RESEARCH ARTICLE

International Journal of Multidisciplinary and Scientific Emerging Research

Available at http://www.ijmser.com/ (ISSN 2349 – 6037)

Intuitionistic Fuzzy Set and Its Application in Student Performance Determination of a Course via Normalized Euclidean Distance Method

Dr. G.Vasanti[1] and T.Viswanadham[2]

Department of Basic Sciences & Humanities,
Aditya Institute of Technology & Management, Tekkali, A.P, India.

Accepted **10** February 2015, Available online 17 March 2015, **Vol.4, No.1 (March 2015)**

Abstract

In this paper we make an exclusive model using Intuitionistic fuzzy set (IFS) to elaborate uncertainty and vagueness involved in determining the student expected performance in a course using normalized Euclidean distance method by measuring the distance between each student and each subject performance respectively. The expected performance is measured by calculating the smallest distance between each student and each subject performance.

Keywords: *Fuzzy sets, intuitionistic fuzzy sets, student performance.*

1. INTRODUCTION

Fuzzy sets (FS) introduced by (Zadeh, 1965) has showed meaningful applications in many fields of study. The traditional view in science, especially in mathematics, is to avoid uncertainty at all levels at any cost. Thus, "being uncertain" is regarded as "being unscientific". But unfortunately in real life most of the information that we have to deal with is mostly uncertain.

In 1983, Atanassov generalized the notion of Zadeh fuzzy subset of a set further by introducing an additional function ν which he called a non membership function with some natural conditions on μ and ν, calling these new generalized fuzzy subsets of a set, intuitionistic fuzzy subsets. The notion of defining intuitionistic fuzzy set as generalized fuzzy set is quite interesting and useful in many application areas. The knowledge and semantic representation of intuitionistic fuzzy set become more meaningful, resourceful and applicable since it includes the degree of belongingness, degree of non-belongingness and the hesitation margin (Atanassov, 1994, 1999). Szmidt and Kacprzyk (2001) showed that intuitionistic fuzzy sets are pretty useful in situations when description of a problem by a linguistic variable given in terms of a membership function only seems too rough. Due to the flexibility of IFS in handling uncertainty, they are tool for a more human consistent reasoning under imperfectly defined facts and imprecise knowledge (Szmidt and Kacprzyk, 2004).

De *et al* (2001) gave an intuitionistic fuzzy sets approach in medical diagnosis using three steps such as; determination of symptoms, formulation of medical knowledge based on intuitionistic fuzzy relations, and determination of diagnosis on the basis of composition of intuitionistic fuzzy relations. Intuitionistic fuzzy set is a tool in modeling real life problems like sale analysis, new product marketing, financial services, negotiation process, psychological investigations etc. since there is a fair chance of the existence of a non-null hesitation part at each moment of evaluation of an unknown object (Szmidt and Kacprzyk, 1997, 2001). Atanassov (1999, 2012) carried out rigorous research based on the theory and applications of intuitionistic fuzzy sets. Many applications of IFS are carried out using distance measures approach. Distance measure between intuitionistic fuzzy sets is an important concept in fuzzy mathematics because of its wide applications in real world, such as pattern recognition, machine learning, decision making and market prediction. Many distance measures between intuitionistic fuzzy sets have been proposed and researched in recent years (Szmidt and Kacprzyk, 1997, 2000 and Wang and Xin, 2005) and used by (Szmidt and Kacprzyk, 2001, 2004) in medical diagnosis.

We show a novel application of intuitionistic fuzzy set in a more challenging area of decision making (i.e. Assessment of student performance in a course). An example of student performance in a course will be presented, assuming there is a database (i.e. a description of a set of performance in different internal examinations P1, P2, P3 & attendance P4 and a set of subjects S). We will describe the state of students knowing the results of their performance. The problem description uses the concept of IFS that makes it possible to render two

important facts. First, values of P1, P2, P3 & P4 attendance of each subject performance changes for each student. Second, in a student performance determination database describing the performance in different subjects for different students, it should be taken into account that for different students aiming for the same performance, values of the same subject performance can be different. We use the normalized Euclidean distance method given in (Szmidt and Kacprzyk, 1997, 2000, 2014) to measure the distance between each student and each subject. The obtained value determines the subject performance of the student.

2. BASIC DEFINITIONS

Definition 1 *(Zadeh, 1965):* A fuzzy set A of a non empty set X is defined as $\langle x, \mu_A(x)\rangle : x \in X$, $\mu_A(x)$ is the membership function of the fuzzy set A. Fuzzy set is a collection of objects with graded membership i.e. having degrees of membership.

Definition 2*(Atanassov, 1999):* An intuitionistic fuzzy set A in X is a pair A = (μ_A, ν_A), where μ_A, ν_A are functions from the set X to the closed interval [0, 1] of real numbers such that for each x∈X, 0≤ $\mu_A x + \nu_A x \leq 1$, where μ_A is called the membership function of A and ν_A is called the non-membership function of A.

Furthermore, we have $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ called the intuitionistic Fuzzy set index or hesitation margin of x in A. $\pi_A(x)$ is the degree of indeterminacy of $x \in X$ to the IFS A and $\pi_A(x) : X \rightarrow [0,1]$ and $0 \leq \pi_A(x) \leq 1$for every $x \in X$. $\pi_A(x)$ expresses the lack of knowledge of whether *x* belongs to IFS A or not.

For example, let A be an intuitionistic fuzzy set with $\mu_A x$ = 0.5 and $\nu_A x$ = 0.3 then $\pi_A(x)$ = 1- (0.5 + 0.3) = 0.2. It can be interpreted as "the degree that the object *x* belongs to IFS A is 0.5, the degree that the object *x* does not belong to IFS A is 0.3 and the degree of hesitancy is 0.2".

Definition 3 *(Szmidt and Kacprzyk, 2014):* The normalized Euclidean distance $d_{n-H}(A,B)$ between two IFS A and B is defined as $d_{n-H}(A,B) =$

$$\left[\frac{1}{2n}\sum_{i=1}^{n}\left(\mu_A(x_i)-\mu_B(x_i)\right)^2+\left(\nu_A(x_i)-\nu_B(x_i)\right)^2+\left(\pi_A(x_i)-\pi_B(x_i)\right)^2\right]^{1/2}$$

where X = {$x_1, x_2, \ldots, x_n$} for i = 1, 2,…, n.

3. APPLICATION OF INTUITIONISTIC FUZZY SETS PERFORMANCE ASSESMENT OF A STUDENT

The essence of providing adequate information of students expected performance in different subjects cannot be overemphasized. This is paramount because the numerous problems of lack of proper knowledge of an institution of their student's performance in different subjects are of great consequence on future. Therefore, it is expedient that the institution be given sufficient information on performance of their students or choice to enhance adequate planning, preparation and proficiency.

We use intuitionistic fuzzy sets as tool since it incorporate the membership degree (i.e. marks of the internal examinations based on the no. of correct answers and weightage of no. of classes attended), the non-membership degree (i.e. marks of the internal examinations based on the no. of incorrect answers and weightage of no. of classes not attended) and the hesitation degree (i.e. the marks allocated to the questions which the student did not attempt and weightage of no. of classes suspended).

Let S = {S1, S2, S3, …, S10} be the set of students, Performance = {P1, P2, P3, P4} be the internal exam1,2,3, and the semester attendance and Subjects = {English(ENG), Environmental Science (ES), Engineering Mathematics(EM), Engineering chemistry (EC), Engineering Drawing (ED), Engineering Mechanics (E.Mech)}. We assume the above students appear for examinations (i.e. over 40 marks each) on the above mentioned subjects to determine their performance in semester end examinations and P4 is based on the attendance of the student in a semester.

Table 1: Below Shows Subjects and Performance Requirements

	P1	P2	P3	P4
English	(0.6,0.3,0.1)	(0.7,0.2,0.1)	(0.8,0.2,0.0)	(0.9,0.1,0.0)
ES	(0.6,0.2,0.2)	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.8,0.1,0.1)
EM	(0.9,0.1,0.0)	(0.8,0.1,0.1)	(0.7,0.1,0.2)	(0.8,0.2,0.0)
EC	(0.7,0.3,0.0)	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.8,0.1,0.1)
ED	(0.7,0.2,0.1)	(0.7,0.3,0.0)	(0.8,0.2,0.0)	(0.7,0.2,0.1)
E.Mech	(0.7,0.3,0.0)	(0.8,0.1,0.1)	(0.8,0,0.2)	(0.8,0.2,0.0)

Table 2: Students Vs Performance

	P1	P2	P3	P4
S1	(0.8,0.2,0)	(0.6,0.4,0)	(0.5,0.5,0)	(0.7,0.3,0)
S2	(0.6,0.4,0)	(0.7,0.3,0)	(0.6,0.4,0)	(0.9,0.1,0)
S3	(0.9,0.1,0)	(0.9,0.1,0)	(0.8,0.2,0)	(0.9,0.1,0)
S4	(0.7,0.3,0)	(0.9,0.1,0)	(0.5,0.4,0.1)	(0.9,0.1,0)
S5	(0.8,0.2,0)	(0.9,0.1,0)	(0.8,0.2,0)	(0.9,0.1,0)
S6	(0.8,0.2,0)	(0.8,0.2,0)	(0.8,0.2,0)	(0.9,0.1,0)
S7	(0.6,0.4,0)	(0.7,0.3,0)	(0.6,0.4,0)	(0.8,0.2,0)
S8	(0.6,0.4,0)	(0.6,0.4,0)	(0.6,0.4,0)	(0.9,0.1,0)
S9	(0.6,0.4,0)	(0.7,0.3,0)	(0.5,0.5,0)	(0.9,0.1,0)
S10	(0.5,0.5,0)	(0.7,0.3,0)	(0.6,0.4,0)	(0.9,0.1,0)

Using **Def.3** above to calculate the distance between each student and each performance with reference to the subjects, we get the table below:

Table 3: Students Vs Subjects:

	English	ES	EM	EC	ED	E.Mech
S1	0.217	0.239	0.229	0.223	0.173	0.264
S2	0.206	0.180	0.223	0.158	0.157	0.193
S3	0.158	0.173	0.111	0.150	0.157	0.159
S4	0.165	0.200	0.180	0.180	0.193	0.193
S5	0.122	0.150	0.122	0.122	0.141	0.132
S6	0.100	0.132	0.122	0.100	0.111	0.132
S7	0.132	0.180	0.217	0.158	0.141	0.200
S8	0.141	0.193	0.244	0.173	0.165	0.229
S9	0.165	0.217	0.250	0.200	0.193	0.244
S10	0.141	0.200	0.259	0.193	0.187	0.223

From the above table, the shortest distance gives the best performance. The student S1 performance in different subjects is likely in the order ED, ENG, EC, EM, ES, E.Mech, S2 performance is to be in the order ED, EC, ES, E.Mech, ENG, EM; S3 performance is to be in the order EM, EC, ED, ENG, E.MECH, ES and so on, ….

4. CONCLUSION

This novel application of intuitionistic fuzzy sets in providing adequate information of students expected performance in different subjects is of great significance because it provides proper knowledge to an institution of their students performance. In the proposed method, we used normalized Euclidean distance to calculate the distance of each student from each performance in respect to the subjects.

REFERENCES

[1] Atanassov. K. T (1983), Intuitionistic fuzzy sets, VII ITKR's Session, Sofia,.

[2] Atanassov. K. T (1986), Intuitionistic fuzzy sets, Fuzzy Sets and Systems 207-96.

[3] Atanassov. K.T (1994), New operations defined over intuitionistic fuzzy sets, Fuzzy Sets and Systems Vol. 61, 2 137-142.

[4] Atanassov. K.T (1999), Intuitionistic fuzzy sets:theory and application, Springer.

[5] Atanassov.K.T (2012), On Intuitionistic fuzzy sets, Springer.

[6] De. S. K, R. Biswas, Roy. A.R (2001), An application of intuitionistic fuzzy sets in medical diagnostic, Fuzzy sets and systems 117 (2) 209-213.

[7] Shinoj. T. K, Sunil. J.J (2012), Intuitionistic Fuzzy multisets and its application in medical diagnosis, International journal of mathematical and computational sciences 634-38.

[8] Szmidt. E, Kacprzyk. J (1997), On measuring distances between intuitionistic fuzzy Sets, Notes on IFS, 3 (4) 1-3.

[9] Szmidt. E, Kacprzyk.J (2000), Distances between intuitionistic fuzzy Sets, Fuzzy Sets and Systems 114 (3) 505-518.

[10] Szmidt.E, Kacprzyk.J (2001), Intuitionistic fuzzy sets in some medical applications, Note on IFS 7 (4) 58-64.

[11] Szmidt. E, Kacprzyk.J (2004), Medical diagnostic reasoning using a similarity measure for intuitionistic fuzzy sets, Note on IFS 10 (4) 61-69.

[12] Szmidt. E (2014), Distances and similarities in intuitionistic fuzzy sets, Springer.

[13] Zadeh. L.A. (1965), Fuzzy sets, Information and Control 8 338-353.

[14] Murthy. N.V.E.S. and Vasanti.G (2012), Properties of Images (Inverse) Images of Intutionistic L-Fuzzy Subsets And Correspondence And Isomorphism Theorems For Intutionistic L-Fuzzy Subgroups, International Journal of Computational Cognition, VOL. 10, NO. 1.

[15] Ejegwa. P. A., Akubo .A. J., Joshua. O. M.(2014), Intuitionistic Fuzzy Set and its application in careers determination via normalized eulidean distance method, European Scientific Journal May edition vol.10, No.15 ISSN: 1857 – 7881 (Print).

[16] Ejegwa. P. A., Akubo. A. J., Joshua. O. M.(2014), Intuitionistic Fuzzy sets in career Determination, Global Journal of Science Frontier Research: F Mathematics and Decision Sciences, Volume 14, Issue 3.

[17] Vasanti.G (2013), More On L-Intuitionist Fuzzy Or L-Vague Quotient Rings, Advances In Fuzzy Sets & Systems, Vol.No. 16, No.2, Pages 65-91, ISSN No: 0973-421X.

[18] Wang.W, Xin.X (2005), Distance measure between intuitionistic fuzzy sets. Pattern Recognition Letters 26, 2063-2069.