Int. J. Nonlinear Anal. Appl. 14 (2023) 7, 45–56
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2023.29690.4229

Evaluating the function of reverse fund in 'Majma Hamiyari tourism development plan' using fuzzy expert system

Abbas Bashiri[a], Seyed Mehdi Mirhosseini-Alizamini[b,*], Mikaeil Janbazi-Ghadi[a]

[a] The CEO of Creative Company, Vice Presidency for Science and Technology, Sari, Iran
[b] Department of Mathematics, Payame Noor University (PNU), 19395-4697 Tehran, Iran

(Communicated by Sirous Moradi)

Abstract

In this article, according to the competition in marketing science, a method for better decision-making and marketing forecast based on fuzzy logic "fuzzy expert system" is presented regarding the tourism development plan of Majma Hamiyari owned by Abbas Bashiri. In this research, the evaluation of the system based on the calculation method of the proposed plan (reverse fund) is presented in attracting different layers of society based on the definition of input variables such as age, education, marital, place of residence, membership in life insurance and membership in the family fund. In fact, the proposed method offers marketing managers a plan that concentrates the most time and financial capital for advertising for a segment of the society that this calculation method (reverse fund) has the greatest effect on attracting customers. The fuzzy expert system was designed with 12 rules after reviewing the rules and removing similar and contradictory rules by using their degree calculation. In this system, by integrating some factors, finally, 6 input variables and one output variable were considered that were used by the product inference engine, singleton fuzzifier and center average defuzzifier. It was observed that the designed fuzzy expert system provides very good results.

Keywords: Fuzzifier, Defuzzifier, Fuzzy expert system
2020 MSC: 97M40, 90C31, 34k36

1 Introduction

The World Organization of UNESCO, which declared 1987-1997 as the World Decade of Cultural Development, has declared cultural development as follows: "The development and progress of the cultural life of a society with the aim of realizing cultural values, in a way that is coordinated with the general state of economic and social development." But among the issues that play a significant role in cultural development is tourism. Tourism is an industry that includes all cultural, economic and social dimensions and today the whole world pays special attention to it. Intercultural communication in tourism has made tourism the best model for a citizen of globalization, and now tourism has become a tool for peace and dialogue between civilizations, and the importance of this issue in the UNESCO World Heritage Convention, regardless of race, religion and nationality Preservation of historical, natural and cultural monuments is clearly visible.

*Corresponding author
Email addresses: bashiri.abbas.73@gmail.com (Abbas Bashiri), m_mirhosseini@pnu.ac.ir (Seyed Mehdi Mirhosseini-Alizamini), mjanbazi@gmail.com (Mikaeil Janbazi-Ghadi)

Received: January 2023 *Accepted:* May 2023

Every society needs people's participation in cultural and social affairs in order to achieve development, dynamism, vitality, maintaining and deepening its physical and mental health, and most experts also emphasize the importance of people's presence and participation in various political, economic, social and They emphasize culture and consider achieving development without the participation of people's groups to be out of reach. This consensus is so much that in the existing atmosphere in different countries, for the implementation of development programs, efforts are made to attract and use the participation of even the rural women and men who lack literacy. According to the UNESCO international organization, there is now a general consensus that "development should start from the people, from what they do, from what they want, and from what they think and believe." Therefore, according to this organization, in the process cultural development, of which the development of tourism culture with the theme of preservation of historical, natural and cultural monuments can be the most significant, all members of the society are involved.

Therefore, for the development of tourism, we must not only increase the incentives for participation and strengthen them, but we must also pay attention to the causes of the decrease in participation and treat the negative and inhibiting factors of participation, which include the following:

A- When the level of knowledge and awareness of society is low, people lack sufficient insight into their historical, natural, cultural and social environment and are less willing to participate.

B- When people don't get their expected rewards from participation.

C- When people's thinking is that their participation or non-participation has no effect on the outcome of the work.

D- When participation involves an action with a high cost.

Since the governments are in charge of the development policy of the society, they supervise its implementation by the organizations, because the development of tourism through the recognition and introduction of historical, natural, and cultural monuments and the participation of the people in this important matter, through intermediaries and agents who It is possible to communicate directly with the people groups. Thus, the formation of powerful non-governmental organizations and organizations that can attract audiences with integrated management and coordinated planning and have the ability to gather their audiences together and with the participation of people to document cultural, natural heritage, traditional arts, handicrafts and tourist attractions are one of the most accessible methods of injecting dynamism, vitality and movement into the body of the society, which of course is only possible with the spiritual support of the government and the removal of obstacles to the growth of these organizations and the attention of these organizations and service organizations to the growth of quality and customer satisfaction it can play an important role in the growth of the tourism industry and the economic development of countries.

But due to the intensification of competition in all business fields, marketing science is also very welcome and in fact it is an ocean composed of efficient sciences of the business world that has a significant impact on the success or failure of economic enterprises. Tourism organizations have also come to the conclusion that the realization of the profitability of the tourism industry is dependent on the understanding and implementation of marketing mechanisms, and the solutions of marketing science are in line with the slogans of the World Organization of UNESCO, "Development and progress in no field can take place without the creation of cultural infrastructures and public participation."

In our country, the investment of the private sector in tourism matters is very small, and one of the characteristics of private organizations is their lack of reliance on the resources of government budgets and the prosperity of the country's cultural and economic sector through the attraction of capital and human resources. It is possible to refer to Iranian Village of Royahai Negin tourism company with registration number 13864 and national ID number 14006058750 owned by Abbas Bashiri as a non-governmental center and a private organization that looks to new horizons and aims to motivate and remove obstacles to people's participation in tourism affairs, by combining science Mathematics and marketing and presenting an innovative method, the tourism development plan of Majma Hamiyari has been presented with the registration number of intellectual property and the license number, so that in this way, it will be accompanied by the government, whose mission is to encourage entrepreneurs and remove obstacles with the aim of development and employment. This field becomes a technology producer.

In order to benefit from the excitement and vitality caused by the period and people's participation, "the company of Village of Dereams" investigated life insurances, clubs and family financial funds and tried to remove the weaknesses and barriers to people's participation in these systems. For example, the clubs were mostly face-to-face and tried to In providing services, they are in accordance with the money they receive from the members of the clubs, such as fitness clubs, mountain climbing or even tourism, which, in addition to receiving a fixed tuition, must pay the relevant funds in order to benefit from the tours, or by examining the family funds, we came to the conclusion that The popularity of these funds is high among the people and they are more than 50 years old, but these funds are implemented between a

group of people who are mostly friends or relatives and know each other, and the person who wins the loan is obliged to pay the loan installments until the end and it is possible The implementation of these funds does not exist on a large scale, because if it wants to be implemented on a large scale, i.e. outside of acquaintances and relatives, it needs the necessary guarantees to pay installments, in other words, doing this is combined with banking affairs and looks like a bank we understand that it brings its own obstacles, but family funds are very popular. In addition, the company of Village of Dereams also investigated life insurance, one of its major weaknesses is providing services and funds to people after at least 20 years. From the point of view of marketing, it is considered a major weakness, therefore, Dehkede Royaha company tried to form a wide social network in the context of a website, application or channel called "Majma Hamyari tourism development Plan" and by eliminating the shortcomings of family funds and life insurances. This project is formed from various tourism and handicraft clubs that people can become a member of one of these clubs according to their financial ability and benefit from the services of these clubs for several years, of course, these services are provided to club members from the very first month So that the defects of life insurances are not seen in this plan.

These clubs were designed with the inspiration of family funds where monthly sums were collected and given to one of the members as a loan. In this club, a form of "reverse fund" has been designed under the name of Majma Hamiyari, which collects monthly amounts, but the main difference between this reverse fund and lending funds is that the amounts that the winners receive in the lottery are no longer in the form of loans, but repayment. Rather, it is in the form of a prize or a free loan in the form of a travel package or a handicraft product that the winner not only does not pay subscription fees from the next month and does not need to be reimbursed, but can use other club services for free until the end of the plan. With this special financial design in this reverse fund, there is no need for a bank loan guarantee, and no need for people to necessarily know each other like a family fund to guarantee repayment. Solving the above concern has enabled the club to reach more people from different walks of life and put the cost of traveling or buying handicraft products in the budget of households.

In these clubs, a system of financial management has been designed and implemented, in which the monthly membership fee of the club members is entered into complex and precise calculations, which have been approved by the country's official expert in the financial and economic field. In fact, this special financial model not only makes all club members will get their paid subscriptions back, but they will all enjoy travel packages and handicrafts for free. In addition, this financial model creates a healthy and new cycle in the cultural economy and tourism economy by investing in the safe systems of the country, such as the teacher insurance system and spending in the cultural and tourism sector. This project has been able to display a high level of technology in terms of combining virtual and in-person services. This complex combination of in-person tourism services (travel packages and handicrafts, conferences and festivals, educational workshops, etc., which all members benefit from for free) and virtual services (financial management system, virtual training courses in various fields of tourism) and handicrafts and holding an online competition with the same topic, etc.) has made this club resilient in the most difficult economic and social conditions.

By presenting a new method of allocating 80 percent of club members' subscription rights to prizes and creating credit and insurance supports, Dehkede Royah company has implemented incentive policies so that members of each club can receive all their paid subscriptions for free. Travel packages, valuable handicraft products and other cultural and welfare services. In other words, the company has supported the tourism economy by using people's participation and creating an atmosphere full of excitement and joy and putting the cost of travel in the basket of households.
It is worth mentioning that this innovation was conceptualized and implemented by experts in the field of IT, mathematics, programming, accounting and sustainability science, whose profiles are available in the creative and knowledge-based system of the scientific vice president of technology. There are more than 50 different types of clubs in the tourism development plan of Hamiyar Association, and the chart of how one of these clubs, which is Hamiyar Hasht Club, is functioning is shown Figure 1.

The following calculations can be made from the data in Table 1.

Special prize (A special prize given to the winner of the lottery in the month)= 10,000,000 Toman + (300,000)×n,

Special prize= returning total payment + [10,000,000+ (n×100,000)].

For instance, if someone who pays 200,000 Toman monthly, wins the special prize in the 20th month of the plan:

Special prize= 10,000,000 Toman + (300,000)×20=16,000,000

Special prize= 20×200,000 + [10,000,000+ (20×100,000)].

where

Cultural prize: The total money dedicated to the winners of the cultural exam in each month.

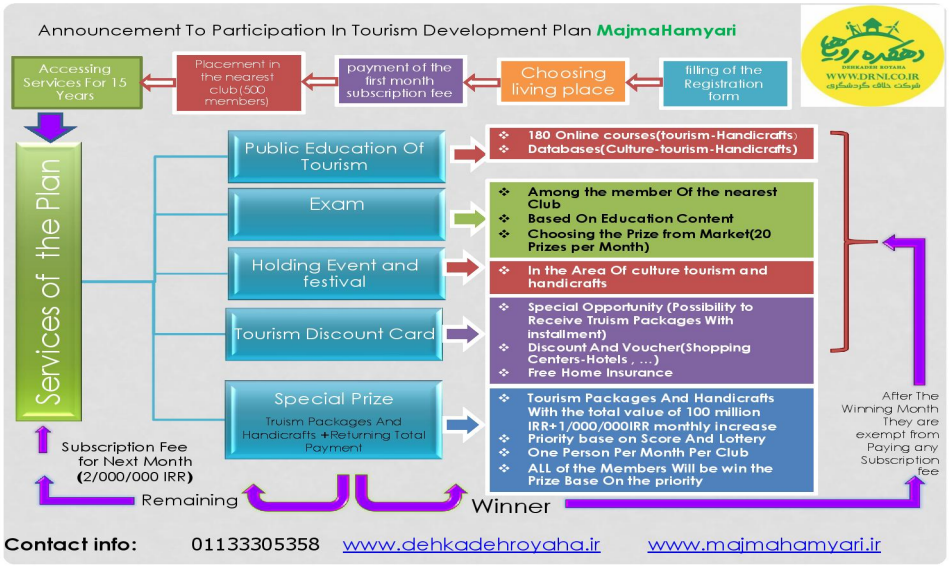

Figure 1: Announcement to participation in tourism development plan Majma Hamyari

Table 1: Data and influential factors in Hamiyar club

Month	Special Prize	Cost	Monthly Balance	Total Balance	Rate	Finacial
1	10000000	300000000	54000000	54000000	1.013	4936000000
2	10300000	29940000	53560000	108262000	1.013	-5021138000
3	10600000	29880000	53120000	162789000	1.013	-5105410594
4	10900000	29820000	52680000	217585000	1.013	-5188814332
5	11200000	29760000	52240000	272654000	1.013	-5271345718
6	11500000	29700000	51800000	327998788	1.013	-5353001212
7	11800000	29640000	513600000	383622772	1.013	-5433777228
8	12100000	29580000	50920000	439529868	1.013	-5513670132
⋮	⋮	⋮	⋮	⋮	⋮	⋮
177	62800000	19440000	-23440000	19691055293	1.013	-593344707
178	63100000	19380000	23880000	19923159000	1.013	-395040988
179	63400000	19320000	-24320000	20157840079	1.013	-193559921
180	63700000	19260000	-24760000	20395132	1.013	11132000

Special prize: A special prize given to the winner of the lottery in the month.

Cost: Total expenses for executing the plan.

Monthly balance: The amount of money held in the account for this month.

Total balance: Total amount of money in the account (interest rate considered).

Rate: Interest Rate.

Financial justification: This value shows the number of months the plan has to be run to have financial justification. This value has to be positive for financial justification.

But as we mentioned, considering the competition in marketing science, in this article we want to make decisions and predict marketing based on the fuzzy logic of the "fuzzy expert system" regarding the tourism development plan of Majma Hamiyari, in other words, to evaluate the system according to the calculation method of this plan (reverse fund) in attracting different strata according to a series of variables such as age, education, residence, life insurance membership, family fund membership and... . In order to advertise, he should focus on which stratum that this method of calculation (reverse fund) has the greatest effect in attracting them.

Consider targeting fuzzy logic experts to target customers for fixed deposit subscriptions, six inputs, age, education, marital, situation, introduction and impact. This data shows the degree of ambiguity in the information provided by the customer and collected by Mama Hamyari from various sources. Fuzzy logic is a powerful tool that deals with human decision-making and reasoning, which includes inaccuracy, uncertainty, ambiguity and approximation. Fuzzy

logic can be used to quantify the share of a set of information in various parameters in terms of fuzzy membership. Fuzzy logic emerges as an attractive tool for various applications such as time series forecasting [1], finance [5], determine the risk management in electronic banking activities [8], determine the retentive causes of pulse body the pulse parameters [9], Coronavirus disease diagnosis [10, 17, 23], decision analysis [14], digital marketing performance measurement [15], decision making [21, 25], designing a model for evaluating marketing channels [2, 24], Analysis of Factors Influencing Marketing Channel [6, 7], fractional programminh problem in a fuzzy invironment [12, 13].

In this study, we create customers who are the target of marketing calls to subscribe. Expert system based on fuzzy logic consists of four components: fuzzifier, inference engine, defuzzifier and the rule base [3, 4].

The role of the fuzziffier is to convert the crisp input variable into linguistic variables that are ready to be processed by the inference engine. The inference engine processes the inputs and rules stored in the input data rule using a fuzzifier and generates a linguistic output. Once the output linguistic values are available, the defuzzifier generates the final clear values of the output linguistic values. The validation process begins with entering two sets of data; one is provided by the customer and the other by tourism development plan of Majma Hamiyari that reviews the customer's profile. The data are obtained from the activities of a tourism development plan of Majma Hamiyari. Information that is very important in making decisions to select target customers is taken in terms of impact factor. Similarly, the values of other inputs can be specified. The normal values of these measurements are used as input to the expert system. The degree of membership related to the input value is determined using the triangular membership functions due to their simplicity and good result by simulation. Membership functions are designed based on available information.

The structure of this paper is arranged as follows: Section 2 we review some preliminaries about fuzzy set theory. Section 3 is dedicated to the development of fuzzy based expert system. In this section introduced general input variables and output variable. Finally, we end this paper with conclusions in Section 4.

2 Preliminaries

In this section, we provide an overview of some basic concepts and results of fuzzy set theory [18, 20].

Definition 2.1. A fuzzy number $\tilde{A} = (a_1, a_2, a_3)$ is called a triangular fuzzy number if its membership function is given as follows:

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{x-a_1}{a_2-a_1}, & a_1 \leqslant x \leqslant a_2, \\ \frac{a_3-x}{a_3-a_2}, & a_2 \leqslant x \leqslant a_3. \end{cases} \tag{2.1}$$

Definition 2.2. A fuzzy number $\tilde{A} = (a_1, a_2, a_3, a_4)$ is called a trapezoidal fuzzy number if its membership function is given as follows:

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{x-a_1}{a_2-a_1}, & a_1 \leqslant x \leqslant a_2, \\ 1, \quad a_2 \leqslant x \leqslant a_3, \\ \frac{a_4-x}{a_4-a_3}, & a_3 \leqslant x \leqslant a_4. \end{cases} \tag{2.2}$$

Definition 2.3. The support of a fuzzy set $\tilde{A}$ is defined:

$$\text{Supp}(\tilde{A}) = \{x \in X; \mu_{\tilde{A}}(x) > 0\}. \tag{2.3}$$

Definition 2.4. The height of a fuzzy set $\tilde{A}$ denoted by $h(\tilde{A})$ is the largest degree of membership obtained by each element in the set.

$$h(\tilde{A}) = \sup(\mu_{\tilde{A}}(x)), x \in X. \tag{2.4}$$

Definition 2.5. A fuzzy number is a convex normalized fuzzy set of real line R whose membership function is partially connected.

Fuzzy set theory is primarily concerned with how quantitatively deal with inaccuracies and uncertainties, and offers the decision maker other tools in addition to the classical definite and probabilistic mathematical tools used in modeling real-world problems.

3 Results and discussion

We now show the design of the fuzzy decision support system, membership functions, fuzzy rule base, fuzzification and defuzzification. Fuzzy logic is a very effective tool that can be used in uncertain situations. Determining input and output variables is the first step in designing a fuzzy decision support system. There are sixteen input variables and one output variable. After that, we designed the membership functions of all variables. Therefore, the designed membership functions determine the membership of objects in fuzzy sets. First, the input of the variables will be described along with their membership functions. After that, the variable output will be introduced with its membership functions. Finally, we will describe the rules used in the system, the process of fuzzification and defuzzification. Sample data are related to the direct tourism development plan of Hamiyari assembly. The goal is to predict whether the customer will subscribe to a term deposit (variable y). Data is from a general data source. This data includes 13 input variables related to customer data:

1. Age.

2. Residence Location: City, Village.

3. Educations: Diploma, Expertise, Phd and Master Science.

4. Marriage: Marital status.

5. Employment status (Situation): Salaried worker, Farmer or Rancher, Freelance job and students.

6. Were the users already members of life insurance or family fund? Yes, No.

7. How to get to know and attract customers in the plan (Introduction):

Verbal advertising,

Media advertising,

Brokerage advertising

8. The effect of plan services on user attraction (Impact):

The calculation method and the new design (reverse fund) which includes the return of users' subscription rights and the granting of travel packages or handicrafts to the user.

Welfare card of the plan, which includes discounts at welfare centers and the possibility of receiving handicraft product travel packages in installments.

Holding conferences, festivals and educational workshops,

Educational content and history.

Freedom of action to the user in choosing the prize in line with the plan and the type of lottery in granting travel installment facilities and the rest of the facilities available in the plan.

9. Receive an award with domestically produced handicraft products: Yes, No.

10. How effective was the display of the deductions of this plan on the site and the broker's agents in attracting and retaining the customers of this plan?

11. Providing the monthly services of this plan, which includes a special award, monthly history awards, and a welfare card that includes travel installment facilities, how effective has it been in attracting and retaining customers?

12. How much has the interaction of the brokers and the staff of the central office of the plan, their support and follow-up been effective in attracting and maintaining and even promoting this plan for customers?

13. Has this plan been able to make customers aware through content production? Yes, No.

To design a fuzzy expert system, first the membership functions according to the latest findings the science that has determined the range of disease variables as follows was defined. In order to fuzzy the input variables, first the range each parameter was extracted by examining texts and guides and functions with their help membership for each variable was considered as follows. Finally, with the help of fuzzy belonging functions, the fuzzy system was designed as follows.

Suppose a fuzzy set in rules if - then fuzzy with center is a natural set. Now fuzzy systems with an if-then fuzzy system with inference engine (3.1) and singleton fuzzifier (3.2) as well as defuzzifier mean center (9).

$$\mu_B(y) = \max_{L=1}^{M} \left[\sup_{x \in U} \left(\mu_A(x) \prod_{i=1}^{n} \mu_{A_i^L(x)} \mu_{B^L(y)} \right) \right], \tag{3.1}$$

$$\mu_A(x) = \begin{cases} 1: & X = X^\star, \\ 0: & X \neq X^\star, \end{cases} \tag{3.2}$$

$$y^\star = \frac{\sum_{L=1}^{M} \bar{y}^L w^L}{\sum_{L=1}^{M} w^L}. \tag{3.3}$$

Also, the output of the system is obtained as follows:

$$f(x) = \frac{\sum_{L=1}^{M} \bar{y}^L (\prod_{i=1}^{n} \mu_{A_i^L}(x))}{\sum_{L=1}^{M} (\prod_{i=1}^{n} \mu_{A_i^L}(x))}, \tag{3.4}$$

where $x \in U \subset \mathcal{R}^n$ fuzzy system input and $f(x) \in U \subset \mathcal{R}$ fuzzy system output. We also do the following to calculate the degree of each law and rule:

$$D(\text{rule}) = \prod_{i=1}^{n} \mu_{A_i^L}(x_{oi}^p) \mu_{B^L}(y_o^p). \tag{3.5}$$

Also, after determining the degree of rules based on the values of higher degrees, similar and contradictory rules with lower degrees are removed.

In this study, the y variable predicts whether the customer is subscribing to the deposit plan or not. In the model, significant input variables are designed, which are: age x_1, education x_2, marital x_3, situation x_4, introduction x_5, impact x_6.

Hence, the membership functions of input and output variables are defined as follows:

A. Input variables

1. Age

This input variable has four fuzzy sets: "Low", "Middle high", "High", "Very high". The membership of their functions is trapezoidal, the age area of fuzzy sets in Table 2 and the membership functions for fuzzy sets in Figure 2 has been specified.

Table 2: Fuzzy sets of Age.

Input variable	Rang	Fuzzy set
Age	¡=18	Low
Age	18-30	Middle
Age	30-50	High
Age	50-100	Very high

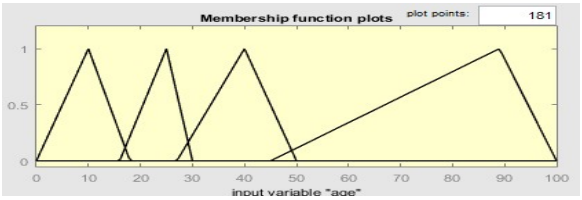

Figure 2: Membership functions for Age

2. Educations

Education is divided into three categories: "Diploma", "Expertise", "Master of science (MSC) and PhD". This input variable has four fuzzy sets, "Low", "Middle high", "High". Their membership functions are triangular. Fuzzy sets of educations domains and functions of fuzzy sets are specified in Table 3 and Figure 3.

Table 3: Fuzzy sets of Educations.

Input variable	Rang(0-100)	Fuzzy set
Educations	0-10	Phd and Master of Science
Educations	10-50	Expertise
Educations	50-100	Diploma

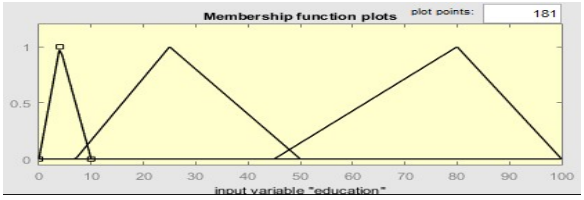

Figure 3: Membership functions for Educations

3. Marital

This input variable has two fuzzy sets namely "Married", "Single". average balance is the annual balance available in Their membership functions are trapezoidal. Fuzzy sets range of Marriage are identified in Table 4 and the membership functions for fuzzy sets are shown in Figure 4.

Table 4: Fuzzy sets of Marital.

Input variable	Rang	Fuzzy set
Marital	Single	Middle
Marital	Married	High

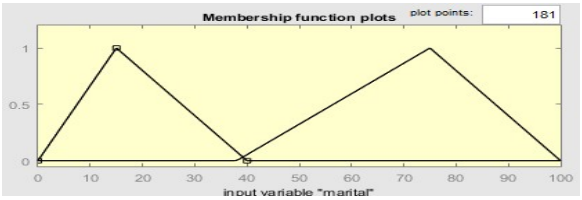

Figure 4: Membership functions for Marital

4. Employment status (Sitution)

The job status in this plan is divided into four groups of people dependent on parents (students), self-employed, farmer or rancher, and income worker. This input variable has four fuzzy sets namely "Low", "Middle high", "High", "Very high". The range and the membership functions are described in Table 5 and in Figure 5.

Table 5: Fuzzy sets of Situation.

Input variable	Rang	Fuzzy set
Situation	Students	Low
Situation	Freelance job	Middle
Situation	Farmer or rancher	High
Situation	salaried worker	Very high

5. Introduction

The method of familiarization and attraction in the project can be mentioned through "verbal, media and brokerage

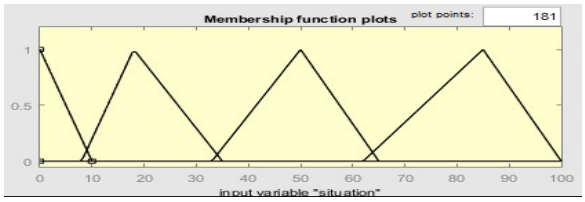

Figure 5: Membership functions for Situation

advertisements". This input variable has three fuzzy sets namely "Low", "Middle", "High". Fuzzy sets range of Marriage are identified in Table 6 and the membership functions for fuzzy sets are shown in Figure 6.

Table 6: Fuzzy sets of Introduction.

Input variable	Rang	Fuzzy set
Introduction	Media advertisements	Low
Introduction	Verbal advertisements	Middle
Introduction	Brokerage advertisements	High

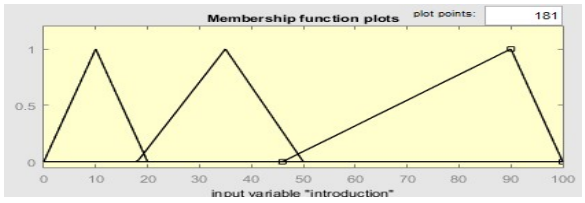

Figure 6: Membership functions for Introduction

6. Impact

He pointed out the effect of the plan's services in attracting users to Awami, such as "new calculation method of the plan (reverse fund), freedom of action for the user in choosing awards, welfare card, content of training and history, conference, festival and educational workshop". This input variable has five fuzzy sets namely "Very Low", "Low", "Middle", "High", "Very high". Fuzzy sets range of Marriage are identified in Table 7 and the membership functions for fuzzy sets are shown in Figure 7.

Table 7: Fuzzy sets of Impact.

Input variable	Rang	Fuzzy set
Impact	Conference and workshop	Very Low
Impact	Freedom in choosing plan awards	Low
Impact	welfare card	Middle
Impact	Educational content and history	High
Impact	Calculation method (Reverse fund)	Very High

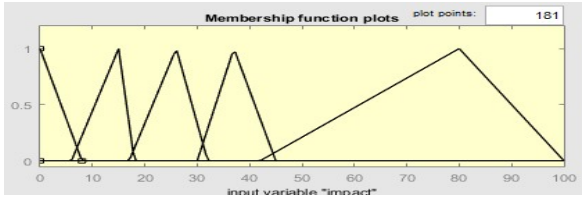

Figure 7: Membership functions for Impact

B. Output variable

Evaluation of the system of attracting people in the tourism development plan of Hamiyari Forum, which is implemented by Dehkede Royahai Negin Iranian company, with the following modes: “low chance”, “middle chance”, “very high chance” and “low chance”. Table 8 identifies these fuzzy sets and their amplitudes. The fuzzy membership functions of sets are triangular as shown in Figure 8.

Table 8: Output.

Input variable	Rang	Fuzzy set
System evaluation	0-0.3	Low Chance
System evaluation	0.2-0.5	High Chance
System evaluation	0.4-0.8	very High Chance
System evaluation	0.7-1	very High Chance

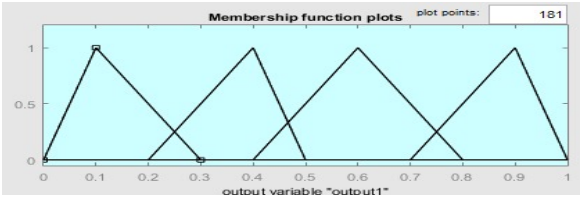

Figure 8: Output

The basis of the law is determined after consultation with prominent banking officials. Out of the 50 fuzzy rules discovered, we randomly selected 12 rules and consulted with banking officials as well as the definition of linguistic terms. Rules as they are judged on their usefulness and unexpectedness are also assessed by the domain of expertise. The basis of the law consists of 12 rules that determine the deposit subscription status by evaluating the input variables mentioned above (Low chance, high chance, very high chance). The rule of law is shown in Tabel 9.

There are 6 inputs and one output in the designed system. This fuzzy system was designed with multiplication

Table 9: Rules for determining advertising contacts

Rule No.	x_1	x_2	x_3	x_4	x_5	x_6	y
1	Young	High	Expertise	Low	Success	High	Very High Chance
2	Young	High	Phd	Medium	Success	Medium	Very High Chance
3	Middle	Medium	MSC	Low	Success	High	High Chance
4	Young	High	Diploma	Medium	Success	High	High Chance
5	Middle	High	Expertise	Low	Success	High	Very High Chance
6	Middle	Medium	MSC	High	Failure	High	Less Chance
7	Middle	Medium	Expertise	Medium	Success	High	High Chance
8	Old	High	MSC	Low	Success	Medium	High Chance
9	Old	High	Diploma	Low	Success	Low	High Chance
10	Young	Low	Diploma	Medium	Failure	High	Less Chance
11	Young	Medium	MSC	Low	Failure	High	Less Chance
12	Middle	High	MSC	High	Failure	High	High Chance

inference engine, singleton fuzzifier and center average defuzzifier. Figure 9 show the user interface of the fuzzy inference system designed to diagnose Majma Hamyari and also, some of the rules used and the fuzzy system knowledge base designed to diagnose this marketing are displayed. The system has been tested by banking experts and one of the tested values has been considered which is depicted in Figure 9.

4 Conclusion

The use of a fuzzy-based expert system aiming at a specific customer has been considered. In this study, the design of a fuzzy decision support system to identify potential customers in terms of data diversity and inaccuracies, which can be used by banking experts to improve Majma Hamyari has been described. These inputs represent the degree

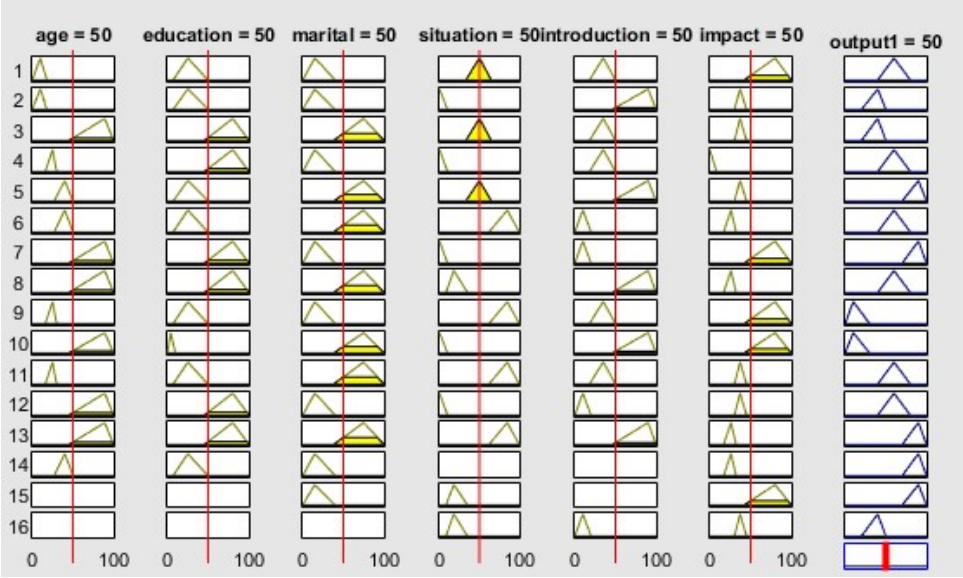

Figure 9: Output

of ambiguous in the information furnished during various time periods. The degree of ambiguous in the information and the level of judgment used by the marketing person in deciding to approach this customer for subscribing the deposit scheme is always a challenge. At this type of problem fuzzy based expert system is a very good tool for decision making for both customer and marketing managers to invest on directed campaigns with a strict and rigorous selection of contacts. In fact, the proposed method offers marketing managers a plan that concentrates the most time and financial capital for advertising for a segment of the society that this calculation method (reverse fund) has the greatest effect on attracting customers.

References

[1] N.A. Agatz, M. Fleischmann, and J.A. Van Nunen, *E-fulfillment and multi-channel distribution-A review*, Eur. J. Oper. Res. **187** (2008), no. 2, 339—356.

[2] A. Alptekinoglu and C.S. Tang, *A model for analyzing multi-channel distribution systems*, Eur. J. Oper. Res. **163** (2009), no. 3, 802-–824.

[3] A. Bashiri, S.M. Mirhosseini-Alizamini and M.M. Nasrabadi, *Application of Fuzzy Logic for Advertising Marketing Campaigns*, Control Optim. Appl. Math. **5** (2021), no. 2, 25–37.

[4] A. Bashiri, S.M. Mirhosseini-Alizamini and M.M. Nasrabadi, *Analysis of factors affecting health tourism in the COVID-19 crisis using fuzzy EDAS method*, Int. J. Nonlinear Anal. Appl. **12** (2021), no. Special Issue, 1175–1188.

[5] D. Bond, *Advertising agencies squeezed by tech giants*, The Financial Times, 2017.

[6] G.Q. Chen and Q. Wei, *Fuzzy association rules and the extended mining algorithms*, Inf. Sci. **147** (2002), 201—228.

[7] R. Chiv F. Nie, S. Wu and S. Tum, *Analysis of factors influencing marketing channel choices by smallholder farmers: A case study of Paddy product in wet and dry season of Prey Veng Province, Cambodia*, J. Sustain. Dev. **147** (2020), 201—228.

[8] P. Dashore and S. Kumar-Jain, *Fuzzy rle based system and metagraph for risk management in electronic banking activities*, Int. J. Engin. Technol. **1** (2009), no. 1, 1793–8236.

[9] M. Dehghandar, H. Khaloozadeh, F. Soltanian and M. Keshavarz, *Application of fuzzy logic to determine the retentive causes of pulse body the pulse parameters*, Iran. Trad. Med. J. Multidis. Engin. Sci. Technol. **3** (2016), no. 2, 3881–3884.

[10] M. Dehghandar, M. Pabasteh and R. Heydari, *Diagnosis of COVID-19 disease by fuzzy expert system designed based on input-output*, J. Control **14** (2021), no. 5, 71–78.

[11] A. Deshmukh and T. Lakshminarayana *A rule-based fuzzy reasoning system for assessing the risk of management fraud*, Int. J. Intell. Syst. Account Finance Manag. **4** (1998), 231–241.

[12] A. Ebrahimnejad, S. Jafarnejad Ghomi and S.M. Mirhosseini-Alizamini, *A revisit of numerical approach for solving linear fractional programming problem in a fuzzy environment*, Appl. Math. Model. **57** (2018), 459–473.

[13] A. Ebrahimnejad, S. Jafarnejad Ghomi and S.M. Mirhosseini-Alizamini, *A new approach for solving fully fuzzy linear fractional programming problems*, 4th Int. Conf. Knowledge-Based Engin. Innov., 2017, pp. 1–4.

[14] S. Guo and H. Zhao, *Fuzzy best-worst multi-criteria decision-making method and its applications*, Knowledge-Based Syst. **121** (2017), 23—31.

[15] J. Jarvinen and H. Karjaluoto, *The use of web analytics for digital marketing performance measurement*, Ind. Market. Manag. **50** (2015), 117–127.

[16] A. Hoque, F.A. Shikha, M. W. Hasanat, I. Arif and A.B.A. Hamid, *The effect of Coronavirus (COVID-19) in the tourism industry in China*, Asian J. Multidis. Stud. **3** (2020), no 1, 52–58.

[17] M. Kamarzarrin and N. Eghbal, *Modeling of self-assessment system of COVID-19 disease diagnosis using Type-2 Sugeno fuzzy inference system*, J. Control **14** (2021), no. 5, 49–57.

[18] N. Khan and F. Khan, *Fuzzy based decision making for promotional marketing campaigns*, Int. J. Fuzzy Logic Syst. **3** (2013), no. 1, 65–77.

[19] N.N. Kyaw, S. Ahn and S.H. Lee, *Analysis of the factors influencing market participation among smallholder rice farmers in magway region, central dry zone of Myanmar*, Sustainability **10** (2018), 4441.

[20] R.A. Lewis and D.H. Reiley, *Down-to-the-minute effects of super bowl advertising on online search behavior*, Proc. 14th ACM Conf. Electronic Commerce Philadelphia, PA, Array, 2013, pp. 639–656.

[21] F. Meng and X. Chen, *A robust additive consistency-based method for decision making with triangular fuzzy reciprocal preference relations*, Fuzzy Optim. Decis. Mak. **17** (2018), 49–73.

[22] F. Merdivenci and H. Karakas, *Analysis of factors affecting health tourism performance using fuzzy DEMATEL method*, Adv. Hospital. Tourism Res. **8** (2020), no. 2, 371–392.

[23] N. Moghanlo and S. Mansouri, *The impact of COVID-19 corona virus on the tourism industry*, 7th Nat. Conf. Modern Stud. Res. Field Geo. Architect. Urban Plan. Iran, 2020.

[24] M. Nasrollahi, M.R. Fathi and A. Faghih *Designing a model for evaluating marketing channels based on the fuzzy best-worst and fuzzy EDAS methods*, J. Bus. Manag. **10** (2018), no, 3, 695–712.

[25] J.R. Saura, P. Palos-Sanchez and L.M. Cerda Suarez, *Understanding the digital marketing environment with KPIs and web analytics*, Future Internet **9** (2017), no. 76, 1–13.