X_{21}-AV_2))}{AV_2} = \frac{max(0,(5-4.375))}{4.125} = \frac{0.625}{4.375} = 0.14$$

$$\text{PDA}_{22} = \frac{max(0,(X_{22}-AV_2))}{AV_2} = \frac{max(0,(5-4.375))}{4.125} = \frac{0.625}{4.375} = 0.14$$

$$\text{PDA}_{23} = \frac{max(0,(X_{23}-AV_2))}{AV_2} = \frac{max(0,(4-4.375))}{4.125} = \frac{0}{4.375} = 0$$

$$\text{PDA}_{24} = \frac{max(0,(X_{24}-AV_2))}{AV_2} = \frac{max(0,(4-4.375))}{4.125} = \frac{0}{4.375} = 0$$

$$\text{PDA}_{25} = \frac{max(0,(X_{25}-AV_2))}{AV_2} = \frac{max(0,(5-4.375))}{4.125} = \frac{0.625}{4.375} = 0.14$$

$$\text{PDA}_{26} = \frac{max(0,(X_{26}-AV_2))}{AV_2} = \frac{max(0,(5-4.375))}{4.125} = \frac{0.625}{4.375} = 0.14$$

$$\text{PDA}_{27} = \frac{max(0,(X_{27}-AV_2))}{AV_2} = \frac{max(0,(4-4.375))}{4.125} = \frac{0}{4.375} = 0$$

$$\text{PDA}_{28} = \frac{max(0,(X_{28}-AV_2))}{AV_2} = \frac{max(0,(3-4.375))}{4.125} = \frac{0}{4.375} = 0$$

$$\text{NDA}_{21} = \frac{max(0,(AV_2-X_{21}))}{AV_{21}} = \frac{max(0,(4.375-5))}{4.375} = \frac{0}{4.375} = 0$$

$$\text{NDA}_{22} = \frac{max(0,(AV_2-X_{22}))}{AV_{22}} = \frac{max(0,(4.375-5))}{4.375} = \frac{0}{4.375} = 0$$

$$\text{NDA}_{23} = \frac{max(0,(AV_2-X_{23}))}{AV_{23}} = \frac{max(0,(4.375-4))}{4.375} = \frac{0.375}{4.375} = 0.09$$

$$\text{NDA}_{24} = \frac{max(0,(AV_2-X_{24}))}{AV_{24}} = \frac{max(0,(4.375-4))}{4.375} = \frac{0.375}{4.375} = 0.09$$

$$\text{NDA}_{25} = \frac{max(0,(AV_2-X_{25}))}{AV_{25}} = \frac{max(0,(4.375-5))}{4.375} = \frac{0}{4.375} = 0$$

$$\text{NDA}_{26} = \frac{max(0,(AV_2-X_{26}))}{AV_{26}} = \frac{max(0,(4.375-5))}{4.375} = \frac{0}{4.375} = 0$$

$$\text{NDA}_{27} = \frac{max(0,(AV_2-X_{27}))}{AV_{27}} = \frac{max(0,(4.375-4))}{4.375} = \frac{0.375}{4.375} = 0.09$$

$$\text{NDA}_{28} = \frac{max(0,(AV_2-X_{28}))}{AV_{28}} = \frac{max(0,(4.375-3))}{4.375} = \frac{1.375}{4.375} = 0.31$$

$$\text{PDA}_{41} = \frac{max(0,(X_{41}-AV_4))}{AV_4} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{PDA}_{42} = \frac{max(0,(X_{42}-AV_4))}{AV_4} = \frac{max(0,(3-4.125))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{PDA}_{43} = \frac{max(0,(X_{43}-AV_4))}{AV_4} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{PDA}_{44} = \frac{max(0,(X_{44}-AV_4))}{AV_4} = \frac{max(0,(5-4.125))}{4.125} = \frac{0.875}{4.125} = 0.21$$

$$\text{PDA}_{45} = \frac{max(0,(X_{45}-AV_4))}{AV_4} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{PDA}_{46} = \frac{max(0,(X_{46}-AV_4))}{AV_4} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{PDA}_{47} = \frac{max(0,(X_{47}-AV_4))}{AV_4} = \frac{max(0,(4-4.125))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{PDA}_{48} = \frac{max(0,(X_{48}-AV_4))}{AV_4} = \frac{max(0,(5-4.125))}{4.125} = \frac{0.875}{4.125} = 0.21$$

$$\text{NDA}_{41} = \frac{max(0,(AV_4-X_{41}))}{AV_{41}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$$

$$\text{NDA}_{42} = \frac{max(0,(AV_4-X_{42}))}{AV_{41}} = \frac{max(0,(4.125-3))}{4.125} = \frac{1.125}{4.125} = 0.27$$

$$\text{NDA}_{43} = \frac{max(0,(AV_4-X_{43}))}{AV_{41}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$$

$$\text{NDA}_{44} = \frac{max(0,(AV_4-X_{44}))}{AV_{41}} = \frac{max(0,(4.125-5))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{NDA}_{45} = \frac{max(0,(AV_4-X_{45}))}{AV_{41}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$$

$$\text{NDA}_{46} = \frac{max(0,(AV_4-X_{46}))}{AV_{41}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0.125}{4.125} = 0.03$$

$$\text{NDA}_{47} = \frac{max(0,(AV_4-X_{47}))}{AV_{41}} = \frac{max(0,(4.125-4))}{4.125} = \frac{0}{4.125} = 0$$

$$\text{NDA}_{48} = \frac{max(0,(AV_4-X_{48}))}{AV_{41}} = \frac{max(0,(4.125-5))}{4.125} = \frac{0}{4.125} = 0$$

The same calculation for the criteria of value of attendance (C2), and achievement (C4).

Cost type criteria for organization value (C3):

$$\text{PDA}_{31} = \frac{max(0,(AV_3-X_{31}))}{AV_3} = \frac{max(0,(3.75-3))}{3.75} = \frac{0.75}{3.75} = 0.2$$

$$\text{PDA}_{32} = \frac{max(0,(AV_3-X_{32}))}{AV_3} = \frac{max(0,(3.75-4))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{PDA}_{33} = \frac{max(0,(AV_3-X_{33}))}{AV_3} = \frac{max(0,(3.75-3))}{3.75} = \frac{0.75}{3.75} = 0.2$$

$$\text{PDA}_{34} = \frac{max(0,(AV_3-X_{34}))}{AV_3} = \frac{max(0,(3.75-3))}{3.75} = \frac{0.75}{3.75} = 0.2$$

$$\text{PDA}_{35} = \frac{max(0,(AV_3-X_{35}))}{AV_3} = \frac{max(0,(3.75-4))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{PDA}_{36} = \frac{max(0,(AV_3-X_{36}))}{AV_3} = \frac{max(0,(3.75-4))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{PDA}_{37} = \frac{max(0,(AV_3-X_{37}))}{AV_3} = \frac{max(0,(3.75-4))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{PDA}_{38} = \frac{max(0,(AV_3-X_{38}))}{AV_3} = \frac{max(0,(3.75-5))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{NDA}_{31} = \frac{max(0,(X_{31}-AV_3))}{AV_3} = \frac{max(0,(3-3.75))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{NDA}_{32} = \frac{max(0,(X_{32}-AV_3))}{AV_3} = \frac{max(0,(4-3.75))}{3.75} = \frac{0.25}{3.75} = 0.07$$

$$\text{NDA}_{33} = \frac{max(0,(X_{33}-AV_3))}{AV_3} = \frac{max(0,(3-3.75))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{NDA}_{34} = \frac{max(0,(X_{34}-AV_3))}{AV_3} = \frac{max(0,(3-3.75))}{3.75} = \frac{0}{3.75} = 0$$

$$\text{NDA}_{35} = \frac{max(0,(X_{35}-AV_3))}{AV_3} = \frac{max(0,(4-3.75))}{3.75} = \frac{0.25}{3.75} = 0.07$$

$$\text{NDA}_{36} = \frac{max(0,(X_{36}-AV_3))}{AV_3} = \frac{max(0,(4-3.75))}{3.75} = \frac{0.25}{3.75} = 0.07$$

$$\text{NDA}_{37} = \frac{max(0,(X_{37}-AV_3))}{AV_3} = \frac{max(0,(4-3.75))}{3.75} = \frac{0.25}{3.75} = 0.07$$

$$\text{NDA}_{38} = \frac{max(0,(X_{38}-AV_3))}{AV_3} = \frac{max(0,(5-3.75))}{3.75} = \frac{1.25}{3.75} = 0.33$$

$$\text{PDA}_{51} = \frac{max(0,(AV_5-X_{51}))}{AV_5} = \frac{max(0,(4-5))}{4} = \frac{0}{4} = 0$$

$$\text{PDA}_{52} = \frac{max(0,(AV_5-X_{52}))}{AV_5} = \frac{max(0,(4-4))}{4} = \frac{0}{4} = 0$$

$$\text{PDA}_{53} = \frac{max(0,(AV_5-X_{53}))}{AV_5} = \frac{max(0,(4-5))}{4} = \frac{0}{4} = 0$$

$$\text{PDA}_{54} = \frac{max(0,(AV_5-X_{54}))}{AV_5} = \frac{max(0,(4-5))}{4} = \frac{0}{4} = 0$$

$$\text{PDA}_{55} = \frac{max(0,(AV_5-X_{55}))}{AV_5} = \frac{max(0,(4-4))}{4} = \frac{0}{4} = 0$$

$$\text{PDA}_{56} = \frac{max(0,(AV_5-X_{56}))}{AV_5} = \frac{max(0,(4-3))}{4} = \frac{1}{4} = 0.25$$

$$\text{PDA}_{57} = \frac{max(0,(AV_5-X_{57}))}{AV_5} = \frac{max(0,(4-3))}{4} = \frac{1}{4} = 0.25$$

$$\text{PDA}_{58} = \frac{max(0,(AV_5-X_{58}))}{AV_5} = \frac{max(0,(4-3))}{4} = \frac{1}{4} = 0.25$$

$$\text{NDA}_{51} = \frac{max(0,(X_{51}-AV_5))}{AV_5} = \frac{max(0,(5-4))}{4} = \frac{1}{4} = 0.25$$

$$\text{NDA}_{52} = \frac{max(0,(X_{52}-AV_5))}{AV_5} = \frac{max(0,(4-4))}{4} = \frac{0}{4} = 0$$

$$\text{NDA}_{53} = \frac{max(0,(X_{53}-AV_5))}{AV_5} = \frac{max(0,(5-4))}{4} = \frac{1}{4} = 0.25$$

$$\text{NDA}_{54} = \frac{max(0,(X_{54}-AV_5))}{AV_5} = \frac{max(0,(5-4))}{4} = \frac{1}{4} = 0.25$$

$$\text{NDA}_{55} = \frac{max(0,(X_{55}-AV_5))}{AV_5} = \frac{max(0,(4-4))}{4} = \frac{0}{4} = 0$$

$$\text{NDA}_{56} = \frac{max(0,(X_{56}-AV_5))}{AV_5} = \frac{max(0,(3-4))}{4} = \frac{0}{4} = 0$$

$$\text{NDA}_{57} = \frac{max(0,(X_{57}-AV_5))}{AV_5} = \frac{max(0,(3-4))}{4} = \frac{0}{4} = 0$$

$$\text{NDA}_{58} = \frac{max(0,(X_{58}-AV_5))}{AV_5} = \frac{max(0,(3-4))}{4} = \frac{0}{4} = 0$$

The value from Table 3 is the value obtained based on the calculation of the posifive distance average value for each alternative of the existing criteria. The calculation results obtained positive distance data from the mean solution (PDA) as in Table 3 below.

Table 3. Positive Distance Average Value (PDA)

	C1	C2	C3	C4	C5
A1	PDA_{11}	PDA_{12}	PDA_{13}	PDA_{14}	PDA_{15}
A2	PDA_{21}	PDA_{22}	PDA_{23}	PDA_{24}	PDA_{25}
A3	PDA_{31}	PDA_{32}	PDA_{33}	PDA_{34}	PDA_{35}
A4	PDA_{41}	PDA_{42}	PDA_{43}	PDA_{44}	PDA_{45}
A5	PDA_{51}	PDA_{52}	PDA_{53}	PDA_{54}	PDA_{55}
A6	PDA_{61}	PDA_{62}	PDA_{63}	PDA_{64}	PDA_{65}
A7	PDA_{71}	PDA_{72}	PDA_{73}	PDA_{74}	PDA_{75}
A8	PDA_{81}	PDA_{82}	PDA_{83}	PDA_{84}	PDA_{85}
A1	0	0.14	0.2	0	0
A2	0	0.14	0	0	0
A3	0.21	0	0.2	0	0
A4	0	0	0.2	0.21	0
A5	0	0.14	0	0	0
A6	0	0.14	0	0	0.25
A7	0.21	0	0	0	0.25
A8	0	0	0	0.21	0.25

The value from Table 4 is the value obtained based on the calculation of the negative distance average value for each alternative of the existing criteria. The calculation results obtained negative distance data from the mean solution (NDA) as in Table 4 below.

Table 4. Negative Distance Average Value (NDA)

	C1	C2	C3	C4	C5
A1	NDA_{11}	NDA_{12}	NDA_{13}	NDA_{14}	NDA_{15}
A2	NDA_{21}	NDA_{22}	NDA_{23}	NDA_{24}	NDA_{25}
A3	NDA_{31}	NDA_{32}	NDA_{33}	NDA_{34}	NDA_{35}
A4	NDA_{41}	NDA_{42}	NDA_{43}	NDA_{44}	NDA_{45}
A5	NDA_{51}	NDA_{52}	NDA_{53}	NDA_{54}	NDA_{55}
A6	NDA_{61}	NDA_{62}	NDA_{63}	NDA_{64}	NDA_{65}
A7	NDA_{71}	NDA_{72}	NDA_{73}	NDA_{74}	NDA_{75}
A8	NDA_{81}	NDA_{82}	NDA_{83}	NDA_{84}	NDA_{85}
A1	0.03	0	0	0.03	0.25
A2	0.03	0	0.07	0.27	0
A3	0	0.09	0	0.03	0.25
A4	0.03	0.09	0	0	0.25
A5	0.33	0	0.07	0.03	0
A6	0.03	0	0.07	0.03	0
A7	0	0.09	0.07	0	0
A8	0.03	0.31	0.33	0	0

4. Calculates positive and negative distance values

The process then determines the weighted sum of PDA and NDA for all available alternatives. For the weight of each criterion, it is obtained based on the weight using the ROC method, namely w_1=0.456 w_2=0.256 w_3=0.156 w_4=0.09 w_5=0.04, the SP value is the result of calculating the weighted amount of PDA using the following equation (8).

$$SP_1 = (w_1 \times PDA_{11}) + (w_2 \times PDA_{12}) + (w_3 \times PDA_{13}) + (w_4 \times PDA_{14}) + (w_5 \times PDA_{15})$$

$$SP_1 = 0.06704$$

$$SP_2 = (w_1 \times PDA_{21}) + (w_2 \times PDA_{22}) + (w_3 \times PDA_{23}) + (w_4 \times PDA_{24}) + (w_5 \times PDA_{25})$$

$SP_2 = 0.03584$

$SP_3 = (w_1 \times PDA_{31}) + (w_2 \times PDA_{32}) + (w_3 \times PDA_{33}) + (w_4 \times PDA_{34}) + (w_5 \times PDA_{35})$

$SP_3 = 0.12696$

$SP_4 = (w_1 \times PDA_{41}) + (w_2 \times PDA_{42}) + (w_3 \times PDA_{43}) + (w_4 \times PDA_{44}) + (w_5 \times PDA_{45})$

$SP_4 = 0.0501$

$SP_5 = (w_1 \times PDA_{51}) + (w_2 \times PDA_{52}) + (w_3 \times PDA_{53}) + (w_4 \times PDA_{54}) + (w_5 \times PDA_{55})$

$SP_5 = 0.03584$

$SP_6 = (w_1 \times PDA_{61}) + (w_2 \times PDA_{62}) + (w_3 \times PDA_{63}) + (w_4 \times PDA_{64}) + (w_5 \times PDA_{65})$

$SP_6 = 0.04584$

$SP_7 = (w_1 \times PDA_{71}) + (w_2 \times PDA_{72}) + (w_3 \times PDA_{73}) + (w_4 \times PDA_{74}) + (w_5 \times PDA_{75})$

$SP_7 = 0.10576$

$SP_8 = (w_1 \times PDA_{81}) + (w_2 \times PDA_{82}) + (w_3 \times PDA_{83}) + (w_4 \times PDA_{84}) + (w_5 \times PDA_{85})$

$SP_8 = 0.0289$

$SN_1 = (w_1 \times NDA_{11}) + (w_2 \times NDA_{12}) + (w_3 \times NDA_{13}) + (w_4 \times NDA_{14}) + (w_5 \times NDA_{15})$

$SN_1 = 0.11638$

$SN_2 = (w_1 \times NDA_{21}) + (w_2 \times NDA_{22}) + (w_3 \times NDA_{23}) + (w_4 \times NDA_{24}) + (w_5 \times NDA_{25})$

$SN_2 = 0.0489$

$SN_3 = (w_1 \times NDA_{31}) + (w_2 \times NDA_{32}) + (w_3 \times NDA_{33}) + (w_4 \times NDA_{34}) + (w_5 \times NDA_{35})$

$SN_3 = 0.03574$

$SN_4 = (w_1 \times NDA_{41}) + (w_2 \times NDA_{42}) + (w_3 \times NDA_{43}) + (w_4 \times NDA_{44}) + (w_5 \times NDA_{45})$

$SN_4 = 0.04672$

$SN_5 = (w_1 \times NDA_{51}) + (w_2 \times NDA_{52}) + (w_3 \times NDA_{53}) + (w_4 \times NDA_{54}) + (w_5 \times NDA_{55})$

$SN_5 = 0.1641$

$SN_6 = (w_1 \times NDA_{61}) + (w_2 \times NDA_{62}) + (w_3 \times NDA_{63}) + (w_4 \times NDA_{64}) + (w_5 \times NDA_{65})$

$SN_6 = 0.0273$

$NP_7 = (w_1 \times NDA_{71}) + (w_2 \times NDA_{72}) + (w_3 \times NDA_{73}) + (w_4 \times NDA_{74}) + (w_5 \times NDA_{75})$

$SN_7 = 0.03396$

$SN_8 = (w_1 \times NDA_{81}) + (w_2 \times NDA_{82}) + (w_3 \times NDA_{83}) + (w_4 \times NDA_{84}) + (w_5 \times NDA_{85})$

$SN_8 = 0.14452$

The values from Table 5 are the values obtained based on the calculation of the weighted sum value of PDA and NDA for each alternative of the existing criteria. The results of the calculation of SP and SN values are as in Table 5 below.

5. Normalization of positive and negative distance weights

The next process normalizes the SP and SN values, the results of normalizing SP values using the following equation (10).

$NSP_1 = \frac{SP_1}{max(SP)}$

$NSP_1 = 0.528$

$NSP_2 = \frac{SP_2}{max(SP)}$

$NSP_2 = 0.2823$

$NSP_3 = \frac{SP_3}{max(SP)}$

$NSP_3 = 1$

$NSP_4 = \frac{SP_4}{max(SP)}$

$NSP_4 = 0.3946$

Table 5. SP and SN Values

Alternative	SP Value	SN Value
A1	SP_1	SN_1
A2	SP_2	SN_2
A3	SP_3	SN_3
A4	SP_4	SN_4
A5	SP_5	SN_5
A6	SP_6	SN_6
A7	SP_70	SN_7
A8	SP_8	SN_8
A1	0.06704	0.11638
A2	0.03584	0.0489
A3	0.12696	0.03574
A4	0.0501	0.04672
A5	0.03584	0.1641
A6	0.04584	0.0273
A7	0.10576	0.03396
A8	0.0289	0.14452
Max Value	0.12696	0.14452

$\text{NSP}_5 = \frac{SP_5}{max(SP)}$

$\text{NSP}_5 = 0.2823$

$\text{NSP}_6 = \frac{SP_6}{max(SP)}$

$\text{NSP}_6 = 0.3611$

$\text{NSP}_7 = \frac{SP_7}{max(SP)}$

$\text{NSP}_7 = 0.833$

$\text{NSP}_8 = \frac{SP_8}{max(SP)}$

$\text{NSP}_8 = 0.2276$

The result of normalizing the SP value uses the following equation (11).

$\text{NSN}_1 = \frac{SN_1}{max(SN)}$

$\text{NSN}_1 = 0.8053$

$\text{NSN}_2 = \frac{SN_2}{max(SN)}$

$\text{NSN}_2 = 0.3384$

$\text{NSN}_3 = \frac{SN_3}{max(SN)}$

$\text{NSN}_3 = 0.2473$

$\text{NSN}_4 = \frac{SN_4}{max(SN)}$

$\text{NSN}_4 = 0.3233$

$\text{NSN}_5 = \frac{SN_5}{max(SN)}$

$\text{NSN}_5 = 1.1354$

$\text{NSN}_6 = \frac{SN_6}{max(SN)}$

$\text{NSN}_6 = 0.1889$

$\text{NSN}_7 = \frac{SN_7}{max(SN)}$

$\text{NSN}_7 = 0.235$

$\text{NSN}_8 = \frac{SN_8}{max(SN)}$

$\text{NSN}_8 = 1$

6. Final Score

The next process calculates the scoring score (AS) using the following equation (12).

$AS_1 = \frac{1}{2}(NSP_1 + NSN_1)$

$AS_1 = 0.66665$

$AS_2 = \frac{1}{2}(NSP_2 + NSN_2)$

$AS_2 = 0.31035$

$AS_3 = \frac{1}{2}(NSP_3 + NSN_3)$

$AS_3 = 0.62365$

$AS_4 = \frac{1}{2}(NSP_4 + NSN_4)$

$AS_4 = 0.35895$

$AS_5 = \frac{1}{2}(NSP_5 + NSN_5)$

$AS_5 = 0.70885$

$AS_6 = \frac{1}{2}(NSP_6 + NSN_6)$

$AS_6 = 0.275$

$AS_7 = \frac{1}{2}(NSP_7 + NSN_{71})$

$AS_7 = 0.534$

$AS_8 = \frac{1}{2}(NSP_8 + NSN_8)$

$AS_8 = 0.6138$

3.3.   Best Student Selection Ranking

The ranking of the best students is based on each candidate's final grade based on U.S. scores. AS values are sorted from highest to lowest. The best residual selection ranking results can be seen in Table 6 below.

Table 6. Best Student Selection Ranking

Alternative	Final Grade	Rank
(A5) Hadi Santoso	0.70885	1
(A1) Rahmat Julianto	0.66665	2
(A3) Bambang Supriyadi	0.62365	3
(A8) Hendrik Yudistira	0.6138	4
(A7) Hilda Sitorus	0.534	5
(A4) Hendra Gunawan	0.35895	6
(A2) Putri Amanda Sari	0.31035	7
(A2) Putri Amanda Sari	Benefit	8

Based on the process The completion steps of the application of the EDAS method in the selection of exemplary students resulted in prospective exemplary student candidates obtained on behalf of Hadi Santoso with a final score of 0.70885 and obtained rank 1, for rank 2 obtained on behalf of Rahmat Julianto with a final value of 0.66665, and rank 3 obtained on behalf of Bambang Supriyadi with a final value of 0.62365.

4.   Conclusion

The result of this study is to provide recommendations for the best students to be selected using the EDAS method and ROC weighting, so as to help schools in decision making. The implementation of the EDAS method in the selection of exemplary student candidates resulted in exemplary prospective students obtained on behalf of Hadi Santoso with a final score of 0.70885 and obtained 1st place, for 2nd place obtained on behalf of Rahmat Julianto with a final score of 0.66665, and 3rd place obtained on behalf of Bambang Supriyadi with a final score of 0.62365.

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