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TOPSIS method for evaluating the Russian higher education quality

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ABSTRACT

In this paper, we investigate the problems for evaluating the Russian higher education quality based on the TOPSIS method. According to the traditional ideas of TOPSIS, the optimal alternative (s) is determined by calculating the distances of every alternative and positive ideal solution (PIS) and negative ideal solution (NIS). It is based on the concept that the optimal alternative should have the shortest distance from the positive ideal solution and on the other side the farthest distance of the negative ideal solution. Finally, an illustrative example for evaluating the Russian higher education quality demonstrates the practicality and effectiveness of the proposed method.

KEYWORDS

Quality evaluation; Russian higher education; TOPSIS.
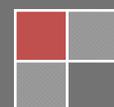
INTRODUCTION

Tradition higher education in the Russian is unique in the world, enjoy a high reputation. But with the changes of Russian economic and social in the nineties of the last century, the development of higher education has been dealt a blow. Beginning of the new century, Russia took the modernization as the main goal to develop higher education, and placed it at strategic position, and reformed continuously for it[1]. In 2003, the Russia joined in "Bologna process", which is to speed up the modernization of the Russian higher education and the pace of internationalization. In order to achieve the modernization of Russian education before 2010, as well as to adapt the principles and objectives of "Bologna process", the Russian implemented a series of influential reform measures in the higher education areas from 2003 to 2008. The five years is a very important stage to promote and deepen Russian higher education reform, and had an important impact for Russian higher education reform. Countries rely mainly on the development of higher education has gradually become the strength of the competition in the world where, when. Gradually enter the line of sight of the attention the issue of quality of higher education has become the focus of community concern. At the turn of the century, set off another wave of reform in the field of higher education, how to effectively safeguard the quality of higher education has clearly become the urgent need to solve the important problem of the world[2-3]. At this time, the signing of the Bologna Declaration in Europe marked tightly to attract the eyes of the world, in full swing to carry out the process of the construction of the European Higher Education Space. Select objects on Higher Education of the Russian State Research profound higher education in China and Russia, in addition to the hope to learn more about the essence of the process and its significant impact brought about by the reform of higher education by the member countries of the Bologna process; historical origins and many similarities in higher education in the two countries, the value Experience more advantage of this feature compared to other countries, is also an important reason[4-5]. Russian Higher Education Quality Assurance system as the starting point, through the use of literature analysis, comparative analysis and case analysis method to collect and analyze data, and analysis of the External Quality Assurance System of Higher Education in Russia, Kabardino-Balkaria State University internal education quality assurance system, summed up the advantages of Russia in the work of the Higher Education Quality Assurance where, combined with our current higher education quality assurance system status quo, and made recommendations for the future carry out the work of the Higher Education Quality Assurance System[6].

In this paper, we investigate the problems for evaluating the Russian higher education quality based on the TOPSIS method. According to the traditional ideas of TOPSIS[7-10], the optimal alternative (s) is determined by calculating the distances of every alternative and positive ideal solution (PIS) and negative ideal solution (NIS). It is based on the concept that the optimal alternative should have the shortest distance from the positive ideal solution and on the other side the farthest distance of the negative ideal solution. Finally, an illustrative example demonstrates the practicality and effectiveness of the proposed method.

TOPSIS METHOD FOR EVALUATING THE RUSSIAN HIGHER EDUCATION QUALITY

In this section, we consider a multiple attribute decision making problems to evaluate the Russian higher education quality based on the TOPSIS method[11-12]. Suppose that $A = \left(a_{ij} \right)_{m \times n}$ is the decision matrix, where a_{ij} is a preference value, given by the decision maker for the alternative $A_i \in A$ with respect to the attribute $G_j \in G$.

In the following, we will extend the TOPSIS method to evaluate the Russian higher education quality based on the TOPSIS method.

Step 1. Calculate the normalized decision matrix. The normalized value b_{ij} is calculated as

If attribute G_j is a benefit criterion:

$$b_{ij} = \frac{a_{ij} - \min\limits_{i} a_{ij}}{\max\limits_{i} a_{ij} - \min\limits_{i} a_{ij}}, \quad i = 1, 2, \cdots, m, \, j = 1, 2, \cdots, n \, . \tag{1}$$

If attribute G_j is a cost criterion:

$$b_{ij} = \frac{\max\limits_{i} a_{ij} - a_{ij}}{\max\limits_{i} a_{ij} - \min\limits_{i} a_{ij}}, \quad i = 1, 2, \cdots, m, \, j = 1, 2, \cdots, n \, . \tag{2}$$

Step 2. Determine the positive ideal solution and negative ideal solution

$$B^{+} = \left\{ b_1^{+}, \cdots, b_n^{+} \right\} = \left\{ \max\limits_{i} b_{ij} \right\} \tag{3}$$

$$B^{-} = \left\{ b_1^{-}, \cdots, b_n^{-} \right\} = \left\{ \min\limits_{i} b_{ij} \right\} \tag{4}$$

Step 3. Calculate the separation measures, using the n-dimensional Euclidean distance. The separation of each alternative from the ideal solution is given as

$$d_i^{+} = \sqrt{\sum_{j=1}^{n} \left(w_j \left(b_j^{+} - b_{ij} \right) \right)^2}, \quad i = 1, \cdots, m \, . \tag{5}$$

Similarly, the separation from the negative ideal solution is given as

$$d_i^{-} = \sqrt{\sum_{j=1}^{n} \left(w_j \left(b_{ij} - b_j^{-} \right) \right)^2}, \quad i = 1, \cdots, m \, . \tag{6}$$

Step 4. Calculate the relative closeness degree to the ideal solution. The relative closeness of the alternative A_i with respect to A^{+} is defined as

$$d_i = d_i^{-} / \left(d_i^{-} + d_i^{+} \right), \quad i = 1, \cdots, m \, . \tag{7}$$

Step 5. Rank the preference order. For ranking alternatives using this index, we can rank alternatives in decreasing order.

NUMERICAL EXAMPLE

In the global field of higher education, the reform of marketization has raised an upsurge since the 1970s and 1980s. Economic factor is the efficient amse of forcing the reform of higher education. As has become worldwide trend of reform, the market mechanism becomes the general orientation of all the measures of reform. Since the disintegration of Soviet Union, Russia, as the main continuator, has forced the political and economic reforms on the basis of all-sided privatization. Russia has finished the transition of mechanism from planned economy to market economy. The reform measures have had a profound impact on the development of education in Russia. Along with the reform and development of market economy, the phenomenon of educational marketization has emerged in the field of higher education in Russia as the particular characteristic of global educational reform. The colleges and

universities of Russia have gradually walked out of "ivory towers" which is keeping away from the society and set foot on the path of market-oriented development. In the 21st century science and technology changes quickly, so mankind has entered an age of knowledge-based economy and high information. The 21st century is one that knowledge-based economy is dominant. The multi-polarity of international politics, the information of social life and the globalization of economic activities, has made quite impact on social fields. And higher education is no exception. Higher education as one of the most important components in national education system, its level of teaching and of scientific research decides on the development of social productive forces and future potential of a nation. Therefore, at present countries all over the world view education reform and development as an important strategy and pay more attention to it, with the aim of being an insurmountable position in the international competition. To increase its competitiveness in the international education market and realize overall revitalization of European education, European countries have implemented Bologna plan, with an aim to establish "European Higher Education Zone", unify degree equivalence and certificate affirmation, attain space integration of higher education in European countries, promote teacher-student circulation and communication between different countries and different colleges, and enhance European Union's position in the international education competition. European integration conforms to Russian strategic interests, and Russia urgently needs comprehensive cooperation with Europe in politics, economy, military affairs and education, with an aim to integrate into European society and become a member of European big communities. In September 2003, Russia formally signed Declaration of Bologna, and entered into the process of creating European higher education integration. After entry into Bologna process, Russian Higher Education had a series of reform which strives for closeness to international higher education, and it will attain system integration with higher education in European countries and education modernization before 2010. In this section, we present an empirical case study of evaluating the Russian higher education quality based on the TOPSIS method. The Russian higher education quality of five possible college schools $A_i (i = 1,2,3,4,5)$ is evaluated. The five attributes include: G_1 is the environment of teaching and studying; G_2 is the management of teaching information; G_3 is the curriculum design and target; G_4 is the empathy; G_5 is the teaching practice. G_1-G_5 is evaluated by experts using 0-100. The five possible college schools $A_i (i = 1,2,3,4,5)$ are to be evaluated by the decision makers under the above five attributes (whose weighting vector $\omega = (0.15, 0.20, 0.10, 0.30, 0.25)^T$), and construct the decision matrix as follows $A = (a_{ij})_{5 \times 5}$:

$$A = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array} \begin{array}{ccccc} G_1 & G_2 & G_3 & G_4 & G_5 \\ \begin{pmatrix} 90 & 95 & 80 & 80 & 83 \\ 70 & 83 & 73 & 72 & 93 \\ 68 & 81 & 85 & 70 & 92 \\ 72 & 62 & 71 & 88 & 98 \\ 51 & 73 & 66 & 61 & 81 \end{pmatrix} \end{array}$$

To get the most desirable college schools, the following steps are involved:
Step 1. Constructing the normalized decision matrix as **B** by using formula (1) and (2):

$$B = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array} \begin{array}{ccccc} G_1 & G_2 & G_3 & G_4 & G_5 \\ \begin{pmatrix} 1.000 & 1.000 & 0.334 & 0.332 & 0.232 \\ 0.140 & 0.712 & 0.446 & 0.076 & 0.054 \\ 0.223 & 0.735 & 1.000 & 0.000 & 0.325 \\ 0.342 & 0.000 & 0.368 & 1.000 & 1.000 \\ 0.000 & 0.436 & 0.000 & 0.379 & 0.000 \end{pmatrix} \end{array}$$

Step 2. Determing the PIS and the NIS

$$C^+ = \begin{bmatrix} 1.000 & 1.000 & 1.000 & 1.000 & 1.000 \end{bmatrix}$$

$$C^- = \begin{bmatrix} 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \end{bmatrix}$$

Step 3. Calculating the separation of each college school from PIS and NIS:

$$d_1^+ = 0.153, d_2^+ = 0.212, d_3^+ = 0.276, d_4^+ = 0.354, d_5^+ = 0.165$$

$$d_1^- = 0.411, d_2^- = 0.245, d_3^- = 0.269, d_4^- = 0.334, d_5^- = 0.556 .$$

Step 4. Calculating the closeness coefficient of each college school from PIS

$$d_1 = 0.332 \, d_2 = 0.514, d_3 = 0.443, d_4 = 0.565 \, , d_5 = 0.498$$

Step 5. According to the closeness coefficient, the ranking order of the five college schools is: $A_4 \succ A_2 \succ A_5 \succ A_3 \succ A_1$ .Obviously, the best selection is the college school A_1 .

CONCLUSION

Bologna process is the most significant and involved the widest range of reforms in the field of European higher education. The goal is to establish in 2010 a European higher education area in Europe and around the world to enhance European higher education system. Bologna process in the higher education announced a number of broad objectives, including the promotion of teachers and student mobility, increase employability of graduates, etc. After Russia joined in the Bologna Process in 2003, the Bologna Process is no longer limited to western European. In order to better integrate into the European higher education area, the Russian higher education is bound to a series of reforms. In this paper, before joining the Bologna Process, the Russian higher educaiton structure, type and curriculum were outlined. The emphasis is to analysis after joining the bologna process, the changes of Russian higher education structure, credit transfer, quality assurance system, graduate employability and academic mobility. And taking to mask polytechnic university for example systematically introduce changes taken placed in Russian higher education and some of the problems faced. In this paper, we investigate the problems for evaluating the Russian higher education quality based on the TOPSIS method. According to the traditional ideas of TOPSIS, the optimal alternative (s) is determined by calculating the distances of every alternative and positive ideal solution (PIS) and negative ideal solution (NIS). It is based on the concept that the optimal alternative should have the shortest distance from the positive ideal solution and on the other side the farthest distance of the negative ideal solution. Finally, an illustrative example for evaluating the Russian higher education quality demonstrates the practicality and effectiveness of the proposed method.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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