

2nd Cyprus International Conference on Educational Research, (CY-ICER 2013)

Practice Over The Private Teaching Institutions Selection Problem In One Of Secondary Schools With Using Multiple Attribute Decision Making Method Of Topsis

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Abstract

Decision-making is the most faced problem in our daily life. In every moment of our life we have to decide over lots of different matters. Those matters can be simple or detailed. We can decide over simple ones with our mind, but we have to use decision-making methods when solving the detailed ones. In this studies, when solving the problem TOPSIS methods is used.

The aim of study is to research thoroughly of special course selection problem of students who study at secondary schools in one of our cities and also to determine the difficulties that they come across in university preparation period. In this study, multiple attribute decision making over of our secondary schools is mentioned.

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Selection and/or peer-review under responsibility of Prof. Dr. Huseyin Uzunboylu, Near East University, Faculty of Education, Cyprus

Keywords: TOPSIS, Decision Making, Private Teaching Institution;

1-Introduction

Educating in higher education is perceived as a necessity in our country. Due to limitations in the education system, Students is directed Private Teaching Institution. Students that studying at the high school level gain to exam with special education courses that ratio is greater than working at preparatory courses.

Private Teaching Institution with a history of about 30-35 years today expanded and increased in numbers as well as their service areas. This well has increased competition between them. Private Teaching Institution are in a great effort to attract successful students particularly. Selection of Students in teaching institutions, it became difficult to decide.

Decision-making process, under the condition of ensuring the desired criteria in alternatives to determine the most appropriate decision process. Similarly, the decision-making process to analyse complex issues and all the detection power issues, generalize of the systematic thinking in decision stages, enable strategic planning, create a

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common platform for participation and to provide a solution that is used to facilitate communication can be defined as a method.

Multi-criteria decision making, decision-making, depending on the state of a set of decision-maker to decide the best decision-making, in other words, a decision-maker considered a number of options that include a set of finite or in the process of his choice using at least two characters (Organ, Kenger, 2012:121)

Multiple criteria decision analysis (MCDA) or Multiple – criteria decision making (MCDM) is sub-discipline and full-grown branch of operation research that is concerned with designing mathematical and computational tools to support the subjective evaluation of a finite number of decision alternatives under a finite number of performance criteria by a single decision maker or by a group .

Among numerous MCDA/MCDM methods developed to solve real-world decision problems, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) continues to work satisfactorily in diverse application areas (Behzadian, vd., 2012:13051).

TOPSIS is a useful technique in dealing with multi-attribute or multi- criteria decision-making problems in real World. It helps decision maker organize the problems to be solved, and carry out analysis, comparisons and ranking of alternatives. Accordingly, the selection of suitable alternatives will be made (Shih, Shyur and Lee, 2007:801).

Today, multi-criteria decision-making offers a wide range of applications. In this study, a multi-criteria and multi-purpose measurement models TOPSIS method will be used. Schoolroom using a variety of criteria on companies operating in the decision-making process created and Private Teaching Institution as a self-assessment opportunity for the future will be presented.

2-TOPSIS Method

TOPSIS method developed as multiple criteria decision technique by Hwang and Yoon (1981). The basic of the method is based on choosing alternative to shortest way of positive ideal solution and furthest way of negative ideal solution (Ustasüleyman, 2009:37). When all criteria are thought together, ideal solution can be identified as combining ideal levels (Ersöz, 2012:110). The steps of Topsis method are characterized below. (Ustasüleyman, 2009:37-38, Demirelli, 2010: 105-106, Yaralıoğlu, 2012):

Step 1: Step 1. Forming An Initial Decision Matrix

At decision matrix lines, decision points that are indented to form initials at columns, measurement factors, which are used to decide, take place. Matrix A is beginning matrix, which is formed by decision maker. Decision matrix is showed below:

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

At decision matrix (m) shows decision point number, (n) shows measurement factor number.

Step 2: Construct Normalized Decision Matrix:

Normalized Decision Matrix is calculated by using parts of matrix A and via formula (1) below.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^m a_{kj}^2}} \tag{1}$$

Matrix R is acquired as below,

$$R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

Step 3 : Construct The Weighted Normalized Decision Matrix

First, weight values (w_i) related to measurement factors are determined ($\sum_{i=1}^n w_i = 1$).

Next, w_i value is multiplied by parts of R matrix at each columns matrix V is acquired. Matrix V is showed below:

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ \dots & \dots & \dots & \dots \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_n r_{mn} \end{bmatrix}$$

Step 4: Determine The Positive and Negative Ideal Solutions

TOPSIS method assumes that each measurement factor has a tendency, which has monotone increase and decrease.

To form ideal solution set, the biggest column value, which is weighted measurement factors at matrix V, (measurement factor minimisation side is the smallest one) is chosen. Finding of ideal solution set is showed below formula

$$A^* = \left\{ (\max_i v_{ij} | j \in J), (\min_i v_{ij} | j \in J') \right\} \tag{2}$$

To be calculated set by (2) formula $A^* = \{v_1^*, v_2^*, \dots, v_n^*\}$ can be showed.

Negative ideal solution set, the smallest column value which is weighted measurement factors at matrix V (measurement factor maximisation side is the biggest one) is shaped by choosing. Finding of negative ideal solution set is showed below formula.

$$A^- = \left\{ (\min_i v_{ij} | j \in J), (\max_i v_{ij} | j \in J') \right\} \tag{3}$$

To be calculated set by (.3) formula $A^- = \{v_1^-, v_2^-, \dots, v_n^-\}$ can be showed. J shows benefit (maximisation), J' shows lost (minimisation) in both formulas.

Step 5: Calculate The Separation Measures For Each Alternative

At **TOPSIS** method, to calculate deviations of negative ideal solution set and positive ideal of measurement factor value related to each decision point use Euclidian Distance Approach. Acquired deviation measures related to decision points are named as Ideal Separation S_i^* And Negative Ideal Separation Measure S_i^- . Calculation of Ideal Separation S_i^* measure at (4) formula, negative ideal separation (S_i^-) measure at (5) formula is showed.

$$S_i^* = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^*)^2} \tag{4}$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2} \tag{5}$$

To be calculated S_i^* and S_i^- number will be as well as decision point number naturally.

Step 6: Calculate The Relative Closeness to the Ideal Solution

Ideal and negative ideal separation measures are used to calculate the relative closeness to the ideal solution (C_i^*) of each decision points. Here used measure is rate of negative ideal separation measure in total separation measure. Calculation of the relative closeness to the ideal solution is showed below formula.

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*}$$

C_i^* Value between $0 \leq C_i^* \leq 1$ gets value and $C_i^* = 1$ ideal solution of decision point shows $C_i^* = 0$ related to absolute closeness to negative ideal solution related to decision point.

3. Practice

3.1. Identification Of Problem

Students know that they have to get into a qualified university for a brilliant future. To get into university, YGS exams are crucial. Most students need private teaching institution to get ready for exams, which are formed as test forms. Because of the spiritual and material difficulties, parents suffer from decision. Getting into university rate together with pay, number of students, free studies, and discount rate make students indecisive about choosing of private teaching institution.

It has been researched that high school students who study for university exams will chose which private teaching institution that will benefit. According to survey which carried on random selection students who study for university exam, choosing private teaching institution criteria's have been identified as pay, getting into university rate, education factor (number of teachers, free lecture, free exams), average student numbers and percentage of discount. The result of survey listed 5 favourite alternative private teaching institution (A, B, C, D, E) in the region.

3.2 Modelling And Solution

TOPSIS method, which is the method of multiple criteria analysis method, was used in this study. The phases of TOPSIS method, which is practiced, for choosing most suitable private teaching institution was described thoroughly below.

Phase 1: The Create of Decision Matrix

Information and defined criteria's about alternative private teaching institution were given in Table 1. Through these data's, decision matrix formed.

Table 1. Decision Matrix

| | Price Of Teaching Institution (Paying) | Getting Into University Rate | Education Factor Rate | Average Student Numbers | Percentege Of Discount |
|--------------------------------|--|------------------------------|-----------------------|-------------------------|------------------------|
| A Private Teaching Institution | 1800 | 82 | 65 | 323 | 25 |
| B Private Teaching Institution | 1650 | 77 | 45 | 345 | 35 |
| C Private Teaching Institution | 1740 | 83 | 61 | 217 | 25 |
| D Private Teaching Institution | 1500 | 71 | 25 | 187 | 15 |
| E Private Teaching Institution | 1700 | 73 | 64 | 278 | 20 |

Phase 2: Calculate Normalisation Rates

Criteria's requires to be normalized because all criteria are in different scale. Normalisation rates have been calculated via data's equality (1) in Table1. This data's are given in Table 2.

Table 2. Normalized Matrix

| | Price Of Teaching Institution (Paying) | Getting Into University Rate | Education Factor Rate | Average Student Numbers | Percentage Of Discount |
|---|--|------------------------------|-----------------------|-------------------------|------------------------|
| A | 0.478 | 0.473 | 0.537 | 0.521 | 0.446 |
| B | 0.438 | 0.445 | 0.371 | 0.557 | 0.625 |
| C | 0.462 | 0.479 | 0.504 | 0.350 | 0.446 |
| D | 0.399 | 0.410 | 0.206 | 0.302 | 0.267 |
| E | 0.452 | 0.421 | 0.528 | 0.449 | 0.357 |

Phase 3: Calculate Weighted Normalisation Values

Normalisation values, which are in Table 2, are calculated multiplying their own criteria’s weights were identified by experts respectively (0.30,0.25,0.15,0.15,0.15).

Table 3. Normalized Weighted Matrix

| | Price Of Teaching Institution (Paying) | Getting Into University Rate | Education Factor Rate | Average Student Numbers | Percentage Of Discount |
|---|--|------------------------------|-----------------------|-------------------------|------------------------|
| A | 0.143 | 0.118 | 0.080 | 0.078 | 0.066 |
| B | 0.131 | 0.111 | 0.055 | 0.083 | 0.093 |
| C | 0.138 | 0.143 | 0.075 | 0.052 | 0.066 |
| D | 0.119 | 0.123 | 0.030 | 0.045 | 0.040 |
| E | 0.135 | 0.105 | 0.079 | 0.067 | 0.053 |

Phase 4: Identify Positive Ideal and Negative Ideal Solutions

Positive ideal solutions are like at Table 4 below and Negative ideal solutions are like at Table 5.

Table 4. Positive Ideal Solutions

| | Price Of Teaching Institution (Paying) | Getting Into University Rate | Education Factor Rate | Average Student Numbers | Percentage Of Discount |
|---|--|------------------------------|-----------------------|-------------------------|------------------------|
| A | 0.143 | 0.118 | 0.080 | 0.078 | 0.066 |
| B | 0.131 | 0.111 | 0.055 | 0.083 | 0.093 |
| C | 0.138 | 0.143 | 0.075 | 0.052 | 0.066 |
| D | 0.119 | 0.123 | 0.030 | 0.045 | 0.040 |
| E | 0.135 | 0.105 | 0.079 | 0.067 | 0.053 |

Table 5. Negative Ideal Solutions

| | Price Of Teaching Institution (Paying) | Getting Into University Rate | Education Factor Rate | Average Student Numbers | Percentage Of Discount |
|---|--|------------------------------|-----------------------|-------------------------|------------------------|
| A | 0.143 | 0.118 | 0.080 | 0.078 | 0.066 |
| B | 0.131 | 0.111 | 0.055 | 0.083 | 0.093 |
| C | 0.138 | 0.143 | 0.075 | 0.052 | 0.066 |
| D | 0.119 | 0.123 | 0.030 | 0.045 | 0.040 |
| E | 0.135 | 0.105 | 0.079 | 0.067 | 0.053 |

Phase 5: Calculate Separation Measures

Via equality, positive separation measures are calculated. Calculated positive separation measures are given at

Table 6. Negative separation measures are given at Table 7.

Table 6. Positive Separation Measures

| | Positive Separation Measures |
|---|------------------------------|
| A | 0.0378 |
| B | 0.0423 |
| C | 0.0417 |
| D | 0.0879 |
| E | 0.058 |

Table 7. Negative Separation Measures

| | Negative Separation Measures |
|---|------------------------------|
| A | 0.0365 |
| B | 0.0444 |
| C | 0.0868 |
| D | 0.0553 |
| E | 0.0658 |

Phase 6: Calculate Positive Ideal Solution Similarity

Using data's at Table 6 and Table 7, via equality (4,5) similarities to positive ideal solution is calculated. The data's are given at Table 8 below.

Table 8. Similarities to Positive Ideal Solution

| | Positive Separation Measures | Negative Separation Measures | Similarities to Positive Ideal Solution |
|---|------------------------------|------------------------------|---|
| A | 0.0378 | 0.0365 | 0.491 |
| B | 0.0423 | 0.0444 | 0.512 |
| C | 0.0417 | 0.0868 | 0.675 |
| D | 0.0879 | 0.0553 | 0.394 |
| E | 0.058 | 0.0658 | 0.531 |

Phase 7: Decision

At these steps of this method, most suitable list of alternative private institutions for decision maker was formed. From big one to little one: $C \succ E \succ B \succ A \succ D$ institutions were formed. The data's are given at Table 9. Below.

Table 9. Ranking of Alternative Private Teaching Institutions

| | Similarities to Positive Ideal Solution | Ranking |
|---|---|---------|
| A | 0.491 | 4 |
| B | 0.512 | 3 |
| C | 0.675 | 1 |
| D | 0.394 | 5 |
| E | 0.531 | 2 |

4. Conclusion

In our country, private teaching institutions that help high school students to get extra information, get into university has very important place in education system. The number of private teaching institution increases day by day and as a result it becomes hard for students to choose most suitable institution according to their own plans.

While choosing, students evaluate different criteria's and at choosing stage they have difficulty choosing in a place where there are both dependent and independent factors.

High school students aim to choose most suitable institution for them. At optimum decision, the most important criteria's are pay, getting into university rate, student number who has get education at institution actively, teacher number and quality which are thought to be as education factor, class capacity, test numbers. Institutions aim to bring prestige choosing successful students. Also, institutions want to get much more students to gain profit according to their establishment target. In short, coming together students and institutions in same target means profit for both sides.

Multiple decision analysis methods come out when students have a problem of choosing private teaching institution. At our work, TOPSIS method was preferred because it is the most used multiple decision techniques. Following the steps of this method, most suitable list of alternative private institutions for decision maker was formed. From big one to little one: C > E > B > A > D institutions were formed.

At decision stage, the most important factor is percentage of getting into university for student. Then, looked into decision matrix, C institution that has first rank for problem solution. Although institution pay has importance of rank, in fact it appeared at rank 2 or 3. When looked C institution, it does not have a maximum pay still it has high one.

When looked into problem generally, the most important criteria while choosing institution are the number of students and institution pay. The other factor of going to institution actively is defined as class capacity and number of teacher.

Free possibilities such as studies and tests are also important for choosing. Consequently, it is seen suitable for choosing institution which has all criteria at optimum level, later they choose institution E. Through data's which are acquired via solution of decision problem, useful information have been gained about choosing.

When method mentioned, multiple criteria decision methods can be used as a means of decision support for such problem solution and at the same time because of being scientific method, it will make solution result valid. It must not be forgotten that TOPSIS method makes such problem solution easier.

Acknowledgement

This study supported by Scientific Research Projects Fund, (PAUBAP-2013KKP1536) of Pamukkale University.

References

- Behzadian M, Otaghsara S. K., Yazdan M. and Ignatius J., (2012), "A State Of The Art Survey Of TOPSIS Applications", *Expert Systems With Applications*, 39, 13051-13069
- İç Yusuf Tansel, (2012), " An Experimentel Design Approach Using TOPSIS Method For He Selection Of Computer-Integrated Manufacturing Technologies", *Robotics and Computer-Integrated Manufacturing*, 28, 245-256
- Ustasüleyman T.(2009), "Bankacılık Sektöründe Hizmet Kalitesinin Değerlendirilmesi : AHS-TOPSID Yöntemi", *Bankacılık Dergisi*, Sayı 69,
- Chang, Ching-Hui, Lin JYH-Juan and Chiang Miao-Chen, (2010), "Domestic Open-end Equity Mutual Fund Performance Evaluation Using Extended TOPSIS Method With Different Distance Approaches" *Expert Systems With Applications*, 37, 4642-4649.
- Koçak H., (2008), "En Uygun Özel Dershane Seçiminde Analitik Hiyerarşi Yönteminin Uygulanması", *Marmara Üniversitesi, İ.İ.B.F., Cilt XXV, Sayı 2.*
- Organ,A. ve Kenger,M.,(2012), "Bulanık Analitik Hiyerarşi Süreci Ve Mortgage Banka Kredisi Seçim Problemine Uygulanması", *Nigde Üniversitesi İ.İ.B.F. Dergisi*, Cilt:5, sayı:2
- Shih,H., Shyur Huan-Jyh and Lee,E.S., (2007), "An Extension of TOPSIS For Group Decion Making", *Mathematical and Computer Modelling*,45, 801-813
- Demirelli, E., (2010), TOPSIS Çok Kriterli Karar Verme Sistemi: Türkiye'deki Kamu Bankaları Üzerine Bir Uygulama", *Journal of Entrepreneurship and Development*, 5:1
- Yaralıoğlu, Kaan, (2012), Soft Yöneylem Teknikleri, TOPSIS, <http://kisi.deu.edu.tr/k.yaralioglu> (Erişim Tarihi:01.01.2013)
- Yoon, K.P. And Hwang C.L.,(1995), Multiple Attribute Decision Making: An Introduction, Sage University Paper Series on Quantative In The Social Sciences, Thousand Oaks. CA.