Determination of Education Scholarship Recipients Using Preference Selection Index

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ABSTRACT

The decision taken in the selection of scholarship recipients for students is one of the responsibilities held by the stakeholders at the high school leadership level. The decision-making stage consists of compliance with the terms or criteria set by the government as the scholarship provider. Implementation of decision support methods for selection of scholarship recipients is required. This can help the leadership to make the selection better. Many methods in decision support systems can solve and make decisions better, including preference selection index. The use of preference selection index applied in the decision support system will result in a more effective decision.

Keywords: PSI, Decision Support Systems, Scholarship

I. INTRODUCTION

The scholarship is a program owned by institutions, companies, governments engaged in the private sector and the country to be given to learners. The scholarship program can help learners and relieve the burden of parents on the cost of education to follow the process of education of their children. The existence of distributed scholarships can also motivate the learners to improve their ability in learning. In obtaining the scholarship is of course through rules that have been established procedures. The importance of education now has been felt by the wider community, but with the weakening economy, making people more pessimistic whether they will be able to finance and send their sons to a higher education level.

Of course with the existence of scholarships in educational programs that exist in an institution will be able to ease the burden of the responsibility of parents. There are two types of scholarships in this case given to students, Student Learning Assistance Academic Achievement Improvement funded by the government. The authors use the first scholarship as the object of research; the benchmark assessment is seen from the value of GPA, income and dependents parent, student activeness organize.

The process of determining students eligible for a scholarship can be supported by the use of multi-criteria decision-making methods. As has been done in previous research, the selection of the best computer lecturers applies the ELECTRE method [1], the decision support system can also determine the amount of tuition reduction by applying Fuzzy Tsukamoto [2]. The selection of laser cutting process conditions using the preference selection index method leads to the conclusion that the Preference Selection Index method can provide an objective approach in determining the criteria weighting in process selection [3]. R Attri has used a preference selection index in decision making during the design phase of the production system life cycle [4].

II. METHODS AND MATERIAL

2.1 Scholarships

Scholarships are the provision of financial assistance to individuals to being able to be used for the sustainability of the education undertaken. Scholarships can be provided by government agencies, companies or foundations. Scholarships may be categorized as either free or granted with work ties after completion of education.

2.2 Preference Selection Index (PSI)

The Preference Selection Index (PSI) method was developed by Maniya and Bhatt (2010) to solve multi-decision decision criteria (MCDM). In the proposed method it is not necessary to establish the relative importance of the attributes [5]. This method is useful when there is conflict in determining the relative importance of attributes. In the stages the weighted PSI method is determined by the information contained in the decision matrix, with the standard deviation or entropy method can identify the objective criteria weight [6].

Several steps to develop the PSI method:

1. Identify the problem.
   Determine alternatives along with related attributes in decision making.
2. Identify the decision matrix.
   m in the X_{ij} matrix is the number of alternatives for selection and n is the number of attributes. While X_{ij} is the decision matrix of i-th alternative with j-th criterion.

$$X_{ij} = \begin{bmatrix} x11 & x12 & ... & x1n \\ x21 & x22 & ... & x2n \\ \vdots & & & \\ xm1 & xm2 & ... & xmn \end{bmatrix} \quad \text{...........................} (1)$$

3. Normalize the decision matrix.
   The normalized decision matrix is constructed using equations (2) and (3). For equation (2) is an advantage attribute.

$$R_{ij} = \frac{x_{ij}}{x_j^{\max}} \quad \text{...}(2)$$

If the smaller value is better than the other value then use the cost attribute, as in equation (3).

$$R_{ij} = \frac{x_j^{\min}}{x_{ij}} \quad \text{.......................................} (3)$$

4. Determination of the mean value of the normalized matrix

$$N = \frac{1}{N} \sum_{i=1}^{m} R_{ij} \quad \text{..............................}(4)$$

5. Calculates the value of preference variation

In this step, the value of preference variation ($\emptyset j$) or each attribute is determined using the following equation:

$$\emptyset_{j} = \sum_{i=1}^{m} [R_{ij} - N]^2 \quad \text{.................................} (5)$$

6. Determine the deviation of preference value
$$\Omega_j = 1 - \emptyset_j \text{...} (6)$$

7. Determine the criteria weight
$$w_j = \frac{\Omega_j}{\sum_{j=1}^{n} \Omega_j} \text{.....................................} (7)$$

8. Determination the preference selection index

$$\Theta_j = \sum_{j=1}^{m} (R_{ij} W_j) \text{..............................} (8)$$

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

III. RESULTS AND DISCUSSION

In this section, there are six alternatives and five criteria. There can be seen in Table I and IV.

TABLE I
The Criteria and Type of Criteria

Criteria	Type
IPK (C1)	Benefit
Supporting Files (C2)	Benefit
Semester (C3)	Benefit
Parent Earnings (C4)	Cost
Income Statement (C5)	Benefit

Table II and III are the range of values for Supporting File Criteria (C2) and Income Statement (C5)

TABLE II.
Files Supporting (C2)

Information	Value
Complete	100
Less Complete	70
Incomplete	35

TABLE III.
Income Statement (C5)

Information	Value
Available	100
Not Available	50

Table IV, a list of alternatives will be selected.

TABLE IV.
The Alternative

Alternative	Criteria				
	C1	C2	C3	C4	C5
A_1	3.80	Complete	5	2,350,000	Available
A_2	3.80	Less Complete	5	2,100,000	Available
A_3	3.75	Complete	3	1,950,000	Available
A_4	3.90	Complete	5	2,250,000	Not Available
A_5	3.50	Complete	3	2,150,000	Available
A_6	3.60	Complete	5	2,050,000	Available

Based on the table V and the range of values on each criterion, the results obtained from each alternative as follows:

TABLE V
Alternative Match Rating Table and Criteria

Alternative	Criteria				
	C1	C2	C3	C4	C5
A_1	3.80	100	5	2,350,000	100
A_2	3.80	70	5	2,100,000	100
A_3	3.75	100	3	1,950,000	100
A_4	3.90	100	5	2,250,000	50
A_5	3.50	100	3	2,150,000	100
A_6	3.60	100	5	2,050,000	100

After defining alternatives and criteria, then make the X_{ij} decision matrix as below.

$$X_{ij} = \begin{bmatrix} 3.8 & 100 & 5 & 2,350,000 & 100 \\ 3.8 & 70 & 5 & 2,100,000 & 100 \\ 3.75 & 100 & 3 & 1,950,000 & 100 \\ 3.9 & 100 & 5 & 2,250,000 & 50 \\ 3.5 & 100 & 3 & 2,150,000 & 100 \\ 3.6 & 100 & 5 & 2,050,000 & 100 \end{bmatrix}$$

Based on equation 1 above, make the matrix normalized.

$X_{j1}{}^{max} = [3.8, 3.8, 3.75, 3.9, 3.5, 3.6]$

$X_{j1}{}^{max} = 3.9$

$R_{11} = \dfrac{X_{11}}{X_{j1}{}^{max}} = \dfrac{3.8}{3.9} = 0.97$

$R_{21} = \dfrac{X_{21}}{X_{j1}{}^{max}} = \dfrac{3.8}{3.9} = 0.97$

$R_{31} = \dfrac{X_{31}}{X_{j1}{}^{max}} = \dfrac{3.75}{3.9} = 0.96$

$R_{41} = \dfrac{X_{41}}{X_{j1}{}^{max}} = \dfrac{3.9}{3.9} = 1$

$R_{51} = \dfrac{X_{51}}{X_{j1}{}^{max}} = \dfrac{3.5}{3.9} = 0.90$

$R_{61} = \dfrac{X_{61}}{X_{j1}{}^{max}} = \dfrac{3.6}{3.9} = 0.92$

This step is done up to j = 6 and generated the normalized matrix (R_{ij}) below.

$$Rij = \begin{bmatrix} 0.97 & 1.00 & 1.00 & 0.83 & 1.00 \\ 0.97 & 0.70 & 1.00 & 0.93 & 1.00 \\ 0.96 & 1.00 & 0.60 & 1.00 & 1.00 \\ 1.00 & 1.00 & 1.00 & 0.87 & 0.50 \\ 0.90 & 1.00 & 0.60 & 0.91 & 1.00 \\ 0.92 & 1.00 & 1.00 & 0.95 & 1.00 \end{bmatrix}$$

The next step is to find the mean values of the normalized matrix

$N_{j1} = 0.97 + 0.97 + 0.96 + 1.00 + 0.90 + 0.92 = 5.73$
$N_{j2} = 1.00 + 0.70 + 1.00 + 1.00 + 1.00 + 1.00 = 5.70$
$N_{j3} = 1.00 + 1.00 + 0.60 + 1.00 + 0.60 + 1.00 = 5.20$
$N_{j4} = 0.83 + 0.93 + 1.00 + 0.87 + 0.91 + 0.95 = 5.48$
$N_{j5} = 1.00 + 1.00 + 1.00 + 0.50 + 1.00 + 1.00 = 5.50$

The value of $Nj = [\ 5.73 \quad 5.70 \quad 5.20 \quad 5.48 \quad 5.50\ ]$

$N = \frac{1}{6}\sum_{i=1}^{n} N_{j1} = \frac{1}{6}.\ 5.73 = 0.9551$

$N = \frac{1}{6}\sum_{i=1}^{n} N_{j2} = \frac{1}{6}.\ 5.70 = 0.9500$

$N = \frac{1}{6}\sum_{i=1}^{n} N_{j3} = \frac{1}{6}.\ 5.20 = 0.8667$

$N = \frac{1}{6}\sum_{i=1}^{n} N_{j4} = \frac{1}{6}.\ 5.48 = 0.9139$

$N = \frac{1}{6}\sum_{i=1}^{n} N_{j5} = \frac{1}{6}.\ 5.50 = 0.9167$

The next step calculates the value of preference variation.

$\emptyset_{j11} = [0.97 - 0.9551]^2 = 0.0004$
$\emptyset_{j21} = [0.97 - 0.9551]^2 = 0.0004$
$\emptyset_{j31} = [0.96 - 0.9551]^2 = 0.0000$
$\emptyset_{j41} = [1.00 - 0.9551]^2 = 0.0020$
$\emptyset_{j51} = [0.90 - 0.9551]^2 = 0.0033$
$\emptyset_{j61} = [0.92 - 0.9551]^2 = 0.0010$

The above steps are done up to j= 6 and will result

$$\varphi_{ij} = \begin{bmatrix} 0.0004 & 0.0025 & 0.0178 & 0.0071 & 0.0069 \\ 0.0004 & 0.0625 & 0.0178 & 0.0002 & 0.0069 \\ 0.0000 & 0.0025 & 0.0711 & 0.0074 & 0.0069 \\ 0.0020 & 0.0025 & 0.0178 & 0.0022 & 0.1736 \\ 0.0033 & 0.0025 & 0.0711 & 0.0000 & 0.0069 \\ 0.0010 & 0.0025 & 0.0178 & 0.0014 & 0.0069 \end{bmatrix}$$

Then summing the rank results to the matrix $\emptyset_{ij}$

$\sum_{i=1}^{n} = \emptyset_{j11} + \emptyset_{j21} + \emptyset_{j31} + \emptyset_{j41} + \emptyset_{j51} + \emptyset_{j61}$
$\quad = 0.0004+0.0004+0+0.0020+0.0033+0.0010$
$\quad = 0.0071$

$\sum_{i=1}^{n} = \emptyset_{j12} + \emptyset_{j22} + \emptyset_{j32} + \emptyset_{j42} + \emptyset_{j52} + \emptyset_{j62}$
$\quad = 0.0025+0.0625+0.0025+0.0025+0.0025+0.0025$
$\quad = 0.0750$

$\sum_{i=1}^{n} = \emptyset_{j13} + \emptyset_{j23} + \emptyset_{j33} + \emptyset_{j43} + \emptyset_{j53} + \emptyset_{j63}$
$\quad = 0.0178+0.0178+0.0711+0.0178+0.0711+0.0178$
$\quad = 0.2133$

$\sum_{i=1}^{n} = \emptyset_{j14} + \emptyset_{j24} + \emptyset_{j34} + \emptyset_{j44} + \emptyset_{j54} + \emptyset_{j64}$
$\quad = 0.0071+0.0002+0.0074+0.0022+0+0.0014$
$\quad = 0.0184$

$\sum_{i=1}^{n} = \emptyset_{j15} + \emptyset_{j25} + \emptyset_{j35} + \emptyset_{j45} + \emptyset_{j55} + \emptyset_{j65}$
$\quad = 0.0069+0.0069+0.0069+0.1736+0.0069+0.0069$
$\quad = 0.2083$

$\emptyset_j = [\ 0.0071\ \ 0.0750\ \ 0.2133\ \ 0.0184\ \ 0.2083\ ]$

The next step determines the deviation in the preference value.

$\Omega_{j1} = 1 - 0.0071 = 0.9929$
$\Omega_{j2} = 1 - 0.0750 = 0.9250$
$\Omega_{j3} = 1 - 0.2133 = 0.7867$
$\Omega_{j4} = 1 - 0.0184 = 0.9816$
$\Omega_{j5} = 1 - 0.2083 = 0.7917$

Then calculate the total overall value on deviation Ω_j

$\sum \Omega_j = 0.9929+0.9250+0.7867+0.9816+0.7917 = 4.4778$

After the total deviation value is known, then look for the weight of each criterion.

$w_1 = \frac{0.9929}{4.4778} = 0.2217$
$w_2 = \frac{0.9250}{4.4778} = 0.2066$
$w_3 = \frac{0.7867}{4.4778} = 0.1757$
$w_4 = \frac{0.9816}{4.4778} = 0.2192$
$w_5 = \frac{0.7917}{4.4778} = 0.1768$

$w = [\ 0.2217\ \ 0.2066\ \ 0.1757\ \ 0.2192\ \ 0.1768\ ]$

The last step then calculates the selection index preference value using equation 8.

$\Theta_1 = 0.21604+0.20657+0.17568+0.18191+0.17680 = 0.95700$
$\Theta_2 = 0.21604+0.14460+0.17568+0.20356+0.17680 = 0.91668$
$\Theta_3 = 0.21320+0.20657+0.10541+0.21922+0.17680 = 0.92120$
$\Theta_4 = 0.22173+0.20657+0.17568+0.18999+0.08840 = 0.88237$
$\Theta_5 = 0.19899+0.20657+0.10541+0.19883+0.17680 = 0.88659$
$\Theta_6 = 0.20467+0.20657+0.17568+0.20853+0.17680 = 0.97225$

The final result of the calculation can be seen in the following table VI.

TABLE VI
Result

Alternative	Value of PSI	Rank
A_1	0.95700	2
A_2	0.91668	4
A_3	0.92120	3
A_4	0.88237	6
A_5	0.88659	5
A_6	0.97225	1

From the calculations, it is clear that $A_6 > A_1 > A_3 > A_2 > A_5 > A_4$ and Alternative A_6 are the best alternative of all available alternatives.

IV. CONCLUSION

The use of the Preference Selection Index method can provide the selection to the scholarship students more selectively. The ease with which the PSI method provides convenience to the decision maker without assigning a weighted value to each criterion to avoid the relative importance of each criterion.

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