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An Approach for Solving Fuzzy Relational Maps Under Uncertainty

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Abstract

This enables decision-makers to model problems more realistically when data is imprecise or subject to variation. This model is more applicable when the data in the first place is an unsupervised one. In the real world, due to uncertainty, complexity may arise in the form of ambiguity. To handle such uncertainty and ambiguity, fuzzy logic and fuzzy numbers have been used as effective tools. Fuzzy logic was introduced by Prof. Lotfi A. Zadeh. in conjunction with the proposal of fuzzy set theory. Fuzzy logic is applied by many researchers to various fields. To define Fuzzy Relational Maps (FRMs) we need a domain space and range space which are disjoint in the sense of concept. In this paper we analyze the various problems of Transgender in Chennai using FRMs. This FRM method is best suited for this study. This method is introduced by W.B.Vasantha Kandaswamy and Yasmin Sultana in 2000. This paper contains five sections. First section is introductory in nature that deals with the basics of FRMs and Transgender issues. Second section deals with the preliminaries of FRM Model. Third section lists the causes and causalities of the problems of transgender. These are arrived at through the linguistic questionnaire administered to 100 Trans genders ten parents and three NGO leaders who have been working for their rights and rehabilitations in Chennai City. In the fourth section we analyze the inter relationship between the causes and causalities listed in the Domain and range spaces using FRM Model. In the Final section we give the conclusion based on our studies and suggestions.

Keywords: FRM, fixed point, Hidden pattern, Unsupervised data's, Transgender, Decision making and optimization, Optimazation and decision making.

1|Introduction

1.1|Fuzzy Relational Maps

In this the issues looked by the FRMs are fuzzy in nature we have used the fuzzy models in examining their anxiety and gathering them organized by their weightage. Fuzzy Mathematics theory has been studied

extensively with this dissertation. Most of the early interest in fuzzy set theory pertained to representing uncertainty in human cognitive processes Fuzziness can be found in many areas of daily life such as in engineering, business, medical and related health sciences, and the natural sciences.

It is particularly frequent, however, in all areas in which human judgment, evaluation and decisions are important. However, in many real life cases, the decision data of human judgments with preferences are often vague so that the traditional ways of using crisp values are inadequate. Due to lack of information, the future state of the real system might not be known completely. A fuzzy mathematical modeling is the representation of the real world problem into a mathematical form in an attempt to find solutions to the problem that corresponds closely to the way human perceive it. Also fuzzy modeling increases the validity of ill-structured system as it offers a deeper understanding on the complexities of decision parameter.

The research conducted in these key areas holds significant scientific and social implications. By advancing methodologies in spherical fuzzy linear programming, multi-objective optimization, and handling uncertainty in decision-making, the scientific community gains deeper insights into fuzzy optimization theory. These advancements can lead to more robust and efficient computational techniques, benefiting various fields such as finance, engineering, and healthcare. Moreover, the practical applications of these methodologies can have a profound social impact by improving decision-making processes in areas like urban planning, environmental management, and public policy. Overall the research contributes to both scientific knowledge and societal welfare by providing innovative solutions to complex optimization problems under uncertainty.

Fuzzy set provides us not only with a meaningful and powerful representation of measurement of uncertainties, but also with a meaningful representation of vague concepts expressed in natural language. Because every crisp set is fuzzy but not conversely. The mathematical embedding of conventional set theory into fuzzy sets is as natural as the idea of embedding the real numbers into the complex plane. Thus, the idea of fuzziness is one of enrichment, not of replacement. A Fuzzy graph is a convenient way of representing information involving relationship between objects. The objects are represented by vertices and relations by edges. When there is vagueness in the description of the objects or in its relationships or in both, it is natural that we need to design a Fuzzy Graph Model. Applications of fuzzy relations are widespread and important. Especially in the field of clustering analysis, neural networks, computer networks, pattern recognition, decision making and expert systems. In each of these, the basic mathematical structure is that of a fuzzy graph.

1.2 | About the Transgenders

Every kid in the womb is initially a girl. It is over time and series of changes that the kid turns into a boy or remains a girl. When these changes are incomplete the kid become a Transgender. Transgender is an Umbrella term for persons whose gender identity and gender expressions or behavior do not conform to that typically associated with the sex to which they were assigned at birth. Gender Identity refers to a person's internal sense of being male, female or something else. Gender expression refers to the way a person communicates gender identity to others through behavior, clothing, hair styles, voice or body characteristics etc.

Gender Identity or sexual Orientation

Transgender people may be straight, lesbian, gay, and bisexual, just as non Transgender people can be. There are many types of trans-people like Lesbian, Gay, Bisexual and Transgender and in short called as LGBT due to some common concern requiring intervention from Government through policy measures to resolve certain basic problems.

Lesbian or gay woman

A transgender woman or a person who is assigned male at birth and transitions to female, who is attracted to other woman would be identified as lesbian or gay woman.

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Gay man

A transgender man or a person who is assigned female at birth and transitions to male, who is attracted to other men would be identified as a gay man.Making a fun of Transgender has always been a fun and since known history..Transgender is a gender given to the world by the nature and the recognition of such people by the people as well as the government is still chaotic. When a transgender is treated like an unequal or is humiliated by the ordinary people, there are not a lot of redressed mechanisms that are available to him. They face immense problem in the society. These people are hardly educated. Most of them are pushed into sex work and out of Illiteracy; they become vulnerable to deadly disease like HIV/AIDS. Thus in the long run they lose hope, self confidence and what not.

1.3 | Previous Research Work

Malhotra et al. [1] estimated the effects of gold plating we have designed a tool based on Fuzzy Cognitive Maps (FCM). With the help of this tool developer can know the effects of doing gold plating on the project and based on the output of the tool the developer can make subsequent decisions regarding the project. Murungwen et al. [2] found that the interactive nature of FCMs reveals hidden knowledge and insights that improve the understanding of the complexity of livelihood systems in a way that is better appreciated by stakeholders. Yang et al. [3] proposes these research one kind of Two layer of True-Tree FCM (TTFCM) to model the system with the relational data in the form of E-R schema through analyzing the relational database and the multi-relational characteristic. The TTFCM includes one FCM in high-level and many FCMs in low-level forming a two-level tree. Also their analysis of vulnerability using the FCM method showed that issues of policy such as changing situations at borders can strongly aggravate vulnerability to climate change by increasing the drought sensitivity of livelihoods.

Vidhya Kannan et al. [4] studied of fuzzy floyd warshall algorithm and the fuzzy rectangular algorithm to find the shortest path. Broumi et al. [5] made an efficient approach for solving time-dependent shortest path problem under fermatean neutrosophic environmet. Vidhya and Saraswathi [6] proposed a novel method for finding the shortest path with two objectives under trapezoidal intuitionistic fuzzy arc costs. Prakash and Appasamy [7] presented an optimal solution for fully spherical fuzzy linear programming problem. Saraswathi [8] developed a fuzzy-trapezoidal DEMATEL approach method for solving decision making problems under uncertainty. Dharmaraj et al. [9] has done an application of a Modified Gauss Elimination Technique for Separable Fuzzy Nonlinear Programming Problems. Vidhya and Saraswathi [10] investigated A* search algorithm for the shortest path under interval-valued Pythagorean fuzzy environment.

Saraswathi and Mahalakshmi [11] solved a new approach for solving the minimal flow, shortest.route, maximal flow and the critical path using network. Appasamy Saraswathi [12] used a triangular fuzzy clustering model under uncertainty. Prakash and Appasamy [13] studied a novel approach for multi-objective linear programming model under spherical fuzzy environment and its application. Karthick et al. [14] used a neutrosophic linear fractional programming problem using denominator objective restriction method. dynamics of continuous. Saraswathi and Nedumaran [15] developed a comparative study for finding the critical path using triangular fuzzy numbers. Nedumaran et al. [16] enhanced the optimum route finding in tourism transportation in tamil nadu using weighted fuzzy graph.

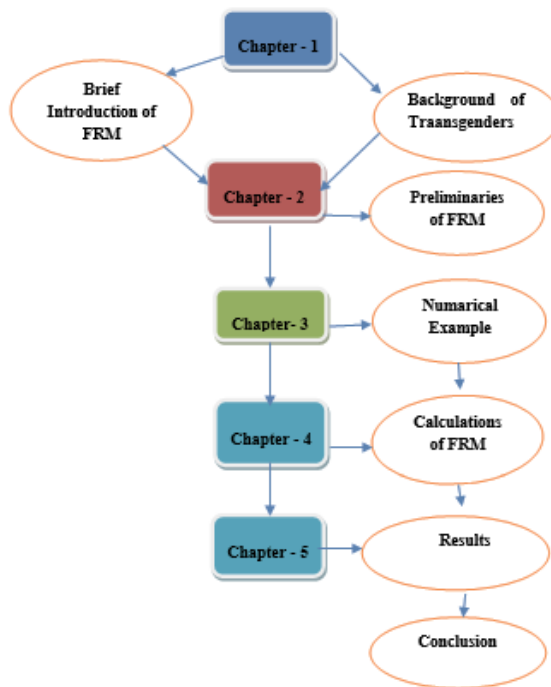The Structure of this research is as below shown in *Fig.1*.

Fig. 1. Structure of this research.

2|Preliminaries of Fuzzy Relational Maps

Definition 1. A Fuzzy logic is a method of describing and processing ambiguous data. In the more traditional propositional logic, such as 'it will rain tomorrow', must be either true or false. However, much of the fact's humans use about the world has some ambiguity.

Definition 2. If X is an universal set and $x \in X$, then a fuzzy set $\tilde{A}$ defined as a collection of ordered pairs,

$$\mu_{\tilde{A}}\tilde{A} = \{(x, (x)), x \in X\}.$$

Where $\mu_{\tilde{A}}(x)$ is called the membership function that maps X to the membership space M.

Definition 3. Fuzzy set defined on the set R of real numbers is called fuzzy number whose membership function is of the form $\tilde{A}: R \rightarrow [0,1]$ under certain condition.

   I. $\tilde{A}$ is normal.

  II. $\tilde{A}$ is convex.

 III. $\tilde{A}$ is piecewise continuous.

Definition 4. A FRM is a directed graph or a map from Domain space to Range Space with concepts like policies or events etc. as nodes and causalities as edges. It represents casual relations between spaces D and R.

Definition 5. The directed edge from D to R denotes the causality of D on R, called relations. Every edge in the FRM is weighted with a number in the set $\{0, 1\}$.

Definition 6. Let D_i and R_j denote the nodes of an FRM. Let e_{ij} be the weight of the edge $D_i R_j$, $e_{ij} = 0,1$}. The weight of the edge $D_i R_j$ is positive if increase in D_i implies increase in R_j or decrease in D_i implies decrease in R_j. i.e., casuality of D_i on R_j is 1. If $e_{ij} = 0$ then D_i does not have any effect on R_j. We do not discuss the cases when increase in D_i implies decrease in R_j or decrease in D_i implies increase in R_j. When the nodes of the FRM are fuzzy sets, then they are called fuzzy nodes, FRMs with edge weights $\{0, 1\}$ are

called simple FRMs. Let $D_1, D_2, \ldots D_n$ be the nodes of the domain space D of an FRM and $R_1, R_2, \ldots R_m$ be the nodes of the range space R of an FRM.

Definition 7. Let the matrix E be defined as E = eij where eij = {0, 1} is the weight of the directed edge $D_i R_j$ (or $R_j D_i$), E is called the relational matrix of the FRM. It is pertinent to mention here that unlike the FRMs, the FRMs can be a rectangular matrix; with rows corresponding to the domain space and columns corresponding to the range space.

Definition 8. Let $D_1, D_2, \ldots D_n$ and $R_1, R_2, \ldots R_m$ be the nodes of an FRM. Let $D_i R_j$ (or $R_j D_i$) be the edges of an FRM, j=1,2,….,m, i=1,2,…n. The edges form a directed cycle if it possesses a directed cycle. An FRM is said to be acyclic if it does not possess any directed cycle.

Definition 9. An FRM with cycles is said to be an FRM with feedback. When the casual relations flow through a cycle in a revolutionary manner, the FRM is called a dynamical system.

Definition 10. Let $D_i R_j$ (or $R_j D_i$), $1 < j < m$, $1 < i < n$. When R_j (or D_i) is switched on and if causality flows through edges of the cycle and if it again causes R_j (or D_i), we say that the dynamical system goes round and round. This is true for any node R_j (or D_i) for $1 < i < n$, (or $1 < j < m$). The equilibrium state of this dynamical system is called the hidden pattern. If the equilibrium state of the dynamical system is a unique state vector, then it is called a fixed point. Consider an FRM with $R_1, R_2, \ldots R_m$ and $D_1, D_2, \ldots D_n$ as nodes. For example let us start the dynamical system by switching on R1orD1. Let us assume that the FRM settles down with R_1 and R_m (or $D_1 a A_1$ and D_n) on i.e. the state vector remains as (1 0 ... 0 1) in R [or (1 0 … 0 1) in D], this state vector is called the fixed point. If the FRM settles down with a state vector repeating in the form $A_2 > \ldots > A_i > A_1$ or $(B_1 > B_2 \ldots B_i > B_1)$ then this equilibrium is called a limit cycle.

Definition 11. Finite number of FRMs can be combined together to produce thejoint effect of all the FRMs. Let E1,..., Ep be the relational matrices of the FRMs with the nodes R₁, R₂,..., Rm and D₁, D₂,..., Dn then the combined FRM is represented by the relational matrix E = E₁+...+ Eₚ.

3|Numarical Example

Adaptation of FRM to the relation between problems and the reasons of the trans-genders

FRMs we divide the very causal associations into two disjoint units. The relation between a teacher and a student or relation between an employee or employer or a relation between doctor and patient and so on. Thus for us to define a FRM we need a domain space and a range space which are disjoint in the sense of concepts. We further assume no intermediate relation exists within the domain elements or node and the range spaces elements. The number of elements in the range space need not in general be equal to the number of elements in the domain space.

The methodology is detailed, and numerical examples are provided to illustrate the process and validate the results. By using linguistic Questionnaire the expert's opinion was arrived at by administering the same to 100 Tran's genders, 10 parents and three NGO leaders. Here we take the problems of the Trans genders in the Domain space added the causes for the problems in the range space as listed below:

3.1|Some Survey Questions for the Transgender Respond:

I.   What does transgender mean.

II. What is the difference between sex and gender.

III. Why are some peoples are the transgender.

IV. How prevalent are transgender people.

V.   What are some categories or types of transgender people.

VI. What is the relationship between transgender and sexual orientation.

VII. How do transgender people experience their transgender feelings.

VIII. Is being transgender a mental disorder.

IX. What kinds of mental health problems do transgender people face.

X. What kinds of discrimination do transgender people face.

XI. Where can I find more information about transgender issues.

Attributes Related to the Domain space given by D1, D2…..D10:He we have taken the Domain Spaces are the main problem for the Transgender

D_1 - Parents disown the Trans genders after certain age.

D_2 - Hormones disorder leading to unnatural behavior.

D_3 - Poverty.

D_4 - Lack of Education.

D_5 - Unemployed.

D_6 - No share in property.

D_7 - Lack of support from Government and non-government organizations.

D_8 - Forced to beg or uncertain prostitution for their livelihood.

D_9 - Unnatural slang in conversation.

D_{10} - Prone to sexual diseases such as STD/HIV/AIDS.

Attributes Related to the Range space given by R1, R2,…..R10

we have taken the Range Spaces are the main reason for the Transgender:

R_1 - Living with trans- people.

R_2 - Lack of permanent shelter.

R_3 - Forced to have illicit sex as marriage is not possible.

R_4 - No sexual identity to be admitted in educational institutions or to register for employ mentor to exercise adult franchise.

R_5 - Subject to teasing due to unnatural behavior.

R_6 - No proper food/ malnutrition.

R_7 - living in depression and trauma.

The Expert Opinion Is Arrived at Through the Responses We Received From the Transgender Themselves

In the first stage the data was converted into a relational map and the relational matrix was obtained form the relational map, and using this the average relational matrix is obtained.In the second stage the average relational matrix is converted into fuzzy relational matrix. The FRMs can be used when we do not have any data but only the opinions and when we have the data using the past experience how give the predictions.

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Here we give some justifications to state why the use of FRMs which we first marked difference between Problems and Causes of Transgenders.

A FRM is a directed graph or a map from Domain space to Range Space with concepts like policies or events etc. as nodes and causalities as edges. It represents casual relations between spaces D and R.
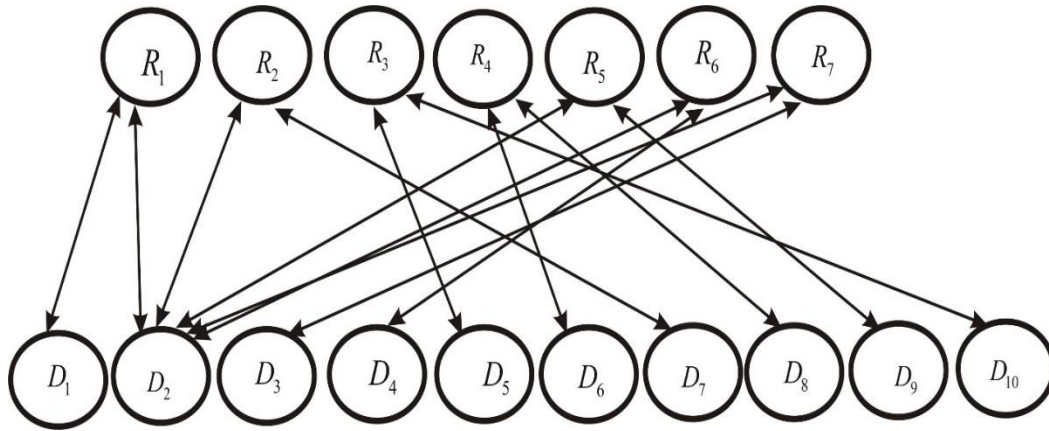
The corresponding directed graph shown in *Fig. 2.*

Fig. 2. The related matrix E_1 of the directed graph is given.

The directed edge from D to R denotes the causality of D on R, called relations. Every edge in the FRM is weighted with a number in the set {0, 1}.

The related matrix E_1 and E_1^T of the directed graph is given

The directed edge from D to R denotes the causality of D on R, called relations. Every edge in the FRM is weighted with a number in the set {0, 1}.

$$E_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix},$$

$$E_1^T = \begin{pmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}.$$

4 | Method of Finding Hidden Pattern

This model is more applicable when the data in the first place is an unsupervised one. To define FRM we need a domain space and range space which are disjoint in the sense of concept. The causes and causalities of the Transgender problems form two disjoint spaces. By using this FRM Model we can analyze the inter relation between doctor and patient, teacher and student, employee and employer methods as teaching and the behavioral outcomes etc. In this discussion the elements of domain space are problems and the range spaces are the causes/reasons. We denote by R the set of nodes $(R_1 \ldots R_m)$ of the range space, where $R = x_1, \ldots x_m / x_j = 0 \text{ or} 1$ for j = 1, 2 ….m. If x_j=1, it means the node R_i is in the 'on 'state and $x_i = 0$ means that the node R_i is in the 'off' state. Similarly D denotes the nodes $D_1 D_2 \ldots D_n$ of the domain space where $D = x_1, \ldots x_n / x_j = 0 \text{ or } 1$ for i =1, 2….n. It means the node D_i is on or off for x_j=0 or 1 respectively.

Let D_2 be kept in "on state" ie.,"hormones disorder leading to unnatural behavior" is in the' on state'

Let, the hidden pattern of the state vector X = (0 1 0 0 0 0) is obtained by the following method.

X=(0 1 0 0 0 0 0 0 0 0).

Let $D_1, D_2, \ldots D_n$ and $R_1, R_2, \ldots R_m$ be the nodes of an FRM. Let $D_i R_j$ (or $R_j D_i$) be the edges of an FRM, j=1,2,….,m, i=1,2,…n. The edges form a directed cycle if it possesses a directed cycle. An FRM is said to be acyclic if it does not possess any directed cycle.

XE_1=(1 1 1 0 1 1 1)=Y.

YE_1^T=(1 1 1 1 1 1 1 1 1 1)=X_1.

$X_1 E_1$=(1 1 1 1 1 1 1)=Y_1.

$Y_1 E_1^T$=(1 1 1 1 1 1 1 1 1 1)=X_2.

An FRM with cycles is said to be an FRM with feedback. When the casual relations flow through a cycle in a revolutionary manner, the FRM is called a dynamical system.

$X_2 E_1$=(1 1 1 1 1 1 1)=y_2.

Y_1=Y_2.

When D_2 "hormones disorder leading to unnatural behavior" is the on state and all other states are off state. The fixed point pair as {(1 1 1 1 1 1 1 1 1 1), (1 1 1 1 1 1 1)}.That the corresponding hidden pattern is a fixed point Y_1=Y_2.

The mathematical formulation of the problem is presented, along with solution techniques and

illustrative examples to demonstrate the applicability of the FRM. A lot of discussion can be made on such fixed points, for the opinion of the Domain Spaces are the main problem for the Transgender and range

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space are the main reasons for the Transgender. It is visibly seen that all the nodes both in the domain space and the range space becomes on, at the very advent of seeing the effect of only one node of the domain space to be in the on state.

The interpretations are also to be carefully given .Likewise in case of the domain nodes all nodes come to the on state. Thus we are notable to distinguish or give a nice interpretation of the state vectors. That is why if a certain stages when the expert is not able to give opinion. To avoid this sort of contradictory fixed points / limit cycles we proceed onto construct and analyze using the FRMs can also be used in the prediction using the past year data.So in this case it is not only the expert's opinion but the interpretation of the data and the opinion analyzed using other methods using FRMs . For this study the raw data is obtained from the problems and reasons for the Transgenders, which is converted into a relational map. The relational map takes edge values as positive real numbers. If the number of concepts in the domain space is M and that of the range space is N we get an M × N causal relational matrix, which we call as the relational matrix.

5 | Results

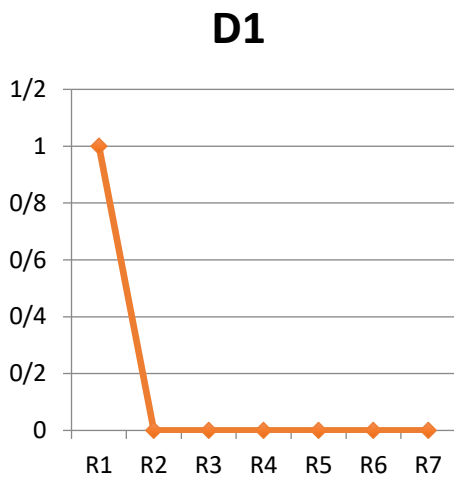The relation between the problems and the Reasons from the graphs.
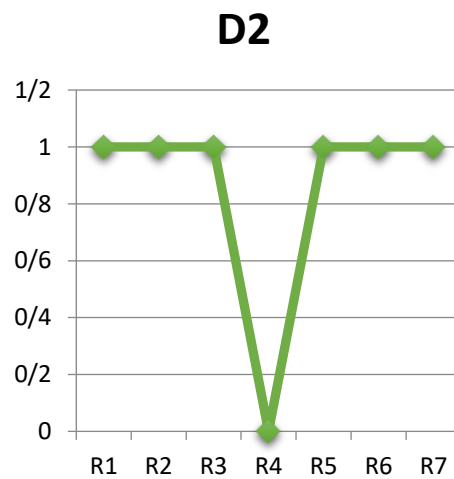

Fig. 3. Parents Vs reasons.
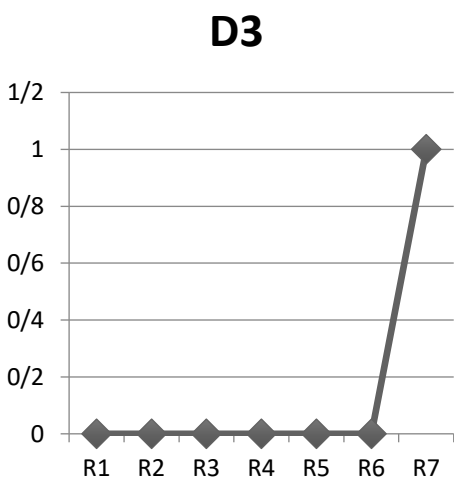

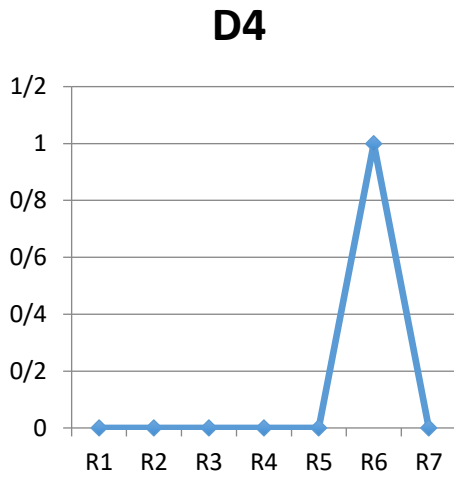Fig. 4. Hormones Vs reasons.

Fig. 5. Poverty Vs reasons.

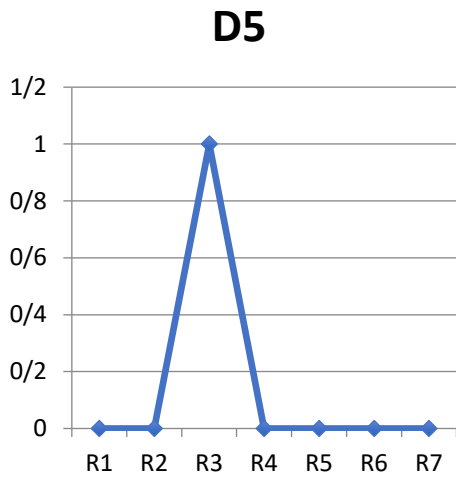Fig. 6. Education Vs reasons.

D5

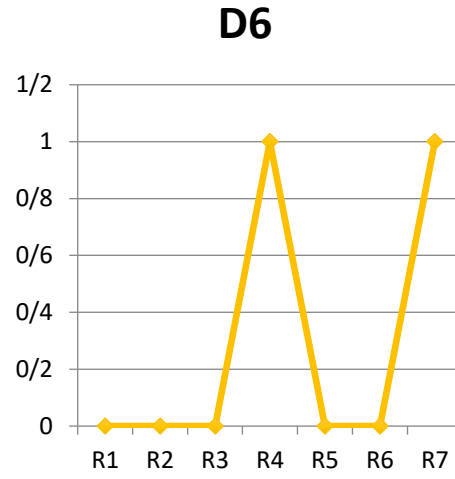Fig. 7. Employers Vs reasons.

D6

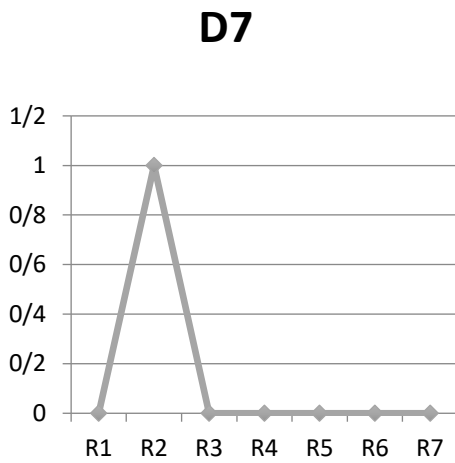Fig. 8. No saving money Vs reasons.

D7

Fig. 9. Govt organizations Vs reasons.

D8
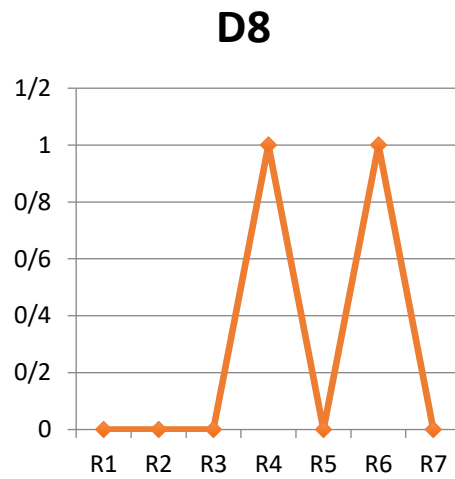
Fig. 10. Beg Vs reasons.

D9
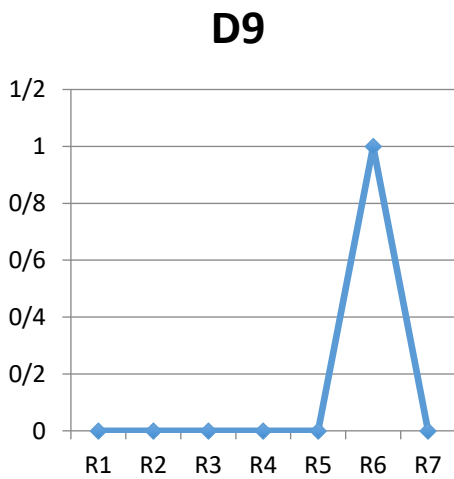
Fig. 11. Language Vs reasons.

D10

Fig. 12. HIV/AIDS Vs reasons.

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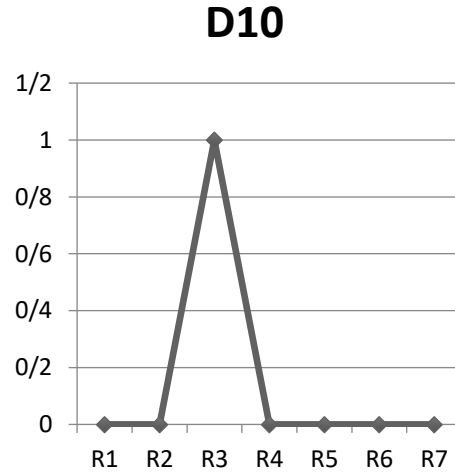
6 | Conclusion

Based on the calculations When D_2 Hormones disorder leading to unnatural behavior is on state all the nodes in Domain and Range spaces comes up to on state. This clearly shows that the problem of Transgender is due to hormones disorder only. According to the analysis considered D_2 (hormones) has in the on state and all other nodes changed in appearance. But people in the family as well as the society do not take up this scientific reason for having been born as transgender. They take it as 'curse of god' and ill treat them, by pushing then from out of family, that forces them to become shelter less beg or enter into prostitution to living. Looking at the graph, it is evident that D_2 (hormones disorder) followed by D_6"no share in property) and D_8 (forces to beg) along with the problem are the major only for their depressed status. Hence Hormones disorder leading to unnatural behavior is the main causes for all the problems.

Based on the graph, no share in property and forces to beg leads to problems of Transgender. From the study, it is seen that while using FRM, Hormones disorder leading to unnatural behavior is the main causes of the Transgender.The governments need to take special effort to include the Trans persons in all the development programmers in important areas as education, employment. As the persons with disabilities are to be provided with free facilities in common places, the transgender too need such provisions. For instance they need to be special toilets for Tran's peoples; the rights to marriage too, should be protected. It is the responsibility of the Government to ensure wide publicity through the print and visual Media, of the fact that caravan's are entitled to get registered in electoral rolls and that transgender.

Individuals could choose either 'male' or 'female' as their gender when applying for official identity documents. The state's education department issued a G.O. creating a "third gender category" for the admission in educational institutions. As per this order, educational institutions have to issue the application form for undergraduate courses that will include transgender as a separate category. This will permit transgender students to join any college of their choice, whether co-educational, men's or

Women's colleges. Further, the government has issued guidelines for schools to provide for counseling of transgender students, counseling for families of transgender students to ensure they don't disown them, and ensuring disciplinary action against schools and colleges who refused to admit aravani's. They need to be a policy of reservation in education and employment measures in proportion to their population. Only then their rights and rehabilitation will be protected and promoted.

6.1 | Based on the Calculations Some Suggestion

Through this comprehensive approach, the research aims to provide decision-makers with a systematic framework for efficiently deriving fixed point, thus contributing to the advancement of effective decision-making strategies in complex environments.

The people must be made aware of through awareness program on the real cause problem being a born as Trans persons. Then the family members as well the society around will treat special care and development. The government needs to take special effort to include the Trans persons in all the development programmers in important areas as education, employment. As the persons with disabilities are to be provided with free facilities in common places, the transgender too need such provisions. For instance they need to be special toilets for Tran's peoples; the rights to marriage too, should be protected. They need to be a policy of reservation in education and employment measures in proportion to their population. Only then their rights and rehabilitation will be protected and promoted.

There is need for their social acceptance. They should be provided separate wards in all government hospitals. The authorities do not admit them in women's ward, because women do not feel comfortable or free in their presence and in men's ward they face sexual abuse. Besides, there are no separate toilet facilities for them.

6.2 | Solutions

    I.   The transgender persons must be properly documented in census.

    II.   Extend financial support for community based organizations run by transgender communities.

    III.   They need to be considered for statutory reservation in educational institutions and job opportunities in public and private sectors.

    IV.   They need to be empowered with high degree of educational and vocational trainings to upgrade their earning and status in the society.

    V.   Support of civil society organization to advocate for their cause and efforts. For example, advocate, for land/ shelter, creation of separate public toilets, hospital wards, recognition of their

    VI.   Right to vote as citizens, reservation seats in election, etc.

    VII.   Since they are prone to heath setbacks, they need proper medical facilities including insurance in the health sector.

    VIII.   To generate awareness, so that the transgender is viewed and understood as a culture, community and a movement.

    IX.   The Government has created a database on Transgender that would help to deal with their.

    X.   Problems and demands such as housing ration card, voter identity, patta, health facility etc.

    XI.   The Government has also issued a Government order for admission of Transgender.

6.3 | Hopes for the Future

This paper has significantly advanced the field of FRMs. This research has significantly advanced the field of FRMs by developing and analyzing various problems and causes of transgenders. The research presented here addresses several complex scenarios that FRMs struggle to handle due to inherent uncertainties. By integrating this work has enriched the theoretical framework and practical applications of FRMs. This article is demonstrating the applicability of these models to real-world problems. This comprehensive exploration not only enhances the precision and robustness of FRMs but also opens new avenues for future research and practical implementations in various domains.

Author Contributions

Appasamy Saraswathi conceptualized the model and led data collection. Seyed Ahmad Edalatpanah conducted the mathematical analysis, and Sanaz Hami Hassan Kiyadeh handled data processing and results validation.

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Data Availability

Data supporting the results of this study are available upon request from the corresponding author.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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