Implementation of preference ranking organization method for enrichment evaluation (*Promethee*) on selection system of student's achievement

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Abstract. Selection of Student Achievement is conducted every year, starting from the level of Study Program, Faculty, to University, which then rank one will be sent to Kopertis level. The criteria made for the selection are Academic and Rich Scientific, Organizational, Personality, and English. In order for the selection of Student Achievement is Objective, then in addition to the presence of the jury is expected to use methods that support the decision to be more optimal in determining the Student Achievement. One method used is the Promethee Method. Preference Ranking Organization Method for Enrichment Evaluation (Promethee) is a method of ranking in Multi Criteria Decision Making (MCDM). PROMETHEE has the advantage that there is a preference type against the criteria that can take into account alternatives with other alternatives on the same criteria. The conjecture of alternate dominance over a criterion used in PROMETHEE is the use of values in the relationships between alternative ranking values. Based on the calculation result, from 7 applicants between Manual and Promethee Matrices, rank 1, 2, and 3, did not change, only 4 to 7 positions were changed. However, after the sensitivity test, almost all criteria experience a high level of sensitivity. Although it does not affect the students who will be sent to the next level, but can bring psychological impact on prospective student's achievement

1.   Introduction

Studying in college, students must be more active in seeking knowledge. Students are people with the ability and opportunity to study in college, so it can be classified as intelligence. Because of the opportunities available, students are expected to be able to act as capable and skilled leaders, either as community leaders or in the workplace. Students are expected to be a dynamic driving force for the process of modernization. The Most outstanding student is a student who successfully achieve high achievement, both academic and non-academic, able to communicate with the Indonesian language and English, be positive, and spirited Pancasila. While students who excel usually have abilities above average in terms of academic, papers, personality, and extracurricular activities and the ability to speak English. There is also the process of selecting outstanding students for this is still subjective. For that field of student affairs and juries who are trusted to test should not make mistakes, this will lead to injustice for participants who are more achievers. It can also be detrimental to the university because with the wrong to send students achievement can reduce the opportunity to score achievement.

2.   Methodology

Four criteria used in this study based on maximization rules where the better the topic and the content of scientific work, the more active in the organization, the better the personality and the better the way of communicating each alternative in the English language the better the value will be obtained by the alternative.

Promethee is a ranking stage with the principle of pairwise comparison where each alternative value on the criteria is compared with the value of other alternatives. The PROMETHEE method flow can be seen in Figure 1.
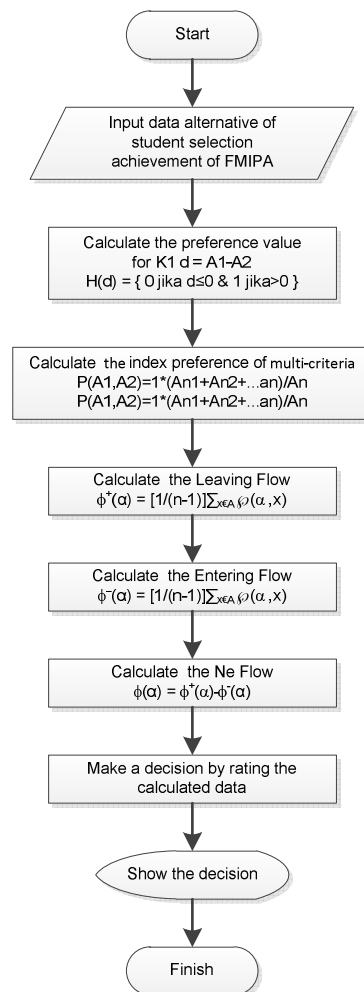

Figure 1. PROMETHEE Method Flow

Criteria and weights used in each criteria for undergraduate students of FMIPA Universita Pakuan degree program are as follows:

Table 1. Criteria and Weights

Criteria	Weights
Scientific Work	30%
Organizational	25%
Personality	20%
English	25%

Alternative data used in this research is the data of student selection of outstanding students of Faculty of Mathematics and Natural Sciences, as follows:

Table 2. Participants of Student Selection of FMIPA

No	Student	Study Program
1	Ikhsan Pratama	Biology
2	Niftrelia SD.	Chemistry
3	Diah Indah P	Mathematics
4	Agvin Pratama	Computer Science
5	Hilda Ayunda	Pharmacy
6	Doni Nugraha	D3 Information System
7	Abdul Basit	D3 Computer Technology

3.   Result and Discussion

3.1. Calculate The Preference Value

Calculating the value of preference is done by comparing the value of one alternative with another alternative for each criterion. For example, on the criteria of scientific work we compare the values of A1 with A2, A1 with A3, A1 with A4 to compare A4 with A3. Furthermore, on organizational criteria compare between A1 with A2, A1 with A3 to compare A4 with A3 and so on until the comparison for English ability criteria. There are two provisions to determine the preference value of each alternative comparison: H (d) is 0 if d ≤ 0 and H (d) is 1 if d> 0.

Table 3. Preference Value of Each Criteria

Preference Value of **Scientific Work Criteria**						
(A1,A2) = 0	(A2,A1) = 1	(A3,A1) = 1	(A4,A1) = 1	(A5,A1) = 0	(A6,A1) = 1	(A7,A1) = 1
(A1,A3) = 0	(A2,A3) = 0	(A3,A2) = 0	(A4,A2) = 1	(A5,A1) = 0	(A6,A2) = 0	(A7,A2) = 1
(A1,A4) = 0	(A2,A4) = 0	(A3,A4) = 0	(A4,A3) = 1	(A5,A1) = 0	(A6,A3) = 0	(A7,A3) = 1
(A1,A5) = 1	(A2,A5) = 1	(A3,A5) = 1	(A4,A5) = 1	(A5,A1) = 0	(A6,A4) = 0	(A7,A4) = 0
(A1,A6) = 0	(A2,A6) = 0	(A3,A6) = 0	(A4,A6) = 1	(A5,A1) = 0	(A6,A5) = 1	(A7,A5) = 1
(A1,A7) = 0	(A2,A7) = 0	(A3,A7) = 0	(A4,A7) = 0	(A5,A1) = 0	(A6,A7) = 0	(A7,A6) = 1
Preference Value of **Organizational Criteria**						
(A1,A2) = 0	(A2,A1) = 1	(A3,A1) = 0	(A4,A1) = 0	(A5,A1) = 0	(A6,A1) = 0	(A7,A1) = 0
(A1,A3) = 1	(A2,A3) = 1	(A3,A2) = 0	(A4,A2) = 0	(A5,A1) = 0	(A6,A2) = 0	(A7,A2) = 0
(A1,A4) = 0	(A2,A4) = 1	(A3,A4) = 0	(A4,A3) = 1	(A5,A1) = 1	(A6,A3) = 1	(A7,A3) = 0
(A1,A5) = 1	(A2,A5) = 1	(A3,A5) = 0	(A4,A5) = 1	(A5,A1) = 0	(A6,A4) = 0	(A7,A4) = 0
(A1,A6) = 1	(A2,A6) = 1	(A3,A6) = 0	(A4,A6) = 1	(A5,A1) = 0	(A6,A5) = 0	(A7,A5) = 0
(A1,A7) = 1	(A2,A7) = 1	(A3,A7) = 0	(A4,A7) = 1	(A5,A1) = 1	(A6,A7) = 1	(A7,A6) = 0
Preference Value of **English Criteria**						
(A1,A2) = 0	(A2,A1) = 1	(A3,A1) = 1	(A4,A1) = 0	(A5,A1) = 0	(A6,A1) = 0	(A7,A1) = 0
(A1,A3) = 0	(A2,A3) = 1	(A3,A2) = 0	(A4,A2) = 0	(A5,A1) = 0	(A6,A2) = 0	(A7,A2) = 0
(A1,A4) = 0	(A2,A4) = 1	(A3,A4) = 1	(A4,A3) = 0	(A5,A1) = 0	(A6,A3) = 0	(A7,A3) = 0
(A1,A5) = 1	(A2,A5) = 1	(A3,A5) = 1	(A4,A5) = 1	(A5,A1) = 0	(A6,A4) = 0	(A7,A4) = 0
(A1,A6) = 1	(A2,A6) = 1	(A3,A6) = 1	(A4,A6) = 1	(A5,A1) = 0	(A6,A5) = 0	(A7,A5) = 0
(A1,A7) = 1	(A2,A7) = 1	(A3,A7) = 1	(A4,A7) = 1	(A5,A1) = 1	(A6,A7) = 1	(A7,A6) = 0
Preference Value of **Personality Criteria**						
(A1,A2) = 0	(A2,A1) = 1	(A3,A1) = 0	(A4,A1) = 0	(A5,A1) = 0	(A6,A1) = 0	(A7,A1) = 0
(A1,A3) = 1	(A2,A3) = 1	(A3,A2) = 0	(A4,A2) = 0	(A5,A1) = 0	(A6,A2) = 0	(A7,A2) = 0
(A1,A4) = 0	(A2,A4) = 1	(A3,A4) = 0	(A4,A3) = 1	(A5,A1) = 1	(A6,A3) = 1	(A7,A3) = 0
(A1,A5) = 1	(A2,A5) = 1	(A3,A5) = 0	(A4,A5) = 1	(A5,A1) = 0	(A6,A4) = 0	(A7,A4) = 0
(A1,A6) = 1	(A2,A6) = 1	(A3,A6) = 0	(A4,A6) = 1	(A5,A1) = 0	(A6,A5) = 0	(A7,A5) = 0
(A1,A7) = 1	(A2,A7) = 1	(A3,A7) = 0	(A4,A7) = 1	(A5,A1) = 1	(A6,A7) = 1	(A7,A6) = 0

3.2. Calculate The Preferences Index of Multi-criteria

To calculate the index of criteria preferences can be calculated using the following formula:

$$\wp(a,b) = \sum_{i=1}^{n} \pi \; P_i(a,b) : \forall a,b \in A$$

The result of the calculation of the multicriteria preference index will form a matrix. Here are the results of the calculation of multicriteria preference index based on the calculation of the above preference values:

	A1	A2	A3	A4	A5	A6	A7
A1	-	0	0.5	0	1	0.75	0.75
A2	1	-	0.75	0.75	1	0.75	0.75
A3	0.5	0	-	0.25	0.5	0.25	0.25
A4	0.25	0.25	0.75	-	1	1	0.75
A5	0	0	0.5	0	-	0	0.75
A6	0.25	0	0.5	0	0.25	-	0.75
A7	0.25	0.25	0.25	0	0.25	0.25	-

3.3. Calculate The Leaving Flow

Leaving flow obtained from calculation 1 divided by the number of alternatives minus 1 then multiplied by the number of horizontal preference index (horizontal). To calculate Leaving Flow can be calculated using the formula below:

$$\Phi^+(a) = [1/(n-1)] \sum_{x \in A} \wp(a,x)$$

Here are the results of Leaving Flow calculation:

$\Phi+(A1) = \frac{1}{7-1} (0 + 0.5 + 0 + 1 + 0.75 + 0.75) = \frac{1}{6}(3) = 0.5$

$\Phi+(A2) = \frac{1}{7-1} (1 + 0.75 + 0.75 + 1 + 0.75 + 0.75) = \frac{1}{6}(5) = 0.83$

$\Phi+(A3) = \frac{1}{7-1} (0.5 + 0 + 0.25 + 0.5 + 0.25 + 0.25) = \frac{1}{6}(1.75) = 0.29$

$\Phi+(A4) = \frac{1}{7-1} (0.25 + 0.25 + 0.75 + 1 + 1 + 0.75) = \frac{1}{6}(4) = 0.67$

$\Phi+(A5) = \frac{1}{7-1} (0 + 0 + 0.5 + 0 + 0 + 0.75) = \frac{1}{6}(1.25) = 0.21$

$\Phi+(A6) = \frac{1}{7-1} (0.25 + 0 + 0.5 + 0 + 0.25 + 0.75) = \frac{1}{6}(1.75) = 0.29$

$\Phi+(A7) = \frac{1}{7-1} (0.25 + 0.25 + 0.25 + 0 + 0.25 + 0.25) = \frac{1}{6}(1.25) = 0.21$

3.4. Calculate The Entering Flow

Entering flow is obtained from calculation 1 divided by the number of alternatives minus 1 then multiplied by the number of multi-criteria preference index vertically (column). To calculate the Entering Flow can be calculated use formula below:

$$\Phi^-(a) = [1/(n-1)] \sum_{x \in A} \wp(x,a)$$

Here's the calculation of Entering Flow:

$\Phi-(A1) = \frac{1}{7-1} (1 + 0.5 + 0.25 + 0 + 0.25 + 0.25) = \frac{1}{6}(2.25) = 0.375$

$\Phi-(A2) = \frac{1}{7-1} (0 + 0 + 0.25 + 0 + 0 + 0.25) = \frac{1}{6}(0.5) = 0.083$

$\Phi-(A3) = \frac{1}{7-1} (0.5 + 0.75 + 0.75 + 0.5 + 0.5 + 0.25) = \frac{1}{6}(3.25) = 0.54$

$\Phi-(A4) = \frac{1}{7-1} (0 + 0.75 + 0.25 + 0 + 0 + 0) = \frac{1}{6}(1) = 0.17$

$$\Phi\text{-(A5)} = \frac{1}{7-1}\ (1 + 1 + 0.5 + 1 + 0.25 + 0.25) = \frac{1}{6}\,(4) = 0.67$$
$$\Phi\text{-(A6)} = \frac{1}{7-1}\ (0.75 + 0.75 + 0.25 + 1 + 0 + 0.25) = \frac{1}{6}\,(3) = 0.5$$
$$\Phi\text{-(A7)} = \frac{1}{7-1}\ (0.75 + 0.75 + 0.25 + 0.75 + 0.75 + 0.75) = \frac{1}{6}\,(4) = 0.67$$

3.5. Calculate The Net Flow

Net Flow is the result of the difference of Leaving Flow calculation minus Entering Flow. Here's the calculation:

$$\Phi(A1) = 0.5 -\ \ 0.38\ \ \ = \ 0.12$$
$$\Phi(A2) = 0.83 - 0.083\ = \ 0.747$$
$$\Phi(A3) = 0.29 - 0.54\ \ \ = -0.25$$
$$\Phi(A4) = 0.67 - 0.17\ \ \ = \ 0.5$$
$$\Phi(A5) = 0.21 - 0.67\ \ \ = -0.46$$
$$\Phi(A6) = 0.29 - 0.5\ \ \ \ = -0.21$$
$$\Phi(A7) = 0.21 - 0.67\ \ \ = -0.46$$

3.6. Taking Results of Decision

Based on the calculation using PROMETHEE method, the winner of the outstanding students of Faculty of Mathematics and Natural Sciences of Pakuan University is Niftrelia SD from Chemistry Department. The results of student selection of outstanding students in 2014 have 3 appropriate rankings, namely rank 1, 2 and 3, where the level of conformity of the results of calculation of PROMETHEE with manual calculation obtained from the data according to divided by the number of data used and multiplied by 100%. The number of alternative rankings on PROMETHEE according to the manual calculation is 3 then ((3/7) * 100) is 48.2%.

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