**International Journal of Assessment Tools in Education**
2020, Vol. 7, No. 3, 379–391

https://doi.org/10.21449/ijate.684360

Published at https://ijate.net/ https://dergipark.org.tr/en/pub/ijate *Research Article*

# Selection of Scholarship Students in Higher Education with VIKOR Method

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**ARTICLE HISTORY**

*Received: Feb. 02, 2020*

*Revised: July 3, 2020*

*Accepted: Aug 14, 2020*

**KEYWORDS**

Scholarship Student Selection,
Higher Education,
Multi Criteria Decision Making,
VIKOR Method

**Abstract:** Selection of students who will benefit from scholarships given in the university are usually done by formed commission. Due to limited number of scholarships offered, commission are obliged to choose the most appropriate students. In this selection process, it is important to make objective evaluation. The commission should mostly interview the applicants face to face. This situation causes time and labour loss and a stressful environment for both members of the commission and the students. An objective scoring system could solve the problems discussed above. In this study, 200 students who applied for the scholarship at Akdeniz University Faculty of Economics and Administrative Sciences to the scholarship were ranked. In this study, firstly the selection criteria of students for the scholarship was determined with the help of researchers and social aid service experts. Then, the weights of the criteria were calculated by the SWING method. These weights were used to rank the students who were eligible for the scholarship by using the VIKOR method. This method will make an objective evaluation and will accelerate the selection process.

## 1. INTRODUCTION

Defined as unrequited assistance to successful and needy students, the scholarship supports students in meeting their physiological and cultural expenses such as accommodation, nutrition, transportation and education. Institutions and organizations select students for scholarship by using various evaluation criteria. Applications are generally evaluated by the commission which formed by these institutions and organizations and the students to be awarded scholarships are determined. Limited number of scholarships makes hard the selection of appropriate student for the commission. Selecting students to be awarded a scholarship from candidate students is a complex decision-making process that requires multiple selection criteria to be considered simultaneously. In this respect, it would be appropriate to approach the scholarship selection process as a multi-criteria decision-making problem.

Many problems may have more than one qualitative or quantitative, contradictory criterion and purpose. One alternative may be best for one criterion, while it may be worse for another criterion. Multi-criteria decision making (MCDM) is a part of operations research that supports

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ISSN-e: 2148-7456 /© IJATE 2020

the decision maker to resolve problems when multiple conflicting criteria are involved and need to be evaluated (Sitorus, Cilliers, & Brito-Parada, 2019). It assists the decision-maker in finding a best choice to these situations.

Multi-criteria decision-making problems are grouped under three headings: Selection, Sorting, and Classification problems. In selection problems, the aim is to determine the best alternative. In the ranking problems, it is aimed that the alternatives will be defined correctly or measurably from good to bad. In classification problems, alternatives are classified according to a preference or criterion. (Yıldırım & Önder, 2015). This study is a ranking problem applied on to scholarship student selection.

There are various studies using MCDM methods on to student selection problems. For example, Yeh (2003) formulated the scholarship student selection as Multiattribute decision making and used comparative methods including Total Sum Method, Simple Additive Weighting (SAW), the Weighted Product (WP) and TOPSIS. Altunok, Özpeynirci, Kazançoğlu and Yılmaz (2010) discussed three MCDM methods namely Analytic Hierarchy Process (AHP), Weighted Product (WP) and TOPSIS method for postgraduate student selection. Mavrotas and Rozakis (2012) proposed PROMETHEE V2 method for selection of students for a postgraduate program. Taşkın, Üstün, and Deliktaş (2013) ranked candidate students for Erasmus Student Mobility by Fuzzy AHP method. Mahmud, Pazil, Mazlan, Jamaluddin, and Hasan (2017) applied Fuzzy AHP to selection of eligible students in receiving the scholarship while Irvanizam (2018) applied Fuzzy TOPSIS method. Deliktaş and Üstün (2017) handled the student selection process in the Erasmus program. They proposed an integrated approach of fuzzy Multimoora and Multichoice Conic Goal Programming. De Farias Aires, Ferreira, Araujo, and Borenstein (2017) developed a hybrid algorithm called ELECTRE-TOPSIS for rank students in Brazilian University. Mardhiyyah, Sejati, and Ratnasari (2019) used MOORA method as decision support system selection process for scholarship selection.

Besides the above studies there are various studies about scholarship selection by using MCDM in Turkey. For example, Erdem Hacıköylü (2006) used AHP to determine the students who will receive nutrition and shelter assistance from Anadolu University. Criteria are grouped into the income status of the family, student's success, student accommodation and the number of children, the presence of parents and siblings' education. By the AHP method, the students who were eligible for help were compared. Abalı, Kutlu, and Tamer (2012) handled the problem of selecting a student for a scholarship at Kırıkkale University Faculty of Engineering. The criteria are the number of children depend on the family, the total monthly income of the family, the status of the parents, the total number of properties owned by the family and the employment status of the student. As a result of the AHP, it was determined that the most important criterion was the total monthly income of the family. By TOPSIS method the most appropriate student for the scholarship was chosen among the five students. Çakır (2016) handled the problem of determining the students at Adnan Menderes University Nazilli Faculty of Economics for part-time job by using AHP based VIKOR method. The main criteria for ranking the students are academic qualification, the monthly income of the student, the number of dependents of the family, the status of the parents, the total monthly income of the family and the family assets. The weights of the criteria were determined by AHP and the student's monthly income was found as the most critical criterion. With the VIKOR method, the 448 applicants were ranked, and first 50 students were invited for interview. Pençe, Tarhan, and Çetinkaya Bozkurt (2017) handled student selection problem for Turkey Education Foundation scholarship at Mehmet Akif Ersoy University Faculty of Education. The criteria are age, gender, class, number of courses failed, OSYM ranking, parental status, the number of dependents of the family, the annual income of the family and the status of the property of the family. As a result of AHP, the criteria with the highest weight was annual income of the student's family. At the end of the study, 27 applicants were ranked by using the TOPSIS method and the first three candidate were found eligible for the scholarships.

The most important part of the scholarship selection process is to objective evaluation of the candidates. An objective scoring system could provide decision support to the commission for selecting appropriate students for scholarships. For this purpose, in this study MCDM based scoring system is proposed for an objective and compromised selection process.

## 2. METHOD

This study was conducted at the beginning of the 2017-2018 academic year, using the information given by 200 students who were studying at Akdeniz University Faculty of Economics and Administrative Sciences. In this study, firstly, the criteria affecting the selection of students for scholarship were determined. The importance weights of criterion calculated by using SWING method. Then, the candidate students were ranked by using the VIKOR method which is one of the multi-criteria decision-making method. Weights of criteria were used in VIKOR method as an input. Since the simplicity and the flexibility of use and understandable procedure makes the VIKOR method suitable for this ranking problem regarding the scholarship students. The VIKOR method was preferred in this study because it is an effective tool for multi-criteria decision making, especially in a situation where the decision maker cannot express or know its preference at the beginning of the system design. This method offers compromise solutions for problems related to conflicting criteria, focusing on raking and selecting a range of specific alternatives.

### 2.1. VIKOR Method

VIKOR method focuses on ranking and selecting from a set of alternatives and determines a compromise solution for a problem with conflicting criteria, which can help the decision-makers to reach a final decision. Here, the compromise solution is a feasible solution, which is the closest to the ideal, and a compromise means an agreement established by mutual concessions. The method provides a maximum group utility for the majority and a minimum of an individual regret for the opponent. It determines the compromise ranking list and compromises the solution by introducing the multi-criteria ranking index based on the particular measure of closeness to the ideal solution. This ranking index is an aggregation of all criteria, the relative importance of the criteria, and a balance between total and individual satisfaction (Liu, Mao, Zhang & Li. 2013). VIKOR method has been applied in many different fields such as supplier selection (Alimardani, Zolfani, Aghdaie, & Tamosaitiene, 2013; Fei, Deng, & Hu, 2019; Abdel-Baset, Chang, Gamal, & Smarandache, 2019), performance evaluation (Kumar, Aswin, & Gupta, 2020; Ture, Dogan, & Kocak, 2019; Buyukozkan & Karabulut, 2017; Wu, Lin, & Chang, 2011; Rezaie, Ramiyani, Nazari-Shirkouhi, & Badizadeh, 2014; Ranjan, Chatterjee, & Chakraborty, 2016; Kaya, İpekçi Çetin, & Kuruüzüm, 2011; Chen & Chen, 2010), personnel selection (Krishankumar, Premaladha, Ravichandran, Sekar, Manikandan, & Gao, 2020), service quality (Gupta, 2018; Yang, Su, & Wang, 2017; Lin, Chen, Chuang, & Lin, 2016), material selection (Jahan, Mustapha, Ismail, Sapuan, & Bahraminasab, 2011; Dev, Aherwar, & Patnaik, 2020) .

Assuming that the rows in the decision matrix represent the alternatives and the columns represent the criteria, the solution steps of the VIKOR method continue as follows (Opricovic & Tzeng, 2004; Büyüközkan & Ruan, 2008; Tong, Chen, & Wang, 2007; İpekçi Çetin & Çetin, 2016; Paksoy, 2017; Çetin & İpekçi Çetin, 2010):

Step 1. Determination the best $f_i^*$ and the worst $f_i^-$ values of all criterion functions, i=1, 2,…,n. If the i-th function represents a benefit, then

$f_i^* = \max_j f_{ij} \quad f_i^- = \min_j f_{ij}$ if the i-th function represents a benefit;

$$f_i^* = \min_j f_{ij} \quad f_i^- = \max_j f_{ij} \quad \text{if the i-th function represents a cost.} \tag{1}$$

Step 2. Computation the values $S_j$ and $R_j$, j=1, 2,…, J

$$S_j = \sum_{i=1}^{n} w_i (f_i^* - f_{ij})/(f_i^* - f_i^-), \tag{2}$$

$$R_j = \max_i [w_i (f_i^* - f_{ij})/(f_i^* - f_i^-)], \tag{3}$$

Here $w_i$ are the weights of criteria.

Step 3. Computation the values $Q_j$, j=1, 2… J

$$Q_j = v(S_j - S^*)/(S^- - S^*) + (1-v)(R_j - R^*)/(R^- - R^*) \tag{4}$$

Where $S^* = \min_j S_j$, $S^- = \max_j S_j$, $R^* = \min_j R_j$, $R^- = \max_j R_j$

$v$ is introduced as weight of the strategy of "the majority of criteria" (or "the maximum group utility"), here $v = 0.5$.

Step 4. Ranking the alternatives, sorting by the values $S_j$, $R_j$ and $Q_j$. The results are three ranking lists.

Step 5. Proposing as a compromise solution the alternative ($a'$) which is ranked the best by the measure Q (minimum) if the following two conditions are satisfied:

C1: "Acceptable advantage": $Q(a'') - Q(a') \geq DQ$ Where $a''$ is the alternative $DQ = 1/(J-1)$; J is the number of alternatives.

C2. "Acceptable Stability in decision making": The alternative $a'$ must also be the best ranked by S or/and R. This compromise solution is stable within a decision-making process, which could be the strategy of maximum group utility (when v > 0.5 is needed), or "by consensus" v ≈ 0.5, or "with veto" (v < 0.5). Here, v is the weight of decision-making strategy of maximum group utility.

If one of the conditions is not satisfied, then a set of compromise solutions is proposed, which consists of:

- Alternatives a′ and a″ if only condition C2 is not satisfied, or
- Alternatives a′,a″,…,a(M) if condition C1 is not satisfied; and a(M) is determined

by the relation Q(a(M))−Q(a′)<DQ for maximum M (the positions of these alternatives are "in closeness").

The best alternative, ranked by *Q*, is the one with the minimum value of *Q*. The main ranking result is the compromise ranking list of alternatives, and the compromise solution with the "advantage rate".

### 2.1.1. *Weights calculation for criteria*

Weights express the relative importance of criteria. As decision makers expressing the importance of criteria can be supported with several methods such as SWING method, SMART, AHP, MACBETH, PAPRIKA (Pazsto, Jurgens, Tominc, & Burian, 2020; Nemeth, Molnar, Bozoki, Wijaya, Inota, Campbell, & Kalo, 2019). Due to its ease in application and the simplicity of its calculations, the SWING method was selected for determining the weights of the criteria. This method makes it easier and more reliable for researchers to get expert ideas.

In the SWING method, performance measurements are considered to be between 0-100. A score of 100 is given to the most important criterion, and then progress is made by providing a score of less than 100 to other criteria. The decision-maker scores all the criteria according to their importance. Finally, normalization is performed by dividing each score to the sum of all scores (Wang, Jing, Zhang, & Zhao, 2009).

In this study, for determining the criteria weights, scoring was done by six academicians who participated in Akdeniz University Scholarship and Social Services Committee. The weights of each criteria calculated with geometric mean of six scores given by academicians. Final weights presented in Table 1.

**Table 1.** *Criteria and weight of scholarship selection*

| | Criteria effective in selection of scholarship | Weights |
|---|---|---|
| C1 | Having a martyr relative | 0.138 |
| C2 | The existence of an individual with disability in the student's family | 0.135 |
| C3 | Monthly income of student's family | 0.125 |
| C4 | Monthly income of student | 0.110 |
| C5 | The number of people the head of the family is responsible for caring | 0.096 |
| C6 | Type of student's social assurance | 0.084 |
| C7 | Where the student earns his income | 0.082 |
| C8 | Whether the place where the family lives is rent | 0.059 |
| C9 | Student's place of residence | 0.043 |
| C10 | The residence of the student's family | 0.032 |
| C11 | Whether parents are alive and their marital status | 0.028 |
| C12 | The father's profession | 0.025 |
| C13 | The mother's profession | 0.022 |
| C14 | Education level of the mother | 0.010 |
| C15 | Education level of the father | 0.010 |

As it can be seen from Table 1, the criterion of having a martyr relative has the highest weight. Education level of the mother and father are the criteria with the lowest weight criteria that is effective in selecting students to be awarded scholarships.

### 2.1.2. *Establishment of decision matrix*

The decision matrix consists of 15 criteria and 200 alternatives (students). Students are studying Akdeniz University Faculty of Economics and Administrative Sciences. The values of students for the criteria are obtained from the Scholarship Application Form and Scoring System which created by Social Services. Sample values of data can be seen in Table 2.

**Table 2.** *Decision matrix*

| Weights | 0,138 | 0,135 | 0,125 | 0,110 | 0,096 | 0,084 | 0,082 | 0,059 | 0,043 | 0,032 | 0,028 | 0,025 | 0,022 | 0,010 | 0,010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Student Number | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 |
| 1 | 10 | 10 | 100 | 80 | 4 | 60 | 40 | 50 | 100 | 40 | 30 | 60 | 0 | 50 | 50 |
| 2 | 10 | 10 | 100 | 100 | 2 | 40 | 100 | 50 | 40 | 40 | 30 | 30 | 100 | 30 | 20 |
| 3 | 10 | 10 | 100 | 100 | 6 | 100 | 100 | 0 | 70 | 40 | 0 | 30 | 100 | 40 | 20 |
| 4 | 10 | 10 | 100 | 100 | 4 | 60 | 60 | 0 | 40 | 40 | 0 | 30 | 100 | 50 | 40 |
| 5 | 10 | 10 | 100 | 80 | 4 | 60 | 80 | 50 | 40 | 40 | 30 | 60 | 100 | 40 | 40 |
| 6 | 10 | 10 | 100 | 100 | 5 | 60 | 60 | 0 | 100 | 30 | 0 | 30 | 0 | 40 | 40 |
| 7 | 10 | 10 | 100 | 60 | 3 | 60 | 60 | 0 | 100 | 40 | 0 | 30 | 100 | 40 | 40 |
| 8 | 10 | 10 | 100 | 80 | 5 | 60 | 40 | 0 | 80 | 40 | 0 | 100 | 60 | 30 | 30 |
| 9 | 10 | 10 | 100 | 20 | 0 | 0 | 40 | 0 | 100 | 30 | 0 | 80 | 100 | 40 | 40 |
| 10 | 10 | 10 | 0 | 80 | 9 | 100 | 40 | 50 | 40 | 40 | 0 | 60 | 0 | 50 | 50 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 191 | 10 | 10 | 80 | 100 | 5 | 40 | 40 | 50 | 100 | 40 | 0 | 40 | 0 | 40 | 20 |
| 192 | 10 | 10 | 100 | 80 | 12 | 100 | 100 | 0 | 100 | 40 | 30 | 0 | 0 | 50 | 50 |
| 193 | 10 | 10 | 100 | 100 | 9 | 100 | 60 | 50 | 80 | 30 | 0 | 80 | 100 | 20 | 20 |
| 194 | 10 | 10 | 100 | 80 | 4 | 60 | 40 | 0 | 80 | 30 | 0 | 40 | 100 | 40 | 40 |
| 195 | 10 | 10 | 100 | 60 | 4 | 100 | 60 | 0 | 80 | 40 | 0 | 100 | 100 | 40 | 40 |
| 196 | 10 | 10 | 100 | 60 | 4 | 60 | 60 | 0 | 80 | 40 | 0 | 30 | 100 | 30 | 30 |
| 197 | 10 | 10 | 100 | 80 | 3 | 100 | 80 | 50 | 100 | 40 | 30 | 0 | 100 | 40 | 40 |
| 198 | 10 | 10 | 100 | 60 | 3 | 60 | 80 | 50 | 40 | 40 | 60 | 60 | 0 | 20 | 20 |
| 199 | 10 | 10 | 100 | 20 | 5 | 60 | 40 | 0 | 100 | 30 | 60 | 0 | 100 | 40 | 40 |
| 200 | 10 | 10 | 80 | 80 | 6 | 0 | 40 | 50 | 70 | 40 | 0 | 40 | 100 | 20 | 10 |

### 2.1.3. *Calculations of VIKOR Method*

Firstly, the best $f_i^*$ and the worst $f_i^-$ values of all criterion functions are determinate from equation (1). After that with using the equation (2), (3) and (4); Sj, Rj and Qj are calculated for each student j=1,2,…,200. (Qj values are computed by selecting v=0.5). Table 3 and Table 4 gives the S and R scores of students respectively while Table 5 gives Q scores and their corresponding rankings.

The students whose numbers are 119, 44 and 89 have the highest score respectively according to VIKOR method. The student with the lowest score is the student 66.

The best alternative (student) according to the Q-values is the student 119 with the minimum value of Q. It satisfies condition C1 and C2. Because $Q(a'') - Q(a') = 0.180 - 0.166 \geq DQ = 0.005$ and this student is also the best ranked by R. Therefore, student 119 has an acceptable advantage and acceptable stability with respect to the other students.

**Table 3.** *S scores of students*

| Rank | Student No | Si | Rank | Student No | Si | Rank | Student No | Si | Rank | Student No | Si | Rank | Student No | Si |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 89 | 0.247 | 41 | 133 | 0.446 | 81 | 166 | 0.510 | 121 | 8 | 0.547 | 161 | 99 | 0.580 |
| 2 | 183 | 0.271 | 42 | 3 | 0.446 | 82 | 198 | 0.511 | 122 | 88 | 0.549 | 162 | 20 | 0.581 |
| 3 | 121 | 0.316 | 43 | 16 | 0.450 | 83 | 184 | 0.512 | 123 | 126 | 0.549 | 163 | 153 | 0.585 |
| 4 | 163 | 0.340 | 44 | 106 | 0.452 | 84 | 11 | 0.512 | 124 | 39 | 0.549 | 164 | 152 | 0.586 |
| 5 | 25 | 0.352 | 45 | 162 | 0.452 | 85 | 164 | 0.513 | 125 | 136 | 0.552 | 165 | 170 | 0.586 |
| 6 | 142 | 0.353 | 46 | 165 | 0.454 | 86 | 195 | 0.514 | 126 | 135 | 0.552 | 166 | 95 | 0.587 |
| 7 | 129 | 0.356 | 47 | 123 | 0.455 | 87 | 112 | 0.514 | 127 | 81 | 0.553 | 167 | 63 | 0.588 |
| 8 | 80 | 0.359 | 48 | 23 | 0.457 | 88 | 154 | 0.514 | 128 | 120 | 0.553 | 168 | 77 | 0.591 |
| 9 | 51 | 0.366 | 49 | 176 | 0.458 | 89 | 177 | 0.514 | 129 | 179 | 0.554 | 169 | 141 | 0.593 |
| 10 | 104 | 0.368 | 50 | 33 | 0.458 | 90 | 174 | 0.515 | 130 | 19 | 0.555 | 170 | 61 | 0.596 |
| 11 | 160 | 0.373 | 51 | 134 | 0.462 | 91 | 105 | 0.516 | 131 | 75 | 0.555 | 171 | 199 | 0.597 |
| 12 | 56 | 0.377 | 52 | 5 | 0.463 | 92 | 90 | 0.516 | 132 | 137 | 0.555 | 172 | 79 | 0.598 |
| 13 | 193 | 0.392 | 53 | 125 | 0.463 | 93 | 22 | 0.518 | 133 | 30 | 0.556 | 173 | 117 | 0.607 |
| 14 | 57 | 0.397 | 54 | 53 | 0.470 | 94 | 72 | 0.522 | 134 | 32 | 0.556 | 174 | 158 | 0.611 |
| 15 | 98 | 0.401 | 55 | 46 | 0.470 | 95 | 127 | 0.523 | 135 | 28 | 0.559 | 175 | 132 | 0.612 |
| 16 | 60 | 0.402 | 56 | 2 | 0.471 | 96 | 114 | 0.524 | 136 | 35 | 0.559 | 176 | 155 | 0.615 |
| 17 | 71 | 0.402 | 57 | 27 | 0.474 | 97 | 187 | 0.525 | 137 | 128 | 0.560 | 177 | 140 | 0.617 |
| 18 | 192 | 0.415 | 58 | 67 | 0.477 | 98 | 24 | 0.527 | 138 | 7 | 0.564 | 178 | 156 | 0.618 |
| 19 | 50 | 0.415 | 59 | 143 | 0.479 | 99 | 191 | 0.527 | 139 | 74 | 0.564 | 179 | 116 | 0.619 |
| 20 | 14 | 0.416 | 60 | 21 | 0.479 | 100 | 69 | 0.527 | 140 | 194 | 0.565 | 180 | 65 | 0.622 |
| 21 | 43 | 0.416 | 61 | 107 | 0.480 | 101 | 161 | 0.528 | 141 | 62 | 0.565 | 181 | 93 | 0.622 |
| 22 | 18 | 0.417 | 62 | 108 | 0.482 | 102 | 13 | 0.531 | 142 | 103 | 0.565 | 182 | 86 | 0.623 |
| 23 | 181 | 0.421 | 63 | 94 | 0.482 | 103 | 186 | 0.531 | 143 | 113 | 0.565 | 183 | 169 | 0.625 |
| 24 | 159 | 0.422 | 64 | 68 | 0.484 | 104 | 47 | 0.533 | 144 | 87 | 0.567 | 184 | 157 | 0.629 |
| 25 | 119 | 0.422 | 65 | 17 | 0.484 | 105 | 150 | 0.533 | 145 | 64 | 0.569 | 185 | 31 | 0.629 |
| 26 | 146 | 0.423 | 66 | 109 | 0.486 | 106 | 6 | 0.535 | 146 | 168 | 0.569 | 186 | 178 | 0.631 |
| 27 | 197 | 0.426 | 67 | 1 | 0.488 | 107 | 78 | 0.535 | 147 | 190 | 0.569 | 187 | 124 | 0.634 |
| 28 | 173 | 0.427 | 68 | 97 | 0.488 | 108 | 4 | 0.535 | 148 | 196 | 0.569 | 188 | 130 | 0.640 |
| 29 | 58 | 0.427 | 69 | 48 | 0.488 | 109 | 49 | 0.537 | 149 | 200 | 0.573 | 189 | 110 | 0.647 |
| 30 | 182 | 0.433 | 70 | 73 | 0.491 | 110 | 38 | 0.538 | 150 | 52 | 0.573 | 190 | 37 | 0.649 |
| 31 | 44 | 0.437 | 71 | 26 | 0.497 | 111 | 148 | 0.539 | 151 | 172 | 0.574 | 191 | 40 | 0.652 |
| 32 | 59 | 0.437 | 72 | 144 | 0.498 | 112 | 91 | 0.539 | 152 | 151 | 0.574 | 192 | 180 | 0.654 |
| 33 | 118 | 0.438 | 73 | 41 | 0.499 | 113 | 189 | 0.541 | 153 | 138 | 0.575 | 193 | 82 | 0.656 |
| 34 | 70 | 0.439 | 74 | 42 | 0.503 | 114 | 122 | 0.542 | 154 | 29 | 0.575 | 194 | 54 | 0.658 |
| 35 | 55 | 0.440 | 75 | 145 | 0.504 | 115 | 36 | 0.543 | 155 | 102 | 0.576 | 195 | 34 | 0.661 |
| 36 | 131 | 0.441 | 76 | 12 | 0.504 | 116 | 147 | 0.544 | 156 | 188 | 0.576 | 196 | 149 | 0.668 |
| 37 | 15 | 0.442 | 77 | 96 | 0.505 | 117 | 84 | 0.544 | 157 | 85 | 0.577 | 197 | 139 | 0.674 |
| 38 | 45 | 0.442 | 78 | 92 | 0.506 | 118 | 175 | 0.544 | 158 | 111 | 0.578 | 198 | 9 | 0.695 |
| 39 | 167 | 0.443 | 79 | 171 | 0.506 | 119 | 115 | 0.545 | 159 | 10 | 0.579 | 199 | 101 | 0.747 |
| 40 | 185 | 0.445 | 80 | 100 | 0.509 | 120 | 83 | 0.546 | 160 | 76 | 0.580 | 200 | 66 | 0.774 |

**Table 4.** *R scores of students*

| Rank | Student No | Ri | Rank | Student No | Ri | Rank | Student No | Ri | Rank | Student No | Ri | Rank | Student No | Ri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 44 | 0.135 | 41 | 39 | 0.137 | 81 | 80 | 0.137 | 121 | 121 | 0.137 | 161 | 161 | 0.137 |
| 2 | 119 | 0.135 | 42 | 40 | 0.137 | 82 | 81 | 0.137 | 122 | 122 | 0.137 | 162 | 162 | 0.137 |
| 3 | 1 | 0.137 | 43 | 41 | 0.137 | 83 | 82 | 0.137 | 123 | 123 | 0.137 | 163 | 163 | 0.137 |
| 4 | 2 | 0.137 | 44 | 42 | 0.137 | 84 | 83 | 0.137 | 124 | 124 | 0.137 | 164 | 164 | 0.137 |
| 5 | 3 | 0.137 | 45 | 43 | 0.137 | 85 | 84 | 0.137 | 125 | 125 | 0.137 | 165 | 165 | 0.137 |
| 6 | 4 | 0.137 | 46 | 45 | 0.137 | 86 | 85 | 0.137 | 126 | 126 | 0.137 | 166 | 166 | 0.137 |
| 7 | 5 | 0.137 | 47 | 46 | 0.137 | 87 | 86 | 0.137 | 127 | 127 | 0.137 | 167 | 167 | 0.137 |
| 8 | 6 | 0.137 | 48 | 47 | 0.137 | 88 | 87 | 0.137 | 128 | 128 | 0.137 | 168 | 168 | 0.137 |
| 9 | 7 | 0.137 | 49 | 48 | 0.137 | 89 | 88 | 0.137 | 129 | 129 | 0.137 | 169 | 169 | 0.137 |
| 10 | 8 | 0.137 | 50 | 49 | 0.137 | 90 | 89 | 0.137 | 130 | 130 | 0.137 | 170 | 170 | 0.137 |
| 11 | 9 | 0.137 | 51 | 50 | 0.137 | 91 | 90 | 0.137 | 131 | 131 | 0.137 | 171 | 171 | 0.137 |
| 12 | 10 | 0.137 | 52 | 51 | 0.137 | 92 | 91 | 0.137 | 132 | 132 | 0.137 | 172 | 172 | 0.137 |
| 13 | 11 | 0.137 | 53 | 52 | 0.137 | 93 | 92 | 0.137 | 133 | 133 | 0.137 | 173 | 173 | 0.137 |
| 14 | 12 | 0.137 | 54 | 53 | 0.137 | 94 | 93 | 0.137 | 134 | 134 | 0.137 | 174 | 174 | 0.137 |
| 15 | 13 | 0.137 | 55 | 54 | 0.137 | 95 | 94 | 0.137 | 135 | 135 | 0.137 | 175 | 175 | 0.137 |
| 16 | 14 | 0.137 | 56 | 55 | 0.137 | 96 | 95 | 0.137 | 136 | 136 | 0.137 | 176 | 176 | 0.137 |
| 17 | 15 | 0.137 | 57 | 56 | 0.137 | 97 | 96 | 0.137 | 137 | 137 | 0.137 | 177 | 177 | 0.137 |
| 18 | 16 | 0.137 | 58 | 57 | 0.137 | 98 | 97 | 0.137 | 138 | 138 | 0.137 | 178 | 178 | 0.137 |
| 19 | 17 | 0.137 | 59 | 58 | 0.137 | 99 | 98 | 0.137 | 139 | 139 | 0.137 | 179 | 179 | 0.137 |
| 20 | 18 | 0.137 | 60 | 59 | 0.137 | 100 | 99 | 0.137 | 140 | 140 | 0.137 | 180 | 180 | 0.137 |
| 21 | 19 | 0.137 | 61 | 60 | 0.137 | 101 | 100 | 0.137 | 141 | 141 | 0.137 | 181 | 181 | 0.137 |
| 22 | 20 | 0.137 | 62 | 61 | 0.137 | 102 | 101 | 0.137 | 142 | 142 | 0.137 | 182 | 182 | 0.137 |
| 23 | 21 | 0.137 | 63 | 62 | 0.137 | 103 | 102 | 0.137 | 143 | 143 | 0.137 | 183 | 183 | 0.137 |
| 24 | 22 | 0.137 | 64 | 63 | 0.137 | 104 | 103 | 0.137 | 144 | 144 | 0.137 | 184 | 184 | 0.137 |
| 25 | 23 | 0.137 | 65 | 64 | 0.137 | 105 | 104 | 0.137 | 145 | 145 | 0.137 | 185 | 185 | 0.137 |
| 26 | 24 | 0.137 | 66 | 65 | 0.137 | 106 | 105 | 0.137 | 146 | 146 | 0.137 | 186 | 186 | 0.137 |
| 27 | 25 | 0.137 | 67 | 66 | 0.137 | 107 | 106 | 0.137 | 147 | 147 | 0.137 | 187 | 187 | 0.137 |
| 28 | 26 | 0.137 | 68 | 67 | 0.137 | 108 | 107 | 0.137 | 148 | 148 | 0.137 | 188 | 188 | 0.137 |
| 29 | 27 | 0.137 | 69 | 68 | 0.137 | 109 | 108 | 0.137 | 149 | 149 | 0.137 | 189 | 189 | 0.137 |
| 30 | 28 | 0.137 | 70 | 69 | 0.137 | 110 | 109 | 0.137 | 150 | 150 | 0.137 | 190 | 190 | 0.137 |
| 31 | 29 | 0.137 | 71 | 70 | 0.137 | 111 | 110 | 0.137 | 151 | 151 | 0.137 | 191 | 191 | 0.137 |
| 32 | 30 | 0.137 | 72 | 71 | 0.137 | 112 | 111 | 0.137 | 152 | 152 | 0.137 | 192 | 192 | 0.137 |
| 33 | 31 | 0.137 | 73 | 72 | 0.137 | 113 | 112 | 0.137 | 153 | 153 | 0.137 | 193 | 193 | 0.137 |
| 34 | 32 | 0.137 | 74 | 73 | 0.137 | 114 | 113 | 0.137 | 154 | 154 | 0.137 | 194 | 194 | 0.137 |
| 35 | 33 | 0.137 | 75 | 74 | 0.137 | 115 | 114 | 0.137 | 155 | 155 | 0.137 | 195 | 195 | 0.137 |
| 36 | 34 | 0.137 | 76 | 75 | 0.137 | 116 | 115 | 0.137 | 156 | 156 | 0.137 | 196 | 196 | 0.137 |
| 37 | 35 | 0.137 | 77 | 76 | 0.137 | 117 | 116 | 0.137 | 157 | 157 | 0.137 | 197 | 197 | 0.137 |
| 38 | 36 | 0.137 | 78 | 77 | 0.137 | 118 | 117 | 0.137 | 158 | 158 | 0.137 | 198 | 198 | 0.137 |
| 39 | 37 | 0.137 | 79 | 78 | 0.137 | 119 | 118 | 0.137 | 159 | 159 | 0.137 | 199 | 199 | 0.137 |
| 40 | 38 | 0.137 | 80 | 79 | 0.137 | 120 | 120 | 0.137 | 160 | 160 | 0.137 | 200 | 200 | 0.137 |

**Table 5.** *Q scores for v=0.50 and students rankings*

| Rank | Student No | Qi | Rank | Student No | Qi | Rank | Student No | Qi | Rank | Student No | Qi | Rank | Student No | Qi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **119** | 0.166 | 41 | 133 | 0.689 | 81 | 166 | 0.749 | 121 | 8 | 0.785 | 161 | 99 | 0.816 |
| **2** | **44** | 0.180 | 42 | 3 | 0.689 | 82 | 198 | 0.750 | 122 | 88 | 0.786 | 162 | 20 | 0.817 |
| **3** | **89** | 0.500 | 43 | 16 | 0.692 | 83 | 184 | 0.751 | 123 | 126 | 0.787 | 163 | 153 | 0.820 |
| 4 | 183 | 0.523 | 44 | 106 | 0.694 | 84 | 11 | 0.751 | 124 | 39 | 0.787 | 164 | 152 | 0.821 |
| 5 | 121 | 0.565 | 45 | 162 | 0.695 | 85 | 164 | 0.753 | 125 | 136 | 0.789 | 165 | 170 | 0.822 |
| 6 | 163 | 0.588 | 46 | 165 | 0.696 | 86 | 195 | 0.753 | 126 | 135 | 0.790 | 166 | 95 | 0.822 |
| 7 | 25 | 0.599 | 47 | 123 | 0.697 | 87 | 112 | 0.753 | 127 | 81 | 0.790 | 167 | 63 | 0.823 |
| 8 | 142 | 0.601 | 48 | 23 | 0.699 | 88 | 154 | 0.753 | 128 | 120 | 0.790 | 168 | 77 | 0.827 |
| 9 | 129 | 0.604 | 49 | 176 | 0.700 | 89 | 177 | 0.753 | 129 | 179 | 0.791 | 169 | 141 | 0.829 |
| 10 | 80 | 0.606 | 50 | 33 | 0.700 | 90 | 174 | 0.755 | 130 | 19 | 0.792 | 170 | 61 | 0.831 |
| 11 | 51 | 0.613 | 51 | 134 | 0.704 | 91 | 105 | 0.755 | 131 | 75 | 0.792 | 171 | 199 | 0.832 |
| 12 | 104 | 0.614 | 52 | 5 | 0.705 | 92 | 90 | 0.756 | 132 | 137 | 0.792 | 172 | 79 | 0.833 |
| 13 | 160 | 0.619 | 53 | 125 | 0.705 | 93 | 22 | 0.757 | 133 | 30 | 0.793 | 173 | 117 | 0.842 |
| 14 | 56 | 0.623 | 54 | 53 | 0.711 | 94 | 72 | 0.761 | 134 | 32 | 0.793 | 174 | 158 | 0.845 |
| 15 | 193 | 0.638 | 55 | 46 | 0.711 | 95 | 127 | 0.762 | 135 | 28 | 0.796 | 175 | 132 | 0.846 |
| 16 | 57 | 0.642 | 56 | 2 | 0.713 | 96 | 114 | 0.763 | 136 | 35 | 0.796 | 176 | 155 | 0.849 |
| 17 | 98 | 0.646 | 57 | 27 | 0.715 | 97 | 187 | 0.763 | 137 | 128 | 0.797 | 177 | 140 | 0.851 |
| 18 | 60 | 0.647 | 58 | 67 | 0.718 | 98 | 24 | 0.765 | 138 | 7 | 0.801 | 178 | 156 | 0.852 |
| 19 | 71 | 0.647 | 59 | 143 | 0.720 | 99 | 191 | 0.766 | 139 | 74 | 0.801 | 179 | 116 | 0.853 |
| 20 | 192 | 0.659 | 60 | 21 | 0.720 | 100 | 69 | 0.766 | 140 | 194 | 0.801 | 180 | 65 | 0.855 |
| 21 | 50 | 0.660 | 61 | 107 | 0.721 | 101 | 161 | 0.767 | 141 | 62 | 0.802 | 181 | 93 | 0.856 |
| 22 | 14 | 0.660 | 62 | 108 | 0.722 | 102 | 13 | 0.769 | 142 | 103 | 0.802 | 182 | 86 | 0.857 |
| 23 | 43 | 0.660 | 63 | 94 | 0.723 | 103 | 186 | 0.769 | 143 | 113 | 0.802 | 183 | 169 | 0.859 |
| 24 | 18 | 0.661 | 64 | 68 | 0.724 | 104 | 47 | 0.771 | 144 | 87 | 0.803 | 184 | 157 | 0.862 |
| 25 | 181 | 0.665 | 65 | 17 | 0.725 | 105 | 150 | 0.771 | 145 | 64 | 0.805 | 185 | 31 | 0.863 |
| 26 | 159 | 0.666 | 66 | 109 | 0.727 | 106 | 6 | 0.773 | 146 | 168 | 0.806 | 186 | 178 | 0.864 |
| 27 | 146 | 0.667 | 67 | 1 | 0.728 | 107 | 78 | 0.773 | 147 | 190 | 0.806 | 187 | 124 | 0.868 |
| 28 | 197 | 0.670 | 68 | 97 | 0.729 | 108 | 4 | 0.773 | 148 | 196 | 0.806 | 188 | 130 | 0.873 |
| 29 | 173 | 0.670 | 69 | 48 | 0.729 | 109 | 49 | 0.775 | 149 | 200 | 0.809 | 189 | 110 | 0.880 |
| 30 | 58 | 0.671 | 70 | 73 | 0.731 | 110 | 38 | 0.776 | 150 | 52 | 0.810 | 190 | 37 | 0.881 |
| 31 | 182 | 0.676 | 71 | 26 | 0.737 | 111 | 148 | 0.777 | 151 | 172 | 0.810 | 191 | 40 | 0.884 |
| 32 | 59 | 0.681 | 72 | 144 | 0.738 | 112 | 91 | 0.777 | 152 | 151 | 0.810 | 192 | 180 | 0.886 |
| 33 | 118 | 0.681 | 73 | 41 | 0.739 | 113 | 189 | 0.779 | 153 | 138 | 0.811 | 193 | 82 | 0.888 |
| 34 | 70 | 0.682 | 74 | 42 | 0.743 | 114 | 122 | 0.780 | 154 | 29 | 0.811 | 194 | 54 | 0.890 |
| 35 | 55 | 0.683 | 75 | 145 | 0.744 | 115 | 36 | 0.781 | 155 | 102 | 0.812 | 195 | 34 | 0.892 |
| 36 | 131 | 0.684 | 76 | 12 | 0.744 | 116 | 147 | 0.781 | 156 | 188 | 0.812 | 196 | 149 | 0.900 |
| 37 | 15 | 0.685 | 77 | 96 | 0.745 | 117 | 84 | 0.782 | 157 | 85 | 0.813 | 197 | 139 | 0.906 |
| 38 | 45 | 0.685 | 78 | 92 | 0.745 | 118 | 175 | 0.782 | 158 | 111 | 0.814 | 198 | 9 | 0.925 |
| 39 | 167 | 0.686 | 79 | 171 | 0.745 | 119 | 115 | 0.783 | 159 | 10 | 0.815 | 199 | 101 | 0.975 |
| 40 | 185 | 0.688 | 80 | 100 | 0.749 | 120 | 83 | 0.784 | 160 | 76 | 0.816 | 200 | **66** | **1.000** |

## 3. DISCUSSION and CONCLUSION

In this study, with the help of researchers and social aid service experts, the criteria which must be considered while selecting students for scholarship are determined. Then, these criteria were weighted by the scholarship committee members with SWING method. The criterion of having a martyr relative was found as the most important criterion. The second most important criterion is the presence of a disabled person in the family. The lowest scoring criteria among the 15 criteria are the education level of both the father and mother. Weights which was found by the SWING method were used in the VIKOR method.

According to the results of the VIKOR method, the student in the first place (number 119) stays in a rented house, his/her family lives in the rural area without paying rent. The student has no disability in himself/herself or his/her family but has martyr relative. His/her parents are alive and living together. And his/her father works as a civil servant. The number dependent member of the family is 4.

It was determined that there were only two students who had martyr relationship in their families. The VIKOR method placed these two students in the first two places as this criterion has the highest weight.

It is tried to provide a decision support on student selection for scholarship by using SWING and VIKOR methods in this study. The criteria affecting the selection of student for scholarship were determined with the cooperation of researchers and social aid service experts. If MCDM methods will be used in student selection for scholarship, the determination of criteria and the determination of their weights is the most important part, because results are very sensitive to these parameters. The expertise and number of people whose opinion will be taken in determining the parameters will increase the reliability of the results. So that, by applying more experts in scholarship field may increase the reliability of the study. In this study, the application of integrated VIKOR method recommended to commission to help their decision in student selection for scholarship. Although the proposed system will provide an objective decision mechanism, it cannot be said that it eliminates the need for an interview.

In addition, different multi-criteria decision-making methods can be applied, and the results can be compared. By integrating methods into a computer software, a decision support platform can be developed for the use of commissions.

### Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the author(s).

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