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Uncertainty analysis of tourism components in Tabriz

Paria Samadi Parviznejad [1], Mohsen Bahrami [2]

[1] Research Expert of Academic Center for Education, Culture and Research (ACECR), Tabriz, Iran;
[2] Professor Department of Mechanical Engineering Solid Design, Tehran, Iran

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ABSTRACT

Purpose: Predicting the profitability of the tourism industry is always faced with uncertainties. Especially in the last two years, when the global pandemic conditions have added to it. The purpose of this study is to investigate and analyze the uncertainties in the components affecting tourism in Tabriz.

Methodology: In addition to library studies, interviews with experts and professors in the field of tourism have been conducted in order to identify the components affecting tourism. Input factors in four areas of strategic planning, tourism potentials, regional conditions and infrastructure facilities and effective consequences on the problem in two economic areas and tourism consequences are categorized. Then, to explain the uncertainty of the obtained components, a fuzzy system is designed in MATLAB software. The system is based on an if-then rule approach with 84 rules that determine the relationship between input and output variables.

Findings: Our findings from the fuzzy system model show that following the current situation, the tourism outcome of Tabriz will be normal and its economic consequences for the city of Tabriz will be inappropriate due to its historical and economic history. Also, changes in regional conditions and urban potentials do not cause much change in the tourism situation. The results of the model show that simply paying attention to the plan and infrastructure without considering other conditions does not create a suitable situation for tourism. That is, plans and infrastructure should serve the better development of urban places and potentials and the proper bedding of regional conditions.

Originality/Value: Despite several years of capital and commercial center of Iran and high capabilities, Tabriz has not been able to achieve a good position in the Iranian tourism industry. Some of these factors are related to the uncertainty in plans and policies, etc. This article with this approach is an innovation in explaining the tourism conditions of Tabriz.

[1] Corresponding Author: psamadi@aut.ac.ir
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1. Introduction

The theory of fuzzy sets was first formally proposed by Professor Lotfali Asgarzadeh in 1965. Although this theory was proposed in 1965, it has long been ignored by western scientists. Of course, other scientists before Asgarzadeh had pointed to the inability of classical mathematics to deal with inaccurate real-world problems, but it was only Professor Asgarzadeh's work that came to fruition with his own pursuits [1]. Fuzzy language descriptions (often called fuzzy systems, or more simply language descriptions) are common representations of systems that are constructed fuzzy if-then rules. These descriptions often suggest complementary or alternative language to traditional systems modeling methods. Although these descriptions have been formulated according to human language, they have a very precise basis that includes sets and fuzzy relations [2]. The Japanese advance in the application of fuzzy logic in the control system (including in industrial equipment, subways, home appliances, etc.) played an important role in attracting the attention of the world, especially western experts and engineers, to the efficiency and effectiveness of this theory. Currently, many applications of fuzzy systems in various fields are reported every day. Of course, fuzzy systems have not eliminated non-fuzzy systems, but have completed them [3]. Researches, especially those who use expert opinions, often face uncertainty in the data. The components of tourism development face uncertainty in inputs, and especially in today's conditions and with the outbreak of the Corona pandemic, the tourism industry has been more affected by this uncertainty. This research has used the opinions of experts to determine the factors affecting tourism in Tabriz. The city of Tabriz has long had a very important place in the decisions of the country, both as a capital in different periods and as a metropolis. The view of Tabriz and the main factors and infrastructures that formed it have been more the economic view and the prosperity of the market and business in different historical periods. In addition to the regional agricultural and industrial status of Tabriz city, the attractions and tourism factors of Tabriz region and city have long been considered as one of the travel and entertainment destinations for domestic and foreign tourists. Identifying the main and effective factors on Tabriz tourism based on past descriptive and analytical studies, expert opinions and collecting the required information, classifying these factors and determining their priority, examining the uncertainty of these factors and providing an appropriate system to investigate and analyze this deficiency Definition and review of their consequences are the goals of this research.

2. Literature Review

The COVID-19 crisis is taking an unprecedented scale. It is dramatically affecting the world economy and, particularly, the tourism sector [4]. This has increased the uncertainty of decisions about the tourism industry. In the context of extreme uncertainty, the use of probabilistic forecasting models is especially suitable. A research uses Monte Carlo simulations to evaluate the outcomes of four possible tourism demand recovery scenarios in the Balearic Islands, which are further used to measure the risks and vulnerability of Balearic economy to the COVID-19 crisis. Results show that fear of contagion and loss of income in tourism emitting countries will result in a maximum 89% drop in arrivals in the Balearic Islands in 2020.Given that most tourism-related occupations are not highly skilled and are characterized by lower salaries, there are greater risks of loss of welfare, especially for women, who are a major share of the tourism labour force. The model shows important differences among minimum, average and maximum estimates for tourism sector production in 2021, reflecting considerable uncertainty regarding the speed of the sector's recovery. The results serve as a basis to prepare a range of policies to reduce destination vulnerability under different crisis outcomes [5]. Tourism destinations

are dynamically complex systems in which behavior is controlled by many interacting components and feedback loops. Yet tourism destination planning has traditionally been based on forecasting models that rely on historical data to predict future trends. In a paper system dynamic modelling was used as an alternative to forecasting models for the scenario-based planning of tourism destinations. It constructs a system dynamic model for tourism development on Cat Ba Island, a rapidly developing tourist destination in Vietnam, and use it to model alternative tourism development scenarios. Results indicate that the current trajectory of tourism development on Cat Ba Island is not sustainable and limits to growth may be reached as early as 2022 due to water shortages, pollution and overcrowding. Beyond this time the destination risks breaching its limits to growth, which creates a further risk, that of eroding carrying capacity through resource depletion and environmental degradation [6]. Another paper presents a new approach to predicting the success of a newly launched service in the tourism industry using a hybrid information system called the adaptive-adaptive fuzzy reasoning system. In this information system, the ability to learn a neural network and the capabilities of fuzzy logic have been used. The data is used as input to the model through a questionnaire related to the development variables of a new service in the tourism industry. The results of this study provide a suitable method for recording uncertainty in the relationships between input variables and output variables to predict the successful launch of a new tourism service [7]. For many years the sustainability assessment of tourist destinations has been based on the carrying capacity, which is a measure that takes into account the preservation of a geographical area (by measuring the number of tourists, the visitor flow and the environmental thresholds) along with its tourist fruition (by assessing the quality of the experience perceived by visitors). Unfortunately, its definition lacks clarity, and its dependence upon qualitative variables makes it unable to provide a unique criterion for its assessment. In a paper, authors propose a fuzzy approach that takes into account the inherent uncertainty and vagueness of the involved variables to assess a destination's sustainability, by introducing a fuzzy indicator. Their approach has been applied to the Italian region of Sicily, showing a high versatility that makes its use possible jointly with (or alternatively to) other existing methodologies developed by European and international institutions [8]. In Another paper, authors investigate the political uncertainty in China's tourism industry using China's anti-corruption campaign as an exogenous shock. They find that when the Chinese government launched its anti-corruption campaign, firms in the tourism industry experienced a significant decline in firm value, and the effect was stronger for companies majoring in high-end tourism products. In addition, they found that tourism companies' long-term financial performance declined after the anti-corruption campaign. Further analysis suggests that the decrease in firms' financial performance was driven by a decline in demand rather than an increase in cost. Their paper suggests that political uncertainty affects the tourism industry in emerging markets. It also details the theoretical contributions and practical implications of the findings [9]. During these years, the sustainable Community-Based Tourism (CBT) notion has received more attention in the context of the tourism industry. Sustainable CBT mainly emphasizes social, environmental, and cultural sustainability and gives power to local communities in any aspect of tourism management. A manuscript aims to propose a novel approach to examine the current status of sustainable CBT in the Indian Himalayan region context. In this regard, a comprehensive framework was developed using experts' opinions, and the relevant literature in tourism studies was reviewed based on sustainable CBT. To this end, this study proposed an integrated decision-making method using Step-wise Weight Assessment Ratio Analysis (SWARA) and MULTIMOORA (Multiple Objective Optimization based on the Ratio Analysis Plus Full Multiplicative Form) under Interval-Valued Pythagorean Fuzzy Sets (IVPFSs). Additionally, some comparisons were discussed with the outcomes obtained from the developed approach and those of extant ones to evaluate the

efficiency of the proposed model. To confirm the applicability of the proposed IVPF-SWARA-MULTIMOORA approach to real-world decision-making problems, a sustainable CBT problem was considered as a case study. The final results confirmed the efficiency of the proposed approach as well as its consistency with the existing ones [10]. New private tourism firms play a key role in promoting local and national wealth creation. Building upon insights from entrepreneurial motivation and human capital theories, in a study fuzzy-set qualitative comparative analysis of longitudinal data was employed to identify the human capital pathways of 1182 entrepreneurs in Portugal engaged in tourism reporting high firm sales growth between 2008 and 2015. Two dimensions of entrepreneur human capital at firm start-up were found to be sufficient for high sales growth: a) Necessity- and opportunity-based entrepreneurs with specific human capital industry experience relating to tourism, and b) Opportunity-based entrepreneurs with managerial experience [11]. Obviously, the Covid-19 pandemic has huge impact on most businesses and has caused serious and countless problems for them. Therefore, providing solutions for affected businesses to recover and improve their activities during pandemic times is inevitable. In this regard, ecotourism centers are one of the businesses that went through this problem and have faced significant dilemmas in their activities. Also, reportedly, there is no related research focusing on the recovery approaches to address these obstacles relating to these kinds of businesses during the pandemic. For this purpose, in a paper, some practical and useful action plans for ecotourism centers are firstly developed to help these businesses. To obtain the action plans, some brainstorming sessions were held consisting of tourism experts, university professors, managers, owners, and some personnel of eco-tourism centers. In order to prioritize the defined action plans, four criteria are considered. Firstly, they compute the weights of the considered criteria by the Fuzzy DEMATEL and then they are prioritized using the Fuzzy VIKOR. The findings of the current study divulge that the AP2 “Standardization of the centers” and AP3 “Estimating demand number and increasing the capacity” and AP7 “Identifying other natural tourist attractions of the region” have the highest and lowest priority to be implemented [12]. One of the main goals of implementation of the Integrated Coastal Zone Management in Iran is to establish sustainable social and economic development in the coastal areas. The main strategy for achieving this goal is by encouraging the economic activities at the coastal areas that are consistent with environmental capacities. Tourist industry has a special place in the national economy, and it plays the most dynamic economic role in sustainable development. A large number of people usually choose this area for recreation as a result of the beautiful landscapes consisting of green forest, hills, rivers and wetland. Therefore, the objective of a study is to determine the optimal tourism sites among various tourism alternatives based on ICZM strategies. This study develops an evaluation model based on the analytic network process (ANP) and the technique for order performance by similarity to ideal solution (TOPSIS), to help the investors in tourism industries, for the selection of the optimal tourism site in the Integrated Coastal Zone Management in a fuzzy environment, where the vagueness and subjectivity are handled with linguistic values parameterized by triangular fuzzy numbers. The ANP is used to analysis the structure of tourism site selection problem and determine the weights of the criteria, while Fuzzy TOPSIS method is utilized to obtain final priorities. A real world application is performed to illustrate the utilization of the model for the tourism site selection problem. Furthermore, for convenience and accuracy in calculating the relative weights of the criteria, Super Decisions software was used. The proposed model adopted in Qeshm Island considers and interprets the effectiveness and feasibility of the model [13].

3. Data and Methodology

3.1. Data

This article uses data a previously published paper entitled "Impact of the Tourism Industry Scenarios in Urban Economy: (Case Study Tabriz)" [14]. In order to conduct research and collect the information needed to answer the research questions, interview and preparation of a questionnaire and evaluate the status of the case study; the document mining method has been used. The statistical population of this research is experts and specialists in the fields of economics and tourism of Tabriz city and East Azerbaijan province, including the Tourism Organization of the General Directorate of Cultural Heritage, Tourism and Handicrafts, and Tabriz Municipality. The reason for choosing the statistical population is the possibility of access to existing data and detailed familiarity with the case study of the research [15]. With the limitations of this research and the limitation of the consequences of this research to the economic field, and through the Cochran's sample formula, 48 people from the statistical community have been selected to collect data and perform tests. Using a questionnaire, the effectiveness of each of the factors and issues of tourism in Tabriz was assessed to determine the importance of each factor in tourism. For this purpose, a suitable design of research thematic questions was performed and statistical samples were distributed among individuals. Out of 48 questionnaires, 36 questionnaires were completed and the analysis phase began. The questionnaire is designed from 20 questions, which are divided into 4 categories as input factors including: strategic planning, historical-cultural potentials, regional conditions, infrastructure facilities and two output factors including: tourism outcome and economic consequences, is closed.

3.1. Methodology

The methodology used in this research is fuzzy systems. The main inspiration behind the introduction of fuzzy sets theory was the necessity for modeling real-world phenomena, which are inherently vague and ambiguous. Human knowledge about complex problems can be successfully represented using the imprecise terms of natural language. The theories of fuzzy sets and fuzzy logic provide formal tools for mathematical representation and efficient processing of such information [15]. An elementary fuzzy statement can also be expressed in the form of an implication forming a fuzzy if-then rule (fuzzy conditional statement):

$$If\ (X\ is\ LA), Then\ (Y\ is\ LB) \tag{1}$$

Defining a relationship between linguistic variables. The statement "$X\ is\ LA$" is called the antecedent (premise), and the statement "$Y\ is\ LB$" is called the consequent (conclusion).

The most important part of a fuzzy system is the inference or processing engine. This is where the rules are defined and decisions are formed based on descriptive variables [16]. Uncertainty in the proper determination of the scores of these factors and the lack of proper determination of the boundary between these scores in cases where descriptive linguistic words such as neither this, nor that or close to it, etc. have been caused by experts. Use fuzzy logic to determine the degree of membership of these privileges and provide related solutions. The latest professional version of MATLAB software has been used to scientifically and effectively investigate this method and also to provide solutions in such situations. Fuzzy numbers are fuzzy sets that are used when an implicit representation of uncertainty with numerical data is required. In other words, they are fuzzy sets that express the meanings of terms

such as approximately 3 or close to 5.5. In fact, fuzzy numbers include terms such as approximate, near, and not exactly next to numerical values. Fuzzy numbers have different shapes, in this study, triangular and trapezoidal fuzzy numbers have been used [17]. The inputs of this fuzzy system are the four variables of planning, infrastructure, urban potentials and regional conditions, and the outputs are the two variables of tourism and economic consequences. For each of these variables, according to the value of the weighted score, the values 1 and 5 are shown as the boundaries of the defined range of scales with trapezoidal fuzzy numbers and the rest of the numbers with a triangular fuzzy number. A fuzzy triangular number is shown $\widetilde{M} = (l, m, u)$ and defined as follows [18, 19]:

$$\mu_{\widetilde{M}}(x) = \begin{cases} \dfrac{x-l}{m-l} & ;\ l < x \leq m \\ \dfrac{u-x}{u-m} & ;\ m < x \leq u \\ 0 & ;Otherwise \end{cases} \tag{2}$$

Where l and u are the lower and upper bounds of the fuzzy number $\widetilde{M}$, respectively. In other words, the degree of membership in l and u is zero and in m its maximum value is 1. When this maximum value is an interval instead of a point, the fuzzy number will be a trapezoid.

4. Results and discussion

Cronbach's alpha coefficient was used to determine the reliability of the questionnaire in this study. The alpha value of all questions is greater than 0.7, which values greater than 0.7 for the Cronbach's coefficient show that the questionnaire has good reliability. According to the scores of the questionnaire for data collection, the fuzzy numbers defined for the input variables are as follows:

Very weak: [0 1 2.5]

Poor: [0.8 2 3.4]

Medium: [1.8 3 4.4]

Good: [2.8 4 5.2]

Very good: [3.8 5 6]

In the definition of fuzzy numbers, an attempt has been made to consider the degree of membership of the numbers of the intervals of the respective points, indicating the uncertainty in the possibility of the ratio of each point to the relevant range. Also, this uncertainty and the possibility of different opinions about a variable has caused the asymmetry between the variables to be considered. For example, a score of 3, while indicating an average quality variable with a membership grade of 1, indicates a weakness with a membership grade of 0.29 and a good grade with a membership grade of 0.17. Figure (1) shows how to model input variables. The fuzzy numbers defined for the output variables are also as follows.

Inappropriate: [0 0 1 3]

Continuation of current conditions: [1 3 5]

Suitable: [3 5 6 6]

Inappropriate and appropriate outcomes of the research are identified as trapezoidal fuzzy numbers and continuation of the current situation with a triangular fuzzy number. For example, the "appropriateness" membership rating indicates that the output membership rating of 5 and above, 1, 3 and below is zero, the modeling of which is shown in Figure (2).

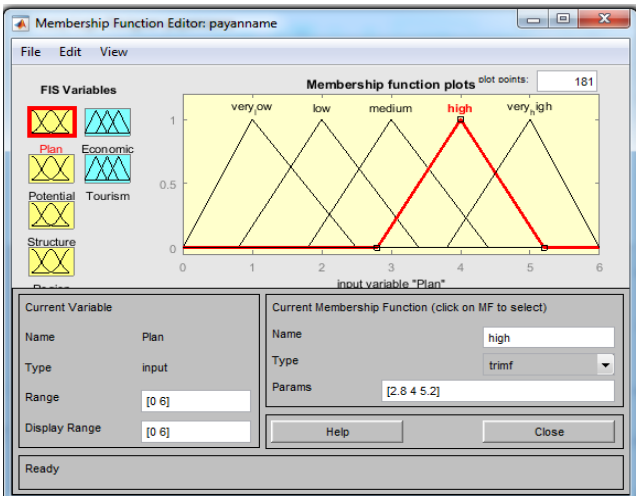

Fig. 1. Input variables in fuzzy model

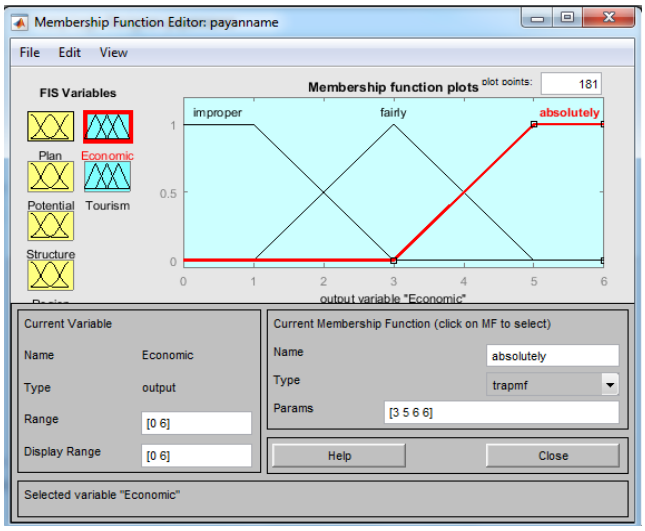

Fig. 2. Output variables in fuzzy model

In the fuzzy system designed based on 5625 possible states of the input and output variables of the problem, 84 rules are defined. These rules cover all possible cases based on the scores obtained from the analysis of the questionnaire and the tests performed to validate their results. For example, when the planning variable is in a very weak or weak state, the rest of the variables are in any case, the economic and tourism consequences will be both unsuitable; As a result, the two rules defined accordingly cover 1000 possible states of the problem. Given the high scores that planning variables and infrastructures have obtained, some definite scenarios will certainly be formed based on them. Rules appropriate to them if the conditions are too weak or inadequate, the adverse economic consequence and tourism outcome are defined, as Rules 1 to 3 indicate. Rules 4 to 8 specify the average conditions for the

planning variable. The best result in this case for the economic consequence of the problem will be the continuation of the existing conditions. Because the change of economic parameters affected by tourism requires appropriate programs. But since some regional tourism conditions and current potentials may be in good shape, it is possible that the outcome of the number of tourists in the near future will be affected. On the other hand, it should be noted that the development of urban facilities and infrastructure will be largely dependent on planning; As a result, the number of independent rules will be small when the planning variable is moderate. Rules 5 to 11 indicate a good state of planning. Combining this mode with excellent mode for planning, which most experts agreed on, shows the basic rules of research and modeling. In these rules, different combinations of the existence of different states between these variables and their consequences are shown. In the best case scenario, despite the strong planning and the existence or codified plan for infrastructure, it should be expected that the economic consequences and the result of tourism will be appropriate and in the absence of such plans, it will be considered inappropriate. The rest of the rules with different combinations show this situation. Simulation of the mentioned fuzzy system and analysis of its sensitivity to different values and qualitative domains can determine the consequences of the problem based on the analysis of rules.

By default, (Fig. 3), the input variables are in the middle state. The outcome of this situation is estimated at 1.46 for economic conditions and 3.22 for tourism. This means that considering the situation of variables in the continuation of almost similar conditions, the result of tourism in Tabriz will be the usual situation, which is not a good indicator for the future of tourism in Tabriz and its economic consequences will be in an unfavorable situation. Graphical and qualitative analysis of this situation also shows that for the economic consequence, one rule fully indicates the unfavorable situation and six rules partially, and for the outcome of tourism, one rule fully indicates the normal situation and six rules are partially.

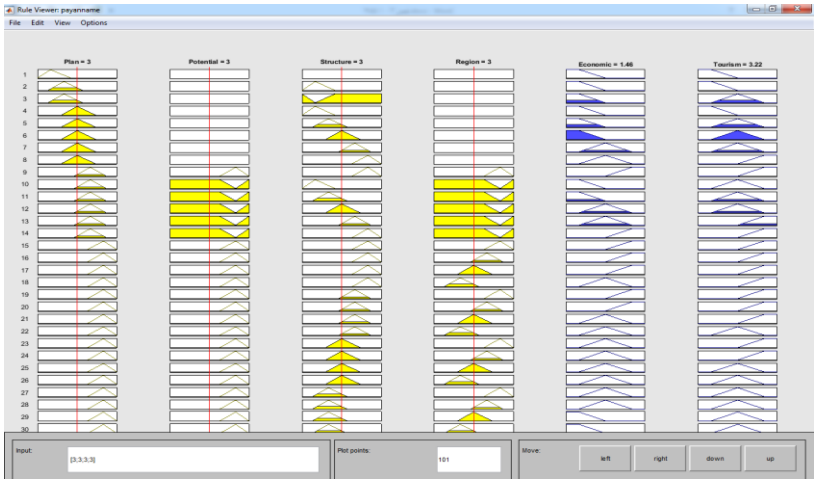

Fig. 3. Fuzzy model rules by default (average input values)

By changing the previous situation to the situation of different regions, there is no significant change in the consequences of the problem, which indicates that the conditions of the region, given the relative stability of the tourism situation, cannot have a significant impact on the consequences of the problem. Leave independently. This is also true for the urban potential variable. This is because experts have emphasized that there will be no significant change in attitudes towards urban potentials in the future, and this will be done for tourists as usual and based on past views. (Fig. 4)

Fig. 4. Fuzzy model rules by changing regional conditions and potentials

Changing the conditions for the planning variable to weak and very weak states, practically shows the unfavorable situation of both economic consequences and tourism result. This is due to the high scores of planning to change attitudes towards tourism and its prosperity. In this case, in the best case for the planning variable with a value of 2, which indicates a relatively poor state of planning in the field of tourism, the outcome of the tourism result with a value of 2.57 is not very good and the economic result with a value of 1.46 indicates a completely inappropriate situation (Fig. 5). Another influential variable in the issue is the existence and development of physical and electronic infrastructure in order to improve the tourism situation. By changing the simulated values for this variable to better than average in the problem, the tourism situation improves significantly. At value 5 for infrastructure as shown in Figure (6), the tourism outcome reaches an excellent value of 4.35, which indicates how much re-tourism in the region depends on the appropriate infrastructure for tourism from the perspective of travelers and experts. In this case, compared to the other cases that are moderate, the situation of economic outcome with a score of 2.84 shows almost the usual situation.

Fig. 5. Fuzzy model rules with Poor variable planning mode

Fig. 6. Fuzzy model rules with excellent variable state infrastructure

One of the appropriate analyzes of the rules is the simultaneous sensitivity analysis on two variables. Since the variables of urban potentials and regional conditions do not cause significant change in outcomes, simultaneous changes in planning and infrastructure have been considered. Considering the current situation, two potential variables have been considered. Urbanization and regional status, the change of the other two variables to good, the approximate value of 4, the economic outcome and the tourism outcome to 2.84 and 4.08, respectively, which according to Figure (7) is an acceptable situation for the outcome. It is economical and suitable for the result of tourism. This shows the importance of the impact of the program and the development of infrastructure simultaneously in the field of tourism.

Another amazing result of the model is when the programming value remains at 5, which means excellent condition and the amount of infrastructure at 4. In this case, both outcomes of the problem show the number 2.84. This issue is completely credible to the opinions of tourism officials that if the

attention to the category of planning is spent in non-essential areas, quite the opposite results can emerge from tourism. Because for tourists, regardless of the type of programs, facilities and attractions have been created that encourage them to return to the region (Fig. 8). Another very important and significant result in the model is 5 due to the change of the infrastructure variable to excellent. In this case, given that the programming variable is in the good range, 4; the economic and tourism implications are shown in Figure (9) with scores of 4.35 and 4.23, respectively. A few points are important here. First, infrastructure development can contribute to the region's economic development in the long run. Second, the importance of simultaneous program development and implementation in the development of tourism programs. Finally, the economic impact of tourism is more important than tourism itself. A small positive change in the attitude and design of the program towards the development of infrastructure and their implementation can make a big change in economic conditions, which is referred to as a synergistic effect in the system. When all the variables are in good condition but the urban potential variable or regional conditions are in a very weak or weak state, the model simulation shows the usual consequences. This shows that although having a proper plan in all areas for tourism and infrastructure development can encourage tourists to travel again and bring positive economic consequences, but what is important is the existence of this potential. Are the conditions and conditions of the region that remain in the mind of the tourist? Therefore, plans and infrastructures should be in the service of better development of urban places and potentials and suitable bedding for regional conditions.

Fig. 7. Fuzzy model rules with good mode both infrastructure and planning variables

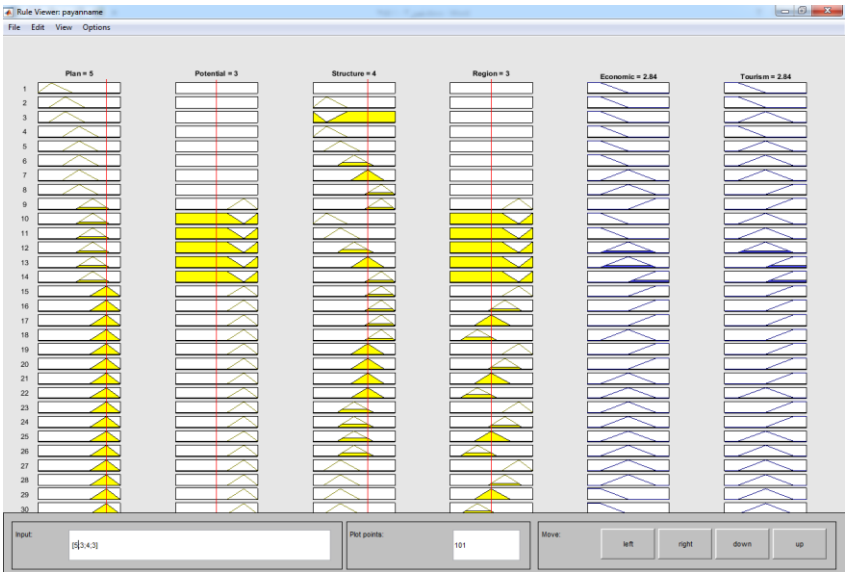

Fig. 8. Fuzzy model rules by upgrading planning regardless of infrastructure area

Fig. 9. Fuzzy model rules with synergistic effect of planning in the field of infrastructure

5. Conclusion Remarks

Designing a fuzzy system to explain the uncertainty of research variables, shows that in continuation of the current situation, the tourism outcome of Tabriz will be normal and its economic consequences for the city of Tabriz will be inappropriate due to its historical and economic history. The system presented in the research shows that changes in regional conditions and urban potentials do not cause much change in the tourism situation. Because tourists are more concerned with tourism based on their former mental approaches, and the lack of infrastructure and programs is an important factor in the weakness of tourism. The planning variable in this study has obtained the highest score for changing views on

tourism and its prosperity. This shows how influential tourism plans and programs can be in the future of the urban economy. The system designed in the research well reflects the synergistic effects of system variables. Changes in plans and programs simultaneously with the development of infrastructure, can completely change the results of tourism and its economic prosperity and be appropriate to the urban situation of Tabriz. These effects may also show a negative side. When programs are spent in unnecessary places, the model shows that the economic consequence will not be in a good condition. The results of the model show that just paying attention to the program and infrastructure, without considering other conditions, does not create a suitable situation for tourism. Therefore, plans and infrastructures should be in the service of better development of urban places and potentials and suitable bedding for regional conditions. In the best conditions, despite the strength of the planning and the existence or codified plan for infrastructure, it should be expected that the economic consequences and the result of tourism will be appropriate and in the absence of such plans, it will be considered inappropriate.

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