APPLICATION OF TOPSIS METHOD FOR DETERMINATION OF ENGLISH COURSE INSTITUTION

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Abstract: English course institutions are one of the most sought after non-formal education places to learn and improve English language skills, especially to be able to master the TOEFL well. To choose a suitable course institution, that is by visiting the respective course places. Of course, things like this take a lot of time, effort, and money. For this reason, a decision support system is needed that can provide recommendations for the best course institutions using the TOPSIS method. The data used are 18 alternatives with criteria including course fees, number of facilities, length of study hours, instructor's TOEFL, and distance from the course. The calculation results provide a recommendation that the alternative A Class IBT is the best English course institution.

Keywords: English Course; Decision Support System; TOPSIS

INTRODUCTION

English is used as an introduction in communicating between nations. With the implementation of English as an international language, people will tend to want to learn English so that they do not lose in international competition. Many people try to learn and master in their own way. Thus, English course institutions are an option for places to study and improve English language skills.

In the city of Pekanbaru, there are several English language courses that provide TOEFL, IELTS and TOEIC programs. To choose the appropriate course institutions, that is by visiting the respective course places. Of course, this kind of thing takes a lot of time, effort, and money. For this reason, a decision support
system is needed that is useful in determining the best course institution. Decision support system (DSS) is a tool that can help make decisions based on certain parameters or to assess certain objects so that ranking can be done to get the best object [1].

Previous studies using the TOPSIS method, namely, DSS for prospective teachers [2], DSS for the best employee [3], and DSS for elective courses [4].

While the research that applies the TOPSIS method, among others, is the selection of flat screen TV's [5], the study program selection [6], to determine book publisher [7], to landfills [8], and social media selection [9]. Furthermore, another DSS researches are to provide loans [10], service quality with SMART [11], to determining the selection of majors with the PROMETHEE method [12], and to determining the plot of the tomb with SAW [13].

The purpose of the research is to build a system as a recommendation for a TOEFL English course institution that will be selected using the TOP-SIS method.

METHOD

Data Collection Technique

The data were obtained through interviews at the TOEFL venue in Pekanbaru City, so that the data obtained were as in table 1, table 2, and table 3.

| No | Alternative | TOEFL Name |
|----|-------------|------------|
| 1  | P           | Class 1 Regular |
|    |             | Class 2 Regular |
|    |             | Class 3 Regular |
|    |             | Class 4 Regular |
|    |             | Class 1 Special |
|    |             | Class 2 Special |
|    |             | Class 3 Special |
|    |             | Class 4 Special |
|    |             | Class IBT     |
| 2  | A           | Class 1 Regular |
|    |             | Class 2 Regular |
|    |             | Class 3 Regular |
|    |             | Class 4 Regular |
|    |             | Class 1 Special |
|    |             | Class 2 Special |
|    |             | Class 3 Special |
|    |             | Class 4 Special |
|    |             | Class IBT     |

Table 3. Criteria and Sub-Criteria

| Criteria | Sub-Criteria | Value |
|----------|--------------|-------|
| K1       | > 5.000.000  | 5     |
|          | 4.000.000 - 5.000.000 | 4     |
|          | 3.000.000 - 3.999.999 | 3     |
|          | 2.000.000 - 2.999.999 | 2     |
|          | < 2.000.000  | 1     |
| K2       | > 11         | 5     |
|          | 8 – 11       | 4     |
|          | 5 – 7,9      | 3     |
|          | 3 – 4,9      | 2     |
|          | < 3          | 1     |
| K3       | > 50         | 5     |
|          | 40 – 50      | 4     |
|          | 30 – 39,9    | 3     |
|          | 20 – 29,9    | 2     |
|          | < 20         | 1     |
| K4       | > 560        | 5     |
|          | 540 – 560    | 4     |
|          | 520 – 539,9  | 3     |
|          | 500 – 519,9  | 2     |
|          | < 500        | 1     |
| K5       | > 9          | 5     |
|          | 7 – 9        | 4     |
|          | 4 – 6,9      | 3     |
|          | 1 – 3,9      | 2     |
|          | < 1          | 1     |
Furthermore, the types of criteria are as seen in Table 4.

| Symbol | Type        | Weight |
|--------|-------------|--------|
| K₁     | Biaya       | 5      |
| K₂     | Keuntungan  | 4      |
| K₃     | Keuntungan  | 3      |
| K₄     | Keuntungan  | 2      |
| K₅     | Biaya       | 1      |

### Method of TOPSIS

The TOPSIS method is a method in which the chosen alternative not only has the shortest distance from a positive solution, but also has the longest distance from a negative solution [14]. The calculation of TOPSIS method ([15], [16], [17]):

1) Develop a normalized decision matrix:

\[ r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x_{ij}^2}} \]  

where \( i : 1, 2, ..., m; j : 1, 2, ..., n; r_{ij} : \) normalization matrix [\( i \)[\( j \)]; \( x_{ij} : \) decision matrix [\( i \)[\( j \)].

2) Compile the weight normalization matrix:

\[ y_{ij} = w_j r_{ij} \]  

where \( w_j : \) weight of criteria \( y_{ij} : \) decision weight normalization matrix.

3) Solution matrix:

\[ A^+ = (y_{1^+}, y_{2^+}, ..., y_{p^+}) \]  
\[ A^- = (y_{1^-}, y_{2^-}, ..., y_{p^-}) \]

where \( y_{j^+} \) and \( y_{j^-} \) are:

\[ y_{j^+} = \begin{cases} \max \; y_{ij} \; \text{jika} \; j = \text{benefit} \\ \min \; y_{ij} \; \text{jika} \; j = \text{cost} \end{cases} \] \( y_{j^-} = \begin{cases} \min \; y_{ij} \; \text{jika} \; j = \text{benefit} \\ \max \; y_{ij} \; \text{jika} \; j = \text{cost} \end{cases} \)  

If the criteria is benefit, then:

\[ y_{j^+} = \max \; y_{ij} \; \text{and} \; y_{j^-} = \min \; y_{ij} \]

and if criteria is cost, then:

\[ y_{j^+} = \min \; y_{ij} \; \text{and} \; y_{j^-} = \max \; y_{ij} \]

4) Calculating distance

- Solution is positive:

\[ d_i^+ = \sqrt{\sum_{j=1}^{m} (y_{j^+} - y_{ij})^2} \]  

where \( d_i^+ : \) alternative distance; \( y_{j^+} : \) solution of positive [\( i \)]; \( y_{ij} : \) normalization weight matrix [\( i \)[\( j \)].

- Solution of negative:

\[ d_i^- = \sqrt{\sum_{j=1}^{m} (y_{j^-} - y_{ij})^2} \]  

where \( d_i^- : \) alternative distance; \( y_{j^-} : \) solution of negative [\( i \)].

5) Calculating of preferences:

\[ v_i = \frac{d_i^-}{d_i^- + d_i^+} \]  

where \( v_i : \) preference value

6) The ranking, the largest value of \( v_i \) is the best alternative of \( A_i \).

### Implementasi Sistem

Implementasi menggunakan bahasa pemrograman PHP dan HTML serta database dengan MySQL.

### RESULTS AND DISCUSSION

#### Data Processing

TOEFL course institution data is given in Table 5.
Table 5. Alternative and Criteria TOEFL

| No | Alternative          | Criteria |
|----|----------------------|----------|
|    |                      | $K_1$ | $K_2$ | $K_3$ | $K_4$ | $K_5$ |
| 1  | P Class 1 Regular    | 1.050 | 7     | 14    | 530   | < 1   |
| 2  | P Class 1 Special    | 1.472 | 8     | 14    | 530   | < 1   |
| 3  | P Class 2 Regular    | 1.750 | 7     | 30    | 530   | < 1   |
| 4  | P Class 2 Special    | 3.040 | 8     | 30    | 530   | < 1   |
| 5  | P Class 3 Regular    | 1.750 | 7     | 30    | 530   | < 1   |
| 6  | P Class 3 Special    | 3.040 | 8     | 30    | 530   | < 1   |
| 7  | P Class 4 Regular    | 1.670 | 7     | 24    | 530   | < 1   |
| 8  | P Class 4 Special    | 2.352 | 8     | 24    | 530   | < 1   |
| 9  | P Class IBT          | 4.420 | 8     | 32    | 530   | < 1   |
| 10 | A Class 1 Regular    | 1.050 | 7     | 14    | 530   | 8     |
| 11 | A Class 1 Special    | 1.472 | 8     | 14    | 530   | 8     |
| 12 | A Class 2 Regular    | 1.750 | 7     | 30    | 530   | 8     |
| 13 | A Class 2 Special    | 3.040 | 8     | 30    | 530   | 8     |
| 14 | A Class 3 Regular    | 1.750 | 7     | 30    | 530   | 8     |
| 15 | A Class 3 Special    | 3.040 | 8     | 30    | 530   | 8     |
| 16 | A Class 4 Regular    | 1.670 | 7     | 24    | 530   | 8     |
| 17 | A Class 4 Special    | 2.352 | 8     | 24    | 530   | 8     |
| 18 | A Class IBT          | 4.420 | 8     | 32    | 530   | 8     |

Furthermore, from table 5 and table 3, the match rating data is obtained as table 6.

Table 6. Match Rating

| No | Alternative      | Kriteria |
|----|------------------|----------|
|    |                  | $K_1$ | $K_2$ | $K_3$ | $K_4$ | $K_5$ |
| 1  | P Class 1 Regular| 1     | 3     | 1     | 3     | 1     |
| 2  | P Class 1 Special| 2     | 1     | 4     | 1     | 3     |
| 3  | P Class 2 Regular| 1     | 3     | 3     | 3     | 1     |
| 4  | P Class 2 Special| 3     | 4     | 3     | 3     | 1     |
| 5  | P Class 3 Regular| 1     | 3     | 3     | 3     | 1     |
| 6  | P Class 3 Special| 3     | 4     | 3     | 3     | 1     |
| 7  | P Class 4 Regular| 1     | 3     | 3     | 3     | 4     |
| 8  | P Class 4 Special| 2     | 4     | 2     | 3     | 1     |
| 9  | P Class IBT      | 4     | 4     | 3     | 3     | 1     |
| 10 | A Class 1 Regular| 1     | 3     | 1     | 3     | 4     |
| 11 | A Class 1 Special| 1     | 4     | 1     | 3     | 4     |
| 12 | A Class 2 Regular| 1     | 3     | 3     | 3     | 4     |
| 13 | A Class 2 Special| 3     | 4     | 3     | 3     | 4     |
| 14 | A Class 3 Regular| 1     | 3     | 3     | 3     | 4     |
| 15 | A Class 3 Special| 3     | 4     | 3     | 3     | 4     |
| 16 | A Class 4 Regular| 1     | 3     | 2     | 3     | 4     |
| 17 | A Class 4 Special| 2     | 4     | 2     | 3     | 4     |
| 18 | A Class IBT      | 4     | 4     | 3     | 3     | 4     |

Calculating TOPSIS Method

The calculation using the TOPSIS method is:

1) Develop a normalized matrix $r$.

From table 6 and eq. (1), we obtain:

$$ r_{11} = \frac{1}{\sqrt{1^2 + 1^2 + \ldots + r^2}} = 0.1240 $$
$$ r_{21} = 0.1240; r_{31} = 0.1240; \ldots; $$
$$ r_{181} = 0.4961 $$

With table 6 and eq. (1), we obtain $r_{ij}$, and matrix $R$:

$$ R = \begin{pmatrix}
0.1240 & 0.2171 & 0.1037 & 0.2502 & 0.0976 \\
0.1240 & 0.2894 & 0.1037 & 0.2582 & 0.0976 \\
0.1240 & 0.2171 & 0.3111 & 0.2582 & 0.0976 \\
0.3721 & 0.2894 & 0.3111 & 0.2582 & 0.0976 \\
0.1240 & 0.2171 & 0.3111 & 0.2582 & 0.0976 \\
0.1240 & 0.2894 & 0.3111 & 0.2582 & 0.0976 \\
0.1240 & 0.2171 & 0.2074 & 0.2582 & 0.0976 \\
0.2481 & 0.2894 & 0.2074 & 0.2582 & 0.0976 \\
0.4961 & 0.2894 & 0.3111 & 0.2582 & 0.0976 \\
0.1240 & 0.2171 & 0.2074 & 0.2582 & 0.3904 \\
0.1240 & 0.2894 & 0.2074 & 0.2582 & 0.3904 \\
0.1240 & 0.2171 & 0.3111 & 0.2582 & 0.3904 \\
0.3721 & 0.2894 & 0.3111 & 0.2582 & 0.3904 \\
0.1240 & 0.2171 & 0.3111 & 0.2582 & 0.3904 \\
0.1240 & 0.2894 & 0.3111 & 0.2582 & 0.3904 \\
0.2481 & 0.2894 & 0.2074 & 0.2582 & 0.3904 \\
0.4961 & 0.2894 & 0.3111 & 0.2582 & 0.3904
\end{pmatrix} $$

$$ r = \begin{pmatrix}
0.1240 & 0.2171 & 0.2074 & 0.2582 & 0.3904 \\
0.1240 & 0.2894 & 0.2074 & 0.2582 & 0.3904 \\
0.1240 & 0.2171 & 0.3111 & 0.2582 & 0.3904 \\
0.3721 & 0.2894 & 0.3111 & 0.2582 & 0.3904 \\
0.1240 & 0.2171 & 0.3111 & 0.2582 & 0.3904 \\
0.1240 & 0.2894 & 0.3111 & 0.2582 & 0.3904 \\
0.1240 & 0.2171 & 0.2074 & 0.2582 & 0.3904 \\
0.2481 & 0.2894 & 0.2074 & 0.2582 & 0.3904 \\
0.4961 & 0.2894 & 0.3111 & 0.2582 & 0.3904
\end{pmatrix} $$

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2) Compile the weight normalization matrix. Using eq. (2), table 4, and matrix \( r \), we obtain:

\[ y_{11} = 1 \times 0.1240 = 0.1240 \]
\[ y_{21} = 1 \times 0.1240 = 0.1240 \]
\[ y_{31} = 0.1240; \ y_{41} = 1.1163; \]

... \[ y_{181} = 1.9846 \]

so that we obtain \( y_{ij} \) and matrix \( y \):

\[
\begin{bmatrix}
0.1240 & 0.6512 & 0.1037 & 0.7746 & 0.0976 \\
0.1240 & 1.1577 & 0.1037 & 0.7746 & 0.0976 \\
0.1240 & 0.6512 & 0.9333 & 0.7746 & 0.0976 \\
0.1240 & 0.6512 & 0.9333 & 0.7746 & 0.0976 \\
1.1163 & 1.1577 & 0.9333 & 0.7746 & 0.0976 \\
0.1240 & 0.6512 & 0.9333 & 0.7746 & 0.0976 \\
0.1240 & 0.6512 & 0.1418 & 0.7746 & 0.0976 \\
0.4961 & 1.1577 & 0.1418 & 0.7746 & 0.0976 \\
0.1240 & 0.6512 & 0.1418 & 0.7746 & 1.5614 \\
0.1240 & 1.1577 & 0.1418 & 0.7746 & 1.5614 \\
0.1240 & 0.6512 & 0.9333 & 0.7746 & 1.5614 \\
1.1163 & 1.1577 & 0.9333 & 0.7746 & 1.5614 \\
0.1240 & 0.6512 & 0.9333 & 0.7746 & 1.5614 \\
0.1240 & 0.6512 & 0.1418 & 0.7746 & 1.5614 \\
0.4961 & 1.1577 & 0.1418 & 0.7746 & 1.5614 \\
1.9846 & 1.1577 & 0.9333 & 0.7746 & 1.5614 \\
\end{bmatrix}
\]

3) Solution matrix

- **Solution of positive \( (A^+) \)**
  Using matrix \( y \) and eq. (5) we obtain
  \[ y_1^+ = \max (0.1240; \ 0.1240; \ 0.1240; \ 1.1163; \ 0.1240; \ 0.1240; \ 0.4961; \ 1.9846; \ 0.1240; \ 0.1240; \ 0.1240; \ 1.1163; \ 0.1240; \ 0.4961; \ 1.9861) = 0.1240 \]
  \[ y_2^+ = 0.6512; \ y_3^+ = 0.1037; \ y_4^+ = 0.7746; \ y_5^+ = 0.0976 \]
  Using eq. (3) we obtain
  \[ A^+ = (1.9846; \ 1.1577; \ 0.9333; \ 0.7746; \ 1.5614) \]

- **Solution of negative \( (A^-) \)**
  In the same way and eq. (6) we obtain
  \[ y_1^- = \min (0.1240; \ 0.1240; \ 0.1240; \ 1.1163; \ 0.1240; \ 0.1240; \ 0.4961; \ 1.9846; \ 0.1240; \ 0.1240; \]

4) Calculating distance

- **Solution of positive**
  Using matrix \( y \), \( A^+ \) and eq. (7) we obtain
  \[ d_1^+ = \sqrt{(1.9846 - 0.1240)^2} \ + \cdots + \sqrt{(1.5614 - 0.0976)^2} = 2.5591 \]

  \[ d_2^+ = 2.5085; \ d_3^+ = 2.4209; \]

- **Solution of negative**
  Using matrix \( y \), \( A^- \) and eq. (8) we obtain
  \[ d_1^- = \sqrt{(0.1240 - 0.1240)^2} + \cdots + \sqrt{(0.0976 - 0.0976)^2} = 0.0000 \]

  \[ d_2^- = 0.5065; \ d_3^- = 0.8296; \]

...
5) Calculating of preferences
Using \( d^+_i, d^-_i \) and eq. (9), we obtain
\[
\begin{align*}
\nu_1 &= \frac{0.0000}{0.0000 + 2.5591} = 0.0000 \\
\nu_2 &= 0.1680; \\
\nu_3 &= 0.2552; \\
\nu_4 &= 0.4494; \\
\nu_5 &= 0.2552; \\
\nu_6 &= 0.4494; \\
\nu_7 &= 0.1116; \\
\nu_8 &= 0.2459; \\
\nu_9 &= 0.5891; \\
\nu_{10} &= 0.4109; \\
\nu_{11} &= 0.4319; \\
\nu_{12} &= 0.4660; \\
\nu_{13} &= 0.6992; \\
\nu_{14} &= 0.4660; \\
\nu_{15} &= 0.6992; \\
\nu_{16} &= 0.4284; \\
\nu_{17} &= 0.5073; \\
\nu_{18} &= 1.0000
\end{align*}
\]

The preference value \( \nu_i \) are in table 7.

| No | Alternative          | Preference |
|----|----------------------|------------|
| 1  | P Class 1 Regular    | 0.0000     |
| 2  | P Class 1 Special    | 0.1680     |
| 3  | P Class 2 Regular    | 0.2552     |
| 4  | P Class 2 Special    | 0.4494     |
| 5  | P Class 3 Regular    | 0.2552     |
| 6  | P Class 3 Special    | 0.4494     |
| 7  | P Class 4 Regular    | 0.1116     |
| 8  | P Class 4 Special    | 0.2459     |
| 9  | P Class IBT          | 0.5891     |
| 10 | A Class 1 Regular    | 0.4109     |
| 11 | A Class 1 Special    | 0.4319     |
| 12 | A Class 2 Regular    | 0.4660     |
| 13 | A Class 2 Special    | 0.6992     |
| 14 | A Class 3 Regular    | 0.4660     |
| 15 | A Class 3 Special    | 0.6992     |
| 16 | A Class 4 Regular    | 0.4284     |
| 17 | A Class 4 Special    | 0.5073     |
| 18 | A Class IBT          | 1.0000     |

6) The ranking
Using table 7, which is sorted from the largest value to the smallest, the ranking is obtained as table 8.

| No | Alternatif   | Preferensi |
|----|--------------|------------|
| 1  | A Class IBT  | 1.0000     |
| 2  | A Class 2 Special | 0.6992 |
| 3  | A Class 3 Special | 0.6992 |
| 4  | P Class IBT  | 0.5891     |
| 5  | A Class 4 Special | 0.5073 |
| 6  | A Class 2 Regular | 0.4660 |
| 7  | A Class 3 Regular | 0.4660 |
| 8  | P Class 2 Special | 0.4494 |
| 9  | P Class 3 Special | 0.4494 |
| 10 | A Class 1 Special | 0.4319 |
| 11 | A Class 4 Regular | 0.4284 |
| 12 | A Class 1 Regular | 0.4109 |
| 13 | P Class 2 Regular | 0.2552 |
| 14 | P Class 3 Regular | 0.2552 |
| 15 | P Class 4 Special | 0.2459 |
| 16 | P Class 1 Special | 0.1680 |
| 17 | P Class 4 Regular | 0.1116 |
| 18 | P Class 1 Regular | 0.0000 |

From Table 7 can recommend that the best English course institution is A Class IBT.

**Display of System**

Display system consists of:
1) Criteria page, admin manages criteria data, namely adding, changing, and deleting, see Image 1.
2) Course page, describes the admin page to add or delete course data, see Image 2.

CONCLUSION

The TOPSIS method can be applied to the DSS for determining the English language course institution. The results of calculations with 18 alternative data, the system provides recommendations, namely alternative A Class IBT is the best English language institution.

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