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FUZZY MULTI-OBJECTIVE EVALUATION OF TOURISM INVESTMENTS IN TURKEY

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Abstract

In recent years, tourism has been one of the major business areas for countries. Especially after the 1980's the share of tourism from individual earnings has increased day by day. For this reason, investments in this sector must be feasible and logical. But in the literature, there are nearly no issues of engineers—which types of tourism or which investment questions must be discussed and calculated numerically. For the numerical example in this study, firstly, we decided the tourism type planned to invest in Turkey with fuzzy ANP from an engineering point of view. Then, three real investment projects from Turkey were found for this tourism type and prioritized using fuzzy ANP. Using these weights and financial data belonging to these projects, we apply fuzzy multi-objective decision-making to see the most feasible investment among these three investments. This application is not only for Turkey but can also be applied to different countries using the same decision-making techniques. This paper brings an engineering point of view to the tourism literature and helps investors with feasible investments. To the authors' knowledge, this will be the first study that deals with tourism investments numerically.

Keywords: tourism, investment, decision making, fuzzy Analytic Network Process, fuzzy Multi-Objective Linear Programming

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TÜRKİYE TURİZM YATIRIMLARININ BULANIK ÇOK AMAÇLI DEĞERLENDİRİLMESİ

Özet

Son yıllarda turizm, ülkeler için önemli iş alanlarından biri olmuştur. Özellikle 1980'lerden sonra turizmin bireysel kazançtan aldığı pay gün geçtikçe artmıştır. Bu nedenle bu sektöre yapılacak yatırımların yapılabilir ve mantıklı olması gerekmektedir. Ancak literatürde, hangi turizm türleri veya hangi yatırım sorularının sayısal olarak tartışılması ve hesaplanması gerektiği ile ilgili neredeyse hiç mühendislik çalışması yoktur. Bu çalışmada sayısal örnek için, ilk olarak mühendislik açısından bulanık ANP ile Türkiye'de yatırım yapmayı planladığımız turizm türüne karar verdik. Daha sonra bu turizm türü için Türkiye'den üç gerçek yatırım projesi bulunmuş ve bulanık ANP kullanılarak önceliklendirilmiştir. Bu projelere ait bu ağırlıkları ve finansal verileri kullanarak, bu üç yatırım arasında en uygun yatırımı görmek için bulanık çok amaçlı karar verme uygulanmıştır. Bu uygulama sadece Türkiye'ye değil, aynı karar verme teknikleri kullanılarak farklı ülkelere de uygulanabilmektedir. Bu makale, turizm literatürüne mühendislik bakış açısı getirmekte ve yatırımcılara yapılabilir yatırımlar konusunda yardımcı olmaktadır. Yazarların bilgisine göre bu çalışma, turizm yatırımlarını mühendislik bakış açısı ile sayısal olarak ele alan ilk çalışma olacaktır.

Anahtar Kelimeler: Turizm, Yatırım, Karar verme, Fuzzy ANP, Çok Amaçlı Lineer Programlama

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1. Introduction

In developing countries, tourism policies are outdated, incomplete, or poorly applied (Singh, 2002), and tourist attractions, such as natural parks, do not have management or land use plans (Nepal, 2000). Recent studies related to recreational ecology showed that mountain tourism in developing regions had adverse effects on natural areas, protected areas, and wetlands (Stevens, 2003; Buntaine et al., 2006). According to United Nations World Tourism Organization (UNWTO), the tourism industry is one of the biggest industries worldwide with its contribution to employment, number of people to serve, and its revenue and added values (Demirel et al., 2009).

In a worldwide assessment, international tourism is the widest point of foreign trade. For several countries, tourism is the most critical export resource, the most important sector that provides the most currency and the motor of development (Lim, 1997).

Such an important topic, the investments in this sector must be feasible because there are many unfeasible investments and many tourism types. In this paper, tourism investments are entirely discussed. For the modeling of the subjective decisions of decision-makers, fuzzy Analytic Network Process (ANP) and fuzzy Goal Programming methodologies are added to the model. The methods of this study, distinctly from the others, fuzzy Analytic Network Process (ANP) and fuzzy Goal Programming methodologies have been used to evaluate tourism investments in Turkey.

The steps of the methodologies used in this article can be given as follows:

Step 1: Criteria and alternatives for tourism types in Turkey are determined considering various factors by the experts.

Step 2: A hierarchical structure for weighting tourism types is composed. Pairwise comparison matrices of alternatives with respect to each criterion are composed, and the criteria are also compared to each other with respect to the goal.

Step 3: Then, fuzzy values in the matrices of pairwise comparisons are defuzzified by using Chang's Extended Analysis Method on fuzzy AHP, and the weight vector of each matrix is obtained. The fuzzy ANP methodology is performed using these weight vectors, and a priority weight is obtained for each alternative. The alternative that has the maximum priority weight is selected as the best.

Step 4: For the best alternative, three real investment projects are similarly prioritized using fuzzy ANP.

Step 5: Using these weights and financial data belonging to these projects, we apply fuzzy multi-objective decision-making to find the most feasible investment among these three investments.

The rest of this paper is organized as follows. Section 2 presents tourism literature and tourism investments in Turkey. Section 3 shows a hierarchical structure for tourism types and location selection in Turkey. In Sections 4, 5, and 6, Multi-Criteria Decision Making (MCDM), Fuzzy Analytic Network Process (ANP), and Fuzzy Multi-Objective Linear Programming are given, respectively. An application of evaluation of tourism investments in Turkey is presented in Section 7. The last section summarizes the findings and makes suggestions for further research.

2. Tourism Literature Review and Tourism Investments

Like any other economic activity, tourism can be thought of essentially as a production process in which raw materials are taken in and assembled into final products, which are then sold to consumers (McKercher, 1993).

Over the past three decades, the academic literature has been focused on tourism planning, economic dimensions, and economic developments (Galani-Moutafi, 2004). In many developing countries, tourism is widely acknowledged to stimulate local economic growth, thanks to service provision, job opportunities, and overall foreign revenues (WTO, 2005; Gurung, DeCoursey, 2000; Brohman, 1996).

Theuns (2002) explained that Third World countries had utilized tourism to improve balances of payments; increase the general income level; create additional employment opportunities; stimulate economic diversification and decrease regional imbalances.

As reported by the World Travel and Tourism Council (WTTC), the contribution of tourism to the global economy in 1999 encompassed 11 percent of Gross National Products; created 200 million jobs, which equates to 8 percent of total employment and will generate 5.5 million new jobs per annum until the year 2010 (Holden, 2000).

Since tourism is likely to become the largest single sector of world trade early in the next century (Hunter, 1997), it is crucial to establish a theoretical framework for investment in the touristic infrastructure. Tourism investments are considered the focal point of tourism development since they provide economical income and job opportunities (Tourism Investment in Saudi Arabia, 2009). Nevertheless, no contributions can be found in the literature that addresses this subject within a decision-oriented optimization model (Kort et al., 2002).

According to Al Gergawi (2003), "the tourism sector is considered to be one of the most attractive for investors. The strong growth in the number of tourists will contribute towards establishing projects with high rates of returns that exceed returns from other sectors".

Paramati et al. (2018) suggested the policy makers of the EU nations to initiate more effective policies to increase the tourism investments. The increasing tourism investments then allow the industry to grow further by ensuring sustainable tourism development across the EU member countries. Also, effective tourism strategies of a developing country can create revenue generating opportunities (tax revenues) and provide sustainable employment for semi-skilled or unskilled workers (Saner et al., 2019).

According to Du et al.'s findings (2019), investments in tourism in and of itself appear to be insufficient for economic growth. Instead, tourism's contribution to the long-term growth of an economy comes through its role as an integral part of a broader development strategy that is more generally focused on standard income determinants.

Tourism has developed as an instrument for creating considerable economic gains with having great association with other industries in the national economy making major indirect earns and also enhances foreign investment, opportunities of trade, investments in private, local development, and public infrastructure (Arshad et al., 2018).

Despite all this, few authors have reported on the challenges the country faces towards tourism development and competitiveness (Andrades and Dimanche, 2017).

Characteristics of tourism investments can be counted as; fixed capital amounts and fixed costs are so high, significant need for labor, a direct relationship between facility-infrastructure and demand-investments, and essential physical planning before construction. Due to all of the reasons explained above, the investments must be made feasible.

3. Hierarchical Structure for Tourism Types and Location Selection in Turkey

In the first section of the application, for the modeling of the problem, the purpose is explained - "prioritization of tourism types for Turkey," then criteria (main criteria and sub-criteria) are determined and described. Experts' views and the studies on this matter were referenced in determining the main and sub-criteria for prioritizing tourism types. Turkey's most commonly preferred tourism types are shown as alternatives: plateau, summer, winter and mountain, and culture tourism. And as shown in Figure 1, the main criteria are financial, time, physical features, and social features (Demirel et al., 2009).

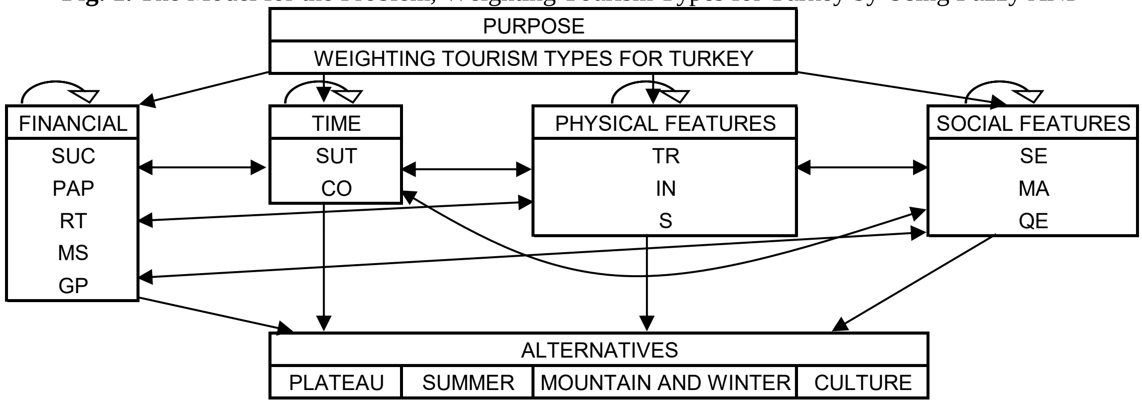
- **Financial criteria:** This main criteria includes the sub-criteria explaining financial decisions. Sub-criteria under this title include "*Set Up Cost* (SUC)", "*Possible Annual Profit* (PAP)", "*Repayment Time* (RT)", "*Market Sharing* (MS)", and "*Government Promotion* (GP)".

- **Time criteria:** Under the time criteria, there are these sub-criteria; "*Set Up Time* (SUT)" and "*Continuity* (CO)".

- **Physical features criteria:** Under the physical features criteria, these sub-criteria exist; "*Transportation* (TR)", "*Infrastructure* (IN)" and "*Size* (S)"

- **Social features criteria:** Under the social features criteria, these sub-criteria can be thought of; "*Suitability for Everyone* (SE)", "*Marketing Ability* (MA)" and "*Qualified Employee* (QE)".

Fig. 1. The Model for the Problem, Weighting Tourism Types for Turkey by Using Fuzzy ANP



In the second section of the application, criteria for summer tourism are determined, and three real investment projects are prioritized using fuzzy ANP. The first investment project is in Çesme (Izmir), the second one is in Kemer (Antalya), and the last one is in Kuşadası (Aydin) (Figure 2).

The main criteria for weighting these 3 investments are financial, time, features of the location and flexibility.

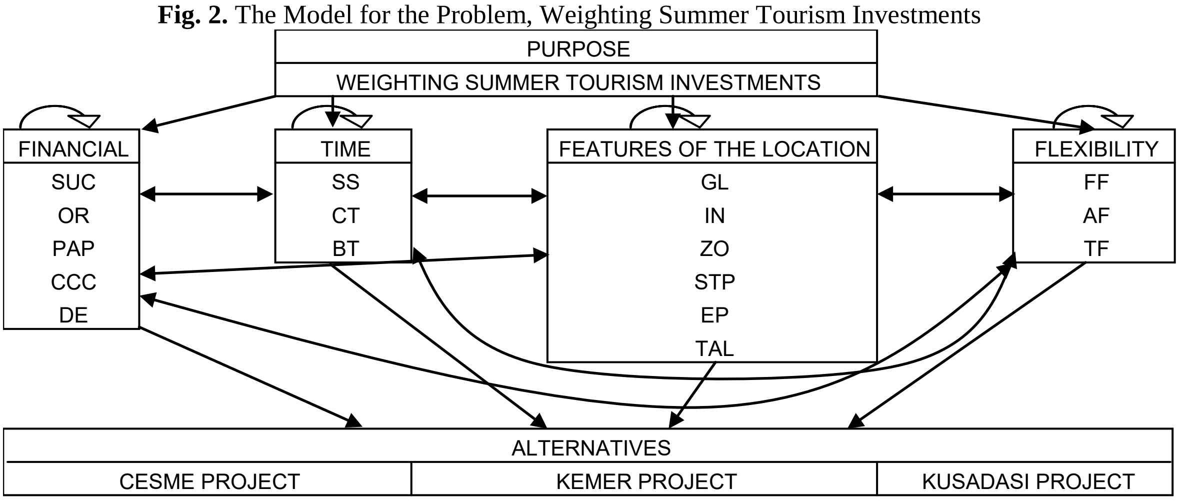
- **Financial criteria:** This main criterion includes the sub-criteria explaining about financial decisions of the investments. Sub-criteria under this title include "*Set Up Cost* (SUC)", "*Occupancy Rate* (OR)", "*Possible Annual Profit* (PAP)", "*Competition/Competitor Companies* (CCC)", and "*Demand* (DE)".

- **Time criteria:** Under this criteria, there are these sub-criteria; "*Shipping Speed* (SS)" for suppliers, "*Customer Transportation* (CT)", and "*Building Time* (BT)".

- **Features of the location:** Under the features of the location criteria, these sub-criteria exist; "*Geographical Location* (GL)", "*Infrastructure* (IN)", "*Zoning* (ZO)", "*Surrounding Touristic Places* (STP)" as museums, historical sites, natural beauties, etc., "*Employee Procurement* (EP)", and "*Tourist Attraction of the Location* (TAL)".

- **Flexibility:** Under flexibility criteria this sub-criteria can be thought; "*Financial Flexibility* (FF)" as described competition power, "*Amount Flexibility* (AF)" that provides the requested number of rooms, services, etc., and "*Time Flexibility* (TF)" that provides requested rooms or services in the requested time.

Fig. 2. The Model for the Problem, Weighting Summer Tourism Investments



4. Multi-Criteria Decision Making (MCDM)

Multi-Criteria Decision Making (MCDM) techniques are gaining popularity. Several methods based on weighted averages, priority setting, outranking, fuzzy principles, and combinations are employed for decisions (Pohekar and Ramachandran, 2004).

Multi-Criteria Decision Making is a well-known branch of decision making. It is a branch of a general class of operations research models that deal with decision problems under some decision criteria. This primary class of models is very often called MCDM. This class is further divided into multi-objective decision making (MODM) and multi-attribute decision making (MADM) (Climaco, 1997). There are several methods in each of the above categories. Priority-based, outranking, distance-based, and mixed techniques are also applied to various problems. Each method has its own characteristics, and the methods can also be classified as deterministic, stochastic, and fuzzy methods. There may be combinations of the above methods (Pohekar and Ramachandran, 2004).

Depending upon the number of decision-makers, the methods can be classified as single or group decision-making methods. Decision-making under uncertainty and decision support systems are also prominent decision-making techniques (Gal and Hanne, 1999).

For the application of this paper, Analytic Network Process with fuzzy numbers is used. Analytic Network Process (ANP) is a generalization of the AHP, where the assumption of a hierarchical structure is relaxed. It resembles a network consisting of clusters of elements, which are the decision-making criteria and the alternatives. The relations between elements depend on the decision-making case (Ridder et al., 2008).

5. Fuzzy Analytic Network Process (ANP)

Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) are the common methods to solve Multi-Criteria Decision Making problems. The decision problem is structured hierarchically at different levels in both methodologies (Mikhailov, 2003). The local priorities in ANP are established in the same manner as in AHP using pairwise comparisons and judgments (Promentilla et al., 2007). The Analytical Network Process is the generalization of Saaty's Analytical Hierarchy Process, one of the most widely employed decision support tools (Promentilla et al., 2006). Similar to the AHP, the priorities in the ANP are assessed indirectly from pairwise comparisons judgments (Mikhailov and Singh, 2003).

The Saaty method enables us to model a complicated decision problem with the help of a hierarchical structure that is composed of the goal, criteria, sub-criteria, and alternatives (Forman, 1999).

In the literature, the Fuzzy ANP method has been used to solve problems like Research and Development Project Selection (Mohanty, 2005), Performance Evaluation (Yellepeddi, 2006), Quality Function Deployment Implementation (Ertay et al., 2005), Enterprise Resource Planning (ERP) Software Selection (Ayag and Ozdemir, 2007). In this paper, Chang's (Chang, 1996) fuzzy AHP algorithm based ANP is used to prioritize tourism types in Turkey.

i. Artificial importance values are described as (5.1):

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j} = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right) \tag{5.1}$$

ii. And with the use of these values, fuzzy addition is done as equations (5.2).

$$S_i = \sum_{j=1}^{m} M_{g_i}^{j} \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j}\right]^{-1} \tag{5.2}$$

iii. Then, priority vectors for the alternatives are calculated as shown below (5.3):

$$V(M_i > M_j) = \begin{cases} 1 & ; m_i \geq m_j \\ 0 & ; l_j \geq u_i \\ \dfrac{(l_j - u_i)}{(m_i - u_i) - (m_j - l_j)} & ; otherwise \end{cases} \tag{5.3}$$

iv. Then the minimum of each column is taken (5.4)

$$V(M \geq M_1, M_2, \ldots, M_k) = \min V(M \geq M_i),\ i=1,2,\ldots,k \tag{5.4}$$

and normalized weights for alternatives are calculated as shown below (5.5):

$$W = (d(A_1), d(A_2), \ldots, d(A_n))^T \tag{5.5}$$

All of the binary comparisons are completed, and these weights are the input of the Analytic Network Process.

6. Fuzzy Multi-Objective Linear Programming

The original Multi-Objective Linear Programming model can be converted to the Fuzzy- Multi-Objective Linear Programming model using the piecewise linear membership function given in (Hannan, 1981) to represent the fuzzy goals of the decision-maker in the Multi-Objective Linear

Programming model given in (Bellman and Zadeh, 1970). In general, a piecewise linear membership function given in (Bellman and Zadeh, 1970) can be adapted to convert the problem to be solved into a common Linear Programming problem.

Zimmermann (1976) firstly extended the Fuzzy Linear Programming approach to a conventional Multi-Objective Linear Programming problem. For each of the objective functions of this problem, it was assumed that the decision-maker has a fuzzy goal, such as the objective functions should be essentially less than or equal to some value. Then, the corresponding linear membership function is defined, and the minimum operator proposed by Bellman and Zadeh (1970) is applied to combine all objective functions. By introducing an auxiliary variable, this problem can be transformed into an equivalent, conventional Linear Programming problem and can be easily solved by the simplex method. Subsequent work on fuzzy goal programming is given in (Hannan, 1981; Leberling, 1981; Luhandjula, 1982; Sakawa, 1988; Moghaddam et al., 2010).

Zimmermann suggests a symmetrical approach for fuzzy objective and fuzzy constraint linear programming problems. According to Zimmermann, a fuzzy objective function can be represented as a fuzzy constraint with a fuzzy access level gained from the decision-maker. In this situation, when fuzzy decision cluster is determined, fuzzy objective and fuzzy constraints are the same.

With respect to Zimmermann's algorithm that used in this study;

$$\underset{\sim}{Max}(Z = c^T x) \tag{6.1}$$

with these constraints;

$$\begin{aligned} &(Ax)_i \underset{\sim}{\leq} b_i \qquad i = 1,2,\ldots,m \\ &x \geq 0 \end{aligned} \tag{6.2}$$

This can be described as calculating *x* from the equation (Zimmermann, 1983).

$$\begin{aligned} &c^T x \underset{\sim}{\geq} b_0 \\ &(Ax)_i \underset{\sim}{\leq} b_i \qquad i = 1,2,\ldots,m \\ &x \geq 0 \end{aligned} \tag{6.3}$$

In these formulas "~" can be described as fuzzy form of notions (Lin and Lee, 1996).

$$\mu_i\left[(Bx)_i\right] = \begin{cases} 0 & ;if \quad (Bx)_i \geq b_i + d_i \\ \in [0,1] & ;if\ b_i \leq (Bx)_i \leq b_i + d_i \\ 1 & ;if \quad (Bx)_i \leq b_i \end{cases} \tag{6.4}$$

d_i is the maximum tolerance limit that determined by the decision maker. The formula can be described as follows (Dyson, 1980):

$$\mu_0(x) = \begin{cases} 0 & ;if \quad c^T x \leq b_0 - d_0 \\ 1 - \dfrac{b_0 - c^T x}{d_0} & ;if\ b_0 - d_0 \leq c^T x \leq b_0 \\ 1 & ;if \quad c^T x \geq b_0 \end{cases} \tag{6.5}$$

$$\mu_1(x) = \begin{cases} 0 & ;if \quad (Ax)_i \geq b_i + d_i \\ 1 - \dfrac{(Ax)_i - b_i}{d_i} & ;if\ b_i \leq (Ax)_i \leq b_i + d_i \\ 1 & ;if \quad (Ax)_i \leq b_i \end{cases} \tag{6.6}$$

Then, with the use of an additional variable (λ) fuzzy linear programming can be turned to traditional linear programming as follows:

Max λ

with these constraints,

$$\begin{aligned} &\mu_0(x) \geq \lambda \\ &\mu_1(x) \geq \lambda \\ &\lambda \in [0,1] \end{aligned} \tag{6.7}$$

If we expand the notation;

Max λ

with these constraints,

$$\begin{aligned} &1 - \frac{b_0 - c^T x}{d_0} \geq \lambda \\ &1 - \frac{(Ax)_i - b_i}{d_i} \geq \lambda \qquad ; \quad \forall i \\ &\lambda \in [0,1] \\ &x \geq 0 \end{aligned} \tag{6.8}$$

Here, before the problem's solution, the decision-maker must decide the parameters of c_j, a_{ij}, b_0, d_0, b_i and d_i.

7. Application

For the numerical example in this study, we first decided the tourism type planned for investing in Turkey with fuzzy Analytic Network Process. Chang's fuzzy AHP algorithm based ANP (Chang, 1996) is used for this fuzzy ANP problem. Then, three real investment projects were found for this tourism type and prioritized using fuzzy ANP. Using these weights and financial data belonging to these projects, we apply fuzzy multi-objective decision-making to find the most feasible investment among these three investments.

7.1. Selecting Tourism Type for Turkey

For the first section of the application, after these purposes, criteria, and alternatives have been determined, three binary comparisons were made with three different experts. Their geometrical averages have been calculated, and the results of the binary comparison have been entered into the Super Decisions software package.

For example, one of the binary comparisons for the alternatives according to marketing ability (MA) is shown in Table 1:

Tab. 1. The Binary Comparison for the Alternatives According to Marketing Ability (MA)

	Plateau	**Summer**	**Winter and Mountain**	**Culture**
Plateau	(1, 1, 1)	(2/5, ½, 2/3)	(2/5, ½, 2/3)	(1, 1, 1)
Summer	(3/2, 2, 5/2)	(1, 1, 1)	(2/3, 1, 3/2)	(3/2, 2, 5/2)
Winter and Mountain	(3/2, 2, 5/2)	(2/3, 1, 3/2)	(1, 1, 1)	(2/3, 1, 3/2)
Culture	(1, 1, 1)	(2/5, ½, 2/3)	(2/3, 1, 3/2)	(1, 1, 1)

As the table is shown above, there are three binary comparisons. The geometric average method is used for every cell. Chang's algorithm is used to solve the fuzzy problem (Chang, 1996). Geometric averages for each cell have been calculated as:

Cell (1,1) = $\sqrt[3]{1x1x1}+\sqrt[3]{0.4x0.286x0.667}+\sqrt[3]{0.4x0.4x0.667}+\sqrt[3]{1x0.667x0.667}=2.661$

Cell (1,2) = $\sqrt[3]{1.5x2.5x0.667}+\sqrt[3]{1x1x1}+\sqrt[3]{0.667x1.5x0.667}+\sqrt[3]{1.5x1.5x0.667}=4.376$

Tab. 2. Artificial Importance Values

Plateau	2,661	3,180	3,921
Summer	4,376	5,664	7,246
M&W	3,581	4,641	6,032
Culture	2,800	3,424	4,329
TOTAL	13,418	16,909	21,528

With the artificial importance values (Table 2), fuzzy totaling calculations are done using Eq. (5.2) as shown in Table 3:

Cell (1,1) = 2.661/21.528 = 0.124

Cell (1,2) = 4.376/21.528 = 0.203 and similarly,

Cell (3,1) = 3.921/13.418 = 0.292

Cell (3,2) = 7.246/13.418 = 0.540

Tab. 3. Fuzzy-sums

	l	m	u
Plateau	0,124	0,188	0,292
Summer	0,203	0,335	0,540
M&W	0,166	0,274	0,450
Culture	0,130	0,202	0,323

With using Eq. (5.3) priority vectors for the alternatives are calculated as (Table 4):

Cell (1,1) = (0.188 ≥ 0.188) = TRUE

Cell (1,2) = (0.188 ≥ 0.335) = WRONG; (0.203 ≥ 0.292) = WRONG; $\dfrac{(0.203-0.292)}{(0.188-0.292)-(0.335-0.203)}=0.337$

Cell (1,3) = (0.188 ≥ 0.274) = WRONG; (0.166 ≥ 0.292) = WRONG; $\dfrac{(0.166-0.292)}{(0.188-0.292)-(0.274-0.166)}=0.593$

Tab. 4. Priority Vectors

	Plateau	Summer	M&W	Culture
Plateau	1,000	1,000	1,000	1,000
Summer	0,377	1,000	0,803	0,474
M&W	0,593	1,000	1,000	0,685
Culture	0,918	1,000	1,000	1,000

Then the minimum of each column are taken (Eq. (5.4)), and pre-normalized data are obtained as (Table 5):

Tab. 5. Pre-normalized Data

Plateau	Summer	M&W	Culture	TOTAL
0,377	1,000	0,803	0,474	2,654

Lastly normalized weights for alternatives are calculated as shown below Eq. (5.5):

Plateau = 0.337/2.654 = 0.142

Summer = 1.000/2.654 = 0.337

M&W = 0.803/2.654 = 0.302

Culture = 0.474/2.654 = 0.179

After these results, the weights for the alternatives according to marketing ability (MA) is shown in Table 6:

Tab. 6. The Weights for Alternatives according to MA

Plateau	0,142
Summer	0,337
M&W	0,302
Culture	0,179

All the weights are entered into the Super Decisions software package, and the weighting is as shown in Table 7:

Tab. 7. Results of Fuzzy ANP Algorithm for Weighting Tourism Types

Alternatives	$W_{\text{Alt}}^{(\text{F-ANP})}$
Plateau tourism	0.1244
Summer tourism	0.3830
M&W tourism	0.1711
Cultural tourism	0.3213

According to the calculations, summer tourism has 0.38, culture tourism has 0.32, mountain and winter tourism has 0.17, and plateau tourism has 0.13 weights. With these results, in Turkey, investments in summer tourism are the most feasible type for Turkey. Then culture tourism, mountain and winter tourism, and plateau tourism are feasible, respectively.

7.2. Selecting Tourism Investment Project and Its Location

For the second step of the application, criteria for summer tourism are determined, and three real investment projects are prioritized using fuzzy ANP. Using these weights and financial data that belong to these projects, we apply fuzzy multi-objective decision-making to find the most feasible investment among these three investments.

7.2.1. Weighting Projects and Their Locations

In this section, Chang's algorithm is used to solve the fuzzy problem (Chang, 1996), then all of the weights are entered into the Super Decisions software package. As a result, the weights for the alternatives Çeşme, Kemer, and Kuşadası Projects are gained. According to the same calculations, Kemer Project has 0.571, Kuşadası Project has 0.226, and Çeşme Project has 0.203 weights, respectively (Table 8). In the next step, these weights will be one of the objectives that aim to be maximized.

Tab. 8. Results of Fuzzy ANP Algorithm for Weighting Summer Tourism Investments

Alternatives	$W_{Alt}^{(F\text{-}ANP)}$
Çeşme Project	0.203
Kemer Project	0.571
Kuşadası Project	0.226

7.2.2. Selecting Projects by Using Fuzzy Goal Programming

These three investment projects are five-star hotels and serve all-inclusive services. They need about 30,000 m^2 area by the sea, and 15,000 m^2 of the area needs to be covered, i.e., for restaurant, rooms, reception, laundry, and other services. We assumed that these hotels have 400 double rooms for 800 persons.

For the setup cost, land and building costs of each hotel are discussed. Land costs are found from the sector and the location analysis, and the building costs are found with the experts' view in Turkey as about 2,000 $/m^2 for the covered area. Thus, the need for land and the covered area is the same for these three projects. To start servicing for hotels, all costs are included, i.e., landscaping, room decoration, covered area decoration, etc.

15,000 m^2 x 2,000 $/m^2 = 30,000,000 $ building cost

And the land costs (30,000 m^2 by the sea) in Çeşme, Kemer, and Kuşadası are 10 million $, 18 million $, and 8 million $, respectively (Table 9).

Tab. 9. Total Set Up Costs

Area	30,000 m^2		
Covered Area	15,000 m^2		
SET UP COST	Çeşme Project	Kemer Project	Kuşadası Project
Land Cost	10 million $	18 million $	8 million $
Building Cost	30 million $	30 million $	30 million $
TOTAL	**40 million $**	**48 million $**	**38 million $**

We have some assumptions for these three investments as:

- Hotels will work two seasons, high-season and low-season in a year, and decide their strategies, prices, and services according to these seasons. Due to their summer tourism-based services, they are closed during the winter season. Their incomes are from 2 seasons, and their outgoings are all year because they also have fixed costs during the winter. And the prices during low and high seasons are also different.

- With sector analysis and experts' view, the cost for one person in the all-inclusive hotel is about 12-15 $. Annual fixed costs and variable costs are included in this cost. This daily cost is found as total yearly costs divided by the total yearly number of the customer.

- The last three-year data of the Republic of Turkey Ministry of Culture and Tourism and sector analysis are used for occupancy rates and room prices per person. And with these data, possible annual profits are calculated (Table 10, 11, 12).

Tab. 10. Financial Data of Çeşme Project

ÇEŞME PROJECT	JAN.	FEB	MAR	APR	MAY	JUN.	JUL.	AUG.	SEP.	OCT	NOV	DEC
OCCUPANCY RATES	-	-	-	-	40%	40%	80%	80%	40%	-	-	-
NUMBER OF BEDS	800	800	800	800	800	800	800	800	800	800	800	800
FULL NUMBER OF BEDS	-	-	-	-	320	320	640	640	320	-	-	-
BED PRICES ($/DAY PERSON)	-	-	-	-	25	25	100	100	25	-	-	-
TOTAL INCOME (DAY)	-	-	-	-	8,000	8,000	64,000	64,000	8,000	-	-	-
TOTAL INCOME (MONTH)	-	-	-	-	240,000	240,000	1,920,000	1,920,000	240,000	-	-	-
DAILY COSTS ($/DAY PERSON)	-	-	-	-	15	15	15	15	15	-	-	-
TOTAL COSTS (DAY)	-	-	-	-	4,800	4,800	9,600	9,600	4,800	-	-	-
TOTAL COSTS (MONTH)	-	-	-	-	144,000	144,000	288,000	288,000	144,000	-	-	-
MONTHLY PROFIT ($)	-	-	-	-	96,000	96,000	1,632,000	1,632,000	96,000	-	-	-
TOTAL PROFIT ($)	3,552,000											

Tab. 11. Financial Data of Kemer Project

KEMER PROJECT	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
OCCUPANCY RATES	-	-	50%	50%	85%	85%	85%	85%	85%	50%	50%	-
NUMBER OF BEDS	800	800	800	800	800	800	800	800	800	800	800	800
FULL NUMBER OF BEDS	-	-	400	400	680	680	680	680	680	400	400	-
BED PRICES ($/DAY PERSON)	-	-	30	30	120	120	120	120	120	30	30	-
TOTAL INCOME (DAY)	-	-	12,000	12,000	81,600	81,600	81,600	81,600	81,600	12,000	12,000	-
TOTAL INCOME (MONTH)	-	-	360,000	360,000	2,448,000	2,448,000	2,448,000	2,448,000	2,448,000	360,000	360,000	-
DAILY COSTS ($/DAY PERSON)	-	-	15	15	15	15	15	15	15	15	15	-
TOTAL COSTS (DAY)	-	-	6,000	6000	10200	10200	10200	10200	10200	6000	6000	-
TOTAL COSTS (MONTH)	-	-	180,000	180,000	306,000	306,000	306,000	306,000	306,000	180,000	180,000	-
MONTHLY PROFIT ($)	-	-	180,000	180,000	2,142,000	2,142,000	2,142,000	2,142,000	2,142,000	180,000	180,000	-
TOTAL PROFIT ($)	11,430,000											

Tab. 12. Financial Data of Kuşadası Project

KUŞADASI PROJECT	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
OCCUPANCY RATES	-	-	-	40%	40%	85%	85%	85%	85%	40%	40%	-
NUMBER OF BEDS	800	800	800	800	800	800	800	800	800	800	800	800
FULL NUMBER OF BEDS	-	-	-	320	320	680	680	680	680	320	320	-
BED PRICES ($/DAY PERSON)	-	-	-	20	20	80	80	80	80	20	20	-
TOTAL INCOME (DAY)	-	-	-	6,400	6,400	54,400	54,400	54,400	54,400	6,400	6,400	-
TOTAL INCOME (MONTH)	-	-	-	192,000	192,000	1,632,000	1,632,000	1,632,000	1,632,000	192,000	192,000	-
DAILY COSTS ($/DAY PERSON)	-	-	-	15	15	15	15	15	15	15	15	-
TOTAL COSTS (DAY)	-	-	-	4,800	4,800	10,200	10,200	10,200	10,200	4,800	4,800	-
TOTAL COSTS (MONTH)	-	-	-	144,000	144,000	306,000	306,000	306,000	306,000	144,000	144,000	-
MONTHLY PROFIT ($)	-	-	-	48,000	48,000	1,326,000	1,326,000	1,326,000	1,326,000	48,000	48,000	-
TOTAL PROFIT ($)	5,496,000											

Then the problem is modeled as a fuzzy multi-objective problem with which investment is the most feasible using the Zimmermann method (1983).

The model's objectives are maximizing the weights of 3 investments (gained from Fuzzy ANP), maximizing annual average occupancy rates, maximizing total annual incomes, and minimizing total annual costs. The notions used in the model are as follows:

m: number of projects

w_i: weight of the alternative,

a_i: average occupancy rate of the alternative i,

b_i: annual income of alternative i,

c_i: annual cost of alternative i,

d_i: investment cost of alternative i,

t: total investment cost,

p: pay-back period.

For the linear programming problem in this section, the model can be described as follows:

Max $z_1 = w_i \cdot x_i$, (i=1,2,…,m)

Max $z_2 = a_i \cdot x_i$, (i=1,2,…,m)

Max $z_3 = b_i \cdot x_i$, (i=1,2,…,m)

Min $z_4 = c_i \cdot x_i$, (i=1,2,…,m)

wrt

$$\sum_{i=1}^{m} d_i x_i \le t$$

$$\frac{d_i}{(b_i - c_i)}.x_i \leq p\,, \qquad \text{(i=1,2,…,m)}$$

$$\sum_{x=1}^{m} x_i = 1$$

$$\forall x_i \geq 0 \text{ and integer} \qquad \text{(x=1,2,…,m)}$$

This problem can be numerically expressed as (using indexes Çeşme:1, Kemer:2, Kuşadası:3):

For the weights → $\max z_1 = 0.203\, x_1 + 0.571\, x_2 + 0.226\, x_3$

For the occupancy rate → $\max z_2 = 0.23\, x_1 + 0.52\, x_2 + 0.42\, x_3$

For annual incomes → $\max z_3 = 4{,}560{,}000\, x_1 + 13{,}680{,}000\, x_2 + 7{,}296{,}000\, x_3$

For annual costs → $\min z_4 = 1{,}008{,}000\, x_1 + 2{,}250{,}000\, x_2 + 1{,}800{,}000\, x_3$

For these objectives, our criteria are investment cost does not exceed 50 million \$ but has a tolerance of ±5 million \$, the investment has eight years pay-back period with a tolerance of ±2 years, and one of the investments is surely made. These assumptions are taken place among criteria as follows Eq. (6.3):

Investment cost → $40{,}000{,}000\, x_1 + 48{,}000{,}000\, x_2 + 38{,}000{,}000\, x_3 \underset{\sim}{\leq} 50{,}000{,}000$

Pay-back periods → $\frac{40{,}000{,}000}{3{,}552{,}000} x_1 \underset{\sim}{\leq} 8$

$$\frac{48{,}000{,}000}{11{,}430{,}000} x_2 \underset{\sim}{\leq} 8$$

$$\frac{38{,}000{,}000}{5{,}496{,}000} x_3 \underset{\sim}{\leq} 8$$

and; $x_1 + x_2 + x_3 = 1$

$x_1, x_2, x_3 \geq 0$ and integer.

Respects to this data, membership function of fuzzy constraints are as follows Eq. (6.6):

$$\mu_1(x) = \begin{cases} 0 & ; if\ g_1(x) \geq 55{,}000{,}000 \\ 1 - \dfrac{(40{,}000{,}000x_1 + 48{,}000{,}000x_2 + 38{,}000{,}000x_3) - 50{,}000{,}000}{5{,}000{,}000} & ; if\ 50{,}000{,}000 \leq g_1(x) \leq 55{,}000{,}000 \\ 1 & ; if\ g_1(x) \leq 50{,}000{,}000 \end{cases}$$

$$\mu_2(x) = \begin{cases} 0 & ; if\ g_2(x) \geq 10 \\ 1 - \dfrac{(11.26x_1) - 8}{2} & ; if\ 8 \leq g_2(x) \leq 10 \\ 1 & ; if\ g_2(x) \leq 8 \end{cases}$$

$$\mu_3(x) = \begin{cases} 0 & ; if\ g_3(x) \geq 10 \\ 1 - \dfrac{(4.20x_2) - 8}{2} & ; if\ 8 \leq g_3(x) \leq 10 \\ 1 & ; if\ g_3(x) \leq 8 \end{cases}$$

$$\mu_4(x) = \begin{cases} 0 & ; if\ g_4(x) \geq 10 \\ 1 - \dfrac{(6.91x_3) - 8}{2} & ; if\ 8 \leq g_4(x) \leq 10 \\ 1 & ; if\ g_4(x) \leq 8 \end{cases}$$

The model can be defined as follows (Eq. (6.7)):

$\max z_1 = 0.203\ x_1 + 0.571\ x_2 + 0.226\ x_3$

$\max z_2 = 0.23\ x_1 + 0.52\ x_2 + 0.42\ x_3$

$\max z_3 = 4{,}560{,}000\ x_1 + 13{,}680{,}000\ x_2 + 7{,}296{,}000\ x_3$

$\min z_4 = 1{,}008{,}000\ x_1 + 2{,}250{,}000\ x_2 + 1{,}800{,}000\ x_3$

$\max z_5 = \lambda$

wrt

$40{,}000{,}000\ x_1 + 48{,}000{,}000\ x_2 + 38{,}000{,}000\ x_3 + 5{,}000{,}000\ \lambda \leq 55{,}000{,}000$

$11.26\ x_1 + 2\lambda \leq 10$

$4.20\ x_2 + 2\lambda \leq 10$

$6.91\ x_3 + 2\lambda \leq 10$

$x_1 + x_2 + x_3 = 1$

$\lambda \leq 1$

$\lambda \geq 0$

$x_1, x_2, x_3 \geq 0$

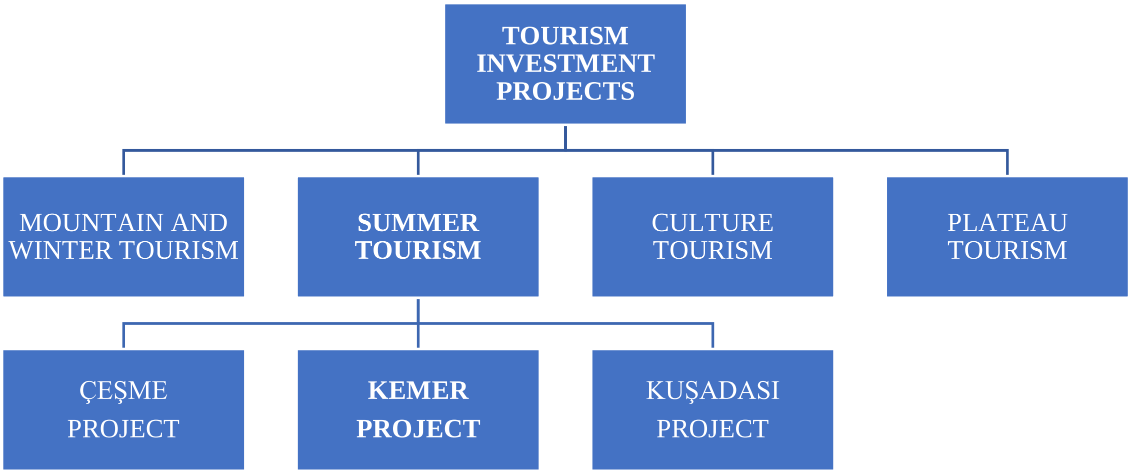
This model is entered into an Operations Research software package, and the optimal solution is as follows:

- Investing in x_2 is more feasible, so Kemer investment must be chosen. Our first objective, maximizing the weights, is maximized as 0.571; the second objective, occupancy rate, is maximized as 0.52; and the third objective, annual incomes, is maximized as 13,680,000$. But the annual costs cannot be minimized simultaneously as 2,250,000$. If we had chosen annual profit as a third objective, instead of separately incomes and costs, indeed this would be maximized.

Investment cost criteria has been achieved and has a surplus of 2 million $. As a pay-back period, Kemer investment has a surplus of 3.8 years. Other non-used criteria (2nd and 4th) have surplus every eight years.

As a result, firstly, we found that the most feasible tourism type for Turkey is "summer tourism"; afterward, we had three summer tourism investments. Secondly, we weighted them, modeled fuzzy multi-objective, and found that the most feasible investment in our application is Kemer (Figure 3).

Fig. 3. Decision Making for Tourism Investments



8. Conclusion

Since tourism is likely to become the largest single sector of world trade early in the next century (Hunter, 1997), it is crucial to establish a theoretical framework for investment in the touristic infrastructure. Tourism investments are considered the focal point of tourism development since they provide economical income and job opportunities (Tourism Investment in Saudi Arabia, 2009). In Turkey, the tourism sector is the second largest sector that attracts investments after the automotive industry. Every year bigger and more advanced investments are made in Turkey recently.

Besides these positives, the sector also has some problems: lack of interest in governance and tourism policies, lack of qualified employees, lack of education about tourism and tourists, irregular construction, and getting stronger of EU member competitor countries with the membership of EU. And, all-inclusive management systems are problematic per se. Because prices decline, hence service quality falls, incoming tourist profile negatively influences day by day. These problems can be the subject of further research.

Tourism development strategies require systemic thinking and comprehensive investment portfolio strategies regarding the tourism industry. Having reviewed the available literature, both theoretical and empirical, it is evident that the effect of public and private investment on tourism growth is positive. A careful examination of the existing studies shows that the research on the effect of investment on tourism is still inadequate and needs more attention (Nawaz and Hassan, 2016). For sustainable tourism, it is necessary to understand the interrelationship between economic growth, and tourism.

In our paper, we refer to the lack of a decision-oriented optimization model for the tourism sector. As mentioned before, in this paper, we first discussed tourism investments, the tourism sector in Turkey, and a literature review about this sector. Secondly, we talked about Multi-Criteria Decision Making, fuzzy Analytic Network Process, and fuzzy Multi-Objective Linear

Programming. Lastly, in the application section, we had a decision about which tourism type is the most feasible and the most logical in Turkey, then we had three tourism investment projects for this type; firstly, we weighted them, lastly with using their weights and some other financial data we modeled the problem as multi-objective linear programming. As a result, investing in summer tourism (to Kemer/Antalya) is the most feasible tourism investment for Turkey.

But we have a dilemma: investing in summer tourism and to Kemer/Antalya area is the most feasible investment but supporting only summer tourism and only to Kemer/Antalya area has a risk for the tourism potential of Turkey. Hence, government promotion for three seasons investments (except summer) and government promotion about transportation and investment to areas with high tourism potential but low recognition can prevent this risk. Thus, tourism types of Turkey can be varied, bounding only to summer can be prevented, the number of incoming tourists can be increased, their socio-demographic profiles can be influenced positively, and contributions to the economy of Turkey can be increased definitely.

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