Application of the MOORA Method for Decision Making in Receiver Foundation Scholarship in AMIK Tunas Bangsa

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Abstract. Foundation scholarship is scholarship whose fund comes from AMIK Tunas Bangsa Foundation and given for student achievement and poor, which aims to prevent collage drop outs for students. Foundation scholarship are given to students achievement and poor, but they dont get scholarship from any source. The criteria used in determining the foundation scholarship recipients are GPA, parents income and the number of dependents. The method applied in determining the foundation scholarship recipients is the MOORA (multi objective optimization on the basis of ratio analysis) method. The MOORA method will produce the exact ranked in determining the foundation scholarship recipients, simple calculation so it is easier to understand and use.

1. Introducing

Scholarship is the provision of assistance to individuals in the form of funds used for the continuity of education. In AMIK Tunas Bangsa, besides scholarships from the government, foundation scholarship is also given to students achievement and poor. Foundation scholarship is scholarship that comes from AMIK Tunas Bangsa foundation.

According to Shankar Chakraborty that decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker [1]. To produce objective decisions in determining scholarship recipients, then used decision support. According to Monisha. A, S. Shalin Christina and Nirmala Santiago that a decision support system (DSS) is an information system that provides support indecision-making activities. DSSs help people make decisions about unstructured problems [2].

In this research, the MOORA method was used to provide recommendations for recipients of foundation scholarship. The MOORA method was first introduced by Willem Karel M. Brauers and Edmundas Kazimieras Zavadskas in their research entitled The MOORA method and its application to privatization in a transition economy [3]. The MOORA method has simpler calculation compared to other decision support system methods. According to Mandal and Sakar in their research that MOORA is the best method compared to other methods [4]. According to Prasad Krande and Shankar Chakraborty [5] that MOORA can rank the material alternatives more precisely, without being influenced by the criteria weights and normalization procedure.
2. Methodology

2.1. Data Used
Sample data used in this research is 10 students of AMIK Tunas Bangsa Pematangsiantar. The following is a sample data:

| No | NIM             | Name               | GPA | Parent’s Income (Inmillion) | The Number of Dependents |
|----|-----------------|--------------------|-----|------------------------------|--------------------------|
| 1  | 201701030082    | Abdullah Ahmad     | 3.91| 3.5                          | 4                        |
| 2  | 201701030096    | Dyah Ayu Safitri   | 3.73| 3                            | 3                        |
| 3  | 201701030031    | Sri Wulandika      | 3.68| 2                            | 2                        |
| 4  | 201701030050    | Frendy Sisko Simbolon | 3.64| 2                            | 3                        |
| 5  | 201701030041    | Alvin Sijabat      | 3.59| 2                            | 3                        |
| 6  | 201701030065    | Nurannisa Pulungan | 3.55| 2.5                          | 2                        |
| 7  | 201701030026    | Pipit Mutiara Dewi | 3.55| 2.7                          | 2                        |
| 8  | 201701030027    | Rika Asma Dewi     | 3.55| 1.2                          | 2                        |
| 9  | 201701030008    | Devi Monika        | 3.55| 1.3                          | 2                        |
| 10 | 201701030013    | Enjelica Rumapea   | 3.5 | 2.3                          | 3                        |

2.2. Flowchart Research
The MOORA method consists of four stages [3][6][7][8]:

![Flowchart](image)

Figure 1. Flowchart Research

Figure 1 shows the flowchart of MOORA. Raw data form the basis of a Response Matrix with objectives, criteria or indicators as columns and alternatives or projects as rows [7]. The method starts with a matrix of responses of all alternatives solution on all objectives [8]. The next step is ratio system. In this steps are calculate ratio and calculate optimization. This ratio system ranks the results in a descending order [7]. Reference point approach will done if we choose this method. If it is enough with the ratio system method, then this step can be skipped. The selection of reference point is done by selecting the ratio of the largest benefit type and the lowest ratio value of the type of cost [3]. Then, the distance between the value of the ratio in each alternative attribute to the reference point is measured using tchebycheff min-max metric [9]. The next step is an alternative ranking which will later produce recommendation data.
3. Results and Discussion

Student data consisting of student names and scholarship recipient criteria are processed by the MOORA method to produce recommendations for foundation scholarships. The stages are:

3.1. Matrix Of Responses

In making the matrix of responses, first define the criterias. Criteria are grouped into benefit (+) or cost (-).

| Criteria ID | Criteria Name                      | Criteria Type |
|-------------|-----------------------------------|---------------|
| C1          | GPA                               | Benefit       |
| C2          | PARENT’S INCOME                   | Cost          |
| C3          | THE NUMBER OF DEPENDENTS          | Benefit       |

Then make a matrix of the sample data values contained in table 1.

\[
\begin{bmatrix}
3.91 & 3.5 & 4 \\
3.73 & 3 & 3 \\
3.68 & 2 & 2 \\
3.64 & 2 & 3 \\
3.59 & 2 & 3 \\
3.55 & 2.5 & 2 \\
3.55 & 2.7 & 2 \\
3.55 & 1.2 & 2 \\
3.55 & 1.3 & 2 \\
3.5 & 2.3 & 3
\end{bmatrix}
\]

Figure 2. Matrix Of Responses

3.2. Ratio System

Brauers et al [6] concluded that for the denominator, the best choice is the square root of the sum of squares of each alternative per attribute.

a. Normalization of the matrix in column 1

\[
X^*_{11} = \frac{3.91}{\sqrt{3.91^2 + 3.73^2 + 3.68^2 + 3.64^2 + 3.59^2 + 3.55^2 + 3.55^2 + 3.55^2 + 3.5^2}} = \frac{3.91}{11.468} = 0.341
\]

\[
X^*_{21} = \frac{3.73}{11.468} = 0.325
\]

\[
X^*_{31} = \frac{3.68}{11.468} = 0.321
\]

\[
X^*_{41} = \frac{3.64}{11.468} = 0.317
\]

\[
X^*_{51} = \frac{3.59}{11.468} = 0.313
\]

\[
X^*_{61} = \frac{3.55}{11.468} = 0.309
\]

\[
X^*_{71} = \frac{3.55}{11.468} = 0.309
\]

\[
X^*_{81} = \frac{3.55}{11.468} = 0.309
\]
X*_{91} = \frac{3.55}{11.468} = 0.309 \\
X*_{101} = \frac{3.5}{11.468} = 0.305 \\

b. Normalization of the matrix in column 2

\[
\begin{align*}
X*_{12} &= \frac{\sqrt{3.5^2 + 3^2 + 2^2 + 2^2 + 2^2 + 2.5^2 + 2.7^2 + 1.2^2 + 1.3^2 + 2.3^2}}{3.5/7.43} = 0.47 \\
X*_{22} &= \frac{3}{7.43} = 0.40 \\
X*_{32} &= \frac{2}{7.43} = 0.27 \\
X*_{42} &= \frac{2}{7.43} = 0.27 \\
X*_{52} &= \frac{2}{7.43} = 0.27 \\
X*_{62} &= \frac{2.5}{7.43} = 0.34 \\
X*_{72} &= \frac{2.7}{7.43} = 0.36 \\
X*_{82} &= \frac{1.2}{7.43} = 0.16 \\
X*_{92} &= \frac{1.3}{7.43} = 0.17 \\
X*_{102} &= \frac{2.3}{7.43} = 0.31 \\
\end{align*}
\]

c. Normalization of the matrix in column 3

\[
\begin{align*}
X*_{13} &= \frac{\sqrt{4^2 + 3^2 + 2^2 + 3^2 + 3^2 + 2^2 + 2^2 + 2^2 + 2^2 + 3^2}}{4/8.49} = 0.47 \\
X*_{23} &= \frac{3}{8.49} = 0.35 \\
X*_{33} &= \frac{2}{8.49} = 0.24 \\
X*_{43} &= \frac{3}{8.49} = 0.35 \\
X*_{53} &= \frac{3}{8.49} = 0.35 \\
X*_{63} &= \frac{2}{8.49} = 0.24 \\
X*_{73} &= \frac{2}{8.49} = 0.24 \\
X*_{83} &= \frac{2}{8.49} = 0.24 \\
X*_{93} &= \frac{2}{8.49} = 0.24 \\
X*_{103} &= \frac{3}{8.49} = 0.35 \\
\end{align*}
\]

The following is the result of the MOORA normalization matrix:

\[
\begin{bmatrix}
0.341 & 0.47 & 0.47 \\
0.325 & 0.40 & 0.35 \\
0.321 & 0.27 & 0.24 \\
0.317 & 0.27 & 0.35 \\
0.313 & 0.27 & 0.35 \\
0.309 & 0.34 & 0.24 \\
0.309 & 0.36 & 0.24 \\
0.309 & 0.16 & 0.24 \\
0.309 & 0.17 & 0.24 \\
0.305 & 0.31 & 0.35 \\
\end{bmatrix}
\]

**Figure 3. Matrix Of Normalisasi**
3.3. Reference Point Approach

For multi-objective optimization, the normalization value of the benefit type minus the normalization value of the type of cost.

\[
Y_1 = (0.341+ 0.47) – 0.47 = 0.341 \\
Y_2 = (0.325+ 0.35) – 0.40 = 0.275 \\
Y_3 = (0.321+ 0.24) – 0.27 = 0.291 \\
Y_4 = (0.317+ 0.35) – 0.27 = 0.397 \\
Y_5 = (0.309+ 0.24) – 0.31 = 0.345 \\
Y_6 = (0.309+ 0.24) – 0.36 = 0.189 \\
Y_7 = (0.309+ 0.24) – 0.16 = 0.389 \\
Y_8 = (0.309+ 0.24) – 0.17 = 0.379 \\
Y_9 = (0.309+ 0.24) – 0.34 = 0.209 \\
Y_{10} = (0.309+ 0.24) – 0.36 = 0.189
\]

3.4. Ranking An Alternatives

The best alternative has the highest value and otherwise the worst alternative has the lowest value.

Table 3. Ranking An Alternatives

| No | Name                | GPA | Parent’s Income (in Million) | The number of dependents | Ranking |
|----|---------------------|-----|-------------------------------|--------------------------|---------|
| 1  | Abdullah Ahmad      | 3.91| 3.5                           | 4                        | 6       |
| 2  | Dyah Ayu Safitri    | 3.73| 2                             | 3                        | 8       |
| 3  | Sri Wulandika       | 3.68| 2                             | 2                        | 7       |
| 4  | Frendy Sisko Simbolon | 3.64| 2                             | 3                        | 1       |
| 5  | Alvin Sijabat       | 3.59| 2                             | 3                        | 2       |
| 6  | Nurannisa Pulungan  | 3.55| 2.5                           | 2                        | 9       |
| 7  | Pipit Mutiara Dewi | 3.55| 2.7                           | 2                        | 10      |
| 8  | Rika Asma Dewi      | 3.55| 1.2                           | 2                        | 3       |
| 9  | Devi Monika         | 3.55| 1.3                           | 2                        | 4       |
| 10 | Enjelica Rumapea    | 3.5 | 2.3                           | 3                        | 5       |

4. Conclusion

The conclusions that can be drawn from this research are:

a. The use of the MOORA method can provide the solution in providing objective recipient recommendation.

b. Calculation with the MOORA method are simpler and easier to understand.

c. The result of the MOORA calculation are more appropriate.

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