Fuzzy Matrix Approach to Study the Maximum Age Group of Stressed Students Studying in Higher Education

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ABSTRACT: These days stress is appeared as a biggest challenge among students of higher education. Several teachers shared that their students struggle to concentrate in their higher studies. Specifically, students in higher studies are affected by stress due to lack of academics, financials and social supports. Some teachers explained that their students often popped up distracted from learning because anxiety, self-worth issues, and fear get in the way. Uni-Health study confirms that 80% of those studying in higher education reported symptoms of stress or anxiety. Further, the NUS survey confirms that nine in 10 students experienced stress. This is an interested research problem, which is based on stress perceptions, stressful experiences and stress managements. Therefore, our main motivation of this study is to identify maximum age group of stressed students studying in higher education using the fuzzy matrix approach and provide the best suggestions to avoid the stress and stress outcomes.

Keywords: Fuzzy matrix approach, Maximum age group, Stressful situations, Higher education.

I. INTRODUCTION

Education system plays an important role in establishment of a country. Specially, higher education represents development and prosperity of a country. But still students in many countries are not getting elementary education, literacy and numeric ability. Children who enroll in schools don't even complete their education. A very low percentage of students enter into higher education after schooling. Those who enter into higher studies stressed and depressed due to various identifying factors such as lack of academic, financial support, family problems, burden of exams, and relationship conflicts with fellows. Extremely stress situation develop negative thoughts and perceptions in a person. Stress situations works like breakers in the success and achieving goals. In the present paper, we will obtain the maximum age group of stressed students studying in higher education using the fuzzy matrixapproach. Initially algebra of fuzzy matrices and the related fuzzy cognitive maps were used by Vasantha Kandasamy and Indira [1] for determining the maximum utility of route. They studied on socio-economic and psychological problems using theory of fuzzy matrices and fuzzy based models. They assumed four categories of matrices such as, initial raw data matrix (IRDM), average time dependent data matrix (ATDM), refined time dependent data matrix (RTDM), and combined effect time dependent data matrix (CETDM), respectively. Afterward these concepts were successively applied in medical sciences, engineering sciences, and industry. Kandasamy *et al.,* (2005) [2] studied the social and psychological problems encountered by rag pickers in Chennai using the combined effect time dependent data matrix. Kalaichelvi and Gnanamalar [3] identified the various types of problems faced by coffee cultivators based on their landholding with the applications of fuzzy matrices.

Victor Devadoss *et al.,* [4] worked on dimensions of women personality in Chennai using combined effect time dependent data matrix William *et al.,* [5] determined the peak age of women having breast cancer in Chennai using refined time dependent data matrices. Narayanamoorthy [6] estimated the maximum age group of silk weaver as bounded labors using fuzzy combined effect time dependent data matrix. Narayanamoorthy *et al.,* [7] obtained maximum age group of endosulfan pesticide victims in Kerela using fuzzy combined effect time dependent-data-matrix. Kirupa and Pathinathan [8] studied on rural Tamil medium student's problems in professional engineering college using CETD matrix. Kalaichelvi and Kalaivanan [9] analyze the Beneficiaries attitude towards education loan using theory of fuzzy matrices. Victor Devadoss and Joe Anand [10] studied on affected women by a Computer Vision Syndrome (CVS) using CETD Matrix. Kuppuswami *et al.,* [11] studied on traffic flow problem using combined effect time dependent-data-matrix. Iftikhar *et al.,* [12] investigated the maximum age group of cigarette smokers due to said attributes using fuzzy matrix method. Iftikhar *et al.,* [13] estimated the maximum age group of divorced women based on some social attributes using fuzzy matrix method. Arazia and Kutugata [14] studied on understanding stress in international students of higher education in Mexican private university. Shkulaku [15] worked on Student's stress in higher education institutions and proposed a critical review based on this study. Ortlieb and Weis [16] analyzed the different factors that make academic careers less insecure based on individual antecedents. Aafreen *et al.,* [17] studied on effects of stress on academic performance of students in different streams and extracted some useful conclusions for managing stress situations. Pappa *et al.,* [18] obtained sources of stress and scholarly identity based on the study of doctoral students of education in Finland. Pascoe *et al.,*

[19] investigated impact of stress on students in the secondary school and higher education. Park and Hahm [20] studied on changes in stress mindset and EEG through E-healthcare based education. Eppelmann *et al.* [21] studied on German high school students based on stress, mental and physical health. Bodha [22] analyzed and studied the services provided by some hospitals to the patients of the State and also suggested some measures for further positive changes in the health care system of Jammu and Kashmir. Khan and Sharma [23] applied fuzzy AHP method in transformer to analyze criteria for condition weight. Kamali *et al.,* [24] studied impact of a particular energy input level on wheat yield in Karaj region, Iran. The main encouragement of this work is to identify peak age group of stressed students studying in higher education using the fuzzy matrix technique and provide the best suggestions to avoid the stress and stress outcomes. The research methodology is based on questionnaire method and data is collected from 150 students in Delhi and National Capital Region (NCR) in India.

II. PRELIMINARIES

This section includes some basic definitions and notations on different types of fuzzy matrices.

Definition 2.1. An initial raw data matrix (IRDM)is the collection of initial data into matrix form by taking age groups as rows and pre assumed attributes as the columns.

Definition 2.2. An average time dependent data matrix (ATDM) is derived by transforming initial raw-data-matrix by dividing each row with length of the respective class intervals.

Definition 2.3. A number of refined time dependent data matrices (RTDMs) are derived by varying a parameter $\alpha \in [0,1]$ and using mean and standard deviation methods. The only entries of refined time dependent data matrices are -1, 0 or 1.

Definition 2.4. A transformation of average time dependent data matrix into a number of refined time dependent data matrices by varying a parameter $\alpha \in [0,1]$ and using mean and standard deviation is obtained using the following mathematical formulae:

If $m_{ij} \leq \bar{x}_j - \alpha\sigma_j$ then $f_{ij} = -1$

Else if $m_{ij} \geq \bar{x}_j + \alpha\sigma_j$ then $f_{ij} = 1$

Else if $\bar{x}_j - \alpha\sigma_j \leq m_{ij} \leq \bar{x}_j + \alpha\sigma_j$ then $f_{ij} = 0$

where $\bar{x}_j = \frac{\sum_{i=1}^{n} m_{ij}}{n}$ and $\sigma_j = \frac{\sum_{i=1}^{n}(m_{ij} - \bar{x}_j)^2}{n}$ for all $j = 1,2,\dots,k$ are simple mean and standard deviation corresponding to each column of the average time-dependent-data-matrix, respectively.

Definition 2.5. A combination of different refined time-dependent-data-matrices by varying $\alpha \in [0,1]$ gives cumulative effect of all the entries, and known as combined effect time dependent-data-matrix (CETDM).

III. OBSERVED ATTRIBUTES WITH SHORT DESCRIPTIONS TO STUDY THE MAXIMUM AGE GROUP OF STRESSED STUDENTS STUDYING IN HIGHER EDUCATION

OA₁. Financial Support

Financial support is a major issue with the students studying in higher education. Most of the students enroll in higher education after their teenage age and enter into the self independence position, but due to lack of fellowships or limited number of fellowships or not sufficient amount of fellowship, they are stressed.

OA₂. Academic Stress

A large population of students studying in higher education is stressed due to high academic stress and high academic work load and busy academic schedule. Academic Stress mainly develops symptoms such as depression, nervousness, behavioral problems and irritability in the students.

OA₃. Inconvenient Timing

Most of the students studying in higher education are stressed due to inconvenient timing; they generally starts functioning in the early morning due to university time schedules and get late night sleep due to hostels environment and other related issues. An inconvenient time schedule elaborates irritations, frustrations and angriness in the students.

OA₄. Social Stress

Social stress among the students mainly develops due to the situation and threatens of one's relationships. Social stress can originate from difficult social interactions and other related situations. Sometimes parents, faculty and elders tend to idealize their college experience upon the students studying in higher education. Responsibilities brings lot of stress in students mind like their family background, needfor money and responsibility of taking care of their family.

OA₅. Drugs and Alcohol Consumptions

The consumption of alcohol and drugs as self medicate develops posttraumatic stress disorder. Posttraumatic Stress is a mental disorder and develops the symptoms such as sexual assault, warfare and threats on a person's life. Committing mistakes are part of life, but when you feel for the mistakes and feel guilty which can bring stress to student's life.

OA₆. Career Selection

Many students are stressed and confused to selecting the best career options due to nonavailability of choices and lack of guidance. Best career choice develops a type of stressor to convince which career one need to select in his/her life. Students are more commonly stressed when they think and worry about their career selection, whether their dreams will be achieved or not.

OA₇. Mentors Problem

Normally mentors play an important role in shaping a student's career. But sometimes students are stressed, when they are working under the watchful eyes of their mentor. Since they are bounded and restricted to works freely on a project.

OA₈. Parenting Care

The parenting care develops the good characteristic of human beings in their children. Parenting care is most important factor in nurturing their Children behaviors. But many students are stressed due to family problem between their parents. Sometimes parents don't care their children properly because they are working and not have too much time to spend with their children. This non availability of proper care develops non affection and gap between parents and their wards.

OA₉. Diseases and Disability

Sometimes students are normally stressed due to the impact of diseases like fever, cold and others diseases due to not taking proper food and sleep. Disability and physical appearance is also the main reasons of stress

among the students because of the fact that they are made fun by their friends at university and home.

Based on above mentioned nine attributes, we have obtained initial data from 120 stressed students of higher education in Delhi (A Capital City of India) and National Capital Region (NCR) in India, as shown in Table 1.

Obtaining initial raw data matrix (IRDM) of order 5×9 of the stressed students studying in higher education by assuming age groups 18-21, 22-25, 26-29, 30-33, 34-37 in the years as rows and pre assumed attributes OA_1, $OA_2, ..., OA_9$ as columns, respectively.

The average time dependent data matrix (ATDM) of order 5×9 of the stressed students studying in higher education is obtained by dividing elements in a row with the time period of respective class.

Now, we calculate the simple mean and standard deviation of each column of the average time dependent data matrix.

Table 1: Number of students responds based on their age groups.

S. No.	Age-Group	Number of Respondent
1.	18-21	20
2.	22-25	30
3.	26-29	30
4.	30-33	20
5.	34-37	20
		Total = 120

Table 2: Initial raw data matrix (IRDM) of the order 5 × 9 of stressed students.

Age-Group	OA$_1$	OA$_2$	OA$_3$	OA$_4$	OA$_5$	OA$_6$	OA$_7$	OA$_8$	OA$_9$
18-21	11	9	13	11	15	15	9	13	8
22-25	13	11	9	13	13	14	11	9	10
26-29	17	17	15	19	13	17	17	15	16
30-33	15	18	13	17	17	15	15	13	18
34-37	13	7	11	15	4	8	13	11	6

Table 3: ATDM of the order 5 × 9 of stressed students.

Age-Group	OA$_1$	OA$_2$	OA$_3$	OA$_4$	OA$_5$	OA$_6$	OA$_7$	OA$_8$	OA$_9$
18-21	3.667	3.000	4.333	3.667	5.000	5.000	3.000	4.333	2.667
22-25	4.337	3.667	3.000	4.333	4.333	4.667	3.667	3.000	3.333
26-29	5.667	5.667	5.000	6.333	4.333	5.667	5.667	5.000	5.333
30-33	5.000	6.000	4.333	5.667	5.667	5.000	5.000	4.333	6.000
34-37	4.333	2.333	3.667	5.000	1.333	2.667	4.333	3.667	2.000

Table 4: Column wise mean and standard deviation of ATDM.

Mean	4.601	4.133	4.066	5.000	4.133	4.600	4.333	4.066	3.866
Standard Deviation	0.679	1.455	0.679	0.943	1.485	1.019	0.943	0.679	1.543

Obtaining different refined time dependent data matrices by taking α = 0.25, 0.45, 0.65, 0.85, and calculating their corresponding row sum as the resultants columns matrices

Obtained RTD matrix for α = 0.25   Obtained Row Sum Matrix

$$\begin{bmatrix} -1 & -1 & 1 & -1 & 1 & 1 & -1 & 1 & -1 \\ -1 & -1 & -1 & -1 & 0 & 0 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & 0 & -1 & -1 & 0 & -1 & -1 \end{bmatrix} \begin{bmatrix} -1 \\ -7 \\ 8 \\ 9 \\ -7 \end{bmatrix}$$

Obtained RTD matrix for α = 0.45   Obtained Row Sum Matrix

$$\begin{bmatrix} -1 & -1 & 0 & -1 & 1 & 0 & -1 & 0 & -1 \\ 0 & 0 & -1 & -1 & 0 & 0 & -1 & -1 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & -1 & -1 & 0 & -1 & -1 & 0 & -1 & -1 \end{bmatrix} \begin{bmatrix} -4 \\ -4 \\ 8 \\ 6 \\ -6 \end{bmatrix}$$

Obtained RTD matrix for α = 0.65   Obtained Row Sum Matrix

$$\begin{bmatrix} -1 & -1 & 0 & -1 & 0 & 0 & -1 & 0 & -1 \\ 0 & 0 & -1 & -1 & 0 & 0 & -1 & -1 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & -1 & 0 & 0 & -1 & -1 & 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} -5 \\ -4 \\ 8 \\ 5 \\ -4 \end{bmatrix}$$

Obtained RTD matrix for α = 0.85   Obtained Row Sum Matrix

$$\begin{bmatrix} -1 & 0 & 0 & -1 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & -1 & 0 & 0 & -1 & -1 & 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} -3 \\ -2 \\ 8 \\ 4 \\ -4 \end{bmatrix}$$

IV. REPRESENTING THE MAXIMUM AGE GROUP OF STRESSED STUDENTS STUDYING IN HIGHER

Education by Plotting Graphs for Different Values of $\alpha \in [0, 1]$

The plotted graphs represent the maximum age groups of stressed students studying in higher education by varying $\alpha \in [0, 1]$ using the theory of fuzzy matrices.
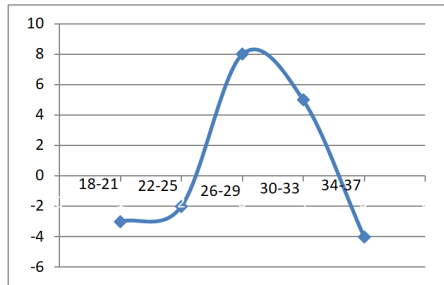

Fig. 1. Graphical representation of the maximum age group of stressed students studying in higher education for $\alpha = 0.25$.
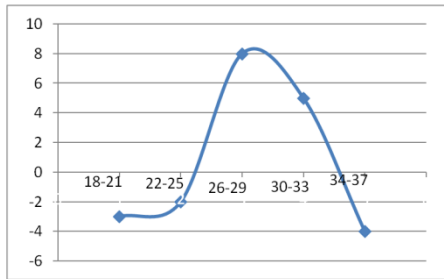

Fig. 2. Graphical representation of the maximum age group of stressed students studying in higher education for $\alpha = 0.45$.
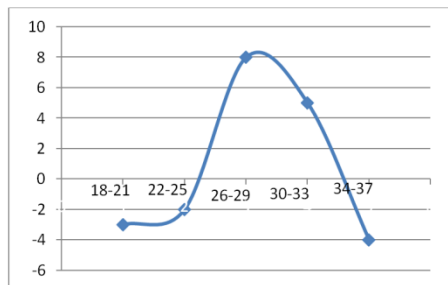
Fig. 3. Graphical representation of the maximum age group of stressed students studying in higher education for $\alpha = 0.65$.
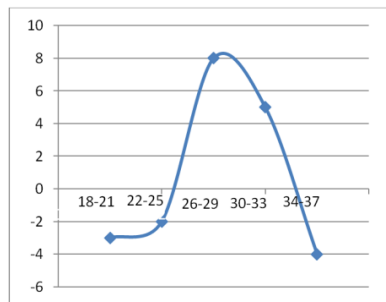

Fig. 4. Graphical representation of the maximum age group of stressed students studying in higher education for $\alpha = 0.85$.
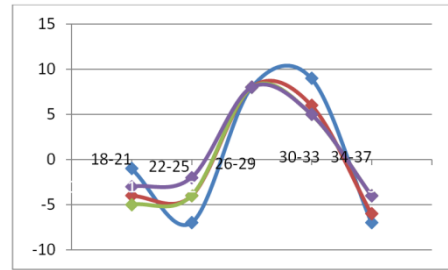

Fig. 5. Graphical comparison of the maximum age group of stressed students studying in higher education based on α = 0.25, 0.45, 0.65 and 0.85.

V. PLOTTING GRAPH FOR THE CETDM TO DEPICTING THE MAXIMUM AGE GROUP OF STRESSED STUDENTS STUDYING IN HIGHER EDUCATION

A combine effect time dependent data matrix is obtained by combining different refined time dependent data matrices by varying $\alpha \in [0, 1]$, which gives the cumulative effect of all the entries. The combined effect time dependant data matrix play a pivotal role in exhibiting the combine effect of all the obtained RTD matrices for different values of α = 0.25, 0.45, 0.65 and 0.85. The CETD matrix application is a simple but very effective method for the recognition of peak age group in which the students of higher studies gets stress on the basis assumed attributes.

Obtained CETD matrix   Obtained row sum matrix

$$
\begin{bmatrix}
-4 & -3 & 1 & -4 & 2 & 1 & -4 & 1 & -3 \\
-1 & -1 & -4 & -3 & 0 & 0 & -3 & -4 & -1 \\
4 & 4 & 4 & 4 & 0 & 4 & 4 & 4 & 4 \\
2 & 4 & 1 & 3 & 4 & 1 & 4 & 1 & 4 \\
-1 & -4 & -2 & 0 & -4 & -4 & 0 & -2 & -4
\end{bmatrix}
\begin{bmatrix}
-13 \\
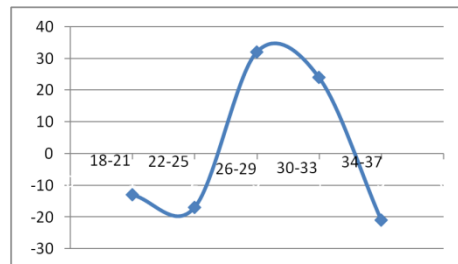-17 \\
32 \\
24 \\
-21
\end{bmatrix}
$$

Fig. 5. Graphical representation of the maximum age group of stressed students studying in higher education for Combined Effect Time Dependent Data Matrix.

VI. CONCLUSIONS

From the above studies and depicted graphs for different values of α = 0.25, 0.45, 0.65 and 0.85 on the stressed students studying in higher education, we concluded that the maximum age group of stressed students remain unchanged by varying $\alpha \in [0, 1]$. It can be easily extracted from the above plots that the stressed student's age group lays in two intervals 26-29 and 30-33. The extracted results are confirmed by cumulative effect of all the RTD matrices for different values of $\alpha, 0 \leq \alpha \leq 1$, known as combined effect time

dependent data matrices. The negative values for the age groups 18-21, 22-25 and 34-37 simply indicate that very few students are stressed in these mentioned age groups as compare to the obtained results. The main motivation to study stress problems is to find out peak age of stressed students so that counselors and psychiatrist can help students by developing self care, self control, dispute resolution, optimistic attitude, self command, breathing, meditation, exercise, proper diet and rest.

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