International Journal of Information System & Technology
Akreditasi No. 36/E/KPT/2019 | Vol. 5, No. 2, (2021), pp. 207-214

Comparative Analysis of Ranking Methods of WASPAS+ROC with Preference Selection Index (PSI) in Determining the Performance of Young Lecturers

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Abstract

Young Lecturers are lecturers who have a relatively new tenure compared to lecturers who have served more than 10 (ten years) at a university. Assessment of the performance of young lecturers at universities is very necessary, it aims to get an assessment of the performance achievements of the tri dharma of higher education that have been passed in several years. In order for the assessment of performance achievements to be more effective, a method is needed in generating decisions. In this study, an analysis of the combination of the Weighted Aggregated Sum Product Assessment (WASPAS) and Rank Order Centroid (ROC) methods was carried out with the Preference Selection Index (PSI) method. The WASPAS method is a ranking method that requires weights. For this reason, the ROC method is used to generate weight values. While the PSI method is a PSI method that is used to rank without the need for a weight value for each attribute. The results showed that alternative A1 is the best alternative with the highest performance with a value of 0.323 (WASPAS+ROC method) and a value of 2.016 (PSI method).

Keywords: *Young Lecturers, Performance, WASPAS, ROC, PSI*

1. Introduction

Lecturers are one of the human resources owned by universities. At this time the performance of lecturers is one of the focuses of government attention. It is intended that lecturers who have good performance will be given allowances by the government in the form of programs such as grants, serdos, and others. To increase motivation in improving the tri dharma of higher education, universities are obliged to assess the performance of their lecturers. In this study, researchers have a focus of study to examine the performance of young lecturers. This is because young lecturers need to be guided and motivated in order to have a good career advancement in general, especially in improving functional positions. In order to be more objective in evaluating the performance of young lecturers, a Decision Support System (DSS) is needed[1]–[3].

In the implementation of making a decision with a decision support system it requires certain methods. So that the resulting decisions are optimal and good. Several decision support system methods used in determining the ranking include the Simple Additive Weighting (SAW) method[4], Preference Selection Index (PSI) [5], [6], Weighted Product (WP) [7], Weighted Aggregated Sum Product Assessment (WASPAS) [8].

Based on previous research conducted by Samuel Damanik and Dito Putro Utomo (2020), the ROC method can produce ideal weight values for the criteria values [9]. In a previous study also conducted by Mesran et al (2019), said that the WASPAS method can be used to determine the recipients of the hopeful family program assistance. The results obtained are that the determination of the recipients of the family of hope program is more objective and accepted by many people [10].

Previous research which was also conducted by Moh. Ilbad Dzulfadli et al (2020) in research on the assessment system for outstanding lecturers using the WASPAS method.

ISSN : 2580-7250

The results obtained from this study are that the assessment of outstanding lecturers is more efficient and effective, where the results obtained are more objective so that they can be accepted [11]. In previous research, this method was also used by Martina Klarasia Siahaan et al (2018) regarding determining regional development priorities by applying the Preference Selection Index. Where the results obtained are more objective and accurate. The data processing process that has been obtained is faster and saves a lot of time [12].

In this study, the authors use a combination of the WASPAS method with ROC which will be compared with the PSI method in determining the performance of the best young lecturers. The final result of the research is expected to provide more effective decisions on the performance of young lecturers

2. Research Methodology

2.1. Weighted Aggregated Sum Product Assessment (WASPAS) Method

The Weighted Aggregated Sum Product Assessment (WASPAS) method is a combination method of the weighted method (WSM) and the weighted product mode (WPM). The WASPAS method can optimize the assessment in determining the lowest score and the highest score[8], [13]–[16].

The stages of the waspas method, namely:

a) Preparing the Decision Matrix (X_{ij})

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & . & X_{1n} \\ X_{21} & X_{22} & . & X_{zn} \\ . & . & . & . \\ X_{m1} & X_{m2} & . & X_{mn} \end{bmatrix} \quad (1)$$

b) Normalizing the Decision Matrix (R_{ij})

if benefit criteria, then:

$$R_{ij} = \frac{X_{ij}}{\mathrm{Max}_i\, X_{ij}} \quad (2)$$

if cost criteria, then:

$$R_{ij} = \frac{\mathrm{Min}_i\, X_{ij}}{X_{ij}} \quad (3)$$

c) Calculating the Value of Relative Importance (Q)

$$Q_i = 0.5 \sum_{j=1}^{n} r_{ij} w_j + 0.5 \prod_{j=1}^{n} (r_{ij})^{w_j} \quad (4)$$

2.2. Rank Order Centroid (ROC) Method

The Rank Order Centroid (ROC) method is one method that can produce a weight value on a criterion. The workings of the ROC method are that the priority of criterion 1 is the highest criterion compared to the second criterion, while the second criterion is the highest priority criterion compared to the third criterion, and so on for each criterion[17], [18]. To get the value of weight (w), the following equation is used:

$$w_m = \frac{1}{m} \sum_{1=1}^{m} \left(\frac{1}{i}\right) \quad (5)$$

2.3. Preference Selection Index (PSI) Method

The Preference Selection Index (PSI) method was developed by Maniya and Bhatt in 2010. The PSI method is aimed at dealing with conflicts in determining the relative importance of each attribute. In the PSI method, the results are obtained with a process of minimal and simple calculations as they are based on statistical concepts without the need for a weight value for each attribute. The following are the steps in the Preference Selection Index method [19]–[24], as follows:

a) Preparing the Decision Matrix (X_{ij})

b) Normalizing the Decision Matrix (R_{ij})

The normalized decision matrix was constructed using equations (6) and (7). If the greater the alternative value, the better (benefit), then use equation 6.

$$R_{ij} = \frac{x_{ij}}{xj^{\max}} \quad (6)$$

If the smaller the alternative value the better (cost), then you can use equation 7.

$$R_{ij} = \frac{xj^{\min}}{x_{ij}} \quad (7)$$

c) Determination of the mean value of the normalized matrix

$$N = \frac{1}{N}\sum_{i=1}^{m} R_{ij} \quad (8)$$

d) Calculates the value of preference variation ($\emptyset_j$)

$$\emptyset_{j} = \sum_{i=1}^{m}[R_{ij-}N]2 \quad (9)$$

e) Determine the deviation of preference value Ω_j

$$\Omega_j = 1 - \emptyset_j \quad (10)$$

f) Determine the criteria weight

$$w_j = \frac{\Omega_j}{\sum_{j=1}^{n}\Omega_j} \quad (11)$$

g) Determination the preference selection index

$$\Theta_i = \sum_{j=1}^{n}(R_{ij}W_j) \quad (12)$$

The alternative that has the largest preference selection index is the best alternative.

3. Result and Discussion

Reporting on the performance of young lecturers is the most important thing, which must be owned by every university. This aims to motivate young lecturers to be more productive and become more experienced in carrying out the tri dharma of higher education. From the performance results obtained, universities can also have future development plans for their human resources, in this case lecturers. In this section, the process of making decisions on the performance of young lecturers at Budi Darma University will be described.

3.1. Determination of Criteria

The criteria needed in determining the performance of young lecturers at Budi Darma University are:

Table 1. List of Criteria

Criteria	Description	Type	Bobot
C_1	Gol	Benefit	0.275
C_2	Scopus Documentation	Benefit	0.184
C_3	Articles in Accredited Journals	Benefit	0.138
C_4	H-Index Scopus	Benefit	0.108
C_5	H-Index GS	Benefit	0.085
C_6	Active in Lecturer Professional Organizations	Benefit	0.067
C_7	Certificate of Competence	Benefit	0.052
C_8	Service Activities	Benefit	0.039
C_9	As an Organization Builder	Benefit	0.027
C_{10}	Age	Cost	0.017
C_{11}	Year of Appointment of Permanent Lecturer	Cost	0.008

In the above criteria, the Rank Order Centroid (ROC) method is used to generate the weight value using equation 5.

3.2. Alternative Determination

In table 2 is a list of young lecturers whose performance will be calculated. Table 2 is also data from the suitability rating between the alternatives and the specified criteria.

Table 2. Match Rating

Alternative	C_1	C2	C_3	C_4	C_5	C_6	C_7	C_8	C_{10}	C_{11}	C_{12}
Soeb Aripin (A_1)	2	0	3	0	4	1	1	3	1	28	2018
Sarwandi (A_2)	1	0	1	0	2	0	0	1	0	27	2019
Rian Syahputra (A_3)	2	0	2	0	0	1	1	3	1	27	2018
Annisa Fadillah Siregar (A_4)	1	2	0	1	0	0	0	1	0	27	2019
Dito Putro Utomo (A_5)	1	0	3	0	9	0	0	3	1	27	2021
Bister Purba (A_6)	2	0	0	0	3	0	0	3	1	30	2018
Alwin Fau (A_7)	2	0	2	0	3	0	0	2	2	27	2018
Meryance Viorentina Siagian (A_8)	1	0	0	0	2	0	0	0	0	28	2020

3.3. Ranking Applying the WASPAS method

After the suitability rating data has been determined (table 2), in this section, the calculation process for the lecturer's performance will be carried out using the WASPAS method. The stages of the WASPAS calculation are as follows:

1) Define the decision matrix

The decision matrix can be seen as follows:

$$Xij = \begin{vmatrix} 2 & 0 & 3 & 0 & 4 & 1 & 1 & 3 & 1 & 28 & 2018 \\ 1 & 0 & 1 & 0 & 2 & 0 & 0 & 1 & 0 & 27 & 2019 \\ 2 & 0 & 2 & 0 & 0 & 1 & 1 & 3 & 1 & 27 & 2018 \\ 1 & 2 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 27 & 2019 \\ 1 & 0 & 3 & 0 & 9 & 0 & 0 & 3 & 1 & 27 & 2021 \\ 2 & 0 & 0 & 0 & 3 & 0 & 0 & 3 & 1 & 30 & 2018 \\ 2 & 0 & 2 & 0 & 3 & 0 & 0 & 2 & 2 & 27 & 2018 \\ 1 & 0 & 0 & 0 & 2 & 0 & 0 & 0 & 0 & 28 & 2020 \end{vmatrix}$$

2) Normalize the decision matrix

To determine the normalization of the decision matrix using equation 2 (benefit criteria) and equation 3 (cost criteria). The results will be seen in table 3 below.

Table 3. Rij Matrix with WASPAS Method

Alternative	C_1	C2	C_3	C_4	C_5	C_6	C_7	C_8	C_{10}	C_{11}	C_{12}
A_1	1.00	0.00	1.00	0.00	0.44	1.00	1.00	1.00	0.50	0.96	1.00
A_2	0.50	0.00	0.33	0.00	0.22	0.00	0.00	0.33	0.00	1.00	1.00
A_3	1.00	0.00	0.67	0.00	0.00	1.00	1.00	1.00	0.50	1.00	1.00
A_4	0.50	1.00	0.00	1.00	0.00	0.00	0.00	0.33	0.00	1.00	1.00
A_5	0.50	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.50	1.00	1.00
A_6	1.00	0.00	0.00	0.00	0.33	0.00	0.00	1.00	0.50	0.90	1.00
A_7	1.00	0.00	0.67	0.00	0.33	0.00	0.00	0.67	1.00	1.00	1.00
A_8	0.50	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.96	1.00

3) Calculating the value of relative importance

The value of relative importance is obtained from the fourth equation, with the determination of 0.5.

Table 4. Value of Relative Importance

Alternative	Qi	Rank
A_1	0.323	1
A_2	0.120	7
A_3	0.282	2
A_4	0.234	4
A_5	0.219	5

Alternative	Qi	Rank
A_6	0.190	6
A_7	0.237	3
A_8	0.090	8

The results shown in table 4 above, that Alternative A1 has the best performance value with 0.323 compared to other alternatives.

3.4. Ranking Applying the PSI method

In this section the author will calculate the performance of young lecturers using the PSI method. Here is the process carried out:

a) Define the decision matrix
The decision matrix can be taken from the Xij decision matrix in the WASPAS section above.

b) Normalizing the Decision Matrix
To obtain the Rij matrix in the PSI method, equation 6 (for benefit criteria) and equation 7 (for cost criteria) can be used. The results of the calculations can be seen in table 5 below.

Table 5. Rij Matrix with PSI Method

Alternative	C_1	C2	C_3	C_4	C_5	C_6	C_7	C_8	C_{10}	C_{11}	C_{12}
A_1	1.000	0.000	1.000	0.000	0.444	1.000	1.000	1.000	0.500	0.964	1.000
A_2	0.500	0.000	0.333	0.000	0.222	0.000	0.000	0.333	0.000	1.000	1.000
A_3	1.000	0.000	0.667	0.000	0.000	1.000	1.000	1.000	0.500	1.000	1.000
A_4	0.500	1.000	0.000	1.000	0.000	0.000	0.000	0.333	0.000	1.000	1.000
A_5	0.500	0.000	1.000	0.000	1.000	0.000	0.000	1.000	0.500	1.000	0.999
A_6	1.000	0.000	0.000	0.000	0.333	0.000	0.000	1.000	0.500	0.900	1.000
A_7	1.000	0.000	0.667	0.000	0.333	0.000	0.000	0.667	1.000	1.000	1.000
A_8	0.500	0.000	0.000	0.000	0.222	0.000	0.000	0.000	0.000	0.964	0.999

c) Determination of the mean value of the normalized matrix
To calculate the Mean value using the 8th equation, the result of the calculation is obtained:
N = [0.5455; 0.0909; 0.3333; 0.0909; 0.2323; 0.1818; 0.1818; 0.4848; 0.2727; 0.7117; 0.7270]

d) Calculates the value of preference variation ($\emptyset_j$)
To calculate the value of preference variation using equation 9, the results can be seen as below
$\emptyset_j$ = [0.8347; 0.8843; 1.4444; 0.8843; 0.7629; 1.5372; 1.5372; 1.3756; 0.9587; 0.5787; 0.5945]

e) Determine the deviation of preference value Ω_j
To calculate the value of preferences using equation 10. The values of the resulting preferences are:
Ω_j = [0.1653; 0.1157; -0.4444; 0.1157; 0.2371; -0.5372; -0.5372; -0.3756; 0.0413; 0.4213; 0.4055]

f) Determine the criteria weight.
The weights are obtained using the 11th equation. The following weights are generated.
w_j = [-0.4211; -0.2948; 1.1324; -0.2948; -0.6042; 1.3687; 1.3687; 0.9569; -0.1053; -1.0735; -1.0331]

g) Determination the preference selection index
The results of the 12th equation to calculate the value of PSI can be seen in table 6 below.

Table 6. Value of PSI

Alternative	Qi	Rank
A_1	2.016	1
A_2	-1.754	6
A_3	1.869	2
A_4	-2.587	8
A_5	-0.883	3
A_6	-1.717	5
A_7	-1.441	4
A_8	-2.412	7

3.5. Ranking Analysis

From the results obtained using a combination of the WASPAS and ROC methods compared to the PSI method, it can be seen in table 7 below.

Table 7. Ranking Analysis

Alternative	WASPAS+ROC	Rank	PSI Method	Rank
A_1	0.323	1	2.016	1
A_2	0.120	7	-1.754	6
A_3	0.282	2	1.869	2
A_4	0.234	4	-2.587	8
A_5	0.219	5	-0.883	3
A_6	0.190	6	-1.717	5
A_7	0.237	3	-1.441	4
A_8	0.090	8	-2.412	7

In table 7 above, it can be seen that a negative value was obtained, this is because the data on the suitability rating for each alternative and the criteria has a value of 0 (zero), so that the results given to each alternative have a negative average value. However, from the two methods compared, the alternative that has the best performance is the same, namely A_1 with a value of 0.323 (WASPAS+ROC method) and a value of 2,016 (PSI method).

4. Conclusion

From the research carried out, it is concluded that effective decisions on evaluating the performance of young lecturers can be produced by using certain methods in the decision support system and in processing it regardless of human involvement. The results of the combination using the WASPAS and ROC methods result that the alternative is the best with a value of 0.323, while using the PSI method it produces a value of 2,016 on alternative A1.

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