Selection of Best Professional Institute in India: The Student Perspective

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Abstract

In recent past, selection of professional institute in India is becoming a strategic issue for a student to get higher education in professional courses. Selection of the right institution should be based on multi-criteria decision-making methods for smart decisions. Five to ten years back, the selection of the professional institutions was less strategic in the absence of ordinal data because of less number of professional institutes were in India. In this work, for selection of best professional institute among a large number of alternatives, we applied multi-criteria decision-making technique with a group of decision makers along with ordinal data of given alternatives. Initially, we aggregated the ordinal data of different choices with each criterion from the binary programming tool. After that, we have the final rankings of various alternatives derived from their group rankings by binary programming along with the criteria weights. With an illustrative case of having five decision makers, five professional institutes and three criteria named as Placement, Infrastructure and faculty profile we have shown the effectiveness of this model.

Keywords

Professional Institute, MCDM, MCGDM

1. Introduction

With a high variety of technological advancements over worldwide, globally increased the demand for a range of professional courses made the importance of those courses in professional institutes. Having a large number of human resources, India is also looking forward to having the more skilled workforce in coming future. For increasing their skilled workforce, India is focusing on their professional educational systems. From the recent academic activities, India is rapidly growing their number of professional institutes and focusing on scientific research programs for meeting their demand. With the increased number of professional institutes in India, now students required having more strategic for selection of professional institutes in today's highly competitive environment. In general, aiming towards higher studies in professional courses consists of all steps from the selection of good professional institute to get placed in reputed firms. Competitive advantages associated with professional institutes can achieve by strategic collaboration with professional institutes and good quality of students. The future success of having a professional degree is highly dependent on the selection of good professional institute. Judging and selecting the professional institute becomes one of the most vital actions from the students for having a professional degree. AS from the financial point of view, the bulk of tuition fees is a major challenge for economically poor students and choosing a good institute requires a good return on investment of having a professional degree. Selection of wrong professional institute can drag a student on the back foot and leads to deteriorating their knowledge base and chances of having a good job. On the other hand selection of reputed professional institute will enhance student's knowledge base and increase their employability. Thus good professional institute selection has drawn considerable attention from students and their parents for having a professional degree.

The objective of the professional institute selection process is to identify a professional institute with the highest potential for enhancing a student's career graph and increase their employability along with their overall growth under healthy environment. Selecting good professional institute from a large number of possible alternatives with various levels of potential and capabilities is a difficult task. This demands better decision making policy for the student perspective. Prioritization of the alternative and selection of the best alternative is the major challenge for students in selection of the good institution.

In today's competitive environment and rapid technological changes, making the selection of professional institute based on placement only is not efficient decision criteria. Multiple criteria including infrastructure, placement, academic excellence, return on investment, extra activities, industrial interface and research these are some activities need to be taken into account simultaneously in the professional institute selection decision-making process [1]. Among these all we identified placement, infrastructure and faculty profile are the three most important criteria which influence in professional institute evaluation and selection in India. In modern management, one needs to consider many other factors with the aim of developing a long-term associated institute branding values. It represents that professional institute selection is a multi-criteria decision-making problem (MCDM). With the complexity and importance of student’s professional institute selection process in India, usually, it requires multiple decision makers such as students, parents, career counselors, teachers, and seniors. So, professional institute selection is a typical multi-criteria group decision-making (MCGDM) problem.

We proposed an MCGDM model based on 0-1 programming for a professional institute selection in which decision makers give ordinal preferences of alternatives on each criterion considered. From this method, we will rank the alternatives for the decision maker group and generalize Bernardo's method for MCDM [2] to MCGDM considering the weights of criteria and decision makers.

Organisation of this paper is as follows. In Section II, literature review of the work is presented. The proposed mathematical model for selection of the best professional institute is presented in section III. In section IV, a numerical example and discussions of the results is presented. Lastly, conclusions of this research work are drawn in Section V.

2. Literature Review

In this paper, we tried to present a brief review over professional institute selection or college selection for higher studies. In general, there are not many past data specifically related to research over the selection of professional institute. The maximum analysis had been done in the generalized form of college selection without any specific consideration of professional or unprofessional institutes [3-5]. Some work is used qualitative techniques and some used quantitative technique. In the quantitative technique, authors used MCDM models for college selection. Professional Institute evaluation and selection are one of the most critical activities of students since professional knowledge performance can have a direct skill development and more return on investment impact over student's education. Because of its increasing importance, we considered professional institute selection in this study with the past related literature of college selection. Early in 2010, A. Pampaloni [3] identified the factors most influential in their college selection decision-making process. Up to date, the criteria for assessing professional institute performance in the professional institute selection process have been widened [4]. Another comprehensive review by Warwick [5] discussed a framework for students and parents base college selection on how well the college will overcome the perceived financial, social, psychological, physical, and functional risks associated with the college experience. Risks of significant differences between students and parents as well as for their level of importance in the selection process were evaluated with the nineteen associated criteria. The most important criterion for both students and parents was the academics of the Institute [5]. The vast majority of the decision models for the professional institute or college selection apply to the final choices phase and which can be classified into five categories: multi-criteria decision making, categorical approaches, artificial intelligence techniques, mathematical programming models, and integrated approaches [6].

The multi-criteria decision-making models concentrate on selection activities, which adopt a limited and countable number of predetermined alternatives through multiple criteria. Weight is assigned to each of the criteria to distinguish between criteria with different importance. The professional institute's grades are multiplied by these weights, and a weighted score (rating) is computed for each professional institute. The professional institute with the highest overall rating can then be selected. Most Approaches utilized, such as AHP, conjoint analysis, the linear weighting method, ELECTRE, PROMETHEE, and TOPSIS can be classified into this kind [7, 8].

The AHP provides a simple but theoretically sound multiple-criteria methodology for evaluating alternatives [9]. So it has been easy to apply for the professional institute selection problem. Pampaloni [3] discussed the application of outranking methods in professional institute or college selection problem. They have illustrated it with an example that the model presented seems to be an additional tool inside the final choice phase of a professional institute selection process. According to the concept of the TOPSIS, a closeness coefficient is defined to determine the ranking order of all professional institutes by calculating the distances to the both fuzzy positive-ideal solution and fuzzy negative-ideal solution simultaneously [6]. We used here methodology used by Li et al. [6] in their supplier selection process which shows implication of modified TOPSIS for group decision-making under ordinal preferences and applied it to here for professional institute selection along with ordinal data.

Professional Institute requires the decision makers to provide qualitative/quantitative assessments for determining the performance of each alternative on each criterion, and relative importance of evaluation criteria on the overall objective of the problems. These type of problems usually causes uncertain, imprecise, indefinite and subjective data being present, which leads decision-making process as complex and challenging one. Thus decision-makers usually are willing or easy to give his ordinal preferences of alternatives. So it is necessary to develop effective MCGDM models for professional institute selection in the presence of ordinal data. Also, the authoritativeness and validity of evaluations of alternatives on the same criteria given by different decision makers may be different, for the abilities, knowledge, positions, and familiarities with the decision-making problem of different decision makers are different. Thus, the weights of decision-makers on each criterion have to be considered respectively.

3. MCGDM Model for Professional Institute Selection with Ordinal Data

In this section, we shall develop a new MCGDM model based on 0-1 programming for professional institute selection with ordinal preferences of the alternatives given by the decision makers. Before presenting the proposed method, we define and formulate the supplier selection problem first.

3.1 Problem Description:

Consider a problem of professional institute selection in India with I number of decision makers evaluating J number of professional institutes based on K number of criteria. Here we are denoting D_i (i=1,2,....,I) for decision maker, P_j

(j=1,2,....,J) for professional institute and C_k (k=1,2,.....,K) for criteria. For the weight of criteria, we have taken W_K which satisfies $\sum_{k=1}^{K} W_k = 1$ and $W_k^i > 0$. R_{kj}^i is the rating of alternative P_j on criteria C_k was given by decision maker D_i and $R_{kj}^i \in \{1,2,\ldots.,J\}$. For certain i, all R_{kj}^i constitute individual decision matrix $R^i = [R_{kj}^i]_{JxK}$ as follows.

$$R^i = \begin{bmatrix} R_{11}^i & \cdots & R_{1K}^i \\ \vdots & \ddots & \vdots \\ R_{J1}^i & \cdots & R_{JK}^i \end{bmatrix}$$

R_{kj}^G is the ranking of alternative P_j on criteria C_k for the group and $R_{kj}^G \in \{1,2,\ldots.,J\}$. R_j^G is the final ranking of alternative P_j for the group and $R_j^G \in \{1,2,\ldots.,J\}$.

3.2 The proposed algorithm

Following Bernardo's method for MCDM [7] and generalizing it to MCGDM, we develop the algorithm below. We first aggregate the individual ordinal preferences to obtain the ranking of all alternatives under each criterion in the opinion of the group. Then the final ranking of them is derived from the group rankings on each criterion. The algorithm proceeds as follows:

Step I: Define the consistency matrix

$M_k^i = \left[m_{kmn}^i\right]_{J\times J}$ for D_i under C_k where,

$$m_{kmn}^i = \begin{cases} 1, & where\ R_{km}^i = n; \\ 0, & otherwise \end{cases}$$

Step II: Calculate the weighted consistency matrix M_k^G under C_k after considering the heights of decision makers under C_k.

$$M_k^G = [m_{kmn}^G] = \sum_{i=1}^{I} W_k^i \times M_k^i$$

Step III: Obtain the ranking R_{kj}^G of P_j for the group with respect to C_k by solving the following 0-1 programming problem:

(S_{1k}) $\quad max \sum_{m=1}^{J} \sum_{n=1}^{J} m_{kmn}^G x_{kmn}^G$

s.t. $\sum_{n=1}^{J} x_{kmn}^G = 1$, m=1,2,...,J

$\sum_{m=1}^{J} x_{kmn}^G = 1$, n=1,2,....,J

$x_{kmn}^G \in \{0,1\}$, m,n=1,2,....,J

$x_{kmn}^G = 1$, (m,n=1,2,....,J), the solution of (S_{1k}), indicates $R_{km}^G = n$, that is to say, the ranking of P_m for the group with respect to C_k is n.

Step IV: Define the consistency matrix $N_k^G = [n_{kmn}^G]_{JxJ}$ for the group under C_k where

$$f_{kmn}^G = \begin{cases} 1, when\ R_{km}^G = n; (m,n = 1,2,\ldots,J) \\ 0, \qquad otherwise \end{cases}$$

Step V: Calculate the weighted consistency matrix $N^G = [n_{mn}^G]_{J\times J} = \sum_{k=1}^{K} \lambda_k \times N_k^G$

Step VI: Obtain the final ranking R_j^G of P_j for the group by solving the following 0-1 programming problem.

(S_2) $max \sum_{m=1}^{J} \sum_{n=1}^{J} n_{mn}^{G} x_{mn}^{G}$

s.t. $\sum_{n=1}^{J} x_{mn}^{G} = 1$, m=1,2,...,J

$\sum_{m=1}^{J} x_{mn}^{G} = 1$, n=1,2,....,J

$x_{mn}^{G} \in \{0,1\}$, m,n=1,2,....,J

$x_{mn}^{G} = 1$, (m,n=1,2,....,J), the solution of (S_2), indicates $R_m^G = n$, that is, the final ranking of S_m for the group is n.

4. Illustrative Case Analysis

Consider a professional institute selection committee consisting of 5 decision makers, five professional institute alternatives and three criteria (Faculty profile, Infrastructure & placement). The weights data and ordinal preferences are listed below and R^i (i=1,2,....,5) as follows:

Table 1. Weights of the criteria and decision makers on each criterion

K	λ_k	W_k^1	W_k^2	W_k^3	W_k^4	W_k^5
1	0.3	0.22	0.26	0.20	0.19	0.13
2	0.3	0.18	0.21	0.26	0.16	0.19
3	0.4	0.18	0.20	0.18	0.21	0.23

$$R^1 = \begin{bmatrix} 4 & 1 & 5 \\ 5 & 3 & 4 \\ 2 & 4 & 2 \\ 3 & 2 & 1 \\ 1 & 5 & 3 \end{bmatrix}, R^2 = \begin{bmatrix} 2 & 4 & 2 \\ 1 & 2 & 5 \\ 3 & 5 & 4 \\ 5 & 3 & 1 \\ 4 & 1 & 3 \end{bmatrix}, R^3 = \begin{bmatrix} 5 & 3 & 3 \\ 2 & 2 & 4 \\ 1 & 4 & 1 \\ 3 & 5 & 5 \\ 4 & 1 & 2 \end{bmatrix}, R^4 = \begin{bmatrix} 1 & 4 & 3 \\ 4 & 2 & 5 \\ 5 & 5 & 4 \\ 2 & 1 & 2 \\ 3 & 3 & 1 \end{bmatrix}, R^5 = \begin{bmatrix} 2 & 3 & 3 \\ 4 & 1 & 2 \\ 5 & 2 & 5 \\ 1 & 5 & 1 \\ 3 & 4 & 4 \end{bmatrix}$$

Now we first detail the procedure of obtaining the final rankings of the professional institutes for the committee by the proposed method.

Step I: Define $M_k^i = \left[m_{kmn}^i\right]_{J \times J}$ below we just list M_1^i as follows.

$$M_1^1 = \begin{bmatrix} 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}, M_1^2 = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}, M_1^3 = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$$

$$M_1^4 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}, M_1^5 = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

Step II: Calculate M_k^G as follows. For example,

$M_1^G = 0.22M_1^1 + 0.26M_1^2 + 0.20M_1^3 + 0.19M_1^4 + 0.13M_1^5$

$$M_1^G = \begin{bmatrix} 0.19 & 0.39 & 0 & 0.22 & 0.20 \\ 0.26 & 0.20 & 0 & 0.32 & 0.22 \\ 0.20 & 0.22 & 0.26 & 0 & 0.32 \\ 0.13 & 0.19 & 0.42 & 0 & 0.26 \\ 0.22 & 0 & 0.32 & 0.46 & 0 \end{bmatrix}$$

Similarly,

$$M_2^G = \begin{bmatrix} 0.18 & 0 & 0.45 & 0.37 & 0 \\ 0.19 & 0.63 & 0.18 & 0 & 0 \\ 0 & 0.19 & 0 & 0.44 & 0.37 \\ 0.16 & 0.18 & 0.21 & 0 & 0.45 \\ 0.47 & 0 & 0.16 & 0.19 & 0.18 \end{bmatrix}, M_3^G = \begin{bmatrix} 0 & 0.20 & 0.62 & 0 & 0.18 \\ 0 & 0.23 & 0 & .36 & 0.41 \\ 0.18 & 0.18 & 0 & 0.41 & 0.23 \\ 0.61 & 0.21 & 0 & 0 & 0.18 \\ 0.21 & 0.18 & 0.38 & 0.23 & 0 \end{bmatrix}$$

Step III: Obtain the ranking R_{kj}^G. For k=1, solve the following 0-1 programming problem:

(S$_{11}$) max $(0.19x_{111}^G + 0.39x_{112}^G + 0.22x_{114}^G + 0.20x_{115}^G + 0.26x_{121}^G + 0.20x_{122}^G + 0.32x_{124}^G + 0.22x_{125}^G +$
0.20x131G+0.22x132G+0.26x133G+0.32x135G+0.13x141G+0.19x142G+0.42x143G+0.26x145G+0.22x151G+0.32x153G+0.46x154G

s.t. $\sum_{n=1}^{5} x_{kmn}^G = 1$, m=1,2,...,5

$\sum_{m=1}^{5} x_{kmn}^G = 1$, n=1,2,....,5

$x_{kmn}^G \in$ {0,1}, m,n=1,2,....,5

To obtain $x_{112}^G = 1, x_{121}^G = 1, x_{135}^G = 1, x_{143}^G = 1, x_{154}^G = 1$,which indicates $R_{11}^G = 2, R_{12}^G = 1, R_{13}^G = 5, R_{14}^G = 3, R_{15}^G = 4$. In the same way we can obtain $R_{21}^G = 3, R_{22}^G = 2, R_{23}^G = 4, R_{24}^G = 5, R_{25}^G = 1$ and $R_{31}^G = 3, R_{32}^G = 5, R_{33}^G = 4, R_{34}^G = 2R_{35}^G = 1.$

Step IV: Define N_k^G as follows

$$N_1^G = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}, N_2^G = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}, N_3^G = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

Step V: Calculate $N^G = 0.3N_1^G + 0.3N_2^G + 0.4N_3^G$

$$N^G = \begin{bmatrix} 0.3 & 0.7 & 0 & 0 & 0 \\ 0 & 0.3 & 0.4 & 0.3 & 0 \\ 0 & 0 & 0 & 0.7 & 0.3 \\ 0.4 & 0 & 0.3 & 0 & 0.3 \\ 0.3 & 0 & 0.3 & 0 & 0.4 \end{bmatrix}$$

Step VI: Obtain the final ranking R_j^G by solving the following 0-1 programming problem:

(S$_2$) $max(0.3x_{11}^G + 0.7x_{12}^G + 0.3x_{22}^G + 0.4x_{23}^G + 0.3x_{24}^G + 0.7x_{34}^G + 0.3x_{35}^G + 0.4x_{41}^G + 0.3x_{43}^G + 0.3x_{45}^G +$
0.3x51G+0.3x53G+0.4x55G

s.t. $\sum_{n=1}^{5} x_{mn}^G = 1$, m=1,2,...,5

$\sum_{m=1}^{5} x_{mn}^G = 1$, n=1,2,....,5

$x_{mn}^G \in$ {0,1}, m,n=1,2,....,5

The solution of (S_2) is $x_{12}^G = 1, x_{23}^G = 1, x_{34}^G = 1, x_{41}^G = 1, x_{55}^G = 1$, which indicates $R_1^G = 2, R_2^G = 3, R_3^G = 4, R_4^G = 1, R_5^G = 5$, that is to say, for the committee, $P_4 > P_1 > P_2 > P_3 > P_5$.

This just shows that the proposed methodology for the professional institute selection is rational and effective. We may get different results for the same decision-making problem with the application of the different methodology.

5. Conclusion

Recently taking evaluation and selection of professional institute in India is one of the most critical activities for students. With the complication and importance of the problem, professional institute selection is a typical MCGDM problem, and the group of decision-makers usually give their ordinal preferences of the different alternatives. We used an MCGDM methodology based on 0-1 programming for professional institute selection with ordinal data and decision makers weights on each criterion. With an illustrative case of a problem, we simulated and found the result of the problem, which shows the proposed method is rational, effective and easy to compute.

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