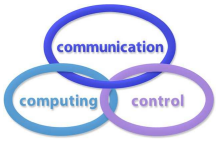
INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL
Online ISSN 1841-9844, ISSN-L 1841-9836, Volume: 17, Issue: 2, Month: April, Year: 2022
Article Number: 4741, https://doi.org/10.15837/ijccc.2022.2.4741



CCC Publications

Data Processing by Fuzzy Methods in Social Sciences Researches. Example in Hospitality Industry

O. Ban, L. Droj, D. Tușe, G. Droj, N. Bugnar

Olimpia Ban*
Department of Business and Economy
University of Oradea, Romania
1 University Street, 410087, Romania
oban@uoradea.ro
*Corresponding author: oban@uoradea.ro

Laurențiu Droj
University of Oradea
410087 Oradea, University Street, 1, Romania
laurentiu.droj@uoradea.ro

Delia Tușe
University of Oradea
410087 Oradea, University Street, 1, Romania
dmerca@uoradea.ro

Gabriela Droj
University of Oradea
410087 Oradea, University Street, 1, Romania
gdroj@uoradea.ro

Nicoleta Bugnar
University of Oradea
410087 Oradea, University Street, 1, Romania
nbugnar@uoradea.ro

Abstract

Likert-type scales are a common technique used in social science. Plus, the Likert scale is among the most frequently used psychometric tools in social sciences and educational research.

Despite its frequently used, the Likert scale raises up many questions mark. We can say that the use of the Likert scale in its classical form is too rigid and loses valuable information. Li (2013, p. 1613) calls on previous studies that "have claimed that fuzzy scales are more accurate than traditional scales due to the continuous nature of fuzzy sets".

The aim of this research is to reduce the inaccuracy caused by the use of the Likert scale, by proposing a method of more appropriate processing of data collected in this way. As shown in this paper, fuzzy methods can be a good alternative.

The research methodology consists of using the usual technique on the set of fuzzy numbers by considering the input data as linguistic variables, subsequently identified by triangular fuzzy numbers. The obtained scale is more elastic with respect to the input data, therefore it better captures the reality. The newly proposed method is applied in the concrete example of the competitors in the hotel field. The Importance-Performance Competitor Analysis is utilized. A weakness of the method is due to the use in its application of data collection with the Likert scale.

The results conclude on the situation of the competitors regarding each attribute considered as in the crisp version of the method, but the identification and processing of data correspond better to the aspects of subjectivity and uncertainty specific to human thinking. A novelty is also the obtaining of a hierarchy within each category of attributes from the quadrants proposed by the Important-Performance Analysis in relation to the competition.

Keywords: Likert scale, social research, fuzzy sets, competitor, hotels.

JEL CLASSIFICATION CODES: M31, Z33, Z32, C60, C81

1 The Likert scale's issues and the fuzzy scale

Likert-type scales is a commonly techniques used in the social science. "Likert scales are useful in social science and attitude research projects" [18]. "Likert scale is applied as one of the most fundamental and frequently used psychometric tools in educational and social sciences research" ([29], p.396).

The Likert scale was introduced by Rensis Likert in 1932 [37] as a way of measuring character and personality traits. Initially it had 5 steps from 1–"strongly approve", 2–"approve", 3–"undecided", 4–"disapprove", 5–"strongly disapprove". Likert used the scale on a set of questions to measure attitude, based on a composite indicator. It is Likert-type items when applied for a single question and Likert scales when applied for a set of questions and a composite indicator is used.

Likert scale is used in many fields, generally social and emotional domains, the purpose being to measure attitude. We call here fields such as: health, education, psychology, political science, economic sciences etc.

The Likert scale is also widely used in empirical studies in tourism and the hospitality industry and the most widely used psychometric scale in survey research ([34], p.1609).

[11] showed that only in 2011, 12 articles were published in the Journal of Extension about Likert scale with 4, 5, 6 or 7 steps.

It is a widely used scale due to its advantages, including: "the numerical measurement results can be directly used for statistical inference (...) measurements based on Likert scaling have demonstrated a good reliability (...) with Likert scaling researchers can collect and analyze a large amount of data with less time and effort" ([34], p.1609).

But the Likert scale has its limits. The Likert scale is considered a non-ordinary, ordinal scale. "Numbers assigned to Likert-type items express a "greater than" relationship; however, how much greater is not implied. Because of these conditions, Likert-type items fall into the ordinal measurement scale" ([11], p.3). But not everyone is of the opinion, a major debate around the Likert scale being whether it is ordinal or interval type [28].

If Likert were an interval scale, then the distance between two steps should be equal to the distances between the other two or two steps, an aspect which cannot be proved in this case [26] (considering the subjective aspects they record).

On the one hand, we can know the order of the answers, being an ordinal scale, but we cannot know the useful number of steps. 3, 4, 5, 6, 7, 9, 10, 11 steps are used for the Likert scale.

Some researchers choose a 3-step scale the alleged reason may be that it forces respondents to a clear position, for or against, others 4 steps but most commonly is seen as a 5-point scale [10], [19].

On the other hand, [33] considers that the 11-step Likert scale is the best (next to the 6) and closer to normal. Others consider the 7-step Likert scale variant to be the best [29]. There are some who recommend using the scale as widely as possible, because we could always collapse points into condensed categories, but not vice versa [2]. Is it true? Would it be possible to adjust the scale after data collection?

Many times, the answers are focused on a certain interval of the scale, an aspect that we discover only after data collection. Bacon ([3], p.3) says regarding the direct data collection that "another problem with direct methods is that the measures may be uniformly high as some customers rate everything as very important".

It seems that this concentration of responses is culturally determined [27]. Concentrating most of the responses at the extremes of the scale, such as between 4 and 5, for example on a Likert scale of 5, as is the case in the Mediterranean area ([27], p. 298), does not help in the actual and useful differentiation between the answers. In this case, the distance between step 4 and step 5 should be greater than the distances between the previous steps and, moreover, a response of 4 has a greater significance than a response of 4. Asian respondents are more reserved in their answers, so they focus on the center of the Likert scale, while other respondents are not at all familiar with Likert-scale questions. The idea has even emerged that respondents tend to give more extreme answers on a horizontal Likert scale than on a vertical one, at least in the online survey [48].

The study done in this paper tries to solve precisely this problem of the number of steps, easy approach with fuzzy numbers.

Adding steps does not solve the problem but it moves the focus to other steps and even increases the confusion, as [15] points out. However, it is stated that the number of steps on the Likert scale influences the answers. The same question is answered differently. "If more respondents tend to give positive responses, then a finer scale, with more response options, could result in a slightly lower mean score" ([19], p.63).

We can say that the use of the Likert scale in its classical form is too rigid and loses valuable information, as Li ([34], p.1610) also considers. In concrete empirical studies (in different cultural areas), there may be answers between which there are differences that are too sensitive for the classic Likert scale steps.

[34] builds fuzzy Likert scales that do not allow information to be lost, like the classic Likert, but neither increases the number of steps to make the application more difficult. Li ([34], p. 1613) calls on previous studies that "have claimed that fuzzy scales are more accurate than traditional scales due to the continuous nature of fuzzy sets". However, [34] increases the accuracy of the scale by adding an additional question to verify (strengthen or weaken) the answer given by each respondent. This measure increases the difficulty of applying the questionnaire and, in addition, invites the respondent to further analyzes to which he is not willing or able to participate.

The creator of a Likert scale data collection tool must decide how many steps to have the scale (before being applied), to take into account the concentration of responses according to cultural influences (in extremes for the Mediterranean area, in the middle of the scale for Asians etc.) in order to obtain useful answers that reflect the reality.

Vonglao [46] said that the data measured using the Likert scale based on fuzzy logic scale was more suitable to be analyzed with the arithmetic mean and standard deviation from the data measured using the Likert scale.

In conclusion, we can say that the Likert scale in its classical form is rigid and not adapted to the different cultural behaviors.

2 Triangular fuzzy numbers

The interest in the use of fuzzy numbers in economics increased more obviously after 2014. Thus, we find multiple applications of fuzzy numbers in: methods of ranking and decision making in economics ([51]; [47]; [44]; [52]; [39]) and data collection with semantic differential scales and for representing the linquistic variables ([7]; [8]; [36]; [23]; [38]; [20]; [40]).

A triangular fuzzy number is a fuzzy set on the set of real numbers given by its membership function as:

$$\mu(x) = \begin{cases} 0, \text{ if } x < a \\ \frac{x-a}{b-a}, \text{ if } a \leq x \leq b \\ \frac{c-x}{c-b}, \text{ if } b \leq x \leq c \\ 0, \text{ if } x > c \end{cases}, \tag{1}$$

where $a, b, c \in \mathbb{R}$,$a \leq b \leq c$. If $a = b$ or/and $b = c$ then the membership function μ is adapted in an obvious way. In fact, if $a = b = c = k$ then we obtain the real number k. The real numbers a, b and c can be viewed as the smallest possible value, the most promising value and the largest possible value that describe a fuzzy quantity, respectively [35].

Usually, a triangular fuzzy number as above is represented as a triple (a, b, c). In addition, difference and multiplication under a positive scalar are defined by:

$$(a, b, c) + (a', b', c') = (a + a', b + b', c + c') \tag{2}$$

$$(a, b, c) - (a', b', c') = (a - c', b - b', c - a') \tag{3}$$

and

$$\lambda \cdot (a, b, c) = (\lambda a, \lambda b, \lambda c) \tag{4}$$

Between the most common approaches to convert triangular fuzzy numbers into real numbers is the expected value (EV) ([25]; [4]) defined by:

$$EV(a, b, c) = \frac{a + 2b + c}{4} \tag{5}$$

3 Importance Performance Competitor Analysis

We chose an example of using the Likert scale, such as the construction of a diagnostic tool widely used in marketing but also in tourism: Importance Performance Competitor Analysis. Importance Performance Competitor Analysis uses Likert scale data collection.

Importance-Performance Analysis is a well-known marketing technique that can assist practitioners in making marketing decisions for elaborating marketing strategies. Important-Performance Analysis (IPA) was launched in 1977 by Martilla and James [41], which analyzes the quality attributes of products / services considering the perceived importance and performance.

It is an easy-to-use tool that provides a quick picture of the measures that managers need to take to improve customer satisfaction. Importance-performance analysis has already been used in many areas, including in the tourism and hospitality industry ([17]; [21]; [22]; [31]; [43]; [42]; [50]).

Although IPA is an easy-to-use and still very popular method, there are many criticisms of it ([30]; [13]; [21]; [6]) and numerous proposals for improvement.

Two of the minuses are considered to be: that the IPA in its original form does not take into account the presence of competitors in the market, that is, the evaluation of the performance of a company is not done in relation to its competitors or to the most important ones ([12]; [30]) and the second, the scores (of direct data collection by Likert scale on the importance of attributes) have a small inter-item variation, the values of the answers are raised uniformly ([3], p.55-71).

Burns [12] proposed SIPA (Simultaneous Importance Performance Analysis) which "improved the IPA by expanding it to explicitly include competitors' performance" ([9], p.4).

By adding the attribute determinancy, Yavas and Shemwell [49] proposed a grid with 16 strategic suggestions.

Lee and Hsieh [32] proposed a revised SIPA by indirectly determining the importance of quality attributes, using multiple regression analysis. The involvement of competitors in IPA analysis is also proposed by Deng et al. ([22], p.38) by "a revised IPA that integrates three-factor theory and benchmarking". They start from the idea that between the performance of the attributes of quality and the overall satisfaction there is no direct and symmetrical linear relationship. Reporting on

competition is also found in the models proposed by Taplin [45] through competitive importance-performance analysis (CIPA) and Chen's competitive zone of tolerance service quality-based IPA (CZIPA) [16].

Albayrak proposes Importance Performance Competitor Analysis (IPCA) in 2015. IPCA "is basically generated by the inclusion of competitor information in the diagonal approach of IPA. In principle, the diagonal approach of IPA is a GAP analysis which compares performance (P) and importance (I) scores of attributes "([1], p.137). Bacon ([3], p.3) states that "Some researchers refer to the examination of the difference between importance and performance as 'gap analysis' (e.g. [24])".

GAP is used on the vertical axis in IPCA and the PD (focal company performance minus competitor company performance, both from attribute perspective) variable is represented on the horizontal axis in IPCA.

$$GAP_i = P_i - I_i \tag{6}$$

$$PD_i = P_{focal\ i} - P_{competitor\ i} \tag{7}$$

In the example given by Albayrak [1], the results obtained in the IPA as compared to those obtained in the IPCA differ substantially. The attributes are distributed in the IPCA in 4 quadrants that suggest the position of the focal company relative to its competitor, indicating the need for action: I "Solid competitive advantage", II "Head-to-head competition", III "Urgent action" and IV "Null advantage" (Figure 1).

Starting from the model of Albayrak [1], the Importance-Performance Analysis in relation to the competition (IPCA) was developed for a congress destination by Caber et al. [14].

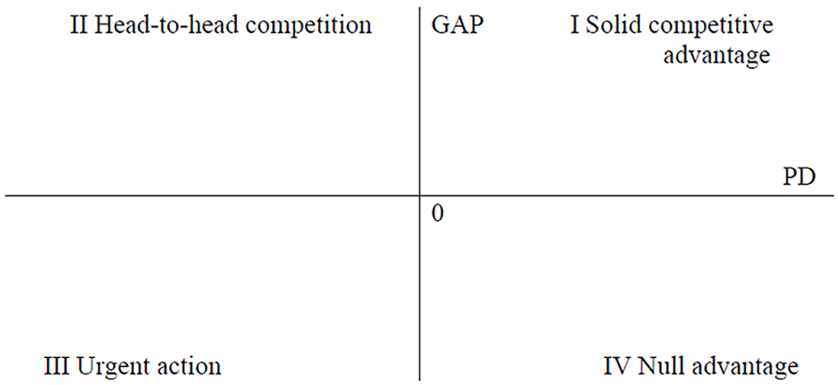


Figure 1: IPCA (Source: adapted after [14])

4 Description of the fuzzy Importance-Performance Competitor Analysis with triangular fuzzy numbers

Our aim is to give a fuzzy method taking into account that the input data, that is the performance and importance are triangular fuzzy numbers.

Let us denote by $P_i = (a_i, b_i, c_i)$, $i \in \{1, \cdots, n\}$ the performance of the focal entity under study, by $I_i = (x_i, y_i, z_i)$, $i \in \{1, \cdots, n\}$ the importance of the focal entity under study and by $P_i^{comp} = (a_i^{comp}, b_i^{comp}, c_i^{comp})$, $i \in \{1, \cdots, n\}$ the performance of the competitor, each one of them with respect to an attribute A_i, $i \in \{1, \cdots, n\}$.

Usually, like in the application presented in Section 5, the values of P_i, I_i, P_i^{comp}, $i \in \{1, \cdots, n\}$ are obtained by aggregating (the simplest through the mean) the answers to a questionnaire.

From (3), (6) and (7) we get

$$GAP_i = P_i - I_i = (a_i - z_i, b_i - y_i, c_i - x_i) \tag{8}$$

and

$$PD_i = P_i - P_i^{comp} = (a_i - c_i^{comp}, b_i - b_i^{comp}, c_i - a_i^{comp}) \tag{9}$$

for every $i \in \{1, \cdots, n\}$.

We need to defuzzify the triangular fuzzy numbers from (8) and (9) for obtaining the four quadrants in an easily interpretable form.

By applying (5) we get

$$\overline{GAP_i} = EV(GAP_i) = \frac{a_i - z_i + 2(b_i - y_i) + c_i - x_i}{4} \tag{10}$$

and

$$\overline{PD_i} = EV(PD_i) = \frac{a_i - c_i^{comp} + 2(b_i - b_i^{comp}) + c_i - a_i^{comp}}{4} \tag{11}$$

for every $i \in \{1, \cdots, n\}$.

Now, we can follow the crisp interpretation, that is in Table 1.

Table 1

$\overline{GAP_i}$	$\overline{PD_i}$	Conclusion on attribute i
positive	positive	*Solid competitive advantage*
positive	negative	*Head-to-head competition*
negative	positive	*Null advantage*
negative	negative	*Urgent action*

From the above description (Table 1) it is easy to see that IPCA [14] is acquired as a particular case of our proposed method. Indeed, by taking $a_i = b_i = c_i = P_i$, $x_i = y_i = z_i = I_i$ and $a_i^{comp} = b_i^{comp} = c_i^{comp} = P_i^{comp}$, from (8) - (11) we obtain $GAP = P_i - I_i$ and $\overline{PD_i} = PD_i = P_i - P_i^{comp}$, for every $i \in \{1, \cdots, n\}$.

5 Triangular fuzzy numbers application to the hotel industry

5.1 Research methodology

The purpose of our research is to adjust the classical interpretation of the answers to the questions of a questionnaire in order to construct the corresponding IPCA matrix. To do this, we call on the subjective association of the answers of a questionnaire with triangular fuzzy numbers, thus obtaining a more elastic approach, which counteracts the effects of upper deviation arising from the use of the Likert scale.

The data used for the research comes from a previous study. In 2012, a survey was conducted [5] among a total of 125 customers of 4-star four hotels in Oradea, Romania. By profile and positioning, these 4 hotels are in direct competition. They have over 50 rooms, target the business clientele and are located on high traffic routes. The survey was conducted using a 5-step Likert scale questionnaire, applied with an operator on a sample of availability. The distribution of valid questionnaires on the 4 hotels was: hotel I-39, hotel II-21, hotel III-29 and hotel IV-36. The distribution of responses on Likert scale are presented on Table 3. The data collection instrument was a questionnaire in which a scale of 21 attributes was used. evaluation of the quality of the hotel services, for measuring the importance and performance of the hotel units in these attributes (Table 2). These are also the output variables but in a different hierarchy given by the fuzzification process. The validity of the questionnaire was verified with the α Cronbach coefficient, the value obtained being a satisfactory one (0.827).

In the present research, the collected and unused data were modeled, namely the assessment of the importance of the quality attributes from the perspective of the 39 respondents of Hotel 1 (considered

Table 2: Service attributes used for hotel service quality evaluation

1.	The room facilities are appropriate
2.	The room is clean enough
3.	The hotel has sufficient restaurant facilities
4.	The staff has an appropriate and professional look
5.	The location of the hotel
6.	The staff provide correct information to guests
7.	The staff is able to offer services in a short period of time
8.	The staff is able to resolve guests' problems
9.	The staff is able to provide information in a short period of time
10.	The availability of staff
11.	Clients complaints are resolved quickly
12.	Different payment facilities are available
13.	The safety of the installations in the hotel
14.	Service professionalism
15.	Service customization
16.	Friendliness of staff
17.	Proper opening hours of hotel's facilities
18.	The hotel has entertaining facilities
19.	Big variety and proper quality of meals
20.	Internet connection is available
21.	Aesthetics of rooms and of the hotel

(data processed from [5])

focal) and the evaluation of Hotel 1, Hotel 2 and Hotel 4 from the perspective of the performance on the 21 quality attributes (Table 3).

The analysis is performed for Hotel 1 (considered focal) compared to Hotel 2/Hotel 4, as its direct competitor, in the spirit of fuzzy set theory, by replacing the Likert scale ratings with triangular fuzzy numbers, as shown in Table 3.

The data analysis from Table 2 shows an increased concentration of data at the top of the 5-step Likert scale, both for importance and performance for all 21 attributes. This situation prevents the clear delineation between attributes in terms of importance and performance for both hotels.

5.2 Results in the moderate choice: Hotel 1 versus Hotel 2 as competitor

Step 1: Assign triangular fuzzy numbers to the responses displayed on the Likert scale

The proposed method involves associating the responses 1,2,3,4 and 5 on the Likert scale with triangular fuzzy numbers (Table 4). The choice of fuzzy numbers respects to a greater extent Likert scale, with equidistant values, and in the other, the Good response regarding the performance is drastically penalized compared to Very Good.

Step 2: Calculate the importance and performance of attributes as triangular fuzzy numbers for Hotel 1 and Hotel 2

Under the notifications in the previous section, we obtain as the arithmetic mean of the triangular fuzzy numbers associated with answers according to Table 4. The results given in Table 5 and Table 6 are obtained based on (2) and (4).

Step 3: This step consists of calculating in fuzzy numbers (moderate choice) of GAP (8) and PD (9). The final results in Table 5 (columns 5 and 6) are obtained by applying (10) and (11).

The results are presented in Table 5. Depending on the combination of obtained values (positive and negative), the dial is set where the quality attribute is assigned. The number of the dial in Table 4 will indicate the measure that Hotel 1 must take in relation to its competitor, Hotel 2.

Step 4: Calculate GAP and PD in original format and compare with GAP and PD in fuzzy numbers (moderate choice)

Table 3

	Hotel 1-Performance on attributes (39 questionnaires)																				
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
VG	31	38	20	32	25	35	30	31	26	32	26	24	27	30	19	36	23	25	12	24	33
G	7	0	16	7	13	3	5	5	11	6	9	13	10	8	17	2	15	13	25	8	6
M	1	1	3	0	1	1	4	3	2	1	4	2	2	1	3	1	1	1	2	5	0
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
VP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hotel 2-Performance on attributes (21 questionnaires)																				
VG	20	19	18	15	12	19	18	17	16	18	17	18	19	18	14	17	16	18	18	19	20
G	1	1	3	6	7	2	3	3	4	2	4	2	2	3	6	3	5	3	2	2	1
M	0	1	0	0	2	0	0	1	1	1	0	1	0	0	1	1	0	0	1	0	0
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hotel 4-Performance on attributes (36 questionnaires)																				
VG	24	15	22	17	16	14	17	26	14	12	15	17	21	18	10	16	13	13	17	15	18
G	8	19	12	17	19	16	17	8	20	20	19	15	12	17	25	18	19	18	15	18	15
M	3	0	1	2	1	5	2	2	2	3	2	2	3	1	1	2	4	5	3	2	3
P	1	2	1	0	0	1	0	0	0	1	0	2	0	0	0	0	0	0	1	1	0
VP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hotel 1-importance of attributes (39 questionnaires)																				
VI	22	36	14	8	22	33	32	30	29	29	32	11	17	29	24	34	15	18	29	32	21
I	15	3	22	28	14	4	3	8	7	9	7	26	21	8	12	5	23	16	8	7	17
M	1	0	2	3	2	2	4	1	3	1	0	2	1	2	3	0	1	5	2	0	1
LI	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hotel 2-importance of attributes (21 questionnaires)																				
VI	13	19	9	5	8	16	20	11	16	16	16	14	16	4	8	14	11	8	7	12	14
I	8	2	10	12	12	5	1	9	4	5	5	7	5	13	10	6	6	8	12	8	7
M	0	0	2	4	1	0	0	1	1	0	0	0	0	4	3	1	4	5	2	1	0
LI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Legend: A-attributes, VG-very good, G-good, M-medium, P-poor, VP-very poor; VI-very important, I-important, LI-less important, U-unimportant
(data processed from [5])

For comparison between the original IPCA and the fuzzy IPCA, GAP and PD were calculated in the original format (Table 7). The calculation of the original and fuzzy GAP and PD gives the distribution in Q (quadrants) in the attributes, from which the indicated measures take. Q1 represents "Solid competitive advantage", Q2-"Head-to-head competition", Q3-"Urgent action" and Q4-"Null advantage". Graphic representation of original IPCA and fuzzy IPCA moderate choice is found in Figure 3, respectively Figure 2.

Differences are observed only for 4 attributes (8, 9, 15 and 16) among the 21.

For the attribute *The staff is able to solve guests' problems* in the classic version is recommended "Urgent action" and in the 1 fuzzy variant it is shown that it has "Head-to-head competition". In the attribute *The staff is able to provide information in a short period of time*, in the classic version it is recommended "Urgent action" and in variant 1 fuzzy it is shown that it has "Head-to-head competition". For the *service customization* attribute, in the classic version it is "Urgent action" while for fuzzy it is "Head-to-head competition". For the *Friendliness of staff* attribute, in the classic version it is "Urgent action" while for fuzzy it is "Solid advantage competition".

Table 4

Importance	**Likert**	**Moderate choice**
Unimportant	1	(0, 1, 2)
Less important	2	(1, 1.75, 2.5)
Medium	3	(1.5, 2.25, 3)
Important	4	(2.5, 3, 3.5)
Very important	5	(4.5, 4.75, 5)
Performance	**Likert**	**Moderate choice**
Very poor	1	(0, 1,1.5)
Poor	2	(0.5, 1.5, 2.5)
Medium	3	(1, 2, 3)
Good	4	(3, 3.75, 4.5)
Very good	5	(4.25, 4.75, 5)

Table 5: GAP fuzzy and PD fuzzy for Hotel 1 (focal) and Hotel 2 competitor

Attributes	***Performance Hotel 1***	***Importance Hotel 1***	***Performance Hotel 2***	***GAP fuzzy***	***PD fuzzy***	***Q***
1.	*3.94, 4.5, 4.85*	*3.56, 3.93, 4.3*	*4.19, 4.70, 4.97*	*0.51*	*-0.19*	*2*
2.	*4.16, 4.67, 4.94*	*4.34, 4.61, 4.88*	*4.03, 4.57, 4.88*	*0.003*	*0.10*	*1*
3.	*3.48, 4.12, 4.64*	*3.12, 3.55, 3.98*	*4.07, 4.60, 4.92*	*0.53*	*-0.45*	*2*
4.	*4.02, 4.57, 4.91*	*2.83, 3.30, 3.76*	*3.89, 4.46, 4.85*	*1.21*	*0.09*	*1*
5.	*3.75, 4.34, 4.78*	*3.53, 3.91, 4.29*	*3.52, 4.15, 4.64*	*0.38*	*0.18*	*1*
6.	*4.07, 4.60, 4.91*	*4.14, 4.44, 4.74*	*4.13, 4.65, 4.95*	*0.10*	*-0.05*	*2*
7.	*3.75, 4.33, 4.73*	*4.03, 4.35, 4.67*	*4.07, 4.60, 4.92*	*-0.06*	*-0.26*	*3*
8.	*3.83, 4.41, 4.78*	*4.01, 4.32, 4.64*	*3.91, 4.47, 4.83*	*0.03*	*-0.06*	*2*
9.	*3.73, 4.32, 4.75*	*3.91, 4.24, 4.57*	*3.85, 4.42, 4.80*	*0.04*	*-0.09*	*2*
10.	*3.97, 4.52, 4.87*	*3.96, 4.28, 4.60*	*3.97, 4.52, 4.85*	*0.19*	*0.004*	*2*
11.	*3.62, 4.23, 4.67*	*4.14, 4.35, 4.73*	*4.01, 4.55, 4.90*	*-0.24*	*-0.31*	*3*
12.	*3.66, 4.27, 4.73*	*3.01, 3.45, 3.89*	*3.97, 4.52, 4.85*	*0.78*	*-0.23*	*2*
13.	*3.76, 4.35, 4.76*	*3.34, 3.74, 4.14*	*4.13, 4.65, 4.95*	*0.56*	*-0.28*	*2*
14.	*3.91, 4.47, 4,84*	*3.93, 4.26, 4.58*	*3.97, 4.52, 4.85*	*0.16*	*-0.04*	*2*
15.	*3.45, 4.10, 4.62*	*3.65, 4.01, 4.38*	*3.73, 4.33, 4.76*	*0.05*	*-0.21*	*2*
16.	*4.10, 4.62, 4.92*	*4.24, 4.52, 4.80*	*3.91, 4.47, 4.83*	*0.04*	*0.14*	*1*
17.	*3.68, 4.29, 4.75*	*3.24, 6.65, 4.06*	*3.95, 4.51, 4.88*	*0.6*	*-0.20*	*2*
18.	*2.66, 3.12, 3.50*	*3.29, 3.71, 4.12*	*4.07, 4.60, 4.92*	*-0.6*	*-1.44*	*3*
19.	*3.28, 3.96, 4.57*	*3.93, 4.26, 4.58*	*3.97, 4.52, 4.85*	*-0.31*	*-0.52*	*3*
20.	*3.35, 3.94, 4.38*	*4.14, 4.43, 4.73*	*4.13, 4.65, 4.95*	*-0.52*	*-0.68*	*3*
21.	*4.05, 4.59, 4.92*	*3.55, 3.92, 4.29*	*4.19, 4.70, 4.97*	*0.62*	*-0.09*	*2*

Legend: Q-quadrant

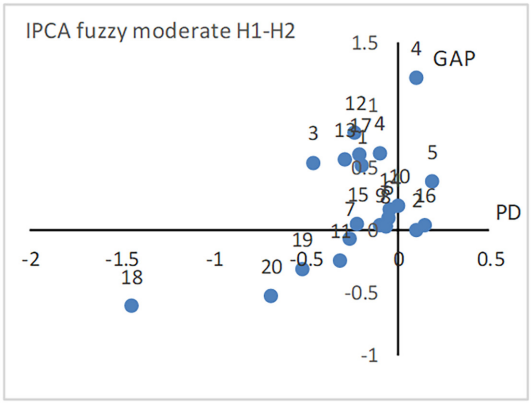


Figure 2: IPCA fuzzy (moderate choice) matrix for Hotel 1 in relation to Hotel 2
(Source: created by the authors based on data processing from Table 7.)

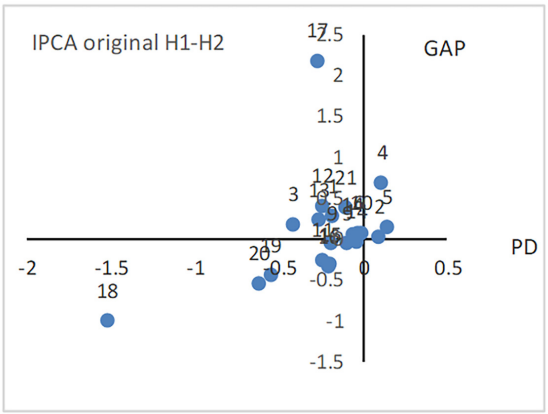


Figure 3: IPCA original matrix for Hotel 1 in relation to Hotel 2
(Source: created by the authors based on data processing from Table 7.)

5.3 Results in the drastic choice: Hotel 1 versus Hotel 2 as competitor

Step 5: In this step the answers different from the higher level ("Very good" and "Very important") were penalized more drastically and GAP and PD were obtained in fuzzy numbers (drastic choice).

Table 6

Importance	**Likert**	**Drastic choice**
Unimportant	1	(0, 1, 2)
Less important	2	(1, 2, 3)
Medium	3	(2, 3, 3.5)
Important	4	(3, 3.75, 4.5)
Very important	5	(4, 4.75, 5)
Performance	**Likert**	**Drastic choice**
Very poor	1	(0, 1, 2)
Poor	2	(1, 2, 3)
Medium	3	(2, 3, 3.5)
Good	4	(2.5, 3, 3.5)
Very good	5	(4, 4.75, 5)

Table 7: GAP and PD original and GAP and PD fuzzy (moderate choice, drastic choice) for Hotel 1 in relation to Hotel 2 competitor

Attrib.	*GAP original*	*PD original*	*Q*	*GAP fuzzy moderate*	*PD fuzzy moderate*	*Q*	*GAP fuzzy drastic*	*PD fuzzy drastic*	*Q*
1.	0.28	−0.18	2	0.51	−0.19	2	0.11	−0.25	2
2.	0.02	0.09	1	0.003	0.10	1	1.08	0.11	1
3.	0.17	−0.42	2	0.53	−0.45	2	0.16	−0.56	2
4.	0.69	0.10	1	1.21	0.09	1	0.57	0.17	1
5.	0.15	0.13	1	0.38	0.18	1	0.47	0.12	1
6.	0.07	−0.03	2	0.10	−0.05	2	0.97	−0.01	2
7.	−0.05	−0.19	3	−0.06	−0.26	3	0.80	−0.15	2
8.	−0.02	−0.04	3	0.03	−0.06	2	0.74	−0.02	2
9.	−0.05	−0.09	3	0.04	−0.09	2	0.57	−0.15	2
10.	0.07	−0.01	2	0.19	0.004	2	0.77	−0.05	2
11.	−0.25	−0.24	3	−0.24	−0.31	3	0.52	−0.24	2
12.	0.41	−0.24	2	0.78	−0.23	2	0.24	−0.39	2
13.	0.23	−0.26	2	0.56	−0.28	2	0.42	−0.35	2
14.	0.05	−0.06	2	0.16	−0.04	2	0.72	−0.14	2
15.	−0.33	−0.20	3	0.05	−0.21	2	0.22	−0.29	2
16.	−0.30	−0.19	3	0.04	0.14	1	0.43	−0.35	2
17.	2.17	−0.27	2	0.6	−0.20	2	0.18	−0.33	2
18.	−1	−1.52	3	−0.6	−1.44	3	−0.72	−1.54	3
19.	−0.43	−0.55	3	−0.31	−0.52	3	−0.03	−0.89	3
20.	−0.53	−0.62	3	−0.52	−0.68	3	0.28	−0.64	2
21.	0.38	−0.10	2	0.62	−0.09	2	0.72	−0.17	2

(Note: for simplification, only two decimal places were kept after the comma, Q-quadrant)

The assignment of fuzzy numbers for the more drastic variant is found in Table 6 and the results for GAP and PD in Table 7. In the more drastic fuzzy variant, 7 attributes (7, 8, 9, 11, 15, 16 and 20) have different positions. In the dials compared to the classic (original) variant, respectively, they changed their position in the opposite direction of the clockwise with a dial. The changes are dramatic, respectively all 7 attributes have gone from the 3–"Urgent action" dial to the 2–"Head-to-head competition". It is possible that modeling with fuzzy sets may better capture reality when the responses are massively focused on certain extreme ranges of scale.

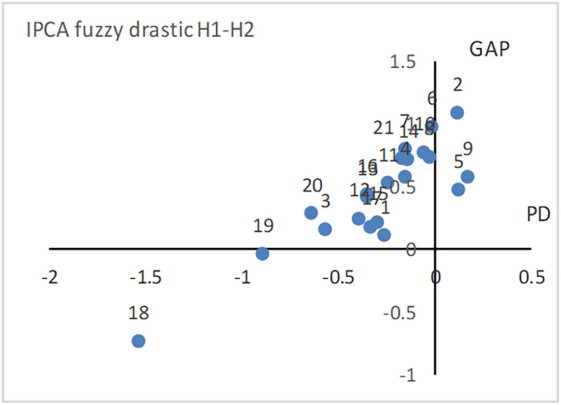


Figure 4: IPCA fuzzy (drastic choice) matrix for Hotel 1 in relation to Hotel 2
(Source: created by the authors based on data processing from Table 7).)

For IPCA testing, I made all the calculations to see the situation in case Hotel 2 is considered focal and Hotel 1 is considered competitor. I calculated GAP and PD in the original version and only the one in fuzzy numbers (drastic choice) (Table 8).

Step 6: Calculate, following the previous steps, the original and fuzzy IPCA (moderate choice and drastic choice) for Hotel 1 (focal) compared to Hotel 4 competitor.

The previous steps are resumed, respectively, are assigned triangular fuzzy numbers (moderate and drastic choice) for the recorded answers regarding the performance of the Hotel 4 to the 21 quality attributes. Then GAP and PD are calculated for Hotel 1 compared to Hotel 4, taking into account the

Table 8: GAP and PD original and GAP and PD fuzzy (drastic) for Hotel 2 focal in relation to Hotel 1 competitor

Attributes	*GAP original*	*PD original*	*Q*	*GAP fuzzy drastic*	*PD fuzzy drastic*	*Q*
1.	0.33	0.18	1	0.25	0.25	1
2.	−0.04	−0.09	3	−0.07	−0.11	3
3.	0.52	0.42	1	0.35	0.56	1
4.	0.66	−0.10	2	0.36	−0.17	2
5.	0.14	−0.13	2	−0.12	−0.12	3
6.	0.14	0.03	1	0.05	0.01	1
7.	−0.09	0.19	4	−0.19	0.15	4
8.	0.28	0.04	1	0.14	0.02	1
9.	0	0.09	1	−0.14	0.15	4
10.	0.04	0.01	1	−0.02	0.05	4
11.	0.04	0.24	1	−0.10	0.24	4
12.	0.14	0.24	1	0.05	0.39	1
13.	0.14	0.26	1	0.05	0.35	1
14.	0.85	0.11	1	0.64	0.14	1
15.	0.38	0.20	1	0.11	0.29	1
16.	0.14	−0.13	2	0.01	0.22	1
17.	0.42	0.19	1	0.19	0.31	1
18.	1.71	0.24	1	0.51	1.28	1
19.	0.57	0.55	1	0.42	0.89	1
20.	0.38	0.52	1	0.26	0.62	1
21.	0.28	0.10	1	0.21	0.17	1

operation of fuzzy numbers. In Table 9 are the results obtained (for moderate choice), which are the basis of the calculation of fuzzy IPCA (moderate choice) (Figure 5). The GAP and PD are calculated in the original version for Hotel 1 in relation to Hotel 4 and the original IPCA is constructed (Figure 6).

Table 9: GAP and PD (moderate choice) for Hotel 1 in relation to Hotel 4 competitor

Attributes	*Performance Hotel 1*	*Importance Hotel 1*	*Performance Hotel 4*	*GAP Fuzzy moderate*	*PD Fuzzy moderate*	*Q*
1.	3.94, 4.5, 4.85	3.56, 3.93, 4.3	3.59, 4.20, 4.65	0.51	0.28	1
2.	4.16, 4.67, 4.94	4.34, 4.61, 4.88	3.38, 4.04, 4.59	0.003	0.60	1
3.	3.48, 4.12, 4.64	3.12, 3.55, 3.98	3.63, 4.25, 4.70	0.53	−0.11	2
4.	4.02, 4.57, 4.91	2.83, 3.30, 3.76	3.47, 4.12, 4.65	1.21	0.42	1
5.	3.75, 4.34, 4.78	3.53, 3.91, 4.29	3.5, 4.14, 4.68	0.38	0.18	1
6.	4.07, 4.60, 4.91	4.14, 4.44, 4.74	3.13, 3.83, 4.43	0.10	0.73	1
7.	3.75, 4.33, 4.73	4.03, 4.35, 4.67	3.47, 4.12, 4.65	−0.06	0.19	4
8.	3.83, 4.41, 4.78	4.01, 4.32, 4.64	3.79, 4.37, 4.77	0.03	0.03	1
9.	3.73, 4.32, 4.75	3.91, 4.24, 4.57	3.37, 4.04, 4.61	0.04	0.26	1
10.	3.97, 4.52, 4.87	3.96, 4.28, 4.60	3.18, 3.87, 4.48	0.19	0.62	1
11.	3.62, 4.23, 4.67	4.14, 4.35, 4.73	3.40, 4.06, 4.62	−0.24	0.15	4
12.	3.66, 4.27, 4.73	3.01, 3.45, 3.89	3.34, 4, 4.62	0.78	0.26	1
13.	3.76, 4.35, 4.76	3.34, 3.74, 4.14	3.56, 4.18, 4.66	0.56	0.15	1
14.	3.91, 4.47, 4, 84	3.93, 4.26, 4.58	3.56, 4.20, 4.70	0.16	0.25	1
15.	3.45, 4.10, 4.62	3.65, 4.01, 4.38	3.29, 3.97, 4.59	0.05	0.11	1
16.	4.10, 4.62, 4.92	4.24, 4.52, 4.80	3.44, 4.09, 4.63	0.04	0.50	1
17.	3.68, 4.29, 4.75	3.24, 6.65, 4.06	3.22, 3.91, 4.51	0.6	0.36	1
18.	2.66, 3.12, 3.50	3.29, 3.71, 4.12	3.17, 3.86, 4.47	−0.6	−0.46	3
19.	3.28, 3.96, 4.57	3.93, 4.26, 4.58	3.35, 4.01, 4.55	−0.31	−0.03	3
20.	3.35, 3.94, 4.38	4.14, 4.43, 4.73	3.34, 4.00, 4.56	−0.52	−0.06	3
21.	4.05, 4.59, 4.92	3.55, 3.92, 4.29	3.45, 4.10, 4.62	0.62	0.47	1

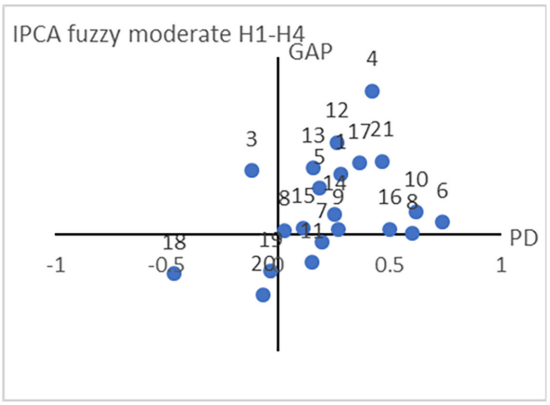


Figure 5: IPCA fuzzy (moderate choice) matrix for Hotel 1 in relation to Hotel 4
(Source: created by the authors based on data processing from Table 9.)

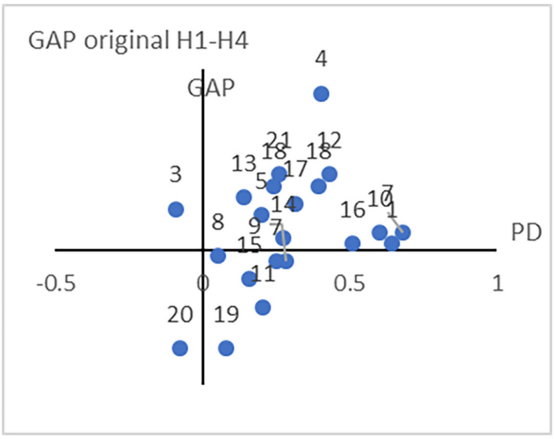


Figure 6: IPCA original matrix for Hotel 1 in relation to Hotel 4
(Source: created by the authors based on data processing from Table 9.)

Repeat operations for building fuzzy IPCA (drastic choice) for Hotel 1 compared to Hotel 4 (Table 10 and Figure 7).

Table 10: GAP and PD original, GAP and PD fuzzy (moderate choice, drastic choice) for Hotel 1 (focal) and Hotel 4 competitor

Attrib.	*GAP original*	*PD original*	*Q*	*GAP Fuzzy moderate*	*PD Fuzzy moderate*	*Q*	*GAP fuzzy drastic*	*PD fuzzy drastic*	*Q*
1.	0.28	0.24	1	0.51	0.28	1	0.11	0.24	1
2.	0.02	0.64	1	0.003	0.60	1	1.08	0.95	1
3.	0.17	−0.09	2	0.53	−0.11	2	0.16	−0.13	2
4.	0.69	0.40	1	1.21	0.42	1	0.57	0.57	1
5.	0.15	0.19	1	0.38	0.18	1	0.47	0.31	1
6.	0.07	0.67	1	0.10	0.73	1	0.97	0.86	1
7.	−0.05	0.25	4	−0.06	0.19	4	0.80	0.47	1
8.	−0.02	0.05	4	0.03	0.03	1	0.74	−0.71	2
9.	−0.05	0.28	4	0.04	0.26	1	0.57	0.45	1
10.	0.07	0.60	1	0.19	0.62	1	0.77	0.82	1
11.	−0.25	0.20	4	−0.24	0.15	4	0.52	0.40	1
12.	0.41	0.25	1	0.78	0.26	1	0.24	0.28	1
13.	0.23	0.14	1	0.56	0.15	1	0.42	0.18	1
14.	0.05	0.27	1	0.16	0.25	1	0.72	0.43	1
15.	−0.33	0.16	4	0.05	0.11	1	0.22	0.33	1
16.	−0.30	0.50	4	0.04	0.50	1	0.43	0.36	1
17.	2.17	0.31	1	0.6	0.36	1	0.18	0.35	1
18.	−1	0.39	4	−0.6	−0.45	3	−0.72	−0.46	3
19.	−0.43	−0.07	3	−0.31	−0.03	3	−0.03	−0.23	3
20.	−0.53	0.07	4	−0.52	−0.06	3	0.28	0.20	1
21.	0.38	0.42	1	0.62	0.47	1	0.72	0.57	1

(Note: for simplification, only two decimal places were kept after the comma)

5.4 Comparisons between original IPCA and fuzzy IPCA in moderate and drastic case

The analysis of quadrant 1–"Solid competitive advantage" in the three situations (original IPCA, fuzzy IPCA moderate choice and fuzzy IPCA drastic choice) for focal Hotel 1 compared to Hotel 2 shows the positioning here in all three situations of 3 attributes (2,4,5) and in the case of IPCA fuzzy moderate choice and attribute 16.

In the case of IPCA analysis from the perspective of Hotel 1 in relation to Hotel 4, in the case of the original IPCA there are 9 attributes positioned here (1,2,4,5,10,12,13,14,17), in the case of IPCA fuzzy moderate choice there are 13 attributes (1,2,4,5,8,9,10,12,13,14,15,16,21) and in the case of IPCA fuzzy drastic choice there are 17 attributes (1,2,4,5,6,7,9,10,11,12,13,14,15,16,17,20,21).

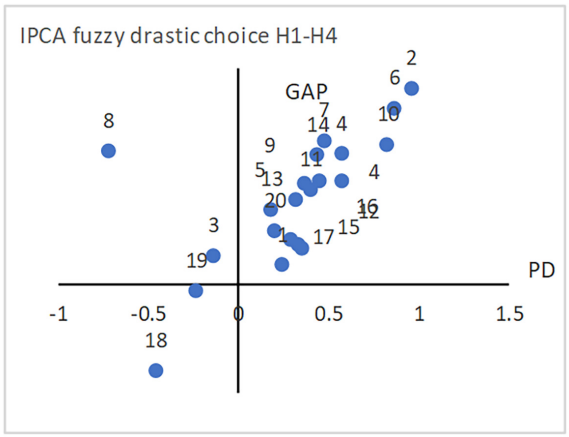


Figure 7: IPCA fuzzy (drastic choice) matrix for Hotel 1 in relation to Hotel 4
(Source: created by the authors based on data processing from Table 10.)

The analysis of quadrant 2–"Head-to-head competition" in all three situations (original IPCA, fuzzy IPCA moderate choice and fuzzy IPCA drastic choice) for focal Hotel 1 compared to Hotel 2, shows different quantitative situations. In the first case there are 9 attributes in this dial (1,3,6,10,12,13,14,17,21), in the second case there are 12 attributes (1,3,6,8,9,10,12,13,14,15,17,21) and in the IPCA version fuzzy drastic choice are 16 attributes (1,3,6,7,8,9,10,11,12,13,14,15,16,17,20,21). These 16 attributes give the fight with the competition. "Although the company goes beyond customer expectations for the attributes positioned in this quadrant, it has lower performance scores for these attributes than its competitors. In such situations, the focal company has to at least reach the competitor's performance level. Benchmarking with the best practice is recommended for performance improvement efforts." ([1], p.138)

The analysis of quadrant 2–"Head-to-head competition" in all three situations (original IPCA, fuzzy IPCA moderate choice and fuzzy IPCA drastic choice) for focal Hotel 1 compared to Hotel 4, shows different quantitative situations. In the original IPCA, in this dial there is 1 attribute (3), in the second situation there are 1 attribute (3) and in the case of IPCA fuzzy drastic choice there are 2 attributes (3,8). Attributes 3–*The hotel has sufficient restaurant facilities* and 8–*The staff is able to solve guests' problems*, are attributes to which Hotel 1 is in direct competition to Hotel 4 but also to Hotel 2.

The analysis of quadrant 3–"Urgent action" in all three situations (original IPCA, IPCA moderate choice and IPCA fuzzy drastic choice) for the focal Hotel 1 compared to Hotel 2, shows different quantitative situations. In the first case there are 9 attributes of quality in this dial (7,8,9,11,15,16,18,19,20), in the second case there are 5 attributes (7,11,18,19,20) and in the third there are two attributes (18,19). It is noted that the two attributes (18,19) of the IPCA variant fuzzy drastic choice are also found in the other two situations (fuzzy moderate and drastic choice) from Hotel 1 in relation to Hotel 4. The conclusion is that this Hotel 1 is categorically deficient, from the perspective of its customers, at entertaining facilities (18–*The hotel has entertaining facilities*) both in relation to Hotel 2 and in relation to Hotel 4. These two attributes 18–*The hotel has entertaining facilities* and 19–*Big variety and proper quality of meals* impose urgent measures. "These attributes reflect the areas of weakness of the focal company, and the quadrant is named 'urgent action' because of the necessity of taking urgent action to improve them" ([1], p.138).

In this case, fuzzy modeling has led to a higher filtering of attributes that qualify for this dial and which require effort concentration.

The analysis of the quadrant 4–"Null advantage" in all three situations (original IPCA, IPCA fuzzy moderate choice and IPCA fuzzy drastic choice) for the focal Hotel 1 in relation to Hotel 2 shows that no attribute was positioned here. The analysis of the quadrant 4–"Null advantage" in all three situations (original IPCA, IPCA fuzzy moderate choice and IPCA fuzzy drastic choice) for focal Hotel 1 compared to Hotel 4 shows in the original IPCA the positioning of 8 attributes (7,8,9,11,15,16,18,20), in the IPCA fuzzy moderate choice of 2 attributes (7,11) and in the third situation no attributes.

For testing the IPCA method, we also calculated the IPCA in the three variants for the focal Hotel 2 in relation to the competing Hotel 1. The results obtained (Table 9) support the conclusions obtained from the analysis of the focal Hotel 1 in relation to the competing Hotel 2, although they are different values of the importance of the attributes.

5.5 Conclusions and future research

Modeling with fuzzy sets ensures greater elasticity compared to the classic Likert scale. The advantage of fuzzy crowd modeling is that it can be operated after data collection. The decision regarding the number of steps of the Likert scale could be made after collecting the answers, by fuzzy modeling the answers according to the general characteristics of the answers. If the collected data show a concentration of responses on certain intervals of the Likert classical scale (as in the present study) which makes it difficult to distinguish between the attributes of quality, the answers can be penalized. A clearer distinction will be made between attributes. At this point, the establishment of triangular fuzzy numbers replacing classical numbers is arbitrary, with future research aimed at finding a method for assigning fuzzy numbers.

Although it has a clear potential, modeling with fuzzy sets still has an important limitation. The limitation is that, subjectively, the researcher must assign values to fuzzy numbers. Solving this problem is one of the future directions of research.

Also as future research, we must take into account that there are several types of sets ("fuzzy intuitionistic", "fuzzy valued between intervals", "fuzzy intuitiveistic value-interval", "double fuzzy", etc.) and these could provide a representation finer answers, almost all possible answers (for example, fuzzy modeling of the "between important and very important" type, but also "fuzzy-value-interval" can do this).

Author contributions

The authors contributed equally to this work.

Conflict of interest

The authors declare no conflict of interest.

References

[1] Albayrak, T. (2015). Importance Performance Competitor Analysis (IPCA): A study of hospitality companies, *International Journal of Hospitality Management*, doi:10.1016/j.ijhm.2015.04.013, 48, 135–142, 2015.

[2] Allen, E.; Seaman, C. (2007). Likert scales and data analyses, *Quality Progress*, 40(7), 64–65, 2007.

[3] Bacon, D. R. (2003). A comparison of approaches to importance-performance analysis, *International Journal of Market Research*, 45(1), 1–15, 2003.

[4] Ban, A. I.; Coroianu, L. (2015). Simplifying the search for effective ranking of fuzzy numbers, *IEEE Transactions on Fuzzy Systems*, 23(2), 327–339, 2015.

[5] Ban, O. I.; Mester, T. I. (2014). Using kano two dimensional service quality classification and characteristic analysis from the perspective of hotels' clients of Oradea, *Revista de turism-studii si cercetari in turism*, (18), 30–36, 2014.

[6] Ban, O.; Bogdan, V.; Tuse, D. (2019). Tourist Destination Assessment by Revised Importance-Performance Analysis, *EURASIAN ECONOMIC PERSPECTIVES, Edited by: Bilgin, MH; Danis, H; Demir, E; Can, U, Book Series: Eurasian Studies in Business and Economics*, doi: 10.1007/978-3-030-18565-7_5, 11(1), 49–68, 2019.

[7] Ban, A. I.; Ban, O. I.; Tuse, D. A. (2016). Derived fuzzy importance of attributes based on the weakest triangular norm-based fuzzy arithmetic and applications to the hotel services, *Iranian Journal of Fuzzy Systems*, 13(5), 65–85, 2016.

[8] Ban, O. I.; Tara, I. G.; Bogdan, V.; Tuse, D.; Bologa, S. G. (2016). Evaluation of hotel quality attribute importance through fuzzy correlation coefficient, *Technological and Economic Development of Economy*, 22(4), 471–492, 2016.

[9] Bei, L.-T.; Shang, C.-F. (2006). Building marketing strategies for state-owned enterprises against private ones based on the perspectives of customer satisfaction and service quality, *Journal of Retailing and Consumer Services*, doi:10.1016/j.jretconser.2004.07.002, 13(1), 1–13, 2006.

[10] Bertram, D. (2007). Likert scales, *Retrieved November*, 2, 2007.

[11] Boone, H. N.; Boone, D. A. (2012). Analyzing likert data, *Journal of extension*, 50(2), 1–5, 2012.

[12] Burns, A. C. (1986). Generating Marketing Strategy Priorities Based On Relative Competitive Position, *Journal of Consumer Marketing*, doi:10.1108/eb008179, 3(4), 49–56, 1986.

[13] Caber, M.; Albayrak, T.; Matzler, K. (2012). Classification of the destination attributes in the content of competitiveness (by revised importance-performance analysis), *Journal of Vacation Marketing*, 18(1) 43–56, 2012.

[14] Caber, M.; Albayrak, T.; İsmayıllı, T. (2017). Analysis of congress destinations' competitiveness using importance performance competitor analysis, *Journal of Convention & Event Tourism*, doi:10.1080/15470148.2017.1288185, 18(2), 100–117, 2017.

[15] Chang, L. (1994). A psychometric evaluation of 4-poing and 6-point Likert-type scales in relation to reliability and validity, *Applied Psychological Measurement*, 18, 205–215, 1994.

[16] Chen, K. Y. (2014). Improving importance-performance analysis: The role of the zone of tolerance and competitor performance. The case of Taiwan's hot spring hotels, *Tourism Management*, 40, 260–272, 2014.

[17] Chu, R. K.; Choi, T. (2000). An importance-performance analysis of hotel selection factors in the Hong Kong hotel industry: a comparison of business and leisure travellers, *Tourism Management*, 21(4), 363–377, 2000.

[18] Croasmun, J. T.; Ostrom, L. (2011). Using Likert-Type Scales in the Social Sciences, *Journal of Adult Education*, 40(1), 19–22, 2011.

[19] Dawes, J. (2008). Do data characteristics change according to the number of scale points used? An experiment using 5-point, 7–point and 10–point scales, *International journal of market research*, 50(1), 61–104, 2008.

[20] Del Chiappa, G.; Martin, J. C.; Roman, C. (2016). Service quality of airports' food and beverage retailers. A fuzzy approach., *Journal of air transport management*, 53, 105–113, 2016.

[21] Deng, W (2007). Using a revised importance-performance analysis approach: the case of Taiwanese hot springs tourism, *Tourism Management*, 28, 1274–1284, 2007.

[22] Deng, Y; Kuo, Y.F.; Chen, W.C. (2008). Revised importance–performance analysis: three-factor theory and benchmarking, *The Service Industries Journal*, 28(1), 37–51, 2008.

[23] Ebrahimnejad, A. (2015). An improved approach for solving fuzzy transportation problem with triangular fuzzy numbers, *Journal of Intelligent & Fuzzy Systems*, 29(2), 963–974, 2015.

[24] Ford, J.B.; Joseph, M.; Joseph, B. (1999). Importance-performance analysis as a strategic tool for service marketers: the case of service quality perceptions of business students in New Zealand and the USA, *Journal of Services Marketing*, 13(2), 171–186, 1999.

[25] Heilpern, S. (1992). The expected value of a fuzzy number, *Fuzzy sets and Systems*, 47(1), 81–86, 1992.

[26] Hodge, D.R.; Gillespie, D. (2003). Phrase completions: An alternative to Likert scales, *Social Work Research*, 27(1), 45–55, 2003.

[27] Hui, C. H.; Triandis, H. C. (1989). Effects of culture and response format on extreme response style, *Journal of cross-cultural psychology*, 20(3), 296–309, 1989.

[28] Jamieson, S. (2004). Likert scales: How to (ab)use them, *Medical Education*, 38, 1217–1218, 2004.

[29] Joshi, A.; Kale, S.; Chandel, S.; Pal, D. K. (2015). Likert scale: Explored and explained, *British Journal of Applied Science & Technology*, 7(4), 396, 2015.

[30] Keyt, J. C.; Yavas, U.; Riecken, G. (1994). Importance-performance analysis: A case study in restaurant positioning, *International Journal of Retail & Distribution Management*, 22(5), 35–40, 1994.

[31] Lee, G; Lee, C.-K. (2009). Cross-cultural comparison of the image of Guam perceived by Korean and Japanese leisure travelers: importance-performance analysis, *Tourism Management*, 30, 922–931, 2009.

[32] Lee, Y.C.; Hsieh, Y.F. (2011). Integration of revised simultaneous importance performance analysis and decision making trial and evaluation laboratory: A study of the mobile telecommunication industry in Taiwan, *African Journal of Business Management*, 5(6), 2312, 2011.

[33] Leung, S.-O. (2011). A Comparison of Psychometric Properties and Normality in 4-, 5-, 6-, and 11-Point Likert Scales, *Journal of Social Service Research*, doi:10.1080/01488376.2011.580697, 37(4), 412–421, 2011.

[34] Li, Q. (2013). A novel Likert scale based on fuzzy sets theory, *Expert Systems with Applications*, doi:10.1016/j.eswa.2012.09.015, 40(5), 1609–1618, 2013.

[35] Li, W.; Yu, S.; Pei, H.; Zhao, C.; Tian, B. (2017). A hybrid approach based on fuzzy AHP and 2-tuple fuzzy linguistic method for evaluation in-flight service quality, *Journal of Air Transport Management*, 60, 49–64, 2017.

[36] Li, D. F. (2012). A fast approach to compute fuzzy values of matrix games with payoffs of triangular fuzzy numbers, *European Journal of Operational Research*, 223(2), 421–429, 2012.

[37] Likert, R. (1932). A technique for the measurement of attitudes, *Archives of Psychology*, 22(140), 1–55, 1932.

[38] Liu, R.; Cui, L.; Zeng, G.; Wu, H.; Wang, C.; Yan, S.; Yan, B. (2015). Applying the fuzzy SERVQUAL method to measure the service quality in certification & inspection industry, *Applied Soft Computing*, 26, 508–512, 2015.

[39] Liu, P.; Liu, X.; Ma, G.; Liang, Z.; Wang, C.; Alsaadi, F.E. (2020). A multi-attribute group decision-making method based on linguistic intuitionistic fuzzy numbers and Dempster–Shafer evidence theory, *International Journal of Information Technology & Decision Making*, 19(02), 499–524, 2020.

[40] Lubiano, M. A.; García-Izquierdo, A. L.; Gil, M. Á. (2021). Fuzzy rating scales: Does internal consistency of a measurement scale benefit from coping with imprecision and individual differences in psychological rating?, *Information Sciences*, 550, 91–108, 2021.

[41] Martilla, J.A.; James, J.C. (1977). Importance-performance analysis, *Journal of Marketing*, 41(1), 77–79 , 1977.

[42] O'Leary, S; Deegan, J (2005). Ireland's image as a tourism destination in France: attribute importance and performance, *Journal of Travel Research*, 43, 247–256, 2005.

[43] Oh, H. (2001). Revisiting importance-performance analysis, *Tourism Management*, 22, 617–627, 2001.

[44] Qi, W.; Huang, Z.; Dinçer, H.; Korsakienė, R.; Yüksel, S. (2020). Corporate governance-based strategic approach to sustainability in energy industry of emerging economies with a novel interval-valued intuitionistic fuzzy hybrid decision making model, *Sustainability*, 12(8), 3307, 2020.

[45] Taplin, R.H. (2012). Competitive importance-performance analysis of an Australian wildlife park, *Tourism Management*, 33(1), 29–37, 2012.

[46] Vonglao, P. (2017). Application of fuzzy logic to improve the Likert scale to measure latent variables, *Kasetsart Journal of Social Sciences*, 38(3), 337–344, 2017.

[47] Wei, G. (2016). Picture fuzzy cross-entropy for multiple attribute decision making problems, *Journal of Business Economics and Management*, 17(4), 491–502, 2016.

[48] Weijters, B.; Millet, K.; Cabooter, E. (2020). Extremity in horizontal and vertical Likert scale format responses. Some evidence on how visual distance between response categories influences extreme responding., *International Journal of Research in Marketing*, 2020.

[49] Yavas, U.; Shemwell, D (1997). Analyzing a bank's competitive position and appropriate strategy, *J. Retail. Bank. Serv*, 19(4), 43–51, 1997.

[50] Zhang, H.Q.; Chow, I. (2004). Application of importance-performance model in tour guides' performance: evidence from mainland Chinese outbound visitors in Hong Kong, *Tourism Management*, 25(1), 81–91, 2004.

[51] Zhang, X.; Liu, P. (2010). Method for aggregating triangular fuzzy intuitionistic fuzzy information and its application to decision making, *Technological and economic development of economy*, 16(2), 280–290, 2010.

[52] Zhao, M.; Wei, G.; Wei, C.; Wu, J. (2021). Improved TODIM method for intuitionistic fuzzy MAGDM based on cumulative prospect theory and its application on stock investment selection, *International Journal of Machine Learning and Cybernetics*, 12(3), 891–901, 2021.

Journal's webpage: http://univagora.ro/jour/index.php/ijccc/

This journal is a member of, and subscribes to the principles of,
the Committee on Publication Ethics (COPE).
https://publicationethics.org/members/international-journal-computers-communications-and-control

Cite this paper as:

Ban O.; Droj L.; Tușe D.; Droj G.; Bugnar N. (2022). Data Processing by Fuzzy Methods in Social Sciences Researches. Example in Hospitality Industry, *International Journal of Computers Communications & Control*, Vol. 17, No. 2, 4741, 2022.

https://doi.org/10.15837/ijccc.2022.2.4741