

APPLICATION OF INTERVAL FUZZY NUMBER MATRICES AND INTERVAL - VALUED FUZZY SOFT SETS IN THE ANALYSIS OF THE FACTORS INFLUENCING HIGH SCORES IN HIGHER SECONDARY EXAMINATIONS

Dr.A.Kalaichelvi

Associate Professor,

Department of Mathematics,

Avinashilingam Institute for Home Science and Higher Education for Women

Coimbatore – 641 043

P.Haritha Malini

M.Phil. Scholar,

Department of Mathematics,

Avinashilingam Institute for Home Science and Higher Education for Women

Coimbatore – 641 043

K.Janofer

M.Phil. Scholar,

Department of Mathematics,

Avinashilingam Institute for Home Science and Higher Education for Women

Coimbatore – 641 043

ABSTRACT

Soft Set Theory and Interval Mathematics are mathematical tools for dealing with uncertainties. Both have rich potential for application in solving real life problems. In this article, the authors intended to analyze the factors contributing high scores in the higher secondary examination and also to identify the prime factor by collecting the data from students, academicians and parents.

INTRODUCTION

High scores in the Higher Secondary Examinations have become the high order priority in the academic life of a student in the present scenario. The parents have more concern and they leave no stone unturned to get their wards a pass with comparatively higher score which enables them to join a course, particularly a professional course, in a reputed institution. Many students perform upto the expectations, though not all.

Here the researchers intended to analyze the factors contributing high scores in the higher secondary examination and also to identify the prime factor by collecting the data from students, academicians and parents.

BASIC DEFINITIONS

Definition:1[4]

Let U be a nonempty finite set of objects called universe and let E be a nonempty set of parameters. An ordered pair (F, E) is said to be a Soft set over U , where F is a mapping from E into the set of all subsets of U . That is, $F : E \rightarrow P(U)$. It has been interpreted that a soft set indeed is a parameterized family of subsets of U .

Example: 2

Let $U = \{c_1, c_2, c_3\}$ be the set of three cars and $E = \{\text{costly}(e_1), \text{metallic colour}(e_2), \text{cheap}(e_3)\}$ be the set of parameters and $A = \{e_1, e_2\} \subset E$. 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 U which describes The “attractiveness of the cars” which Mr. S(say) is going to buy .

Definition: 3[6]

Let U be a universe. A fuzzy set X over U is a set defined by a function μ_x representing a mapping $\mu_x : U \rightarrow [0, 1]$. Here, μ_x called membership function of X , and the value $\mu_x(u)$ is called the grade of membership of $u \in U$. The value represents the degree of u belonging to the fuzzy set X . Thus, a fuzzy set X over U can be represented as follows,

$$X = \{(u / (\mu_x(u)) : u \in U, \mu_x(u) \in [0, 1]\}$$

The set of all the fuzzy sets over U will be denoted by $F(U)$.

Definition: 4[2]

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

Example: 5

Let $U = \{c_1, c_2, c_3\}$ be the set of three cars and $E = \{\text{costly}(e_1), \text{metallic colour}(e_2), \text{getup}(e_3)\}$ be the set of parameters and $A = \{e_1, e_2\} \subset E$. Then

$(G, A) = \{G(e_1) = \{c_1/0.6, c_2/0.4, c_3/0.3\}, G(e_2) = \{c_1/0.5, c_2/0.7, c_3/0.8\}\}$ is the fuzzy soft set over U describes the “attractiveness of the cars” which Mr. S(say) is going to buy.

Definition: 6[5]

An Interval Fuzzy Number is defined as $\hat{A} = [a_L, a_R] = \{a : a_L \leq a \leq a_R\}$ where, $a_L, a_R \in [0, 1]$. A matrix of order $n \times n$ is said to be an Interval Fuzzy Number Matrix (IFNM) if all its elements are the Interval Fuzzy Numbers.

Definition: 7[7]

An interval-valued fuzzy set \hat{X} on a universe U is a mapping such that $\hat{X} : U \rightarrow \text{Int}([0, 1])$, where $\text{Int}([0, 1])$ stands for the set of all closed subintervals of $[0, 1]$, the set of all interval-valued fuzzy sets on U is denoted by $\tilde{F}(U)$.

Suppose that $\hat{X} \in \tilde{F}(U)$, $\forall x \in U$, $\mu_{\hat{X}}(x) = [\mu_{\hat{X}}^-(x), \mu_{\hat{X}}^+(x)]$ is called the degree of membership an element x to \hat{X} . $\mu_{\hat{X}}^-(x)$ and $\mu_{\hat{X}}^+(x)$ are referred to as the lower and upper degrees of membership x to \hat{X} where $0 \leq \mu_{\hat{X}}^-(x) \leq \mu_{\hat{X}}^+(x) \leq 1$.

Definition: 8[7]

Let U be an initial universe and E be a set of parameters, a pair (F, E) is called an interval-valued fuzzy soft set over $\tilde{F}(U)$, where F is a mapping given by $F : E \rightarrow \tilde{F}(U)$.

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To analyze the factors influencing the higher academic performance of higher secondary students, opinion of three groups of respondents were collected. The first group G_1 consists of fifty high performers who are pursuing professional courses in leading professional colleges. The second group G_2 consists of fifty academicians handling higher secondary subjects. The third group G_3 consists of parents of high performers.

The authors conducted a pilot study and identified the following factors influencing high scores in Higher Secondary Examinations.

F_1 – Exposure to the scoring techniques

F_2 – Better motivation

F_3 – Planned preparation

F_4 – Proper guidance and counseling

F_5 – Special coaching imparted by tuition centers

F_6 – Good economic condition and good environment at home

Each respondent was asked to give a score value ranging between 1 and 10 for each factor. Using the data, Mean (M) and Standard Deviation (S.D) were calculated for each group G_1, G_2, G_3 . An Interval Fuzzy Number Matrix was framed by taking the six factors $F_1, F_2, F_3, F_4, F_5, F_6$ as rows and the three groups G_1, G_2, G_3 as columns.

Each entry in the matrix is an Interval Fuzzy Number which was framed by taking $\frac{M - S.D}{10}$ and $\frac{M + S.D}{10}$ as the left and right end points of the interval respectively.

$$A = \begin{matrix} & G_1 & G_2 & G_3 \\ \begin{matrix} F_1 \\ F_2 \\ F_3 \\ F_4 \\ F_5 \\ F_6 \end{matrix} & \begin{pmatrix} [0.7, 1.0] & [0.9, 1.0] & [0.5, 0.7] \\ [0.6, 0.7] & [0.8, 0.9] & [0.8, 0.9] \\ [0.7, 0.8] & [0.9, 1.0] & [0.6, 0.7] \\ [0.7, 0.8] & [0.8, 0.9] & [0.7, 0.8] \\ [0.7, 0.9] & [0.6, 0.8] & [0.7, 0.8] \\ [0.7, 0.8] & [0.7, 0.8] & [0.8, 0.9] \end{pmatrix} \end{matrix}$$

The following is the algorithm for finding the solution to the problem using Interval-Valued Fuzzy Soft Sets:

Step 1: Construct the Interval-Valued Fuzzy Soft Set (H, E), where H is a mapping given by $H : E \rightarrow \tilde{F}(U)$. Let $U = \{ F_1, F_2, F_3, F_4, F_5, F_6 \}$ and $E = \{ G_1, G_2, G_3 \}$.

$$H(G_1) = \{ \langle F_1, [0.7, 1.0] \rangle, \langle F_2, [0.6, 0.7] \rangle, \langle F_3, [0.7, 0.8] \rangle, \langle F_4, [0.7, 0.8] \rangle, \langle F_5, [0.7, 0.9] \rangle, \langle F_6, [0.7, 0.8] \rangle \}$$

$$H(G_2) = \{ \langle F_1, [0.9, 1.0] \rangle, \langle F_2, [0.8, 0.9] \rangle, \langle F_3, [0.9, 1.0] \rangle, \langle F_4, [0.8, 0.9] \rangle, \langle F_5, [0.6, 0.8] \rangle, \langle F_6, [0.7, 0.8] \rangle \}$$

$$H(G_3) = \{ \langle F_1, [0.5, 0.7] \rangle, \langle F_2, [0.8, 0.9] \rangle, \langle F_3, [0.6, 0.7] \rangle, \langle F_4, [0.7, 0.8] \rangle, \langle F_5, [0.7, 0.8] \rangle, \langle F_6, [0.8, 0.9] \rangle \}$$

Step 2: $\forall F_i \in U$, compute the choice value c_i for each features F_i such that

$$c_i = [c_i^-, c_i^+] = \left[\sum_{G_i \in E} \mu_{H(G_i)}^-(F_i), \sum_{G_i \in E} \mu_{H(G_i)}^+(F_i) \right], \text{ where } i = 1 \text{ to } 6.$$

$$c_1 = [2.2, 2.7], c_2 = [2.3, 2.6], c_3 = [2.2, 2.5], c_4 = [2.2, 2.5], c_5 = [2.0, 2.5], c_6 = [2.2, 2.5]$$

Step 3: $\forall F_i \in U$, compute the score r_i of F_i such that

$$r_i = \sum_{F_j \in U} ((c_i^- - c_j^-) + (c_i^+ - c_j^+)), \text{ where } i, j = 1 \text{ to } 6.$$

Thus, we have $r_1 = 1.1, r_2 = 1, r_3 = -0.2, r_4 = -0.2, r_5 = -1.4, r_6 = -0.2$

Step 4: The decision is any one of the elements in $S = \max_{h_i \in U} \{r_i\}$.

In our problem, the factor “**Exposure to scoring techniques (F₁)**” is the best choice because $\max_{h_i \in U} \{r_i\} = \{F_1\}$. This result is reasonable because we can see that $c_1 \geq c_i$, where $i = 2,3,4,5,6$. i.e. F_1 has the highest choice value.

CONCLUSION

In the present competitive world it becomes imperative to identify the contributing factors and its order of significance for various issues relating to social and economic development, academic performance, entrepreneurship development, personnel management, marketing management and so on. Application of mathematical concepts facilitates the authorities concerned to analyze the issues scientifically and arrive at the most reliable decision. The concepts of interval fuzzy number matrices and interval-valued fuzzy soft sets have rich potentials for developing such decision making models suitable for social, economical, commercial and managerial issues.

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