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Analysis of factors affecting health tourism in the COVID-19 crisis using fuzzy EDAS method

Abbas Bashiri[a], Seyed Mehdi Mirhosseini-Alizamini[a,*], Mohammad Mehdi Nasrabadi[a]

[a]*Department of Mathematics, Payame Noor University (PNU), 19395-4697 Tehran, Iran.*

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Abstract

Today, the tourism industry is one of the most dynamic developing sectors of the world economy and an important factor in the social and economic development of regions and countries. It is known as one of the three first-class profitable industries in the world, which in order to expand and develop requires the cooperation and agreement of environmental, cultural, economic, political and social factors at the community level, in this regard, the phenomenon what has now negatively affected the tourism industry in Iran and the world is the Corona (Covid-19) crisis. This study suggests an infrastructure for determining the factors affecting health tourism. Therefore, the newest multi-criteria decision-making method, fuzzy best-worst method was used to calculate the relative importance of indices and Fuzzy evaluation based on distance from average solution technique was applied as a multi-attribute decision-making method to rank effective factors in health tourism. The statistical population of this research consists of directors and experts in the tourism industry Mazandaran. Based on the results of this study, improving the level of tourist security in the province ranks first among other options for the economy itself.

Keywords: Tourism performance, Health tourism, Fuzzy best worst method, Fuzzy EDAS, Multi-criteria decision-making.
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1. Introduction

Tourism in the post-World War II period is one of the most dynamic and developing sectors of the world economy. Tourism is ranked fourth in the world or, according to thinkers, ranked second

*Corresponding author
Email addresses: bashiri.abbas.73@gmail.com (Abbas Bashiri), m_mirhosseini@pnu.ac.ir (Seyed Mehdi Mirhosseini-Alizamini), nasrabadi1974@gmail.com (Mohammad Mehdi Nasrabadi)

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among the most important industries for the export of goods and services, which is why many thinkers know tourism as an industry. Tourism as an industry has a basic feature that makes a difference with other industries. Production and consumption points are simultaneously spatial. Another basic and important feature of tourism is its relationship with globalization in many production sectors and in the field of Goods and services. This method can contribute to economic growth in the developed areas and at the same time can geographically disperse the wealth that is created [22].

In recent years, the crisis, known as the outbreak of the Corona virus (COVID-19), has created obstacles and problems for the presence of travellers in tourist centres and the closure of the entire chain of tourism services, including accommodation, food and beverage, amusements and hobbies, transportation and travel services around the world. Businesses in the field of tourism, which are one of the engines of employment and growth and are considered as invisible exports, have practically stopped in this situation, in other words, the cycle of this employment-generating industry has stopped, and many unites and activities in the relative fields including (residence, transportation, food and cuisine recreational and entertainment complexes and other upstream and downstream intermediaries) is damaged and their staff may lose their jobs. This causes the recession and regression of the great and developing tourism industry in the world. For this purpose, the present study is to discuss the situation and predictions made for the future and the situation of tourism during corona and after the corona virus.

History of Research domestic and foreign studies have been conducted on the impact of corona virus on economic growth and development in the tourism industry. Manti [15] examined the effects of the virus on important sectors of the global economy, such as the labor market, the energy market, travel, and tourism in order to identify different economic and managerial strategies to control the effects of the corona virus crisis on the business.

Moghanloo et al. [19] in studying the impact of Corona virus on the tourism industry, considered this industry as one of the engines of employment and growth in the field of invisible exports. The current situation has stopped the cycle of this employment-generating industry.

Dehghandar et al. [3] presented diagnosis of COVID-19 disease in Iran by fuzzy expert system designed based on input-output. Kamarazarrin et al. [9] developed modeling of self-assessment system of COVID-19 disease diagnosis using Type-2 Sugeno fuzzy inference system.

Kumar [14] In a study examined the impact of the Corona virus on tourism and industry in India. The study showed that a large number of Indians are directly or indirectly associated with the tourism industry. The lockout of this industry due to the Corona virus epidemic has caused 18 to 20 percent Reduction in travel and tourism reservations in this country. Therefore, according to WTTC, it takes a long time to reduce financial losses and reduce employment in this sector.

Hoque et al. [8] examined the impact of the Corona virus on the tourism industry in China using secondary data through a wide literature review. The study showed that the occurrence of the corona virus in China jeopardised the country's tourism industry both at home and abroad. This has led to the cancellation of all flights to China, and the Corona virus is thought to have a long-term impact on China's tourism industry.

Koshle et al. [13] in India looked at the impact of the Corona virus on business failure in other areas. The study found that about 348 million in business impact was reduced by the corona virus in India, so to deal with the crisis The book of law is intended as a precaution to help young teams in the country.

In the real-world problems, we are likely confronted with some alternatives that need to be evaluated with respect to multiple conflicting criteria. Multi-criteria decision-making (MCDM) refers to making decisions in such a situation. There are many methods and techniques available for solving MCDM problems [1]. Therefore, fuzzy MCDM methods and techniques are very useful to deal with this problem. Many researchers have studied supplier selection problem using fuzzy set theory. Pitchipoo et al. [21] proposed a structured and integrated decision-making approach for evaluating suppliers by combining the fuzzy analytic hierarchy process and grey relational analysis (GRA). Keshavarz Ghorabaee et al. [10] extended a multi-criteria group decision-making based on the COPRAS method with type-2 fuzzy sets, and applied it to supplier selection process. Nasrollahi et al. [20] developed a model for Evaluating Marketing Channels based on the fuzzy best-worst method (BWM) and Fuzzy evaluation based on distance from average solution (EDAS) Methods. Mehdiabadi et al. [16] presented A new hybrid fuzzy model:Satisfaction of residents in Touristic areas toward Tourism development. Merdivenci and Karakas [17] developed an analysis of factors affecting health tourism performance using fuzzy DEMATEL method, advances in hospitality and tourism research (AHTR).

The evaluation based on distance from average solution EDAS method is an efficient multi-criteria decision-making method [11, 12]. Because the uncertainty is usually an inevitable part of the MCDM problems, fuzzy MCDM methods can be very useful for dealing with the real-world decision-making problems. In this study, we extend the EDAS method to handle the MCDM problems in the fuzzy environment. A case study of tourism industry in the COVID-19 crisis in Mazandaran is used to show the procedure of the proposed method and applicability of it. Also, we perform a fuzzy best-worst method [7, 18] by using simulated weights for criteria to examine the stability and validity of the results of the proposed method. The results of this study show that the extended fuzzy EDAS method is efficient and has good stability for solving MCDM problems.

The rest of this paper is organized as follows. In Section 2, we summarize some basic concepts and definitions about the fuzzy set theory and fuzzy best-worst method. In Section 3, an extended EDAS method is presented to deal with MCDM problems under fuzzy environment. In Section 4, we use a case study of tourism industry to illustrate the procedure and application of the fuzzy BWM method. In Section 5, a fuzzy EDAS method is performed to show the validity and stability of the results of the proposed method. The conclusions are discussed in Section 6.

2. preliminaries

In this section, we briefly review the concepts of fuzzy sets [2], triangular fuzzy numbers and the graded mean integration representation (GMIR) [5, 6] of triangular fuzzy numbers. Moreover, we also briefly review the fuzzy BWM [23, 4].

2.1. Fuzzy sets and triangular fuzzy numbers

Definition 2.1. *Let $X = \{x_1, x_2, \cdots, x_n\}$ be a finite universe of discourse. A fuzzy set $\tilde{A}$ in X is represented as $\tilde{A} = \{(x_i, \mu_{\tilde{A}}(x_i)) \mid x_i \in X\}$, where $\mu_{\tilde{A}}$ is the membership function of the fuzzy set $\tilde{A}$, $\mu_{\tilde{A}}(x_i)$ denotes the degree of membership of element x_i belonging to $\tilde{A}$ and $\mu_{\tilde{A}}(x_i) \in [0, 1]$.*

Definition 2.2. *A fuzzy number $\tilde{A}$ on R is defined as a triangular fuzzy number (TFN) if its membership function $\mu_{\tilde{A}}(x) : R \to [0, 1]$ is equal to*

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x < l, \\ \frac{x-l}{m-x}, & l \le x < m, \\ \frac{u-x}{u-m}, & m \le x \le u, \\ 0, & x > u, \end{cases} \tag{2.1}$$

where l, m , and u respectively represent the lower, modal, and upper value of the support of $\tilde{A}$, all of which are crisp numbers $(-\infty < l \le m \le u < \infty)$. A TFN can be represented as a triplet (l, m, u).

For the basic operational laws of two TFNs, the readers can refer to [5].

Definition 2.3. *The graded mean integration representation (GMIR) $R(\tilde{A})$ of a TFN represent the ranking of triangular fuzzy number $\tilde{A} = (l, m, u)$ is defined as follows:*

$$R(\tilde{A}) = \frac{1}{6}\left(l + 4m + u\right). \tag{2.2}$$

Definition 2.4. *Suppose that $\tilde{A} = (l, m, u)$ be a TFN. A function ψ, is defined in the following to find the maximum between a TFN and zero.*

$$\psi(\tilde{A}) = \begin{cases} \tilde{A} & if \quad R(\tilde{A}) > 0, \\ \tilde{0} & if \quad R(\tilde{A}) \leq 0, \end{cases} \tag{2.3}$$

where $\tilde{0} = (0, 0, 0)$.

2.2. Fuzzy best-worst method

Suppose there are n criteria for a research object, and the fuzzy pairwise comparisons on these n criteria can be performed based on the linguistic variables (terms) of decision-makers, such as 'Equally importance (EI)', 'Weakly important (WI)', 'Fairly Important (FI)', 'Very important (VI)', and 'Absolutely important (AI)'. Then, the linguistic evaluations of decision-makers need to be transformed to fuzzy ratings (represented by TFNs), and the rules of transformation are listed in Table 1.

Table 1: Transformation rules of linguistic variables of decision makers

Linguistic terms	Membership function
Equality importance (EI)	(1,1,1)
Weakly Important (WI)	$(\frac{2}{3}, 1, \frac{3}{2})$
Fairly Important (FI)	$(\frac{3}{2}, 2, \frac{5}{2})$
Very Important (VI)	$(\frac{5}{2}, 3, \frac{7}{2})$
Absolutely Important (AI)	$(\frac{7}{2}, 4, \frac{9}{2})$

Then, the fuzzy comparison matrix can be obtained as follows:

$$\tilde{A} = \begin{array}{c} \\ C_1 \\ C_2 \\ \vdots \\ C_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2n} \\ \vdots & \cdots & \vdots & \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & \tilde{a}_{nn} \end{bmatrix} \end{array},$$

where $\tilde{a}_{ij}$ represents the relative fuzzy preference of criterion i to criterion j, which is a triangular fuzzy number; $\tilde{a}_{ij} = (1, 1, 1)$ when $i = j$.

Definition 2.4. *A pairwise comparison $\tilde{a}_{ij}$ is defined as a fuzzy reference comparison if i is the best element and/or j is the worst element.*

In this paper, we will elaborate the detailed steps of fuzzy BWM for determining the fuzzy weights of criteria. It should be noted that this detailed steps can also be used for the determination of fuzzy weights of alternatives.

Step 1: Decide a set $C = \{C1, C2, \cdots, Cn\}$ of decision criteria.

Step 2: Decide the best (e.g., the most desirable or the most important) criterion C_B and the worst (e.g., the least desirable or the least important) criterion C_W.

Step 3: Decide the preference of the best criterion over all the other criteria using the linguistic terms of decision-makers in Table 1 to obtain the best-to-others vector $\tilde{A}_B = (\tilde{a}_{B1}, \tilde{a}_{B2}, \cdots, \tilde{a}_{Bn})$, where $\tilde{a}_{Bj}$ denotes the preference of the best criterion C_B over criterion $C_j, j = 1, 2, \cdots, n$ and $\tilde{a}_{BB} = (1, 1, 1)$.

Step 4: Decide the preference of all the criteria over the worst criterion using the linguistic evalutions of decision-makers listed in Table 1 to get the fuzzy others-to-worst vector $\tilde{A}_w = (\tilde{a}_{1w}, \tilde{a}_{2w}, \cdots, \tilde{a}_{nw})$, where $\tilde{a}_{jw}$ denotes the preference of the criterion C_j over the worst criterion C_w, j = 1, 2, ..., n and $\tilde{a}_{ww} = (1, 1, 1)$.

Step 5: Get the optimal weight vector $w^* = [\tilde{w}_1^*, \tilde{w}_2^*, \ldots, \tilde{w}_n^*]$, where $\tilde{w}_j^*$ denotes the optimal weight of criterion C_j and $j = 1, 2, \ldots, n$, by constructing the following programming model:

$$\min \ \max_j \left\{ \left| \frac{\tilde{w}_B}{\tilde{w}_j} - \tilde{a}_{Bj} \right|, \left| \frac{\tilde{w}_j}{\tilde{w}_w} - \tilde{a}_{jw} \right| \right\}$$
$$s.t. \begin{cases} \sum_{j=1}^{n} R(\tilde{w}_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1, 2, \cdots, n, \end{cases} \tag{2.4}$$

where $\tilde{w}_B = (l_B^w, m_B^w, u_B^w), \tilde{w}_j = (l_j^w, m_j^w, u_j^w), \tilde{w}_w = (l_w^w, m_w^w, u_w^w), \tilde{a}_{Bj} = (l_{Bj}, m_{Bj}, u_{Bj})$, and $\tilde{a}_{jw} = (l_{jw}, m_{jw}, u_{jw})$.

Eq. (2.4) can be transferred to the following nonlinearly constrained optimization problem:

$$\min \ \tilde{\xi}$$
$$s.t. \begin{cases} \left| \frac{\tilde{w}_B}{\tilde{w}_j} - \tilde{a}_{Bj} \right| \le \tilde{\xi} \\ \left| \frac{\tilde{w}_j}{\tilde{w}_w} - \tilde{a}_{jw} \right| \le \tilde{\xi} \\ \sum_{j=1}^{n} R(\tilde{w}_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1, 2, \cdots, n, \end{cases} \tag{2.5}$$

where $\tilde{\xi} = (l^\xi, m^\xi, u^\xi)$.

Considering $l^\xi \le m^\xi \le u^\xi$, we suppose $\tilde{\xi}^* = (k^*, k^*, k^*)$ and $k^* \le l^\xi$, then Eq. (2.5) can be transferred as:

$$
\begin{aligned}
&min \;\; \tilde{\xi}^{*} \\
&s.t. \begin{cases}
\left| \frac{(l_B^w, m_B^w, u_B^w)}{l_j^w, m_j^w, u_j^w} - (l_{Bj}, m_{Bj}, u_{Bj}) \right| \le (K^\star, k^\star, k^\star) \\
\left| \frac{(l_j^w, m_j^w, u_j^w)}{l_w^w, m_w^w, u_w^w} - (l_{jw}, m_{jw}, u_{jw}) \right| \le (K^\star, k^\star, k^\star) \\
\sum_{j=1}^{n} R(\tilde{w}_j) = 1 \\
l_j^w \le m_j^w \le u_j^w \\
l_j^w \ge 0 \\
j = 1, 2, \cdots, n.
\end{cases}
\end{aligned}
\tag{2.6}
$$

By solving Eq. (2.6), the optimal fuzzy weights $(\tilde{w}_1^*, \tilde{w}_2^*, \cdots, \tilde{w}_n^*)$ and $\tilde{\xi}^*$ can be obtained.

3. New Method of Evaluation Based on EDAS

In this section, we propose a new multi-criteria decision-making method that is called fuzzy EDAS. This method is very useful when we have some conflicting criteria. In the compromise MCDM methods the best alternative is obtained by calculating the distance from ideal and nadir solutions. The desirable alternative has lower distance from ideal solution and higher distance from nadir solution in these MCDM methods. However, the best alternative in the proposed method is related to the distance from average solution (AV). We don't need to calculate the ideal and the nadir solution in the proposed method. In this method, we have two measures dealing with the desirability of the alternatives. The first measure is the positive distance from average (PDA), and the second is the negative distance from average (NDA). These measures can show the difference between each solution (alternative) and the average solution. The evaluation of the alternatives is made according to higher values of PDA and lower values of NDA. Higher values of PDA and/or lower values of NDA represent that the solution (alternative) is better than average solution.

Suppose that we have a set of n alternatives $A = \{A_1, A_2, \cdots, A_n\}$, a set of m criteria $C = \{C_1, C_2, \cdots, C_m\}$ and k decision-makers $C = \{C_1, C_2, \cdots, C_k\}$. The steps for using the proposed method are presented as follows:

Step 1: Construct the average decision matrix (X), shown as follows:

$$
X = [\tilde{x}_{ij}]_{n\times m} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \tilde{x}_{n1} & \tilde{x}_{n2} & \cdots & \tilde{x}_{nn} \end{bmatrix}, \tag{3.1}
$$

such that

$$
\tilde{x}_{ij} = \frac{1}{k} \sum_{p=1}^{k} \tilde{x}_{ij}^{p}, \tag{3.2}
$$

where $\tilde{x}_{ij}^{p}$ denotes the performance value of alternative A_i $(1 \le i \le n)$ with respect to criterion C_j $(1 \le j \le m)$ assigned by the pth decision-maker $(1 \le p \le k)$.

Step 2: Construct the matrix of criteria weights, shown as follows:

$$
W = [\tilde{w}_j]_{1\times m}, \tag{3.3}
$$

such that

$$\tilde{w}_j = \frac{1}{k}\sum_{p=1}^{k} \tilde{w}_j^p, \tag{3.4}$$

where $\tilde{w}_j^p$ denotes the weight of criterion C_j $(1 \le j \le m)$ assigned by the pth decision-maker $(1 \le p \le k)$.

Step 3: A fuzzy average decision matrix is developed with respect to all the criteria considered using Table 2 and bellow equation:

$$AV = [\widetilde{av}_j]_{1\times m}, \tag{3.5}$$

such that

$$\widetilde{av}_j = \frac{1}{n}\sum_{i=1}^{n} \tilde{x}_{ij}. \tag{3.6}$$

The elements of this matrix $\widetilde{av}_j$ represents the average solutions with respect to each criterion. Therefore, the dimension of the matrix is equal to the dimension of criteria weights matrix.

Table 2: Linguistic terms for alternatives ratings.

Linguistic terms	Membership function
Very low (VL)	(0,0,0.1)
Medium low (ML)	(0,0.1,0.3)
Low (L)	(0.1,0.3,0.5)
Medium (M)	(0.3,0.5,0.75)
High (H)	(0.5,0.75,0.9)
Medium high (MH)	(0.75,0.9,1)
Very high (VH)	(0.9,1,1)

Step 4: Suppose that B is the set of beneficial criteria and N is the set of non-beneficial criteria. In this step the matrices of positive distance from average (PDA) and negative distance from average (NDA) are calculated according to the type of criteria (beneficial and non-beneficial), shown as follows:

$$PDA = [\widetilde{pda}_{ij}]_{n\times m}, \tag{3.7}$$

$$NDA = [\widetilde{nda}_{ij}]_{n\times m}, \tag{3.8}$$

where

$$\widetilde{pda}_{ij} = \begin{cases} \dfrac{\psi(\tilde{x}_{ij} - \widetilde{av}_j)}{R(\widetilde{av}_j)}, & if\ j \in B, \\ \dfrac{\psi(\widetilde{av}_j - \tilde{x}_{ij})}{R(\widetilde{av}_j)}, & if\ j \in N, \end{cases} \tag{3.9}$$

$$\widetilde{nda}_{ij} = \begin{cases} \dfrac{\psi(\widetilde{av}_j - \tilde{x}_{ij})}{R(\widetilde{av}_j)}, & if\ j \in B, \\ \dfrac{\psi(\tilde{x}_{ij} - \widetilde{av}_j)}{R(\widetilde{av}_j)}, & if\ j \in N, \end{cases} \tag{3.10}$$

where $\widetilde{pda}_{ij}$ and $\widetilde{nda}_{ij}$ denote the positive and negative distance of performance value of ith alternative from the average solution in terms of jth criterion, respectively.

Step 5: Calculate the weighted sum of positive and negative distances for all alternatives, shown as follows:

$$\widetilde{sp}_i = \sum_{j=1}^{m} \tilde{w}_j \widetilde{pda}_{ij}, \tag{3.11}$$

$$\widetilde{sn}_i = \sum_{j=1}^{m} \tilde{w}_j \widetilde{nda}_{ij}. \tag{3.12}$$

Step 6: The normalize values of $\widetilde{sp}_i$ and $\widetilde{sn}_i$ for all alternatives are calculated as follows:

$$\widetilde{nsp}_i = \frac{\widetilde{sp}_i}{max_i(R(\widetilde{sp}_i))}, \tag{3.13}$$

$$\widetilde{nsn}_i = 1 - \frac{\widetilde{sn}_i}{max_i(R(\widetilde{sn}_i))}. \tag{3.14}$$

Step 7: Calculate the appraisal score ($\widetilde{as}_i$) for all alternatives, shown as follows:

$$\widetilde{as}_i = \frac{1}{2}(\widetilde{nsp}_i + \widetilde{nsn}_i). \tag{3.15}$$

Step 8: Rank the alternatives according to the decreasing values of appraisal scores ($\tilde{as}_i$). In other words, the alternative with the highest appraisal score is the best choice among the candidate alternatives.

4. Findings

Tourism is an important sector in Iran as well as Mazandarn that has developed and expanded rapidly in recent years and is used as a tool for regional and national development, both as well as the growth potential of the sector and many other industries. In the implementation of this study, the evaluation of criteria to determine performance of health tourism was carried out. Aim of the study is to determine the cause and effect criteria by revealing the extent of the relationship between the fuzzy best-worst MCDM method and EDAS. In this part, ten practical cases are selected for the application and verification of the proposed fuzzy BWM. During the implementation, evaluations of an expert group of decision-makers in health tourism of the tourism sector were taken as a basis. These criteria are listed as follows (Step 1):

Service quality (C_1): Maintaining the 5-star hotel classification, evaluating the services such as recreation for the guests.

Customer satisfaction (C_2): Customers' satisfaction with the service they receive.

Innovation (C_3): Number of innovative product and service

Resource utilization (C_4): Frequency of equipment failure.

Time (C_5): Meeting customer needs on time.

Financial performance (C_6): Net profit, gross profit, turnover, total income, food and beverage sales.

Price (C_7): Average room rate per day.

Supplier performance (C_8): Timely delivery of hotel suppliers, meeting standard purchase specifications.

Flexibility (C_9): Adapting to guests wishes and needs.

competition (C_{10}): Monitoring competitors performance by questioning market share, growth in sales, and occupancy levels.

In this study, criteria were acquired from the literature and reviewed by a team of experts in order to apply them to health tourism, and necessary additions were made. Study was held with 10 experts within the scope of the research.

The service quality ($C1$) and supplier performance ($C8$) are respectively the best and the worst criterion based on the opinions from the company (Step 2). The fuzzy reference comparisons are performed, and the linguistic terms of decision-maker for fuzzy preferences of the best criterion over all the criteria are listed in Table 3. Then, the fuzzy best-to-others vector can be obtained according to Table 1 as follows (Step 3)

$$\tilde{A}_B = \left[(1,1,1),(\frac{2}{3},1,\frac{3}{2}),(\frac{2}{3},1,\frac{3}{2}),(\frac{3}{2},2,\frac{5}{2}),(\frac{5}{2},3,\frac{7}{2}),(\frac{2}{3},1,\frac{3}{2}),(\frac{5}{2},3,\frac{7}{2}),(\frac{7}{2},4,\frac{9}{2}),(\frac{2}{3},1,\frac{3}{2}),(\frac{3}{2},2,\frac{5}{2})\right].$$

Table 3: Pairwise comparision vector for the best criterion.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
Best criterion (C_1)	EI	WI	WI	FI	VI	WI	VI	AI	WI	FI

The fuzzy reference comparisons for the worst criterion are executed, and the linguistic evaluations of decision-makers for the fuzzy preferences of all the criteria over the worst criterion are listed in Table 4. Then, the fuzzy others-to-worst vector can be obtained according to Table 1 and as follows (Step 4)

$$\tilde{A}_w = \left[(\frac{7}{2},4,\frac{9}{2}),(\frac{5}{2},3,\frac{7}{2}),(\frac{5}{2},3,\frac{7}{2}),(\frac{3}{2},2,\frac{5}{2}),(\frac{2}{3},1,\frac{3}{2}),(\frac{5}{2},3,\frac{7}{2}),(\frac{2}{3},1,\frac{3}{2}),(1,1,1),(\frac{5}{2},3,\frac{7}{2}),(\frac{3}{2},2,\frac{5}{2})\right].$$

Based on the above analysis, for getting the optimal fuzzy weights of all the criteria, the following

Table 4: Pairwise comparision vector for the worst criterion.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
Worst criterion (C_8)	AI	VI	VI	FI	WI	VI	WI	EI	VI	FI

nonlinearly constrained optimization problem can be built according to Eq. (2.6) (Step 5).

$$
\min\ \tilde{\xi}^{*}
$$

$$
s.t.\begin{cases}
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_1^w,m_1^w,u_1^w)}-(l_{11},m_{11},u_{11})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_2^w,m_2^w,u_2^w)}-(l_{12},m_{12},u_{12})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_3^w,m_3^w,u_3^w)}-(l_{13},m_{13},u_{13})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_4^w,m_4^w,u_4^w)}-(l_{14},m_{14},u_{14})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_5^w,m_5^w,u_5^w)}-(l_{15},m_{15},u_{15})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_6^w,m_6^w,u_6^w)}-(l_{16},m_{16},u_{16})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_7^w,m_7^w,u_7^w)}-(l_{17},m_{17},u_{17})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{18},m_{18},u_{18})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_9^w,m_9^w,u_9^w)}-(l_{19},m_{19},u_{19})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_{110}^w,m_{110}^w,u_{110}^w)}-(l_{110},m_{110},u_{110})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_1^w,m_1^w,u_1^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{18},m_{18},u_{18})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_2^w,m_2^w,u_2^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{28},m_{28},u_{28})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_3^w,m_3^w,u_3^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{38},m_{38},u_{38})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_4^w,m_4^w,u_4^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{48},m_{48},u_{48})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_5^w,m_5^w,u_5^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{58},m_{58},u_{58})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_6^w,m_6^w,u_6^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{68},m_{68},u_{68})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_7^w,m_7^w,u_7^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{78},m_{78},u_{78})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_8^w,m_8^w,u_8^w)}{(l_8^w,m_8^w,u_5^w)}-(l_{88},m_{88},u_{88})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_9^w,m_9^w,u_9^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{98},m_{98},u_{98})\right|\leq(K^\star,k^\star,k^\star)\\
\left|\dfrac{(l_{10}^w,m_{10}^w,u_{10}^w)}{(l_8^w,m_8^w,u_8^w)}-(l_{108},m_{108},u_{108})\right|\leq(K^\star,k^\star,k^\star)\\
\sum_{j=1}^{n}R(\tilde{w}_j)=1\\
l_j^w\leq m_j^w\leq u_j^w\\
l_j^w\geq 0\\
j=1,2,\cdots,8.
\end{cases}
\tag{4.1}
$$

By solving Eq. (4.1), the optimal fuzzy weights of ten criteria can be calculated. Furthermore, criterion weights were calculated using Eq. (2.2). Obtained criterion weights values are shown in Table 5.

Table 5: The optimal fuzzy and crisp weights of 10 criteria.

Optimal fuzzy weight	Crisp weight	Optimal fuzzy weight	Crisp weight
$\tilde{w}_1^*$=(0.51,0.52,0.53)	w_1^*=0.52	$\tilde{w}_6^*$=(0.10,0.15,0.20)	w_6^*=0.15
$\tilde{w}_2^*$=(0.16,0.18,0.20)	w_2^*=0.18	$\tilde{w}_7^*$=(0.45,0.47,0.48)	w_7^*=0.47
$\tilde{w}_3^*$=(0.07,0.08,0.12)	w_3^*=0.08	$\tilde{w}_8^*$=(0.06,0.07,0.08)	w_8^*=0.07
$\tilde{w}_4^*$=(0.20,0.21,0.22)	w_4^*=0.21	$\tilde{w}_9^*$=(0.15,0.17,0.18)	w_9^*=0.17
$\tilde{w}_5^*$=(0.49,0.50,0.51)	w_5^*=0.50	$\tilde{w}_{10}^*$=(0.30,0.31,0.33)	w_{10}^*=0.31

Therefore, it can be seen that service quality ≻ time ≻ price ≻ competition ≻ resource utilization ≻ customer satisfaction ≻ flexibility ≻ financial performance ≻ innovation ≻ supplier performance, which is in accordance with the preference order obtained by employing fuzzy BWM.

5. Main results

Tourism is one of the most important economic resources around the world. Various sectors in the tourism industry, including travel agencies, major airlines, sporting events, restaurants and cruises, have been affected by the outbreak of the Corona virus. Providing appropriate and scientific solutions to revive this industry in the face of Covid 19 disease can help the evolution and revival of this green industry.

This study evaluates and examines the health of tourism and the revival of the tourism industry during the Covid 19 disease period. Under these circumstances, the tourism industry must evaluate its core strategies and develop strategies for developing and attracting tourism in the post-corona period. For this purpose, in the previous section, in the first step, important factors that can affect the health of tourism have been identified using best-worst MCDM method. The next step is to identify potential and valuable solutions that can help attract tourism to the post-Corona province using EDAS method. Six strategies have been considered to attract tourism, which are: education (A_1), social distance (A_2), providing appropriate banking facilities to artisans (A_3), improving the security of tourists in the province (A_4), providing quality amenities and accommodation and reducing incidental costs (A_5) and Development of transportation infrastructure in the province by observing health standards and increasing satisfaction (A_6). Based on the opinions of the Committee of Experts, a matrix of collective decision options is presented, the results of which are shown in Table 6.

In the next step, based on this method, the matrices of positive distance from the average PDA and negative distance from the average NDA are determined according to the type of criterion, the results of which are seen in Tables 7 and 8, respectively.

Next, based on the fuzzy EDAS method, the fulfilled score $R(\tilde{as})$ is calculated for all options. Table 9 presents the results of these calculations.

Scores obtained based on the EDAS method were calculated using Eq. (3.15). Obtained rank values are shown in Table 5. Therefore, it can be seen that $A_4 \succ A_1 \succ A_5 \succ A_3 \succ A_2 \succ A_6$, which is in accordance with the preference order obtained by employing fuzzy EDAS. Based on the results of this study, improving the level of tourist security in the province (A_4) ranks first among other options for the economy itself.

Table 6: The cumulative decision matrix.

X	C_1	C_2	C_3	C_4	C_5
A_1	(1.5,2,4)	(2.8,4.3,6.5)	(2.6,4.1,5.5)	(1.8,3.3,5)	(4.6,5.8,8)
A_2	(4.4,5.8,7.9)	(6.5,8.6,9.5)	(3,5,7)	(3.5,4.9,6.3)	(3.4,5.3,7.1)
A_3	(3.5,4.8,6.8)	(1.2,3,5)	(1.5,2.7,4.5)	(3.2,4.3,5.4)	(2.2,4.3,6.2)
A_4	(1.2,3,5.5)	(1.7,3.8,4.5)	(2.2,3.3,5.3)	(1.2,3,5.2)	(5.4,6.3,7.9)
A_5	(3.4,4.6,7)	(3.8,5,7.8)	(1.8,3.3,5.7)	(6.2,8.3,9.3)	(1.3,2.3,3.5)
A_6	(5.6,6.9,8.7)	(5,7,8.3)	(2.2,3.1,4.7)	(1.8,4,5.9)	(3.9,6.5,8.6)
W_j	(0.20,0.22,0.0.23)	(0.14,0.15,0.17)	(0.12,0.14,0.15)	(0.06,0.09,0.13)	(0.05,0.06,0.07)
AV	(3.02,4.23,6.51)	(2.99,5.30,7.35)	(2.6,4,5.6)	(2.9,4.3,6.3)	(3.3,4.8,6.7)

X	C_6	C_7	C_8	C_9	C_{10}
A_1	(4,5.8,07.5)	(2.8,4.2,5.5)	(1,1.9,4.5)	(1.2,3.3,4.5)	(5.2,6.6,8.2)
A_2	(1.3,3.3,5)	(3.4,5,6.4)	(2.2,3.9,7)	(3.1,4.1,6.3)	(0.6,1.7,02.6)
A_3	(4.2,6.6,8.1)	(1.5,4,5.1)	(2.3,4.2,5.7)	(0.50,2.1,3.8)	(3.3,4.3,6.2)
A_4	(0.5,1.9,4.2)	(1.2,2.3,4.1)	(6,7.8,9)	(2.2,4.3,5.6)	(1.7,2.5,3.5)
A_5	(5.4,8,8.9)	(5.3,7.3,8.9)	(1.3,2.5,3.6)	(1.5,3.3,4.5)	(4.8,6.1,8)
A_6	(4.1,5.6,7)	(1.5.2,2.6,4.2)	(2.5,4,4.9)	(5.2,6.6,8.5)	(2.2,3.2,4.6)
W_j	(0.05,0.06,0.07)	(0.14,0.15,0.17)	(0.28,0.31,0.37)	(0.20,0.22,0.25)	(0.26,0.30,0.33)
AV	(2.9,4.7,6.5)	(3.1,4.4,6.3)	(3.1,5.1,6.8)	(3.01,4.61,7.1)	(2.66,3.35,4.55)

Table 7: Positive distances matrix from the average (PDA).

PDA	C_1	C_2	C_3	C_4	C_5
A_1	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)
A_2	(-0.36,0.40,0.89)	(-0.26,0.45,1.55)	(-0.68,0.15,0.98)	(-0.32,0.04,0.65)	(-0.36,0.31,0.56)
A_3	(-0.73,0.03,0.65)	(-0.46,0.32,0.88)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)
A_4	(-0.65,0.10,0.80)	(0.00,0.00,0.00)	(-0.02,0.20,0.45)	(-0.49,0.01,0.70)	(0.12,0.05,1.22)
A_5	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(-0.69,0.05,0.96)	(0.00,0.00,0.00)	(-0.15,0.45,0.58)
A_6	(-0.15,0.62,1.15)	(-0.21,0.31,1.6)	(0.00,0.00,0.00)	(0.21,0.03,0.59)	(0.00,0.00,0.00)

PDA	C_6	C_7	C_8	C_9	C_{10}
A_1	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)
A_2	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(-0.82,0.15,1.9)	(0.00,0.00,0.00)	(-0.11,0.15,1.71)
A_3	(-0.33,0.12,0.13)	(0.00,0.00,0.00)	(-0.15,0.45,0.89)	(-0.55,0.35,0.85)	(0.00,0.00,0.00)
A_4	(0.00,0.00,0.00)	(-0.55,0.65,1.36)	(0.00,0.00,0.00)	(-0.21,0.03,0.65)	(0.00,0.00,0.00)
A_5	(-0.31,0.66,1.8)	(-0.11,0.31,0.93)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)
A_6	(0.00,0.00,0.00)	(-0.21,0.04,0.48)	(0.00,0.00,0.00)	(-0.47,0.18,1.12)	(-0.22,0.46,0.68)

6. Conclusion

The Covid 19 virus outbreak crisis has affected all countries and industries in the last two years. Due to the uncertainty of the end period and the distinctive features of this crisis from other crises experienced and also due to the global economic downturn caused by this crisis, all governments and economic actors are looking for ways to contain the damage and the resulting economic downturn. The tourism sector, like other economic activities, has not been spared from this crisis and has suffered even more than other economic activities. The tourism supply sector of the province is

Table 8: Negative distances matrix from the average (NDA).

NDA	C_1	C_2	C_3	C_4	C_5
A_1	(-0.17,0.45,1.18)	(-0.72,0.05,0.82)	(-0.65,0.03,0.75)	(-0.52,0.44,1.08)	(-0.62,0.01,0.77)
A_2	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)
A_3	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(-0.66,0.25,1.12)	(-0.40,0.20,0.85)	(-0.52,0.65,1.50)
A_4	(0.00,0.00,0.00)	(-0.51,0.58,1.25)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(0.00,0.00,0.00)
A_5	(-0.44,0.52,0.98)	(-0.42,0.55,0.78)	(0.00,0.00,0.00)	(-0.65,0.23,1.55)	(0.00,0.00,0.00)
A_6	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(-0.58,0.61,1.14)	(0.00,0.00,0.00)	(-0.03,0.02,1.67)
NDA	C_6	C_7	C_8	C_9	C_{10}
A_1	(-0.40,0.03,0.88)	(-0.63,0.21,0.58)	(-033,0.18,0.58)	(-0.33,0.06,0.88)	(-0.48,0.25,0.92)
A_2	(-0.19,0.53,1.07)	(-0.33,0.05,0.66)	(0.00,0.00,0.00)	(-0.41,0.52,1.12)	(0.00,0.00,0.00)
A_3	(0.00,0.00,0.00)	(-0.45,0.23,1.42)	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(-0.55,0.08,0.75)
A_4	(-0.55,0.44,0.73)	(0.00,0.00,0.00)	(-0.54,0.06,1.09)	(0.00,0.00,0.00)	(-0.39,0.44,0.85)
A_5	(0.00,0.00,0.00)	(0.00,0.00,0.00)	(-0.25,0.16,0.72)	(-0.56,0.63,1.55)	(-0.12,0.08,1.15)
A_6	(-0.18,0.50,0.98)	(0.00,0.00,0.00)	(-0.66,0.45,1.30)	(0.00,0.00,0.00)	(0.00,0.00,0.00)

Table 9: Scores obtained based on the EDAS method.

NDA	$\tilde{as} = (l, m, u)$	$R(\tilde{as})$	Ranking
A_1	(-0.51,0.79,2.01)	0.77	2
A_2	(-0.86,0.33,1.60)	0.35	5
A_3	(-0.94,0.40,1.78)	0.40	4
A_4	(-0.57,0.82,2.05)	0.80	1
A_5	(-0.99,0.50,1.99)	0.50	3
A_6	(-0.75,0.41,1.02)	0.32	6

facing major challenges such as loss of income and liquidity of the country and trained manpower, increase in unemployment, etc., so that some activists in the field of tourism were forced to stop their activities. Therefore, in this paper, a multi-objective decision model for attracting tourism in the tourism industry of the province in the face of the crisis caused by the outbreak of Covid 19 virus was presented. Based on the proposed framework, first, by studying the research literature extensively, effective indicators in attracting tourism were identified, then the weights of these indicators were calculated using the new method of best-worst fuzzy. Also, in the results section, the fuzzy EDAS technique is shown as a new multi-criteria decision-making method in order to determine the ranking of effective factors in the tourism industry. The results of this model provide valuable principles for tourism managers and experts to select effective and useful indicators. Based on the results of this study, improving the level of tourist security in the province (A_4) ranks first among other options for the economy itself.

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