IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.7, Special Issue.1, Jan 2019 E-ISSN: 2347-2693

Comparative Evaluation of Students' Performance in Campus Recruitment of a Technical Institution through Fuzzy-Multi Criteria Decision Making Techniques

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Available online at: www.ijcseonline.org

***Abstract*—** In today's world Campus placements at any Technical college in India and in the life of any student/graduate are very defining moments that students look up to and prepare themselves thoroughly to score high and well but as well as to impress their potential future employers. It is the one time that students get a precise chance to make that practical application of their technical and employable soundness to the representatives of the corporate management of the particular industry they opted for or chose in the first place. Campus Placement is a process of performance evaluation of each selected candidates with respect to some pre-assigned specific criteria by the experts. For these, an attempt has been made here to assessment of some criteria by (TOPSIS) "Technique for Order Preference by Similarity to Ideal Solution" and (AHP) "Analytical Hierarchy Process" under Interval Type-1 fuzzy environment (IT1F) and Interval Type-2 fuzzy environment (IT2F). These factors for Placement system are identified through the different company's placement procedure. Here several experts gave their opinion on the basis of students' performance. The result showed that the proposed model yields more realistic way to evaluate the performance for each student according to pre assigned criteria.

***Keywords*—** IT1F set, IT2F set, AHP, TOPSIS, Group Decision Making and Spearman Rank Correlation Method

I. INTRODUCTION

The opportunity when strikes its way we have to avail without any excuses. The main concept of campus placement revolves round the talent hunt, the student need to pull up their socks and gear up for the challenge. Placements give students the opportunity to gain skills specific to their subject or industry of choice as well as the employability skills required for real-life work. This process reduces the time for an industry to pick the candidates according to their need. But it is a burdensome activity and hence bulk of the companies finds it difficult to recognize the right talent in a short time of span. So, we have sketch a model under the environment of Interval Type-1 fuzzy and Interval Type-2 fuzzy set to evaluate the performance of 10 (ten) students with respect to students' performance criteria: 60% aggregate or above throughout academics (C1), basic knowledge of technical field (C2), excellent communication & aptitude skill (C3) and Max of 2 backlogs/Reattempts in Under Graduation (C4). That will help to companies to select the best one for their organization. Actually the aim of this paper is to present not only a hypothetical methodology in multi criteria decision making problems but also a practical application in campus placement system. The proposed approach integrates Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS) and Analytic Hierarchy Process (AHP) techniques under Interval Type-1 fuzzy (IT1F) and Interval Type-2 fuzzy (IT2F) environment. While AHP and TOPSIS provides a comprehensive framework to solve multi criteria decision making (MCDM) problems in campus placement and the IT1F enables to deal with much vagueness, on the same time IT2F minimize the effects of uncertainties in rule-based fuzzy system during linguistic assessment of decision makers.

The study is organized as follows: Section II emphases about the Experts' opinion, Section III focuses about MCDM approaches using two methodologies, Section IV analyze the performance evaluation of students on the basis of some experts' opinion followed by the comparison among the results. At the end of the paper in Section V concludes the paper. This proposed methodology is effectively more powerful than the usual methods.

II.EXPERTS' OPINION

In this survey, after completion of B-Tech degree of Ten students [S1;S2;S3;S4;S5;S6;S7;S8;S9;S10] were examined and selected by various test and interviews which are arranged by the experts' of the renowned organization in the campus placement. Experts' gave their opinions which are H

(high), MH (medium high), M (medium), VL (very low) on the basis of 60% aggregate or above throughout academics (C1), basic knowledge of technical field (C2), excellent communication & aptitude skill (C3) and Max of 2 backlogs/Reattempts in Under Graduation (C4), presented in Table 1.

Table 1. Experts' Opinion against each Student

Criteria	Alternative									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
C1	MH	H	M	M	M	MH	H	M	MH	MH
C2	VL	VL	H	H	H	VL	VL	H	H	H
C3	H	H	H	VL	H	VL	H	VL	H	VL
C4	VL	VL	VL	VL	VL	H	H	VL	VL	H

III. MCDM APPROACHES

This paper gives methodological approach combining AHP and TOPSIS techniques under the IT1F and IT2F environment to evaluate the best employee for a renowned company after completion of B-Tech degree.

A. Interval Type-1 Fuzzy Set (IT1F)

A class of objects entwined is a fuzzy set; with a range of grades of membership. A membership function characterizes such a set which assigns to each object a grade of membership ranging between zero and one [7,19]. Fuzzy logic is a powerful mathematical tool for representing uncertainty in every field. Their role is significant when applied to complex phenomena which are not easily described by traditional mathematical methods, especially when the goal is to find a good approximation solution [6]. Fuzzy sets have proven to be an eminent way for solving the decision problems where the information available is subjective and vague [3,13,15].

B. Interval Type-2 Fuzzy Set (IT2F)

Type-2 fuzzy set by Zadeh (1975) is a continium of the type-1 fuzzy set by (Karnik and Mendel, 2001; Mendel, 2007).The general type-2 fuzzy sets have not usually implemented to real applications because of the containing complex computational operations (Mendel et al., 2006; Kahraman et al., 2014). (Mendel and John, 2002) emphasized the robust handling of vagueness by IT2F and thus increases the probability of accurate results (Dereli and Altun, 2013).

a) Definition 1. A type-2 fuzzy-set; $\tilde{\tilde{A}}$ in the universe of discourse X can be formulated by a type-2 membership function $\mu_{\tilde{\tilde{A}}}$ given as :

$$\tilde{\tilde{A}} = \{((x,u), \mu_A \approx (x,u))\}; \forall x \in X; \forall u \in J_x \subseteq [0,1], 0 \le \mu_A(x,u) \le 1$$

Where $J_x \subseteq [0,1]$

b) Definition 2. In the universe of discourse X;a type-2 fuzzy set $\tilde{\tilde{A}}$ presented by type-2 membership function $\mu_{\tilde{\tilde{A}}}$. If all $\mu_{\tilde{\tilde{A}}}(x,u) = 1$, then $\tilde{\tilde{A}}$ is called as an IT2FSs. An IT2FSs $\tilde{\tilde{A}}$ can be considered as a unique case of a type-2 fuzzy set, given as follows:

$$\tilde{\tilde{A}} = \int_{x \in X} \int_{u \in J_x} 1/(x,u) \ where \ J_X \subseteq [0,1]$$

c) Definition 3. The upper and the lower membership function of an IT2FS are given below;

Type-1 fuzzy sets | reference points of the IT2FSs | Upper membership function

$$\tilde{\tilde{A}}_i = (\tilde{A}_i^U, \tilde{A}_i^L) = \Big((a_{i1}^U, a_{i2}^U, a_{i3}^U, a_{i4}^U; H_1(\tilde{A}_i^U), H_2(\tilde{A}_i^U)) \ (a_{i1}^L, a_{i2}^L, a_{i3}^L, a_{i4}^L; H_1(\tilde{A}_i^L), H_2(\tilde{A}_i^L)) \Big)$$

Lower membership function

C. Analytical Hierarchy Process (AHP)

The pair-wise comparison method and the hierarchical model were developed in 1980 by Saaty in the context of the Analytical Hierarchy Process (AHP) [17,18]. AHP is an approach to decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives [4]. Buckley (1985) extended Saaty's AHP by integrating with fuzzy sets. In this paper, Buckley's approach is employed to obtain importance weights of criteria.

D. Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS)

TOPSIS enumerates the principle of maintaining the shortest Euclidian distance from the positive ideal solution whereas maintaining a shortest distance from the negative ideal solution (Chen and Hwang, 1992; Opricovic and Tzeng, 2004). Since it's inception by Hwang and Yoon [1], the process of TOPSIS relies on the performance ratings and criteria weights to be Real Valued Floats. Multi-objective nonlinear programming problems using TOPSIS were first tackled by Abo-sinna and Amer [9]. Jahanshahloo, HosseinzadehLotfi and Izadikhah [5] extend the concept of TOPSIS to develop a methodology for solving multi-criteria decision-making problems with interval data.

E. Group Decision Making

When decision is particularly complex in nature with personal interests and conflicting preferences among a good number of decision-makers involved; solutions may lead to an unsatisfactory conclusion and sometimes may be even erroneous. In this regard, effective group decision-making can be viewed as a process in which individual interests are reduced and integrated so as to form a single group preference or consensus [14]. An integrated approach can be used where rank coefficient values can be used as a bench

mark to ascertain the conflicting nature of decision makers and their strength.

F. Spearman Rank Correlation Method

Spearman rank correlation coefficient ρ is useful to determine the measure of association/correlation (including positive or negative direction of a relationship) between ranks achieved by different MCDM methods and/or different decision-makers and/or different scenarios for a given set of alternatives. Spearman rank correlation Characteristics of R can be explained in Table 2.

IV. ANALYSIS AND DISCUSSION

a) After using the results of ten students, we prepare pair wise comparison matrix under the interval type-1 and type-2 fuzzy environment and calculate the weights of the criteria by AHP again under the IT1F and IT2F environment which is shown in Table 4 and Table 5 respectively.

b) Under the IT1F and IT2F environment, the input of TOPSIS is the weighted normalized matrix which is obtained from AHP. Calculate the relative closeness to the ideal solution; find average value of assessment of the alternatives according to ideal solution values in descending order.

c) In this study it is seen that the final ranking of students in IT1F (Table 6) and in IT2F (Table 7) are not same. There are huge differences between them. So, we have used decision making method to get the single ranking structure, which will help to the organization to select the best one from the ten students. But, finally by using Spearman Rank Correlation Method we got LOW relation (Table 2) between them from Table 8. Again there is a conflicting situation. One question is arising. Is there any relation between IT1F and IT2F? Actually Fuzzy logic has the tendency to handle vagueness and uncertainty in a data set of same size. In this study various approaches of Fuzzy Logic, namely, Interval Type-1 Fuzzy Logic, Interval Type-2 Fuzzy Logic are being used for decision making. So, a comparative study on the various parameters of Interval Type-1 Fuzzy Logic and Interval Type-2 Fuzzy Logic is conducted to assess the performance of students to select the best one from ten students.

d) Type-1 Fuzzy Logic is rather a simple approach and results in the fast generation of outputs, but Type-2 Fuzzy Logic can provide better results in many cases. As a result in our proposed model, final ranking structure in Table 7(Type 2 Fuzzy) is more accurate than the Table 6 (Type 1 Fuzzy) according to pre assigned criteria. Student S7 has all the credit points to get the first position in ranking in Table 7, where as S10 in has below points. But S10 got first position in TABLE 6. That implies after using the Interval Type-2 Fuzzy Logic, we have reached at final and accurate result of ranking. Similarly remaining students also got their accurate position in TABLE 7 according to the points whatever he/she has scored in various test and interviews.

e) Lastly by using Spearman Rank Correlation Method we got LOW relation between Type-1 Fuzzy Logic and Interval Type-2 Fuzzy Logic in TABLE 8.That signifies Type-2 fuzzy sets can handle such uncertainties because their membership functions are fuzzy.

f) Our proposed model has showed the path to discover the eligible candidate for any renowned organization in campus placement which is very essential part for economic society as well as for the world.

Table 2. Spearman rank correlation Characteristics

Correlation	Nature of	Remark
0.9 - 1.0	Very High	Very Strong relationship
0.7 – 0.9	High	Marked relationship
0.4 – 0.7	Moderate	Substantial relationship
0.2 – 0.4	Low	Definite relationship
< 0.2	Slight	Small relationship

Table 3. Linguistic Terms of Performance of Best Student Evaluation

Linguistic terms	IT2F											
Very Low (VL)	0	0	0	0.1	1	1	0	0	0	0.5	0.9	0.9
Medium (M)	0.3	0.5	0.5	0.7	1	1	0.4	0.5	0.5	0.6	0.9	0.9
Medium high (MH)	0.5	0.7	0.7	0.9	1	1	0.6	0.7	0.7	0.8	0.9	0.9
High (H)	0.9	1	1	1	1	1	1	1	1	1	0.9	0.9

Table 4. Weights of Criteria under IT1F

Criteria	Weight
C1	0.3700535
C2	0.3450535
C3	0.1850267
C4	0.0998663

Table 5. Weights of Criteria under IT2F

Criteria	Fuzzy Weights					
C1	0.667	0.684	0.684	0.691	1.000	1.000
	0.632	0.644	0.644	0.655	0.900	0.900
C2	0.220	0.215	0.215	0.212	1.000	1.000
	0.231	0.228	0.228	0.225	0.900	0.900
C3	0.080	0.073	0.073	0.071	1.000	1.000
	0.094	0.089	0.089	0.085	0.900	0.900
C4	0.033	0.028	0.028	0.026	1.000	1.000
	0.043	0.039	0.039	0.036	0.900	0.900

Table 6. Ranking of Students under IT1F

Alternatives	D_i^+	D_i^-	C_i	Rank
S1	0.1537263	0.0616577	0.2862687	9
S2	0.1434842	0.0942094	0.396348	8
S3	0.0941047	0.1202018	0.5608875	4
S4	0.10854	0.10481	0.4912585	6
S5	0.091389	0.1174331	0.5623593	3
S6	0.1560645	0.0482424	0.236127	10
S7	0.1369066	0.098753	0.4190493	7
S8	0.1054641	0.1049778	0.4988446	5
S9	0.0809901	0.111432	0.5791018	2
S10	0.080837	0.1431831	0.6391528	1

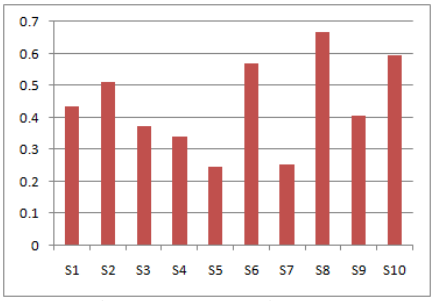

Figure 1: Performance ranking of students under IT1F

Table 7. Ranking of Students under IT2F

Alternatives	d(Xi1,X1*) For C1		d(Xi2,X2*) ForC2		d(Xi3,X3*) For C3		d(Xi4,X4*) For C4	
S1	0.157386	0.17105	0	0	0.079661	0.09	0.056248	0.27838
S2	0.364078	0.34601	0	0	0.079661	0.09	0	0
S3	0	0	0.230586	0.228002	0.079661	0.09	0	0
S4	1.92E-16	0	0.230586	0.228002	0	0	0	0
S5	1.92E-16	0	0.230586	0.228002	0.079661	0.09	0	0
S6	0.157386	0.17105	0	0	0	0	0.030594	0.040254
S7	0.364078	0.34601	0	0	0.079661	0.09	0.030594	0.040254
S8	0	0	0.230586	0.228002	0	0	0	0
S9	0	0	0.230586	0.228002	0.079661	0.09	0	0
S10	0	0	0.230586	0.228002	0.079661	0.09	0.030594	0.040254

Alternatives	Dj-		Ci		Avg	Rank
S1	0.293295	0.53943	0.382170	0.540591	0.46138	3
S2	0.443739	0.43601	0.602052	0.461327	0.531689	2
S3	0.310247	0.31801	0.420934	0.336469	0.378702	6
S4	0.230586	0.228	0.312853	0.241240	0.277046	8
S5	0.310247	0.31801	0.420934	0.336469	0.378702	5
S6	0.187981	0.2113	0.248190	0.213565	0.230878	10
S7	0.474333	0.47627	0.633900	0.489462	0.561681	1
S8	0.230586	0.228	0.312853	0.241240	0.277046	9
S9	0.310247	0.31801	0.420934	0.336469	0.378702	6
S10	0.340842	0.35826	0.455501	0.368186	0.411844	4

Table 8. Spearman rank correlation coefficient

	Type 1 Fuzzy	Type 2 Fuzzy
Type 1 Fuzzy	1	0.0242
Type 1 Fuzzy	0.0242	1

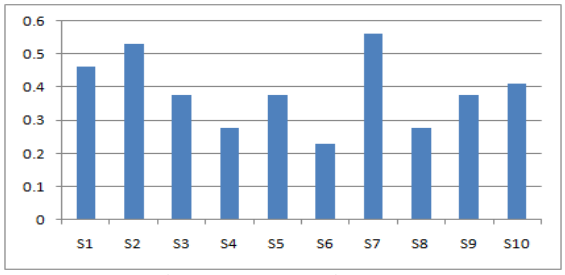

Figure 2: Performance ranking of students under IT2F

Comparative study of Figure1 and Figure 2 will be discussed briefly at the conclusion part of the paper.

V. CONCLUSION

a) In this paper it is clear that Campus Placement form an important part of a business's ethos, corporate social responsibilities and identify by developing the skills of students or those that are important to the future of their industry. Ultimately a high-quality placement should provide benefits for all parties involved.

b) In this context we have discussed a comparative study on the various parameters of Interval Type-1 Fuzzy Logic and Interval Type-2 Fuzzy Logic to assess the performance of students to select the best one from ten students in a renowned Organization Campus Placement.

c) The concept of Interval Type-2 fuzzy sets (IT2F) as an extension of the Type-1 fuzzy sets. Interval Type-2 fuzzy logic has been attracting great research interests in recent times. Numerous reported outcomes have exposed that the Type-2 fuzzy sets are better able to handle uncertainties than their Type-1 Fuzzy Sets.

d) Karnik and Mendel [8] pointed out that an IT2F logic system can be thought of as a collection of many different embedded T1 fuzzy logic systems. Type-2 fuzzy sets minimize the effects of uncertainties in rule-base fuzzy logic systems. The implanted Type-1 fuzzy sets used to compute the bounds of the type-reduced interval change as input changes. The upper and lower membership functions of the same Interval Type-2 fuzzy set may be used simultaneously in computing each bound of the type-reduced interval. Type-1 fuzzy sets do not have these properties. These are the advantages of using Type-2 fuzzy sets.

e) That's why in our study, to overcome the difficulties we are presenting a proposed model of the comparative study of Interval Type-1 fuzzy sets and the Interval Type-2 fuzzy sets together at a time. As a result we got comparatively better result of ranking of ten (10) students in Type-2 fuzzy sets than the Type-1 fuzzy set.

f) Finally this framework establishes a multi criteria decision making approach that integrates two types of Fuzzy sets to analyze the performance of students to get a dream job in a renowned organization which presents a great preference to the Placement team of any

distinguished association to increase their goodwill and maintains the tradition.

VI. FUTURE WORK

Our aim is to explore the use of fuzzy based Multi-Criteria Decision Making and statistical techniques in Indian higher education. In future we will study and should focus in incorporating more performance factors to be used as input data and more intelligent decision making from expert's point of view with the help of Type 1 and Type-2 fuzzy, which is ongoing process.

ACKNOWLEDGMENT

We would like to thank our guide, Dr. Dipendra Nath Ghosh for his never-ending support in helping us to build up this and letting us follow our vision.

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