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HOW DIFFERENT N-POINT LIKERT SCALES AFFECT THE MEASUREMENT OF SATISFACTION IN ACADEMIC CONFERENCES

Abstract: *Satisfaction in the segment of academic conferences has not been analysed as much as the hotels in the field of tourism. This paper presents a fuzzy logic approach that evaluates the satisfaction of conferences held at the Technical University of Loja in 2013. The satisfaction experienced by the delegates is measured through triangular fuzzy numbers and the concept of the degree of optimality, via the closeness to ideal solutions. Using different fuzzy numbers representations, and different Likert scales, we test whether the obtained synthetic satisfaction indicators are affected. Results indicate that the indicators are highly robust to the use of different fuzzy numbers representations, clarification methods and Likert scales. Thus, it can be concluded that binary answer formats can be safely used to measure satisfaction in the context of academic conferences. This result is concordant with that obtained by Dolnicar and Grün (2007) in the analysis of brand image measurement.*

Keywords: *Triangular fuzzy numbers, TOPSIS, Satisfaction, Likert scales, Academic conferences*

1. Introduction

Relevant factors and attributes that influence attendance at Meetings, Incentives, Conferences, and Exhibitions (MICE) events have been analysed from different angles and perspectives. According to Mair (2014), previous literature deals with: (1) the attendee decision-making process; (2) the meeting planners' site selection process; and (3) the economic impacts of conferences and conventions. Whitfield et al. (2014), analysing the MICE literature, proposed another taxonomy which overlapped with that of Mair: (1) a site or venue selection issue (Comas & Moscardo, 2005; Crouch & Louviere, 2004; Fawzy, 2008; Robinson & Callan, 2005); (2) attractors of potential or actual attendees (Breiter & Milman, 2006; Severt et al., 2007; Whitfield & Webber, 2011; Yoo & Chon, 2010); (3) a destination image issue (Baloglu & Love, 2005; Bradley et al., 2002; Lee & Back, 2007; Oppermann, 1996). It can be seen that there was a consensus of the first two categories, but in any case, very often, the boundaries of the different frameworks are not strict and some papers deal with one or a combination of two or three of the aforementioned subcategories, in which the audience research and evaluation of social and economic impact becomes crucial (Peperkamp et al., 2014).

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In another strand of the literature, Dolnicar (2013) contended that social scientists are still using carelessly formulated questions and bad measures because they do not have a clear guidance on how to develop good survey questions and measures. '*Instead, recommendations about measurement in the social sciences are scattered across disciplines*' (p. 551). So in order to mitigate or minimize the suspicious derived from Rossiter (2011) (The author alleged that all the findings in the social sciences based on Likert items and Semantic Differential items are suspect—and this means the majority of findings!), the author proposed a careful guidance relating to the survey researchers' typical challenges: (1). How to define what is being measured? (2). How many questions to ask? (3). How to ask a question (the query)? (4). How to allow respondents to answer (the return)?

Regarding this last issue, there is enough controversy among social scientists about the benefits of the different existing formats. For example, Alwin (1997) concluded that in the measurement of satisfaction with various domains of life, 11-point scales clearly are more reliable than comparable 7-point scales. Most of the studies in social science are based on these multi-category answer formats, especially five and seven point Likert scales. However, Dolnicar (2012) contended that this trend is underpinned by the fact that in the majority of the papers from a total of eighty three empirical papers published in the Journal of Travel Research, the justification for the chosen format was inexistent or this was justified because someone else used the same answer format in a previous study. Thus, this trend was motivated by inertia instead of innovative and valid rationality. The author finally concluded that the binary-answer format outperforms the most commonly used multi-category answer format – the seven-point format – as a measure of evaluative beliefs in survey research. However, a word of caution is expressed regarding that this result cannot be generalized to other contexts different from evaluative beliefs. Rossiter (2011) has argued conceptually that binary-answer formats are not appropriate in overall attitude contexts.

In this regard, this paper aims to shed more light in this debated issue with the analysis of the preferences of the delegates who attended different academic conferences at the Universidad Técnica Particular de Loja during the year 2013. A survey questionnaire was developed to measure the satisfaction (SAT) experienced by the delegates. The measurement of delegates' SAT is based on a fuzzy model for group Multi Criteria Decision Making (MCDM). The MCDM will be used to calculate a SAT index for the total of the sample and each of the segments extracted from our database. The answers to the questionnaire provide information for the SAT attributes in linguistic terms that result in uncertain, imprecise, and vague information. Thus, how to aggregate this vague information poses a real challenge into the MCDM process. Nevertheless, this challenge has usually been overcome with the help of the fuzzy theory since the seminal work of Zadeh (1965). Zadeh (1975) and Mamdani and Assilian (1975) develop the theoretical underpinnings of the fuzzy logic.

In response to the existing controversy regarding the answer format and within the fuzzy logic methodological framework, this paper posits more empirical evidence on the use of binary answer formats in a field that has not been researched previously, addressing three important issues that are usually neglected in the literature of the social science: (1) Are the results robust to the use of crisp information when surveys include linguistic scales? (2) Are the fuzzy TOPSIS methods to obtain SAT synthetic indicators robust enough to changes in the representation of the linguistic answers using different triangular fuzzy numbers (TFNs)? (3) Are the results robust to translations from 9 point Likert scales to 3 point Likert scales and binary answer formats using different translation functions?

The analysis of the relationship between the number of response categories used in the survey questions, the different TFNs representations, the different clarification methods, and the obtained SAT conference synthetic indicators, will provide valid insights about whether the results are affected by changes in these three up to now debated issues. The hypothesis that there exist a positive association between all the results will be empirically tested, and the results point out into the direction that the hybrid TOPSIS SAT conference synthetic indicator is robust to the selection of different number of response categories, different TFNs representations or even different clarification methods. A novel aspect of this paper is that previous studies have only compared different answer formats according to some limited criteria like reliability, validity, structural equivalence, user-friendliness and stability to response styles. In our case, we extend the domain of analysis to robustness on the synthetic SAT indicator results obtained by the fuzzy TOPSIS approach.

The remainder of the paper is organized as follows: Section 2 offers some insights from the literature, section 3 describes the data section, section 4 details the methodology, section 5 presents and discusses the results, and section 6 offers some concluding remarks.

2. Literature review

Mair and Thompson (2009) review a number of papers that examine the delegates' motivation of those who attend at conferences identifying some similarities and differences in the approach and findings. The literature review determines a conceptual framework that can be followed in the research of motivations of conference delegates. The authors find different type of conferences, international and regional, as well as a group of common factors such as location, cost, networking, social aspects, intervening opportunities, conference/ association activities and personal and professional development (p. 401).

Networking opportunities is considered one of the most important factors that delegates take into account when they decide to attend a conference. The previous studies suggest that personal interaction with other fellow colleagues facilitates keeping up the pace with new discoveries in any field as well as learning new skill needed for future promotion and career consolidation (Jago & Deery, 2005; Severt et al., 2007; Witt et al., 1995). The majority of delegates is highly time constrained, so they investigate in advance the potential for new collaboration with other colleagues attending the conference.

Measuring the delegates' satisfaction is always a challenge for researchers for different issues that will be explained below. A well-grounded theory (Groves et al., 2011; Krosnick 1991, 1999) establishes that respondents, filling a survey, need to face four different cognitive processes: (1) they, first, need to read and understand the question; (2) the respondent needs to map relevant information of the object that has been formed in the brain; (3) the abstract information has to be translated into a single judgment; and (4) the single judgment takes finally the form of one of the possible answers in the survey administration (Krosnick, 1999).The four processes demand a high burden to the respondents from a cognitive point of view, and depending on different answer styles regarding effort and interest, respondents can be categorized as optimizers or satisfiers. Optimizers are those who provide more valid responses vs. satisfiers who can respond less efficiently or even randomly. Krosnick (1999) finds that satisfiers are more likely to occur: "(a) the greater the task difficulty, (b) the lower the respondent's ability, and (c) the lower the respondent's motivation" (p. 548).

The rest of the section follows the four researchers' typical challenges that need to be addressed when researchers want to

minimize the task difficulty in order to increase the number of optimizers. We adapt the challenges list for the SAT construct of the present study: (1) how to define SAT in the MICE segment with especial emphasis in scientific conferences; (2) how to design the questionnaire taking into account the administration and the respondents; (3) how to ask the questions making a pre-test to clarify the query; (4) and how to allow respondents to answer providing some multiple formats that permit us to compare different rating scales. A brief overview of the existing literature on how to measure SAT in scientific conferences will be followed by a discussion of the survey design, the wording of the questions and the strategy of the answer format that allow us to compare different scale formats.

2.1. SAT in the MICE segment

Siu et al. (2012) contend that 'confronted with the growing competitive convention and exhibition business, cities which have the convention and exhibition facilities are urged to monitor customers' perceptions of their service to enhance repeat visits and customer loyalty (p. 236)'. Thus, convention and exhibition venues need to monitor the satisfaction or the SAT that attendants to the event experience. SAT in service industries has been usually approximated by the "servicescape" concept since Booms and Bitner (1981), who defined "servicescape" as 'the environment in which the service is assembled and in which the seller and customer interact, combined with tangible commodities that facilitate performance or communication of the service (p. 36)'. Previous literature on MICE point out that facilities, equipment and environment have a significant impact on customers' perceived quality of the convention venues (Breiter & Milman, 2006; Hultsman, 2001; Kuo et al., 2010; Robinson & Callan, 2005; Wu & Weber, 2005).

2.2. The questionnaire design

The questionnaire design was developed in three phases: First, a list of service attributes of international conferences was developed and determined based on expert interviews and empirical research review. In the second phase, the questionnaire was administered and pre-tested to those who had participated in international conferences in the departments of the university where special emphasis was put to know whether some important attributes define the overall SAT conference index was or not missing. In the last phase, answer formats were discussed taking into account the principal aim of this research. A way to obtain simple translations for different and typical satisfaction Likert scales was discussed with other researchers in order to make the comparison between different category answer-formats possible.

The design of the questionnaire included multiple measures of several SAT components that delegates experience during their attendance. The following twelve SAT components were assessed –the number of attributes that conform each component is written between parenthesis: destination as stimulus (5); professional opportunities and social networking (5); formation opportunities (5); security and health at destination (3); connectivity and accessibility (2); Hotel check-in (2); Accreditation delivery service (2); Food Service (6); Transport Service (4); Leisure and recreation (4); Convention Centre Cleaning Service (2); Convention Centre General Services (5). In summary, it can be seen that SAT is conformed by 45 individual attributes. Other important parts of the questionnaire referred to general assessment of SAT experienced at the conferences and some socio-demographic variables. The complete list of the attributes will be shown in the next section.

2.3. The queries

The query is one of the most crucial parts in the design of questionnaires, but in our case this was in part mitigated because question wording were less important than explanations and interpretations given by the four interviewers. The key challenge in formulating survey questions is to ensure that respondents understand clearly the meaning of what is being asked. Dolnicar (2013) made a number of practical recommendations on how to reduce variability of interpretation in the queries based on other previous experiments and experience (Cantril, 1940; Converse & Presser, 1986; Payne, 1980), and our questionnaire was developed having in mind this reference list. Thus, the query employed for all the attributes included in the questionnaire was as follows: what was the satisfaction degree you have experienced with respect to the following attributes?

2.4. The answer

The questionnaire presented an anticipated answer format using a nine-point scale (unipolar) that was verbally labelled into a 3-point Likert scale that used 3 different emoticons (bipolar). The respondent had a chart with this information for clarification when they answered each of the 45 attributes. Figure 1 presents the chart that respondents had in the moment of the interview. It can be seen that the emoticons were verbally labelled as unsatisfied, moderately satisfied and very satisfied. Each of these three emoticons was split into 3 different points up to complete the 9 point-Likert scale.

Satisfaction Level								
☹ (Unsatisfied)			☹ (Moderately satisfied)			☺ (Satisfied)		
1	2	3	4	5	6	7	8	9

Figure 1. Clarification chart for the satisfaction attributes

As the verbal scale was clearly bipolar, a better numerical representation could have been established as -4,…,0,…,4. However, it was decided that the use of 1 to 9 seemed more acceptable during the focus group and the meetings with the colleagues from the university.

3. Data

For the analysis of the perception of the quality experienced by the delegates at the events organised by the Technical University of Loja in the period September 2012-March 2013, a total of 332 surveys were administered to attendees. Survey respondents were approached during coffee and lunch breaks, and only the non-local participants were selected.

The surveys were carried out by a group of four students previously trained by the main researchers for this activity. Table 1 details the events in which surveys were carried out as the basis for our analysis. The interviews averaged twenty minutes.

A descriptive analysis of the 45 attributes included in the analysis is shown in Table 2, where the average and standard deviation figures, as well as the number of not-applicable answers are represented. At no surprise, it can be seen that the attributes that can be considered little satisfiers are related to the connectivity of Loja (connections between Loja and other major cities, transport to Loja and shuttle time between the city and airport), the Wi-Fi and the ease of access on foot from the hotel to the convention centre.

The top five high-satisfiers attributes were on the other hand: the friendliness of the staff of the customer service for the participants, the friendliness of the staff of recreation and amusement services, to gain

prestige from attending the congress, the friendliness of the staff of the cleanliness service of the Convention Centre and the congress topics and themes.

Table 1. Events carried out at UTPL from September 2012-March 2013

Month	Name of event	Type of event	Research field
SEPTEMBER/ 2012	IV INTERNATIONAL SEMINAR – WORKSHOP FOR PEACE STUDENTS	International	Social Sciences
OCTOBER/ 2012	LATIN AMERICAN WORLD YOUTH PARLIAMENT CONFERENCE	International	Humanities
OCTOBER/ 2012	FOR816 SYMPOSIUM	International	Science & Engineering
OCTOBER/ 2012	II MUSICOLOGY CONFERENCE	International	Social Sciences
OCTOBER/ 2012	2012 ATICA and I-SUMMIT CONFERENCE	International	Science & Engineering
NOVEMBER/ 2012	IST DIOCESE CONFERENCE ON BIOETHICS	National	Science & Engineering
DECEMBER/ 2012	DIAGNOSTICS & TREATMENT OF VIRAL BACTERIAL INFECTIONS AND SKIN MIKOTICS	National	Science & Engineering
MARCH/ 2013	LATIN DRUPAL SUMMIT LOJA, 2013	International	Science & Engineering

Source: UTPL (2013) and own elaboration

The attributes with the higher rates of non-response are characterized by those delegates who did not travel to Loja by plane, almost 34 per cent of delegates travelled by road; those who did not get the accreditation from the service, either because they were invited or keynote speakers or simply did not pick up the credential; and those who did not stay in hotels because they visited some family members, friends or relatives.

Table 2. Delegates' satisfaction. Descriptive analysis

Attributes	Average	S.D.	N.A.	Answers Percentage
Destination Temperature	7,65	1,65	0	100,00%
Overall Image of Loja	8,17	1,31	0	100,00%
Ease of access on foot from the hotel to CC	5,77	2,21	0	100,00%
Congress hotel quality	7,40	1,78	0	100,00%
Attractive destination to go accompanied	7,28	1,79	0	100,00%
Op. to exchange knowledge	7,86	1,29	0	100,00%
Op. to meet new colleagues	8,13	1,05	0	100,00%
Op. to re-meet old colleagues	7,11	1,76	0	100,00%
Op. to present a conference	6,63	1,74	0	100,00%
Gain prestige from attending the congress	8,35	0,78	0	100,00%
Op. to increase knowledge and training	8,14	1,20	0	100,00%
Op. to listen to prestigious experts	7,41	1,89	0	100,00%
Quality conferences given at the congress	7,61	1,79	0	100,00%
Congress topics and themes	8,19	1,02	0	100,00%
Op. to be up to date with scientific developments	6,14	1,60	0	100,00%
Public safety in Loja	8,03	1,23	0	100,00%
Hospital close to the convention centre	7,71	1,57	0	100,00%

Table 2. Delegates' satisfaction. Descriptive analysis (continued)

Hygiene and sanitation levels in the hotels and restaurants	7,49	1,63	0	100,00%
Connections between Loja and other major cities	4,48	2,20	0	100,00%
Shuttle time between the city and airport	5,57	2,47	113	65,96%
Hotel check-in	7,27	2,01	20	93,98%
Hotel. Friendliness of staff	7,15	1,99	20	93,98%
Accreditation delivery service	7,10	2,15	26	92,17%
Accreditation delivery service. Friendliness of staff	7,12	1,99	20	93,98%
Breakfast	7,98	1,30	0	100,00%
Breakfast. Friendliness of staff	7,77	1,33	0	100,00%
Lunch	6,98	2,25	0	100,00%
Lunch. Friendliness of staff	7,72	1,84	0	100,00%
Dinner	7,89	1,38	0	100,00%
Dinner. Friendliness of staff	7,92	1,36	0	100,00%
Transport to Loja	4,85	2,57	0	100,00%
Transport to Loja. Friendliness of staff	6,31	2,01	0	100,00%
Public Transport	8,05	1,14	0	100,00%
Public Transport. Friendliness of staff	8,17	1,01	0	100,00%
Leisure, fun	7,48	1,89	0	100,00%
Leisure, fun . Friendliness of staff	8,09	1,30	0	100,00%
Recreation, amusement	8,16	1,00	0	100,00%
Recreation, amusement. Friendliness of staff	8,40	0,89	0	100,00%
Cleanliness of the Convention Centre	7,54	1,36	0	100,00%
Cleanliness of the Convention Centre. Friendliness of staff	8,31	1,02	0	100,00%
Refreshments service	7,01	2,02	0	100,00%
Refreshments service. Friendliness of staff	7,03	1,75	0	100,00%
Customer service for the participants	8,13	1,19	0	100,00%
Customer service for the participants. Friendliness of staff	8,42	0,90	0	100,00%
WIFI	5,72	2,01	0	100,00%

4. Methodology

4.1. Fuzzy Logic

As many authors contend the questionnaires, based mainly on ratings associated with emoticons or verbal labelled terms like "little-satisfied", "middle-satisfied", and "very-satisfied", provide uncertain information, and fuzzy logic can resolve this vagueness, and ambiguity of human judgement (Benítez et al., 2007). Basically, fuzzy Logic was introduced to express these verbal labelled terms in decision making (DM) process. Zadeh (1984) claimed that the imprecise information is adequately treated by fuzzy logic because intermediate values to be defined between exact and true conventional values can now be formulated mathematically (Methods based on Fuzzy Logic are becoming very popular in the field of measuring satisfaction, service quality or experienced quality (Tsaur et al., 2002; Yeh & Kuo, 2003; Benítez et al., 2007; Lin, 2010; Kabir & Hasin, 2012; Bai et al., 2014; Saeida Ardakani et al., 2015)).

One of the most well-known classical MCDM methods that have been extensively applied in the literature is based on the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) developed by Hwang and Yoon (1981). It obtains the best performance as the observation having the shortest distance from the Positive Ideal Solution (PIS), and the farthest distance from the Negative Ideal

Solution (NIS) (Benitez et al., 2007; Wang & Elhag, 2006).

In this paper, we are going to parameterize a triangular fuzzy number $\tilde{A}$ by a triplet (a_1, a_2, a_3). The membership function $\mu_A(x)$ is defined below as:

$$\mu_A(x) = \begin{cases} \dfrac{x - a_1}{a_2 - a_1}, & a_1 \le x \le a_2, \\ \dfrac{x - a_3}{a_2 - a_3}, & a_2 \le x \le a_3, \\ 0, & otherwise. \end{cases} \quad (1)$$

Each linguistic term with its magnitude from 1 to 9 was characterized by a triangular fuzzy number for representing its approximate value range between 0 and 100 (We have used this range, but other ranges, such as (0-1), (0-7) or (0-10) would also be valid.), and denoted as (a_1, a_2, a_3), where $0 \le a_1 \le a_2 \le a_3 \le 100$, and a_2 is the most likely value of the linguistic term, and a_1 and a_3 are the lower and upper bounds used, respectively, to reflect the fuzziness of the term. The default values of the linguistic terms will be discussed below when discussing the different scenarios adopted in the analysis, and the membership functions can be calculated according to the equation 1. We use different alternative answer formats: (1) a nine-point Likert scale obtained from a division of a three-point emoticon Likert scale; (2) a three-point emoticon Likert scale fully verbally labelled; (3) a binary transformation according to different strategies.

Different market segments opinions are aggregated according to the average fuzzy number of n triangular numbers $\tilde{A}_i = \left(a_1^{(i)}, a_2^{(i)}, a_3^{(i)}\right)$, where $i = 1, 2, 3, \cdots, n$, as follows:

$$\tilde{A} = (a_1, a_2, a_3) = \left(\frac{1}{n}\right) \bullet \left(\tilde{A}_1 \oplus \tilde{A}_2 \oplus \cdots \tilde{A}_n\right) = \left(\frac{\sum_{i=1}^{n} a_1^{(i)}, \sum_{i=1}^{n} a_2^{(i)}, \sum_{i=1}^{n} a_3^{(i)}}{n} \right), \quad (2)$$

where $\bullet$ is the multiplication of a scalar and a fuzzy number, and $\oplus$ is the add operation of fuzzy numbers, so $\tilde{A}$ is the overall average performance valuation for each segment included in the analysis. Eq. (2) shows that the average performance can also be represented by a new triangular fuzzy number (Buckley, 1985).

4.2. Defuzzification procedure and the TOPSIS method

Defuzzification is a technique to convert the fuzzy number into crisp real numbers that locates the Best Nonfuzzy Performance (BNP) value. There are several available methods, like for example, the mean-of-maximum, the center-of-area, and the α-cut method (Zhao & Govind, 1991).

In this paper, we use the BNP value, defined as follows, $v_{\tilde{A}} = (a_1 + 2a_2 + a_3)/4$ for the triplet (a_1, a_2, a_3) of a triangular fuzzy number $\tilde{A}$. This method (Chen, 1996) has been used by its simplicity and the lack of requirement of analyst's personal judgment.

Once the crisp performance matrix is obtained, the TOPSIS method is applied to rank the SAT experienced by each of the segments (Hwang & Yoon, 1981; Zeleny, 1982). Thus, ideal solutions are computed based on the following equations:

$$A^{+} = \left\{ \left(\max v_{ij} \,\middle|\, j \in J \right), \left(\min v_{ij} \,\middle|\, j \in J' \right), i = 1, 2, \cdots, m \right\} \quad (3)$$

$$A^{-} = \left\{ \left(\min v_{ij} \,\middle|\, j \in J \right), \left(\max v_{ij} \,\middle|\, j \in J' \right), i = 1, 2, \cdots, m \right\} \quad (4)$$

where J and J' form a partition of the different criteria according to their benefit or cost characteristic. In our case there are no dimensions with cost characteristics.

After the determination of ideal solutions, we calculate the Euclidean distance between ideal solution and negative ideal solution for each observation as:

$$S_i^{+} = dist(V_i, A^{+}) = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - A_j^{+} \right)^2} \quad i = 1, 2, \cdots, m \quad (5)$$

$$S_i^{-} = dist(V_i, A^{-}) = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - A_j^{-} \right)^2} \quad i = 1, 2, \cdots, m \quad (6)$$

Then, we calculate the relative closeness to the positive ideal solution for each of the segments as;

$$SQI_i = \frac{S_i^{-}}{S_i^{+} + S_i^{-}} \quad i = 1, 2, \cdots, m \,, \quad (7)$$

where $0 \leq SQI_i \leq 1$. An observation is closer to an ideal solution as $SATI_i$ approaches to 1. A set of alternatives can be sorted according to the descending order of $SATI_i$. This approach has been widely used in different decision contexts (e.g. Athanassopoulos & Podinovski, 1997; Bai & Sarkis, 2013; Chang & Yeh, 2001; Chen & Hwang, 1991; Kahraman et al., 2013; Min & Peng, 2012; Ou, 2016; Yeh et al., 2000; Zeleny, 1998).

4.3. Scenarios

We use eleven different scenarios that can be seen in Table 3 and that will be compared with the TOPSIS method applied to the average values using the crisp information according to the numeric scale (1-9): (1) the nine-point Likert scale and the TFN method using symmetrical observations in all the points from 20 until 80, with the same spread of 20, and degenerated TFNs in the extreme points with the same spread at 0 and 100 (We have adapted TFN to the 9-point Likert scale from other previous analysis. Researchers can use very different approaches depending on the nature of the data. Sun and Lin (2009) prefer to use symmetric TFN centered in the points 1, 3, 5, 7 and 9 for a 5-point Likert scale. However, Kaya and Kahraman (2014) preferred to use asymmetric TFN in the extremes of the scale. In our case, we plan to check the stability of the SAT index to different TFN representations so both approaches will be used.); (2) the nine-point Likert scale and the TFN method using symmetrical observations in all the points with the same spread of 20; (3) the nine-point Likert scale using uniform crisp information; (4) the three-point Likert scale where the endpoints are degenerated at crisp information with values of 0 and 100, the midpoint is represented by a TFN centred at 50 with a spread of 50; (5) the three-point Likert scale with all the points represented by TFNs, but the spread is highly asymmetric between the lower two satisfaction values (66) and the positive endpoint value (4) which is degenerated with a positive skew; (6) the three point Likert scale with an increasing spread between the first two points (it changes from 40 to 60) and the positive endpoint is considered crisp information at 100; (7) the three point Likert scale with a decreasing spread between the

first two points (it changes from 50 to 40) and the positive endpoint is considered crisp information at 100; (8) the three point Likert scale with a constant spread between the first two points (40), all the values lower than 20 are eliminated from the universe of discourse, and the positive endpoint is considered crisp information at 100; (9) binary formats obtained by the translation of the lower four points with symmetrical TFN centred at 50 and 75, spread of 50, and with elimination of all the values lower than 25; (10) binary formats obtained by the translation of the lower three points with the same TFNs representation of the previous case; (11) binary formats obtained by the translation of the lower five points with the same TFNs representation of the case nine; (12) binary formats obtained by the translation of the lower six points with the same TFNs representation of the case nine (S10 and S12 can also be seen as special binarization processes for a three point Likert scales using the lowest and the two lower categories for defining the unsatisfied category).

Table 3. Likert Scales and TFN representations

Scale	1	2	3	4	5	6	7	8	9
S1*	(0,0,20)	(10,20,30)	(20,30,40)	(30,40,50)	(40,50,60)	(50,60,70)	(60,70,80)	(70,80,90)	(80,100,100)
S2*	(0,10,20)	(10,20,30)	(20,30,40)	(30,40,50)	(40,50,60)	(50,60,70)	(60,70,80)	(70,80,90)	(80,90,100)
S3*	10	20	30	40	50	60	70	80	90
S4*	(0,0,0)	(25,50,75)	(100,100,100)						
S5*	(0,33,66)	(33,66,99)	(96,100,100)						
S6*	(0,20,40)	(20,50,80)	(100,100,100)						
S7*	(0,30,50)	(30,50,70)	(100,100,100)						
S8*	(20,40,60)	(50,70,90)	(100,100,100)						
S9[1]	(25,50,75)	(50,75,100)							
S10[2]	(25,50,75)	(50,75,100)							
S11[3]	(25,50,75)	(50,75,100)							
S12[4]	(25,50,75)	(50,75,100)							

*3 verbal labels in the endpoints and midpoint. In S1 the 9-point Likert scale is considered
[1]Translation to binary responses. Unsatisfied (1-4)
[2]Translation to binary responses. Unsatisfied (1-3)
[3]Translation to binary responses. Unsatisfied (1-5)
[4]Translation to binary responses. Unsatisfied (1-6)

As explained above, different approaches have been followed to binarize multi category answer formats. As Dolnicar and Grün (2013) argued, 'researchers frequently binarize multi-categorical data using the middle point to split respondents (p.1229). However, in some cases such binarization might not actually match the internal translation process that respondents follow as they can have different preferences and personal styles that make them to be more or less exigent in answering to be or not satisfied. In our case, the translation between scales has been done assuming implicitly that all the respondents use the same transformation from one scale to another; unfortunately this is not usually the case because different respondents can have different transformations, but this problem is partly resolved by blurring the information with our fuzzy approach.

5. Results

Table 4 shows the ideal-positive and ideal-negative solutions. The table is structured according to six columns. The 45 dimensions that have been researched are shown in the first column. In the second and the third columns are the vectors of the ideal positive solution and the segment that perceived this attribute better than the others. Analysing the segments that appear in the positive ideal solutions, it can be seen that age for those older than 60 years old is one of the most significant in this solution, followed by other

segments that are either related to expenditure in leisure and fun activities. The fourth and the fifth columns display similar information, but in this case, they highlight the worst results. The most representative segment is related to loyalty attributes. Other representative segments are related to the young segment of delegates (less than 20 years old) and those who share a room with other two people in a triple room. Finally, the sixth column shows the percentage of variation between ideal solutions (which helps to obtain a classification of those dimensions that are interpreted as being more or less heterogeneous).

Table 4. Positive and negative ideal solutions

Attribute	PIS+	Segment	PIS-	Segment	Var. Perc.
Destination Temperature	90.28	'Expenditure. Leisure-Fun. >61 $'	65.00	'I will come back on vacation (2)'	38.89%
Overall Image of Loja	95.00	'>60 years'	62.37	'Triple room'	52.32%
Ease of access on foot from the hotel to CC	81.67	'Expenditure. Leisure-Fun. >61 $'	27.86	'<20 years'	193.16%
Congress hotel quality	95.00	'Recreation. Malacatos'	51.50	'Expenditure. Comida. >61 $'	84.47%
Attractive destination to go accompanied	91.25	'i will come back on vacation (4)'	62.03	'Night cost. 21-40 $'	47.11%
Op. to exchange knowledge	92.00	'i will recommend for vacation (4)'	68.19	'5 nights'	34.92%
Op. to meet new colleagues	92.50	'Recreation. El Cisne'	61.05	'Triple room'	51.51%
Op. to re-meet old colleagues	95.00	'>60 years'	54.00	'i will recommend for vacation (4)'	75.93%
Op. to present a conference	90.83	'Expenditure. Leisure-Fun. >61 $'	43.33	'i will come back on vacation (2)'	109.62%
Gain prestige from attending the congress	95.00	'Recreation. Malacatos'	80.00	'i will come back on vacation (7)'	18.75%
Op. to increase knowledge and training	95.00	'>60 years'	60.00	'Triple room'	58.33%
Op. to listen to prestigious experts	91.39	'Expenditure. Leisure-Fun. >61 $'	51.67	'Dinner. Cafet. UTPL'	76.88%
Quality conferences given at the congress	95.00	'>60 years'	53.33	'I will recommend for vacation (2)'	78.13%
Congress topics and themes	95.00	'I will recommend Convention Centre (4)'	70.00	'Recreation. Malacatos'	35.71%
Op. to be up to date with scientific developments	87.78	'Expenditure. Leisure-Fun. >61 $'	46.67	'I will come back on vacation (2)'	88.10%
Public safety in Loja	95.00	'Recreation. Malacatos'	64.00	'I will recommend for vacation (4)'	48.44%
Hospital close to the convention centre	92.50	'Dinner. Cafet. UTPL'	60.00	'I will recommend Convention Centre (4)'	54.17%
Hygiene and sanitation levels in the hotels and restaurants	90.83	'Recreation. El Cisne'	50.00	'Triple room'	81.67%
Connections between Loja and other major cities	81.00	'>60 years'	25.00	'I will come back on vacation (4)'	224.00%
Shuttle time between the city and airport	85.00	'Recreation. El Cisne'	20.00	'Recreation. Malacatos'	325.00%
Hotel check-in	95.00	'Expenditure. Leisure-Fun. >61 $'	59.88	'Leisure-Fun. Cine'	58.66%
Hotel. Friendliness of staff	89.00	'Lodging. Other'	20.00	'<20 years'	345.00%

Table 4. Positive and negative ideal solutions (continued)

Accreditation delivery service	89.00	'>60 years'	47.50	'I will recommend for vacation (4)'	87.37%
Accreditation delivery service. Friendliness of staff	92.50	'Dinner. Cafet. UTPL'	30.00	'<20 years'	208.33%
Breakfast	88.42	'Expenditure. Dinner. >61 $'	63.33	'I will come back on vacation (2)'	39.61%
Breakfast. Friendliness of staff	95.00	'Recreation. Malacatos'	65.00	'I will recommend Convention Centre (4)'	46.15%
Lunch	89.21	'Triple room'	47.50	'I will come back on vacation (4)'	87.81%
Lunch. Friendliness of staff	92.50	'Expenditure. Leisure-Fun. >61 $'	40.00	'I will come back on vacation (2)'	131.25%
Dinner	92.22	'Expenditure. Leisure-Fun. >61 $'	63.10	'<20 years'	46.16%
Dinner. Friendliness of staff	95.00	'Dinner. Cafet. UTPL'	67.63	'Triple room'	40.47%
Transport to Loja	72.50	'Recreation. Malacatos'	15.00	'I will recommend for vacation (2)'	383.33%
Transport to Loja. Friendliness of staff	86.80	'Lodging. Other'	33.33	'I will come back on vacation (2)'	160.40%
Public Transport	95.00	'Recreation. Malacatos'	60.00	'I will come back on vacation (2)'	58.33%
Public Transport. Friendliness of staff	95.00	'Recreation. Malacatos'	65.00	'I will come back on vacation (2)'	46.15%
Leisure, fun	92.00	'I will recommend for vacation (4)'	55.00	'Recreation. Malacatos'	67.27%
Leisure, fun. Friendliness of staff	95.00	'>60 years'	70.00	'Recreation. El Cisne'	35.71%
Recreation, amusement	89.00	'I will recommend for vacation (4)'	69.17	'Dinner. Cafet. UTPL'	28.67%
Recreation, amusement. Friendliness of staff	95.00	'>60 years'	74.17	'Dinner. Cafet. UTPL'	28.09%
Cleanliness of the Convention Centre	95.00	'Recreation. Malacatos'	66.67	'I will recommend for vacation (3)'	42.50%
Cleanliness of the Convention Centre. Friendliness of staff	95.00	'Recreation. Malacatos'	75.00	'I will come back on vacation (2)'	26.67%
Refreshments service	85.00	'>60 years'	34.00	'I will recommend for vacation (4)'	150.00%
Refreshments service. Friendliness of staff	90.00	'I will come back on vacation (2)'	57.03	'Night cost. 21-40 $'	57.82%
Customer service for the participants	95.00	'>60 years'	65.00	'I will recommend for vacation (4)'	46.15%
Customer service for the participants. Friendliness of staff	95.00	'>60 years'	77.00	'I will recommend for vacation (4)'	23.38%
WIFI	77.00	'I will recommend for vacation (4)'	43.81	'<20 years'	75.76%

The TOPSIS SAT indicators, for each of the scenarios under analysis, measure the quality of global services attained by each of the researched segments. For each scenario, statistical significance of the difference between the rankings obtained is determined using Spearman's rank-correlation test. Spearman's rank-correlation test, which is a

special form of correlation test, is used when the actual values of paired data are substituted with the ranks that the values occupy in the respective observations (Crawley, 2007). In this study, Spearman's test evaluates the similarity of each scenario, analysing the rankings obtained for each segment under analysis of the TOPSIS approach used under different TFNs' representations and different answer formats (Table 5). We test the null hypothesis (H0: There is no similarity between the two rankings), using a test statistic, and comparing this with a pre-determined level of significance value. It can be seen that our proposal based on the TOPSIS method is really robust to different specifications of TFNs and different answer formats. In all the analysed cases, we conclude that the alternative hypothesis "H1: The two rankings are similar" is accepted. The values of the tests and their corresponding probabilities are omitted from the table for the ease of exposition. It can be seen that there are two paired indicators that are equal, that is S2 and S3, and S4 and S5. S2 and S3 because it can be shown that if the final matrix before applying TOPSIS is equal, the indices are the same, and it does not matter whether this information provides from crisp or fuzzy approaches. At the end, what matters is how researchers use the measures provided by the Likert scale, and it is evident that sometimes it really depends on the qualitative information or own researchers' personal judgement. The pair S4 and S5 was not so self evident, but now readers can figure out that independently of the selected TFN representation, what really matters is how this information is clarified if researchers apply TOPSIS to a crisp information matrix. In this case, it can be seen that the distances between the points are proportional, and for that reason both indices are the same. Once this conclusion was appraised then it became evident that for binary answer formats, the use of different TFNs is absolutely superfluous as the SAT indices would be the same.

Table 5. Spearman correlation coefficients between scenarios

Scenarios	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
S1	0.999	0.999	0.977	0.977	0.981	0.981	0.976	0.907	0.889	0.961	0.974
S2		1.000	0.982	0.982	0.984	0.983	0.981	0.919	0.903	0.968	0.974
S3			0.982	0.982	0.984	0.983	0.981	0.919	0.903	0.968	0.974
S4				1.000	0.996	0.991	1.000	0.929	0.931	0.954	0.973
S5					0.996	0.991	1.000	0.929	0.931	0.954	0.973
S6						0.999	0.995	0.906	0.905	0.951	0.988
S7							0.990	0.892	0.889	0.947	0.993
S8								0.932	0.933	0.954	0.972
S9									0.986	0.923	0.861
S10										0.908	0.855
S11											0.934

Source: Own elaboration.

All the coefficients show a positive association between all the SAT indexes with $p<0.001$

Figure 2 shows the stair-step plots of S1 versus each scenario and it is a simple way to plot a list of points so that they are joined with stair steps instead of straight lines

between the points. In essence, instead of joining (x_t,y_t) and (x_{t+1},y_{t+1}) with a straight line, sometimes it is preferable to use stair steps using first the lowest or the highest gradient. In our case, the highest gradient was used. In order to compare the two indices under analysis, the straight line ($y=x$) was also represented.

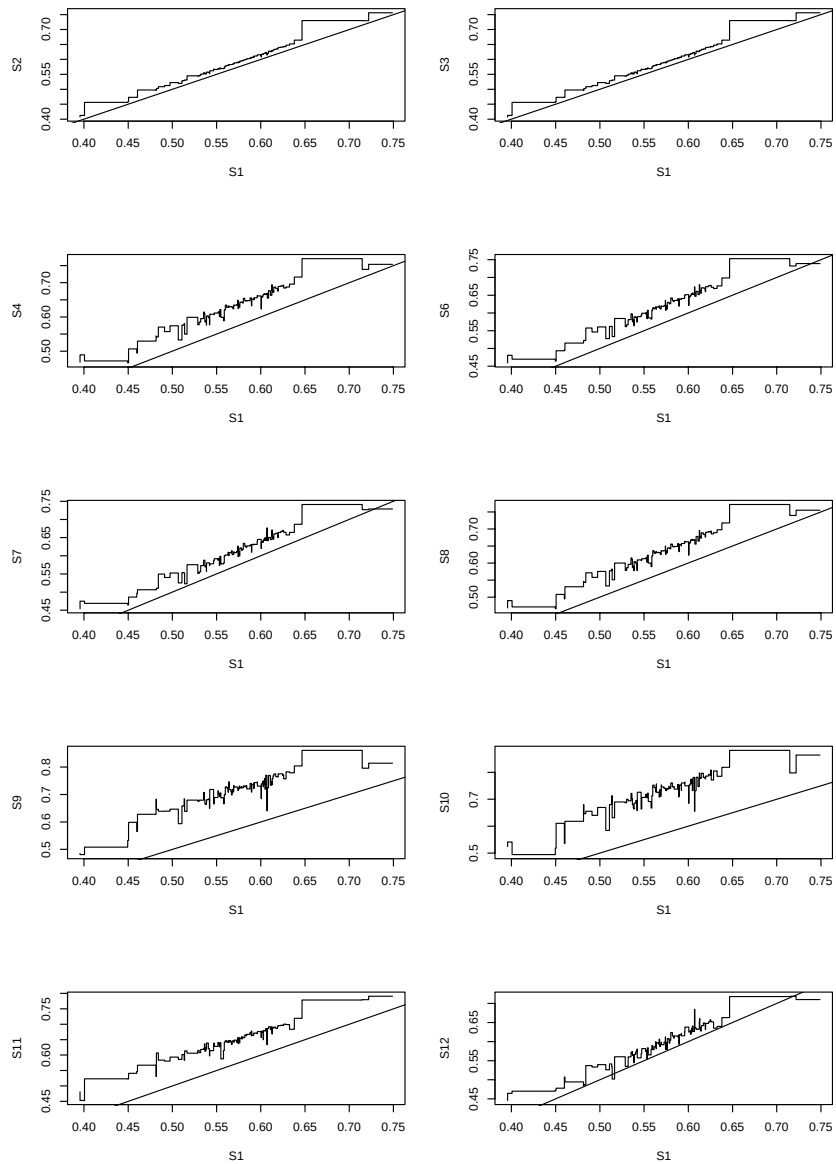

Figure 2. Graph comparison between S1 and S_i

It can be seen that most of the indices are above the straight line and that in all the cases there some steps down, as we could have deduced from the values of the Spearman coefficients. The area left between the plot and the straight line could be used as an approximation of how different two indices are. The proportional factor will be

cancelled out in equation seven. However, a word of caution should be given here, as for individual attributes would not be the same if other analysis were done using any of the both representations. For example, in the importance performance IPA analysis proposed by Martilla and James (1977), the representative values of the Likert scale are very important when researchers perform the analysis, so results and conclusions depend on a certain degree in these values, and it would not be the same considering S4 or S5. Comparing the results for S1 and S2, it can be seen that the main differences are observed in the tails of the distribution of the ordered ranking S1, and this pattern is the result of the asymmetric TFNs selected for both extreme points. Another interesting result to highlight is that the positive association between S1 and other binary answer formats is more intense as the collapsing process for unsatisfied delegates is increased from three to six points. This result poses an interesting area for future research using repeated surveys with binary answer formats to analyse the mapping between these two different approaches. In any case, our results might also be used to support those obtained by Dolnicar (2012) who claimed that, in the context of measuring evaluative beliefs, the binary-answer format with two answer options outperforms a seven-point answer format. The same word of caution as above applies here.

6. Conclusions

The fuzzy, TOPSIS, and a description of a group of twelve scenarios was presented emphasizing that fuzzy is an adequate tool to infer statistical properties from data that are in essence vague and imprecise. Different answer formats, different TFNs representations, and different translations from 9-point Likert scale to binary formats were proposed in order to analyse the stability of results regarding the synthetic SAT indicators obtained for a group of 106 different segments that were formed with socio-demographic and other personal traits variables.

Our findings revealed that the positive ideal solution was highly represented by the group of senior delegates and other personal traits more related to loyalty. On the other hand, for the negative ideal solution, the young delegates and other loyalty groups were over-represented. This can also be analysed in the future, that is, to what extent SAT at the conferences is affected by age or by loyalty responses.

We present empirical evidence on the robustness of our SAT conference synthetic indicator after applying the Spearman's rank correlation test to changes in TFNs representation, numerical representations for multi-category Likert scales, different answer formats or different transformations from multi-category answer formats to binary formats. Thus, some important practical implications for market researchers are obtained with regard to the use of forced binary scales instead of the traditional ordinal multi-category Likert-type scales, as this type of answer format can be recommended as a way to reduce the burden of the fatigue imposed by the surveys participation without compromising the SAT results obtained for a group of delegates attending academic conferences.

Regarding other empirical insights, it was showed that it did not matter whether the information matrix was or not obtained using only crisp information of the multi-category answer format, that is, precise numerical representation of the ordinal values, or using fuzzy logic. This result shows important evidence with respect to the degree of certainty that researchers can have regarding the type of information provided by semantic scales. In essence, it can be said that when researchers represent this information with an accurate representative "crisp" number, the synthetic indicator obtained will be equal to the one obtained by the fuzzy approach. However, how to obtain an accurate "crisp"

candidate is still an open area in which more research is needed.

The TFNs also produced the same SAT conference indicator if the distances between the points are proportional, but a word of caution is given here if these average results are going to be used in other methods like Importance Performance Analysis (IPA). The closeness or positive association between 9-point TFN and binary formats was more intense when the number of points to consider that a delegate is unsatisfied increases from three to six. This can be partially explained in this particular case, because most of the delegates tend to give good marks in the majority of attributes. Again, these results might not be entirely transferable to other contexts or segments within the MICE industry. For example, it is well known that the MICE industry encompasses multiple sub segments of events within the acronym (meetings, incentive travel, conferences, and exhibitions). For example, attendees' responses to different events can vary, so these asymmetries observed in our case might not be present in other type of events.

The main limitation of this study is that the binary answer format is based on transformations instead of repeated-measures with-in the respondents. The last approach was previously used by Dolnicar and Grün (2007a, b) in the analysis of attitudes and behavioural intentions with three repeated surveys using different scales: binary, ordinal and metric. Our limitation is explained by the research design in which the benefits of administering a complex survey to all the non-local delegates was clearly preferred.

A replication study with repeated measures should be conducted in future having in mind that a short-format questionnaire needs to be developed as the burden of 20 minutes can limit the application of repeated surveys to the same respondents. This is also an interesting area for future research as short representative scales are needed in each of the MICE segments. Furthermore, other sub dimensions included in the questionnaire could also be analysed to explore to what extent the findings for the overall SAT index are generalizable.

Another important area of future work is the study of metric scales because as Dolnicar and Grün (2009) showed, respondents use the metric scale very differently when they provide information about different constructs. The findings, obtained by applying the Kolmogorov-Smirnov test for equality of distributions between beliefs and behavioural intentions, can be extended to the analysis of each of the individual items included in the survey, so it can be hypothesized to what extent the metric scale is also attribute dependant.

And finally, another interesting line of future research is to compare and to contrast the results of the SAT synthetic indicator based of the fuzzy hybrid method with other statistical methods such as Structural Equation Models (SEM) or Latent Class Models (LCM).

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