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AN APPLICATION OF FUZZY SOFT SETS IN STUDENTS' EVALUATION

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ABSTRACT

The concept of fuzzy soft set is applied here to extend Biswas's method for students' evaluation with a hypothetical case study.

Keywords: *Soft sets, Fuzzy soft sets, and Soft Evaluation Knowledge.*

1. INTRODUCTION:

Molodtsov **(1999)** pointed out that the existing theories, viz., theory of probability, theory of fuzzy sets, theory of intuitionistic fuzzy sets, theory of vague set, theory of interval mathematics, theory of rough sets, can be considered as mathematical tools for dealing with uncertainties but all these theories have their own limitations. The reason for this is most possibly the inadequacy of the parameterization tool of the theories. So he developed a new mathematical theory called "Soft Set" for dealing with uncertainties and soft set is free from the above limitations. The absence of any restrictions on the approximate description in soft set theory makes this theory very convenient and easily applicable in practice.

In [3],Biswas pointed out that the chief aim of education institutions is to provide students with the evaluation reports regarding their test/examination as sufficient as possible and with the unavoidable error as small as possible and presented a fuzzy evaluation method(*fem*) for applying fuzzy sets [3] in students' answerscripts evaluation. He also modified the fuzzy evaluation method to propose a generalized fuzzy evaluation method (*gfem*) for students' answerscripts evaluation. In [4], Chen and Lee pointed out that the methods presented in [3] have two drawbacks, (1) It would take a large amount of time to deal with the matching operations of the matching function and (2) Two different fuzzy marks might be translated into the same awarded letter grade which would be unfair for students'evaluation. Thus, they presented two methods for evaluating students' answerscripts using fuzzy sets.

A soft set is a parameterized family of subsets of the universal set. We can say that soft sets are neighborhood systems, and that they are a special case of context-dependent fuzzy sets. In soft set theory the problem of setting the membership function, among other related problems, simply does not arise. This makes the theory very convenient and easy to apply in practice. Soft set theory has potential applications in many different fields, including the smoothness of functions, game theory, operations research, Riemann integration, Perron integration, probability theory, and measurement theory. Most of these applications have already been demonstrated in Molodtsov's paper. Saikia et al.[10,11] applied fuzzy soft set and intuitionistic fuzzy soft sets in medical diagnosis. In this paper, we present a new method for students' answerscript evaluation using fuzzy soft set theory. The proposed method can evaluate students' answerscript in a more flexible and more intelligent manner.

2. PRELIMINARIES:

Throughout this work, U refers to an initial universe, E is a set of parameters, $P(U)$ is the power set of U and $A \subset E$.

Definition 2.1: Let X be a universal set, E a set of parameters and $A \subset E$. Then a pair (F,A) is called soft set over X, where F is a mapping from A to 2^X , the power set of X.

Example 2.1: Let $X=\{c_1,c_2,c_3\}$ be the set of three cars and $E=\{$costly(e_1), metallic colour (e_2) cheap (e_3)$\}$ be the set of parameters, where $A=\{e_1,e_2\} \subset E$. Then $(F,A)=\{F(e_1)=\{c_1,c_2,c_3\},F(e_2)=\{c_1,c_3\}\}$is the crisp soft set over X which describes the "attractiveness of the cars" which Mr. S(say) is going to buy .

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Definition 2.2: Let X be a universal set, E a set of parameters and $A \subset E$. Let $\mathbb{F}(X)$ denotes the set of all fuzzy subsets of X. Then a pair (F, A) is called fuzzy soft set over X, where F is a mapping from A to $\mathbb{F}(X)$.

Example 2.2: Let $X=\{c_1,c_2,c_3\}$ be the set of three cars and $E=\{$costly(e_1), metallic colour(e_2)

cheap(e_3)$\}$ be the set of parameters, where $A=\{e_1,e_2) \subset$ E. Then

$G,A)=\{G(e_1)=\{c_1/.6,c_2/.4,c_3/.3\},G(e_2)=\{c_1/.5,c_2/.7,c_3/.8\}\}$ is the fuzzy soft set over X describes the " attractiveness of the cars" which Mr. S(say) is going to buy .

3. APPLICATION OF FUZZY SOFT SETS IN STUDENTS' EVALUATION:

Here we present an application of fuzzy soft set theory in students' answerscripts evaluation following Biswas approach [3]. Assume that there are five satisfaction levels to evaluate the students' answerscripts regarding a question of an examination i.e. excellent (e_1), very good (e_2), good (e_3), satisfactory (e_4) and unsatisfactory (e_5). Let X be a set of satisfaction level, X = {excellent (e_1), very good (e_2), good (e_3), satisfactory (e_4) and unsatisfactory (e_5)} and again let S = {0%. 20%, 40%, 60%, 80%, 100%} be the degree of satisfaction of the evaluator for a particular question of the student's answerscript. Suppose Q is a set of questions for a particular paper of 100 marks. We first assume X as a universal set and S the set of parameters. Then a fuzzy soft (F, S) is constructed over the X, where F is a mapping F: S $\to I^X$ and I^X is the set of all fuzzy sets over X. This fuzzy soft gives a relation matrix, say, R, called expert students evaluation matrix. We refer to the matrix R as "Soft Evaluation Knowledge".

Again we construct another fuzzy soft set (F_1, X) over Q, where F_1 is a mapping given by $F_1: X \to I^Q$ and I^Q is the set of all fuzzy sets over Q. This fuzzy soft gives a relation matrix R_1, called examination knowledge matrix. Than we obtain a new relation $T= R_1 \circ R$ called satisfaction question matrix in which the membership values are given by

$$\mu_T(Q_i, S_k) = \vee\{\mu_{R_1}(Q_i, e_j) \wedge \mu_R(e_j, S_k)\}, \text{ where } \vee = \max \text{ and } \wedge = \min$$

Corresponding to each question Q_i of the paper for the matrix T, we take the highest membership value .x_i (say) which indicates that the degree of satisfaction of the question Q_i is $100x_i\%$. Then the highest score of the question Q_i is $H(Q_i)$ $=100x_i\%$. If $M(Q_i)$ is the mark allotted to the question Q_i then the total score of the student is calculated by the formula

$$= \frac{1}{100}\sum \{H(Q) \times M(Q_i)\}$$

3.1 Algorithm:

- input the fuzzy soft sets (F,S) over the set X of satisfaction levels, where S is the set of degree of satisfaction of the particular question paper and also write the soft evaluation knowledge R representing the relation matrix of the fuzzy soft set (F,S).
- input the fuzzy soft set (F_1,X) over the set Q of questions of the paper and write its relation matrix R_1.
- compute the relation matrix $T = R_1 \circ R$
- compute the highest score for each question for the matrix T.
- calculate the total score for the student for each paper.

3.2 Case Study:

Consider a candidate's answerscripts to a paper of 100 marks. Assume that in total there were four questions to be answered. Let X be a set of satisfaction level and let

$X=\{e_1, e_2, e_3, e_4, e_5\}$where e_1, e_2, e_3, e_4 and e_5 represents excellent, very good, good, satisfactory and unsatisfactory respectively. Suppose an evaluator is using fuzzy soft grade sheet. Consider X be as the universal set and S = {0%, 20%, 40%, 60%, 80%, 100%} be the set of degree of satisfaction of the evaluator's as the set of parameters.
Suppose that

$F(0\%) = \{ e_1/0, e_2/0, e_3/0, e_4/.4, e_5/1\}$
$F(20\%) = \{ e_1/0, e_2/0, e_3/.1, e_4/.4, e_5/1\}$
$F(40\%) = \{ e_1/.8, e_2/.8, e_3/.8, e_4/.9, e_5/.4\}$
$F(60\%) = \{ e_1/.9, e_2/.9, e_3/.9, e_4/.6, e_5/.2\}$
$F(80\%) = \{ e_1/1, e_2/.9, e_3/.4, e_4/.2, e_5/0\}$
$F(100\%) = \{ e_1/1, e_2/.8, e_3/.2, e_4/0, e_5/0\}$

Then the fuzzy soft set (F,S) is a parameterized family $\{F(0\%), F(20\%), F(40\%), F(60\%), F(80\%), F(100\%)\}$ of all fuzzy sets over the set X and are determined from expert student evaluation documentation. Thus the fuzzy soft set (F,S) gives an approximate description of the fuzzy soft examination knowledge of the four questions and their level of

satisfaction. This fuzzy soft set (F,S) is represented by matrix R, called expert students evaluation matrix and is given by

$$\mathrm{R} = \begin{array}{c} \\ e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \end{array} \begin{array}{c} \begin{array}{cccccc} 0\% & 20\% & 40\% & 60\% & 80\% & 100\% \end{array} \\ \begin{bmatrix} 0 & 0 & .8 & .9 & 1 & 1 \\ 0 & 0 & .8 & .9 & .9 & .8 \\ 0 & .1 & .8 & .9 & .4 & .2 \\ .4 & .4 & .9 & .6 & .2 & 0 \\ 1 & 1 & .4 & .2 & 0 & 0 \end{bmatrix} \end{array}$$

Suppose an evaluator is using fuzzy soft grade sheet. Suppose there are four questions Q_1, Q_2, Q_3 and Q_4 in the question paper and we consider the set $Q = \{Q_1, Q_2, Q_3, Q_4\}$ as universal set and $S = \{e_1, e_2, e_3, e_4\}$ as the set of parameters respectively. The evaluator's satisfaction level for the student for question w.r.t. parameters are respectively

$F_1(e_1) = \{ Q_1/.2, Q_2/1, Q_3/.2, Q_4/.8\}$
$F_1(e_2) = \{ Q_1/.8, Q_2/.8, Q_3/.6, Q_4/.5\}$
$F_1(e_3) = \{ Q_1/.6, Q_2/.4, Q_3/.4, Q_4/.1\}$
$F_1(e_4) = \{ Q_1/0, Q_2/0, Q_3/.2, Q_4/0\}$
$F_1(e_5) = \{ Q_1/0, Q_2/0, Q_3/0, Q_4/.1\}$

Than the fuzzy soft set (F_1, X) is a parameterized family $\{F_1(e_1), F_1(e_2), F_1(e_3), F_1(e_4), F_1(e_5)\}$ of all fuzzy set over the set S and are determined from evaluator satisfaction for a particular student. This fuzzy soft set (F_1, X) gives approximate description of the fuzzy soft examination knowledge of the four question and their level of satisfaction. This fuzzy soft set (F_1, X) is represented by relation matrix R_1, called examination knowledge matrix and given by

$$\mathrm{R}_1 = \begin{array}{c} \\ \mathrm{Q}_1 \\ \mathrm{Q}_2 \\ \mathrm{Q}_3 \\ \mathrm{Q}_4 \end{array} \begin{array}{c} \begin{array}{ccccc} e_1 & e_2 & e_3 & e_4 & e_5 \end{array} \\ \begin{bmatrix} .2 & .8 & .6 & 0 & 0 \\ 1 & .8 & .4 & 0 & 0 \\ .2 & .6 & .4 & .2 & 0 \\ .8 & .5 & .1 & 0 & .1 \end{bmatrix} \end{array}$$

Then combining the relation matrices

$$\mathrm{T} = \mathrm{R}_1 \circ \mathrm{R} = \begin{array}{c} \\ \mathrm{Q}_1 \\ \mathrm{Q}_2 \\ \mathrm{Q}_3 \\ \mathrm{Q}_4 \end{array} \begin{array}{c} \begin{array}{cccccc} 0\% & 20\% & 40\% & 60\% & 80\% & 100\% \end{array} \\ \begin{bmatrix} 0 & .1 & .6 & .8 & .8 & .8 \\ 0 & .1 & .8 & .8 & .8 & .8 \\ .2 & .2 & .6 & .6 & .6 & .6 \\ .1 & .1 & .8 & .8 & .8 & .8 \end{bmatrix} \end{array}$$

Hence the highest score for Q_1 is .8 i.e. it indicates that the degree of satisfaction of the question Q_1 of the students answer scripts evaluation by the evaluator is 80%. Similarly for Q_2 is 80%, Q_3 is 60% and Q_4 is 80% respectively. Therefore $H(Q_1) = 80$, $H(Q_2) = 80$, $H(Q_3) = 60$ and $H(Q_4) = 80$. Again suppose that Q_1 carries 20 marks Q_2 carries 30 marks, Q_3 carries 25 marks and Q_4 carries 25 marks.

Therefore the total score of the student

$$= \frac{1}{100} \sum \left\{ H(Q_i) \times M(Q_i) \right\}$$

= 1/100 {80 x 20 + 80 x 30 + 60 x 25 + 80 x 25}

= 1/100 {1600 + 2400 + 1500 + 2000}

= 75.

4. CONCLUSION:

We have applied the notion of fuzzy soft sets in evaluating students' answerscripts. A case study has been taken to exhibit the simplicity of the technique.

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