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An Application of Intuitionistic Fuzzy Sets in Choice of Discipline of Study

K. Meena and Lija Ponnappen

Department of Basic Science & Humanities,
Muthoot Institute of Technology & Science,
Varikoli, India.

Abstract

The problem of decision making in an imprecise environment has found paramount importance in recent years. Intuitionistic fuzzy sets are interesting and useful to deal with real-life situations. In this paper we apply the concept of intutionistic fuzzy set to study the student choice, under non-government quota, of various disciplines at one of the premier institute of technology. The normalized Eudidean distance method is used to measure the distance between the category classified in terms of ranking in CEE (Common Entrance Exam) or marks obtained in HSS (Higher Secondary School) exam and the various disciplines of engineering.

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1. Introduction

Among the several generalisations of fuzzy set theory for various objectives, the notion introduced by Atanassov [1] in defining intuitionistic fuzzy sets (IFS) has tremendous application. Fuzzy sets are IFS though the converse is not necessarily true. Intuitionistic fuzzy sets may be more appropriate to deal with, in different areas namely logic programming decision making problems [3, 4, 5] etc. Many applications of IFS [9] are carried out using distance measures approach [8]. Distance measure between IFS is an important concept in fuzzy mathematics because of its application in real-world.

In the present paper we show a novel application of IFS in the choice of disciplines in technical graduation course. An example of discipline choice is illustrated. The marks obtained by the students in the Higher Secondary School (HSS) exam in a set of subjects Physics (P), Chemistry (C), Mathematics (M) and the discipline choice namely Mechanical Engineering (ME), Civil Engineering (CE), Electronics & Communication Engineering (ECE), Electrical & Electronics Engineering (EEE) and Computer Science Engineering (CSE) made by students are studied using IFS. The normalised euclidean distance method measures the distance between the category which is subject to ranking in CEE/marks of HSS and the disciplines of engineering. The smallest obtained value gives an estimate of the nearness of the rankings to the favourable discipline of engineering.

2. Preliminary

In this section some basic concepts applied in this paper are recalled.

Definition 2.1. [2] Let a set E be fixed. An intuitionistic fuzzy set (IFS) A in E is an object having the form

$$A = \{\langle x,\ \mu_A(x),\ \nu_A(x)\rangle / x \in E\}$$

where the function. $\mu_A : E \to [0,1]$ and $\nu_A : E \to [0,1]$ define the degree of membership and the degree of non-membership respectively of the element $x \in E$ to the set A, which is a subset of E and for every $x \in E$, $0 \leq \mu_A(x) + \nu_A(x) \leq 1$. The amount $\pi_A(x) = 1 - (\mu_A(x) + \nu_A(x))$ is called the hesitation part, which may cater to either membership value or non-membership value or both.

Definition 2.2. [7] If A and B are two IFSs of the set E then

i $A \subset B$ iff $\forall x \in E$, $\mu_A(x) \leq \mu_B(x)$ and $\nu_A(x) \geq \nu_B(x)$

ii $A = B$ iff $\forall x \in E$, $\mu_A(x) = \mu_B(x)$ and $\nu_A(x) = \nu_B(x)$

iiii $\bar{A} = \{\langle x,\ \nu_A(x),\ \mu_A(x)\rangle / x \in E\}$

iv $A \bigcap B = \{\langle x,\ \min\ (\mu_A(x),\ \mu_B(x)),\ \max\ (\nu_A(x),\ \nu_B(x))\rangle / x \in E\}$

v $A \cup B = \{\langle x,\ \max\ (\mu_A(x),\ \mu_B(x)),\ \min\ (\nu_A(x)\nu_B(x))\rangle / x \in E\}$

Obviously every fuzzy set has the form.

$$\{\langle x,\ \mu_A(x),\ \mu_{A^c}(x)\rangle / x \in E\}$$

Definition 2.3. [6] The normalized Euclidean distance $d_{n-H}(A, B)$ between two IFS. A and B is defined as

$$d_{n-H}(A, B) = \frac{1}{2n}\Big[\sum_{i=1}^{n} [\mu_A(x_i) - \mu_B(x_i)]^2 + [\nu_A(x_i) - \nu_B(x_i)]^2 + (\pi_A(x_i) - \pi_B(x_i))^2\Big]^{1/2}\ X = \{x_1 \ldots x_n\}\ \text{for}\ i = 1, 2, \ldots, n\ .$$

3. Application of IFS in Determining Distribution of Students in Disciplines of Engineering

In this section we present an application of IFS theory to determine the choice of engineering discipline by students. In the given study let D = {CE, CSE, ECE, EEE, ME } be the different disciplines in engineering and S = { Physics, Chemisty, Mathematics } be the set of subjects related to the common entrance examination (CEE) and HSS exam. Let R = { upto 5000 CEE rank / $\geq$ 95% marks in Maths, between 5000–10000 rank / $\geq$ 90% marks in Maths, between 10000–15000 rank / $\geq$ 85% marks in Maths, between 15000–20000 and $\geq$ 60% marks, above 20000 rank and $\geq$ 60% marks } be the category affixed by the institute to divide the assistanceship and fee structure. Now let us discuss the intuitionistic fuzzy theoretical approach applied here.

The intuitionistic fuzzy set is used as a tool with the membership degree μ (the degree of correct answers) the non-membership degree ν (the degree of incorrect answers) and the hesitation degree π (the degree associated with questions failed to attempt)

To see the application of the method let-us make a hypothetical case study below.

Case - Study

The choice of a technical graduation course by the elite rank holders of the CEE, under non-government quota, at Muthoot Institute of Technology & Science (MITS) is studied through intuitionistic fuzzy sets. The study is about the choice of an engineering discipline, made by 150 students who gave the Common Entrance Examination.

The table 1 indicates the average marks secured by students in Physics, Chemistry and Mathematics in the HSS examination and their discipline choice

Table 1: Discipline Vs. Subjects

	Subject		
Discipline	Physics	Chemistry	Mathematics
Civil	(0.87, 0.1, 0.03)	(0.86, 0.1, 0.04)	(0.88, 0.1, 0.02)
Computer	(0.89, 0.1, 0.01)	(0.87, 0.1, 0.03)	(0.89, 0.1, 0.01)
Electronics	(0.87, 0.1, 0.03)	(0.86, 0.1, 0.04)	(0.86, 0.1, 0.04)
Electronical	(0.84, 0.1, 0.06)	(0.82, 0.1, 0.08)	(0.82, 0.1, 0.08)
Mechanical	(0.88, 0.1, 0.02)	(0.89, 0.1, 0.01)	(0.87, 0.1, 0.03)

The performance in each subject is given by the membership, non-membership and hesitation degree.

The table 2 gives the category affixed by the institute and the average marks secured in Physics, Chemisty and Mathematics at the HSS examination/ranks obtained in CEE

Table 2: Category Vs. Subjects

	Subject		
Category	Physics	Chemistry	Mathematics
Upto 5000 CEE / $\geq$ 95% in Mathematics	(0.9, 0.05, 0.05)	(0.9, 0.05, 0.05)	(0.95, 0.05, 0)
B/w 5000–10000 rank / $\geq$ 90% in Mathematics	(0.88, 0.1, 0.02)	(0.87, 0.1, 0.03)	(0.89, 0.1, 0.01)
B/w 10000–15000 / $\geq$ 85% in Mathematics	(0.87, 0.1, 0.03)	(0.86, 0.1, 0.04)	(0.83, 0.1, 0.07)
B/w 15000–20000 and / $\geq$ 60% in Mathematics	(0.86, 0.1, 0.04)	(0.86, 0.1, 0.04)	(0.78, 0.1, 0.12)
Above 20000 rank and $\geq$ 60% ranks in Mathematics	(0.8, 0.1, 0.1)	(0.77, 0.01, 0.13)	(0.7, 0.1, 0.2)

The table 3 gives the distance between the category and the discipline

Table 3: Category Vs. Discipline

	Discipline				
Category	CE	CSE	ECE	EEE	ME
1	0.0513	0.0486	0.0580	0.0835	0.0545
2	0.01	0.0075	0.0191	0.0548	0.0163
3	0.0289	0.370	0.0173	0.0294	0.0294
4	0.0580	0.0661	0.0473	0.0346	0.0560
5	0.1230	0.1215	0.1134	0.0785	0.1287

4. Conclusion

In this paper, the normalized Euclidean distance method was applied to IFS to investigate the relative choice of branch in engineering of the students. In the study we analyse that the academically stronger students have opted for computer science engineering and relatively weaker students have opted for electrical and electronics engineering. The hierarchy of the choice of discipline, by the students, in a descending order is CSE, CE, ME, ECE, EEE. The application of IFS is significant as it exhibits of the most likely choice/trends in selection of a technical course by the students.

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