

Assessment of School Students using Fuzzy Matrix Solution (FMS)

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Abstract

Fuzzy set theory plays an important role in pattern recognition. It serves as an interface between linguistic variables and quantitative characterization. Fuzzy set membership value can be use to provide missing of incomplete information Fuzzy relation provides solutions of our daily life problems depend on two different situation. Teacher quality matters a great deal in terms of student learning. Therefore, teacher quality measurement is important. Even though performance of student i.e. Excellent, good, normal or bad will be depending on his/her own specialty. In this paper we will try to obtain conclusion about students performance by giving membership grades to his/her specialty from 0 to 1 in the fuzzy relation matrix R_o (an occurrence relation obtained by observations on sufficient number of student), R_c (a conformability relation confirmed by expert in education sector) and R_s (a matrix which contains degree of specialty seen by educationist for testing the model).

Key words: FMS, Max. Min., Min. Max., Education system, Award

1 Introduction

As serious changes are being seen in science, and hence uncertainty increases but uncertainty is undesirable in science and therefore it must be avoided by all possible means. When science deals with the practical aspects of life then uncertainty is obvious but it is regarded as unscientific. According to the alternative (or modern) view, uncertainty is considered essential to science; it is not only an unavoidable plague, but it has, in fact, a great utility. Computer helps us in solving problem easily, speedily, perfectly because its base is mathematics which forces it to maintain basic

principles of mathematics i.e. accuracy. Therefore computer alone cannot solve practical life's complex problems in all aspects because complex problems related to life like expectation of profit in business, disease diagnosis in medical field, psychological problems in social field etc. are not accurate they vary and therefore some modification is required .

Zadeh was the first mathematician who tried to overcome such problems of uncertainty by introducing Fuzzy set theory about 50 year ago , which is a generalization of classical set theory, in the sense that a given universe χ and a subset A of it, any element x of χ , instead of having a degree of membership either 0 or 1 in A as postulated under the classical set theory, can have a membership value $\mu_A(x) \in [0,1]$ in a set A which represents the degree of its belonging to A . In other word, A is a fuzzy subset of universe χ , characterized by the membership function $\mu_A(x)$, $x \in \chi$.

The Study of **Occurrence relation R_o and Conformability relation R_c** in education sector using fuzzy matrices is useful because a Specialty may likely to occur with a given award but may also commonly occur with several other distinctions, therefore limiting its power as a discriminating factor among them is important. On the other hand, another Specialty may be relatively with a given awards.

An, **Occurrence relation R_o** provides knowledge about the tendency or frequency of appearance of Specialty when the specific distinction is present i.e. how often does the Specialty occur with award.

A **Conformability relation R_c** describes the discriminating power of the Specialty to confirm the presence of the award i.e. how, strongly does the Specialty confirm awarded. The distinction between occurrence and conformability is important.

The above said relations are determined from educationist and observation of the related students with specialty. By giving membership grades to linguistic terms *always, often, unspecific, seldom, and never* 1, .75, .5, .25, or 0 respectively in fuzzy relation R_o and R_c we can draw different types of conclusions about students. This can be explained with an example given in our main result.

2 Definitions & Terminology:

We use following definitions and terminology in our proposed methodology for computation of student's quality.

2.1 Matrix:

For occurrence relation is $R_o = S \times D$, indicates the frequency of occurrence of specialty with awards D

For confirmative relation is $R_c = S \times D$, corresponds to the degree to which specialty confirms the award D .

For a fuzzy relation $R_s = P \times S$ specifying the degree of presence of specialty S_1, S_2, S_3, S_4 , for the students. This indicates the degree to which the specialty is present in student P

Using relations R_S , R_O , and R_C four different indication relations can be calculated as below,

The occurrence indication relation R_1 calculated by $R_1 = R_S * R_O$

The conformability indication relation R_2 is calculated by $R_2 = R_S * R_C$

The nonoccurrence indication relation R_3 calculated by $R_3 = R_S * (1 - R_O)$

Finally, **the non-symptom indication relation R_4** is calculated by $R_4 = (1 - R_S) * R_O$

The above said relation requires Multiplication of fuzzy Matrix using max. min. rule as explain below.

2.2 Product of two fuzzy matrices:

Since product of two fuzzy Matrix multiplications under usual method is not a fuzzy matrix. So we need to define a compatible operation analogous to product that the product again happens to be a fuzzy matrix. However even for this new operation if the product XY is to be defined we need the number of columns of X is equal to the number of rows of Y . The two types of operations which we can have are max-min operation and min-max operation.

Let

$$X = \begin{pmatrix} 0.3 & 1 & 0.7 & 0.2 & 0.5 \\ 1 & 0.9 & 0 & 0.8 & 0.1 \\ 0.8 & 0.2 & 0.3 & 1 & 0.4 \\ 0.5 & 1 & 0.6 & 0.7 & 0.8 \end{pmatrix} \text{ be a } 4 \times 5 \text{ fuzzy matrix and let}$$

$$Y = \begin{pmatrix} 0.8 & 0.3 & 1 \\ 0.7 & 0 & 0.2 \\ 1 & 0.7 & 1 \\ 0.5 & 0.4 & 0.5 \\ 0.4 & 0 & 0.7 \end{pmatrix} \text{ be a } 5 \times 3 \text{ fuzzy matrix.}$$

XY defined using max. min function.

$$XY = \begin{pmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \\ C_{41} & C_{42} & C_{43} \end{pmatrix}$$

where,

$$\begin{aligned} C_{11} &= \max \{ \min (0.3, 0.8), \min (1, 0.7), \min (0.7, 1), \min (0.2, 0.5), \min (0.5, 0.4) \} \\ &= \max \{ 0.3, 0.7, 0.7, 0.2, 0.4 \} \\ &= 0.7. \end{aligned}$$

$$\begin{aligned} C_{12} &= \max \{ \min (0.3, 0.3), \min (1, 0), \min (0.7, 0.7), \min (0.2, 0.4), \min (0.5, 0) \} \\ &= \max \{ 0.3, 0, 0.7, 0.2, 0 \} \\ &= 0.7 \dots \text{ and so on.} \end{aligned}$$

$$XY = \begin{pmatrix} 0.8 & 0.4 & 1 \\ 0.8 & 0.4 & 0.8 \\ 0.7 & 0.6 & 0.7 \end{pmatrix} \text{ is a } 3 \times 3 \text{ matrix.}$$

Now suppose for the same X and Y we adopt the operation as min. max operation
We get

$$D = \begin{pmatrix} D_{11} & D_{12} & D_{13} \\ D_{21} & D_{22} & D_{23} \\ D_{31} & D_{32} & D_{33} \\ D_{41} & D_{42} & D_{43} \end{pmatrix}$$

Where

$$\begin{aligned} D_{11} &= \min \{ \max (0.3, 0.8), \max (1, 0.7), \max (0.7, 1), \max (0.2, 0.5) \max (0.5, 0.4) \} \\ &= \min \{ 0.8, 1, 1, 0.5, 0.5 \} \\ &= 0.5. \\ D_{12} &= \min \{ \max (0.3, 0.3), \max (1, 0), \max (0.7, 0.7), \max (0.2, 0.4), \max (0.5, 0) \} \\ &= \min \{ 0.3, 1, 0.7, 0.4, 0.5 \} \\ &= 0.3 \dots \text{and so on.} \end{aligned}$$

Thus we have

$$D = \begin{pmatrix} 0.5 & 0.3 & 0.5 \\ 0.4 & 0.1 & 0.7 \\ 0.4 & 0.4 & 0.2 \\ 0.6 & 0.5 & 0.7 \end{pmatrix}$$

The process of fuzzy matrix multiplication is tedious and time consuming. So we calculate it by a computer program using Java Language as developed in [8].

3 Main result:

Case Study: To assess the award as Excellent, Good, Average, Bad student in the school education, using Fuzzy matrix Solution (FMS) proposed in Raich et.al.[8].

Consider,

S = Set of Specialty/ Nature/ quality of Students,

D = Set of all distinction/ achievement/ award and

P = Set of all students.

Set of Specialty/ Nature/ quality of Students, $S = \{S_1, S_2, S_3, S_4\}$

Where,

S_1 = Creative in nature, consistently doing something forms a habits, willing to learn, Pay attention in class, help other students about their difficulties.

S_2 = Interactive in class, ask question about his queries, complete his home work.

S_3 = Often misunderstands original thoughts of a speaker, writer and derives a wrong conclusion.

S_4 = Not interesting to learn, Angry on others.

$D = \{D_1, D_2, D_3, D_4\}$

Where,

D_1 = represent the Excellent student, 80% - 100%.

D_2 = represent Good student, (60% - 80%).

D_3 = represent Average student and, (40% - 60%).

D_4 = represent Bad students, (Below 40%).

$P = \{P_1, P_2, P_3\}$ set of students consider in the example.

Using Computer program software Fuzzy matrix solution (FMS) developed by Raich at al we can obtain conclusion matrix shown in the following result.

Occurrence relation $R_o =$					Conformability relation $R_c =$				
	D1	D2	D3	D4		D1	D2	D3	D4
S1	1	.6	.4	.15	S1	1	.8	0	0
S2	.6	.9	.7	.3	S2	.6	1	.4	0
S3	.2	.4	.9	.7	S3	0	.4	1	.6
S4	0	.3	.5	1	S4	0	.2	.8	1

specifying the degree of presence of specialty in student $R_s =$

	S1	S2	S3	S4
P1	.9	.9	.1	0
P2	.7	.6	.8	.9
P3	.3	.2	.9	1

The occurrence indication relation R_1 calculated by $R_1 = R_s * R_o$					R_2 calculated by $R_2 = R_s * R_c$				
	D1	D2	D3	D4		D1	D2	D3	D4
P1	0.9	0.9	0.7	0.3	P1	0.9	0.9	0.4	0.1
P2	0.7	0.6	0.8	0.9	P2	0.7	0.7	0.8	0.9
P3	0.3	0.4	0.9	1	P3	0.3	0.4	0.9	1

The nonoccurrence indication relation R_3 calculate by $R_3 = R_s * (1 - R_o)$					The non-symptom indication relation R_4 calculate by $R_4 = (1 - R_s) * R_o$				
	D1	D2	D3	D4		D1	D2	D3	D4
P1	0.4	0.4	0.6	0.85	P1	0.2	0.4	0.9	1
P2	0.9	0.7	0.6	0.7	P2	0.4	0.4	0.4	0.3
P3	1	0.7	0.5	0.30	P3	0.7	0.8	0.7	0.3

4 Conclusion & Results :

In R_1 value 1 for (P_3, D_4) shows that P_3 student occur poor category it conform in poor category as value 1 in R_2 for (P_3, D_4) is again 1. In non occurrence indication relation R_3 the value for $(P_3, D_1) = 1$ shows that P_3 never occurred excellent student and last the non symptom indication relation R_4 for $(P_1, D_4) = 1$ shows that, student P_1 symptoms are not suitable to become D_4 i.e. Poor student.

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