Research Article

Decision Support System in Scholarship Acceptance Selection Using The Vikor Method

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ABSTRACT

This study aims to apply the vikor method in the selection of scholarship receipts at Bengkulu Dehasen University. Designing the process by describing how the VIKOR (Visekriterijumsko Kompromisno Rangeranje) method should be used based on criteria (indications, achievements, credits and living expenses) fulfilled by prospective scholarship recipients in accordance with the provisions of Dehasen Bengkulu University in selecting scholarship acceptance. Based on the results obtained it can be proven that the condition of Acceptable stability in decision making is fulfilled (Namely a smaller value than 1) and Intan P Can be proposed to be a compromise solution which is the best ranking of scholarship recipients ranking by this VIKOR (Visekriterijumsko Kompromisno Rangeranje) method.

Keywords: Decision Support System, Vikor, Scholarship

Introduction

Educational institutions ranging from elementary schools to universities become a benchmark in building the nation's future generations. scholarship is defined as a form of appreciation given to individuals in order to continue their education to a higher level (Andri, 2008) Dehasen University (UNIVED) Bengkulu is one of the tertiary institutions in Indonesia that provides scholarship programs for outstanding students and has financial limitations.

The Faculty of Computer Science is one of the departments at UNIVED. The Faculty of Computer Science has 5 majors namely Informatics, Computer Systems Engineering, Information Systems, Information Management and Computer Engineering. Based on observations, the selection process at the Faculty of

Computer Science consists of two stages, namely the completeness of the file and the selection stage of the scholarship recipient (Bernadth, 2009). The selection stage for scholarship recipients is still using the manual method. Manual selection is a ranking process that is carried out still by sorting out the existing files in accordance with due regard to the criteria. This manual selection has a weakness in the ordering of data and ranking so that it can cause errors, then ranking manually requires a longer time (Departemen Pendidikan dan Kebudayaan, 2012).

Decision Support System is an interactive information system that provides information, modeling, and data manipulation. Where in this issue SPK is expected to help resolve existing

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problems using predetermined criteria (Erny, 2009).

The Visekriterijumsko Kompromisno Rangiranje (VIKOR) method is one of the MADM methods that sees the closest solution / alternative as an approach to the ideal solution in ranking (Badudu & Sutarni, 2010). In this study, the VIKOR method will be used as a method for determining scholarship recipients. The VIKOR method was chosen because of its ability to rank and can compromise alternatives.

From the description above, the title is taken on "Decision Support System in Scholarship Acceptance Selection at Bengkulu Dehasen University Using the Vikor Method."

Material and Method

VIKOR (Visekriterijumsko Kompromisno Rangiranje) method provides ranking to the nearest solution, even though there are conflicting criteria, so that the decision maker in this case the maker can choose the right ranking in accordance with the available alternatives.

The basic equations of the VIKOR method and the steps for completion can be seen below:

- a) Develop criteria and alternatives in the form of a decision matrix (F):

$$F = \begin{matrix} & C_1 & C_2 & C_3 & \dots & C_c \\ \begin{matrix} A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_n \end{matrix} & \begin{bmatrix} x_{11} & x_{12} & x_{13} & \dots & x_{1c} \\ x_{21} & x_{22} & x_{23} & \dots & x_{2c} \\ x_{31} & x_{32} & x_{33} & \dots & x_{3c} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & x_{n3} & \dots & x_{nc} \end{bmatrix} \end{matrix}$$

Where A_i alternative i , $i = 1, 2, \dots, n$; C_j is the criterion- j and x_{ij} is an element of the matrix that shows the level of performance of alternative- i .

- b) Next determine the criteria weight (W) as follows, with a fixed value: $W = [0.45, 0.20, 0.05, 0.30]$, and perform a positive value calculation

$$\begin{aligned} f_j^+ &= \{\min f_{ij} | j = 1, 2, \dots, c\} \\ &= \{f_1^+, f_2^+, \dots, f_j^+, \dots, f_c^+\} \\ f_j^- &= \{\max f_{ij} | j = 1, 2, \dots, c\} \\ &= \{f_1^-, f_2^-, \dots, f_j^-, \dots, f_c^-\} \end{aligned}$$

- c) Make a normalization matrix by first calculating the positive and negative values of each criterion. In determining positive and negative values, it is necessary to consider each type of criteria (max / min) to determine the best value for these criteria. After the positive and negative values are obtained, then calculate the normalization of the decision matrix (N).

$$N_{ij} = \frac{f_{ii}^+ - x_{ij}}{f_{ij}^+ - f_{ij}^-}$$

- d) Normalized decision matrix (N) is then multiplied by the criteria weight (W).

$$F_{ij} = N_{ij} \times BK_i$$

Calculating the utility measures of each alternative, there are two utility measures that are calculated S and R.

- e) Calculating the VIKOR index value (Q) before calculating Calculating the VIKOR index value (Q) of each alternative, it is necessary to first calculate the values of S^+ , S^- , R^+ , and R^- .

$$Q_i = \left[v \frac{(S_i - S^+)}{(S^- - S^+)} \right] + \left[(1-v) \frac{(R_i - R^+)}{(R^- - R^+)} \right]$$

- f) Rank alternatives by sorting starting from the smallest Q value
- g) The final step is to propose a compromise solution. A compromise solution can be proposed by proving two conditions, the value of V (the value of the weighting strategy of the maximum group utility) are $V = 0.4$ (with veto), $V = 0.5$ (by consensus), and $V = 0.6$ (voting by majority rule).

- a. Proof 1

Proving the condition of acceptable advantage with the equation.

$$\begin{aligned} DQ &= \frac{1}{(J-1)} \\ Q(A^{(2)}) - Q(A^{(1)}) \end{aligned}$$

- b. Proof 2

Proving the acceptable stability condition in decision making.

Result and Discussion

To understand this Vikor Method, the following stages of completion are presented in

ranking the selection of scholarship receipts at Bengkulu Dehasen University. The following data are known:

Table 1. Preliminary Data

Alternatif		Criteria			
Kode	Name	C1	C2	C3	C4
A1	Shinta S.	2.77	7	130	1700000
A2	Intan	3.57	3	130	1500000
A3	P. Yuna	3.41	7	75	1500000
A4	Hilmi D.	3.68	7	50	1800000
A5	Mirza	3.27	3	45	2200000
A6	James	3.33	7	90	2500000
A7	M. Usman	3.13	7	90	3200000
A8	Firza	2.50	7	90	2700000
A9	L. Alfian	3.68	2	90	1250000
A10	Kevin	2.78	2	90	2200000
A11	Dewi T.	3.94	3	90	1750000
A12	S. Gatot	2.55	4	62	3200000
A13	Zaki	3.57	6	450	2000000

Remarks Table 1.

C1: Achievement Index (IP)

C2: Achievements (Number of Achievements prospective scholarship recipients have)

C3: SKS that have been taken

C4: Parental Income (Life Expense (Rp))

The criteria considered for scholarship recipients are as follows:

- Performance Index (IP) - the higher the better; weight: 45% high IP shows the academic ability of students. So that the IP criteria become the highest assessment weight in determining this outstanding scholarship
- Achievement - the higher the better; weight: 5%, Achievement shows the ability of prospective scholarship recipients
- SKS that have been taken - the lower the better; weight: 25%. The low level of SKS is considered by the leadership to be able to stimulate the enthusiasm of young students to score achievements so that the semester criteria are taken into consideration in determining this outstanding scholarship. SKS Taken - the lower the better; weight: 25%. The low level of SKS is considered by the leadership to be able to stimulate the enthusiasm of young students to score achievements so that the semester criteria are taken into consideration in determining

this outstanding scholarship.

- Economic Burden (Parental Income) (Rp)) - the lower the better; weight: 25% Criteria Income parents included as one of the assessment criteria because the income of parents can see income from the family of the prospective scholarship recipient.

Step 1:

Arrange alternatives and criteria in the form of a decision matrix (F) as follows:

Step 2:

Determine the criteria weights (W) as follows: $W = [0.45, 0.20, 0.05, 0.30]$ Calculate the positive (f^+) negative (f^-) of each criterion with the equation:

$$\begin{aligned}
 f^+ &= \max\{f_{1,1}; f_{2,1}; f_{3,1}; \dots; f_{13,1}\} \\
 f^+ &= \max\{3,25; 3,24; 2,74; \dots; 2,75\} \\
 f^+ &= 3,91 \\
 f^- &= \max\{f_{1,1}; f_{2,1}; f_{3,1}; \dots; f_{13,1}\} \\
 f^- &= \max\{3,25; 3,24; 2,74; \dots; 2,75\} \\
 f^- &= 2,74
 \end{aligned}$$

After that proceed to calculate the normalization of decision matrix N, namely $N_{1,1}$ to

N13,1; N1,2 to N13,2; N1,3 to N13,3; N1,4 to N13,4 in the following way:

$$N_{1,1} = (3,91 - 2,77)/3,91 - 2,74$$

Step 3:

Forming a Normalization Matrix:

Step 4:

The Normalization Matrix (N) is multiplied by the weight of the criteria, with the following equation:

$$F^* = N_{1,1} \times W_1$$

$$F^* = N_{13,1} \times W_1$$

And so on obtained as follows:

$$F_{1,1}^* = 0,253;$$

$$F_{2,1}^* = 0,257;$$

$$F_{3,1}^* = 0,450;$$

$$F_{4,1}^* = 0,223;$$

$$F_{5,1}^* = 0,430;$$

$$F^* = 0,134;$$

$$F^* = 0,373;$$

$$F^* = 0,050;$$

$$F^* = 0,073;$$

$$F^* = 0,015.$$

Step 5:

Menghitung nilai utility measure dari setiap alternatif S dan R dengan rumus :

$$S_1 = F_{1,1}^* + F_{1,2}^* + F_{1,3}^* + F_{1,4}^* = 0.325 + 0.250 + 0.048 + 0.040 = 0.663$$

$$S_1 = F_{1,1}^* + F_{1,2}^* + F_{1,3}^* + F_{1,4}^* = 0.325 + 0.250 + 0.048 + 0.040 = 0.663$$

$$S_2 = F_{2,1}^* + F_{2,2}^* + F_{2,3}^* + F_{2,4}^* = 0.102 + 0.050 + 0.048 + 0.223 = 0.424$$

$$S_2 = F_{2,1}^* + F_{2,2}^* + F_{2,3}^* + F_{2,4}^* = 0.102 + 0.050 + 0.048 + 0.223 = 0.424 \dots \text{and so on until}$$

$$S_{17} = F_{17,1}^* + F_{17,2}^* + F_{17,3}^* + F_{17,4}^* = 0.313 + 0.250 + 0.025 + 0.085 = 0.674$$

$$S_{17} = F_{17,1}^* + F_{17,2}^* + F_{17,3}^* + F_{17,4}^* = 0.313 + 0.250 + 0.025 + 0.085 = 0.674$$

The calculation of RR Regret measures according to the equation is as follows:

$$R_1 = \max\{F_{1,1}^* ; F_{1,2}^* ; F_{1,3}^* ; F_{1,4}^*\} = \max\{0.325 ; 0.250 ; 0.048 ; 0.040\} = 0.325$$

$$R_1 = \max\{F_{1,1}^* ; F_{1,2}^* ; F_{1,3}^* ; F_{1,4}^*\} = \max\{0.325 ; 0.250 ; 0.048 ; 0.040\} = 0.325$$

$$R_2 = \max\{F_{2,1}^* ; F_{2,2}^* ; F_{2,3}^* ; F_{2,4}^*\} = \max\{0.102 ; 0.050 ; 0.048 ; 0.223\} = 0.223$$

... and so on until

$$R_{17} = \max\{F_{17,1}^* ; F_{17,2}^* ; F_{17,3}^* ; F_{17,4}^*\} = \max\{0.313 ; 0.250 ; 0.025 ; 0.085\} = 0.313$$

Step 6:

Calculating the VIKOR index value (Q) Before calculating the VIKOR index value (Q) of each alternative, it is necessary to first calculate the S+, S-, R+ and R- values as follows:

$$S^+ = \max\{S_1 ; S_2 ; S_3 ; \dots ; S_{17}\} = \max\{0.663 ; 0.424 ; 0.640 ; \dots ; 0.674\} = 0.703$$

$$S^- = \min\{S_1 ; S_2 ; S_3 ; \dots ; S_{17}\} = \min\{0.663 ; 0.424 ; 0.640 ; \dots ; 0.674\} = 0.211$$

$$R^+ = \max\{R_1 ; R_2 ; R_3 ; \dots ; R_{17}\} = \max\{0.325 ; 0.223 ; 0.250 ; \dots ; 0.313\} = 0.400$$

$$R^- = \min\{R_1 ; R_2 ; R_3 ; \dots ; R_{17}\} = \min\{0.325 ; 0.223 ; 0.250 ; \dots ; 0.313\} = 0.113$$

Step 7:

Alternate ranking by sorting from the smallest Q value. The full ranking results are as follows:

Table 2. Alternative Ranking ranking results

Rangking	Alternatif		Nilai Q	
	kode	Nama	kode	Nilai
1	A9	L. Alfian	Q9	0
2	A11	Dewi T.	Q11	0.164
3	A5	Mirza	Q5	0.266

Rangking	Alternatif		Nilai Q	
	kode	Nama	kode	Nilai
4	A13	Zaki	Q13	0.293
5	A2	Intan	Q2	0.407
6	A4	Hilmi D.	Q4	0.588
7	A6	James	Q6	0.609
8	A3	P. Yuna	Q3	0.674
9	A10	Kevin	Q10	0.700
19	A7	Usman	Q7	0.721
11	A1	Shinta S.	Q1	0.829
12	A12	S. Gatot	Q12	0.934
13	A8	Firza	Q8	1.000

Step 8:

The final step is to propose a compromise solution. A compromise solution can be proposed by proving both conditions. In proving this compromise solution the values of v (the weighting value of the strategy of the maximum group utility) are $v = 0.4$ (with veto), $v = 0.5$ (by consensus), and $v = 0.6$ (voting by majority rule).

Proof I:

Proof of conditions for Acceptable advantage

The resulting value of difference is greater than the value of DQ , so that the condition of Acceptable advantage is fulfilled (That is a smaller value than 1).

Based on the results obtained, it can be proven that the condition of Acceptable stability in decision making is fulfilled.

Table 3. Ranking of Vikor Method Ranking

Alternatif, dengan $DQ=0.071428571428571$											
Rang			$v=0.44$			$v=0.5$			$v=0.56$		
	S	R	Nama	Q	Qm-Q1	Nama	Q	Qm-Q1	Nama	Q	Qm-Q1
1	8	8	Intan P.	0	0	Intan P.	0	0	Intan P.	0	0
2	11	2	Mirza	0.087	0.087	Mirza	0.097	0.097	Mirza	0.107	0.107
3	2	11	Usman K.	0.187	0.187	Usman K.	0.183	0.183	Usman K.	0.179	0.179
4	9	15	Yuna	0.2	0.2	Yuna	0.202	0.202	Yuna	0.204	0.204
5	12	9	T. Lina	0.258	0.258	T. Lina	0.275	0.275	T. Lina	0.293	0.293
6	10	7	H. Enrico	0.374	0.374	H. Enrico	0.386	0.386	H. Enrico	0.398	0.398
7	7	10	Shinta	0.383	0.383	Shinta	0.396	0.396	Shinta	0.409	0.409
8	1	4	Vicky	0.566	0.566	Alfian	0.572	0.572	Alfian	0.565	0.565
9	5	5	Alfian	0.579	0.579	Vicky	0.589	0.589	Vicky	0.612	0.612
10	4	1	P. James	0.616	0.616	P. James	0.622	0.622	P. James	0.627	0.627
11	3	3	Oscar M.	0.782	0.782	Oscar M.	0.786	0.786	Oscar M.	0.789	0.789
12	14	14	Hilmi K.	0.905	0.905	Hilmi K.	0.904	0.904	Hilmi K.	0.902	0.902
13	13	13	Dewi	1	1	Dewi	1	1	Dewi	1	1

Based on the results of proving both conditions can be seen that both conditions are met. Diamond P can be proposed to be a compromise solution and is the best ranking of scholarship recipient ranking with the VIKOR method.

Conclusion

Vikor method is very well used in ranking to be used as a reference in supporting decision making. Specifically for scholarship recipients at the Faculty of Computer Science, Department of Informatics, Dehasen University

Bengkulu. The main candidates for scholarship recipients are students who have or rank the lowest ranking in the SPK-Vikor application. Based on the results of proving the two conditions above can be seen that both conditions are met. So students named Intan P can be proposed to be a compromise solution and are the best ranking of scholarship recipient ranking by the VIKOR method. But the VIKOR method still requires quite a long and complicated calculation time so that the development of a computerized application system is needed that can help calculations to be faster, precise, easy and efficient.

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