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A fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class on the example of V4 countries

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ABSTRACT

The main goal of this study is to develop a fuzzy model for assessing the level of satisfaction of tourists with accommodation establishments according to social class using the example of V4 countries. The study aims to support decision-making regarding the assessment of the level of satisfaction of tourists from accommodation establishments according to social class, which reflects the individual and collective psychology of consumers. At the first stage of the model, according to the selected criteria, the level of satisfaction of tourists with accommodation establishments in the region is assessed, taking into account the social class of the tourist. Additionally, generalized estimates of the level of satisfaction of tourists from accommodation establishments in the regions are derived, based on which a ranking series of regions can be built. In the second stage, the degree of satisfaction with visiting accommodation establishments by a potential social class (tourist) in a certain region is predicted. Based on the output data, a decision is made regarding future scenarios to support the decision-making of interested parties, such as tourists, businesses, and public authorities.

Keywords: Social class, consumer marketing, accommodation establishments, fuzzy modeling, regional tourism

1. Introduction

It is extremely important to understand the psychology of tourists as consumers for the success of destinations. The social context and essential motivations for tourism have changed significantly in recent years, with tourism increasingly being considered an important mechanism of social relations (Gossling et al., 2018; Del Bosque and San Martín, 2008). This also supports the development of innovative tools to increase quality and to make the supply in the tourism industry more attractive. An investigation of tourist satisfaction is a multidimensional process that enables the use of individual and collective marketing psychology for the innovative development of the tourism industry. Within them, several factors of tourist satisfaction are examined, including the assignment of tourists to certain social classes. The social class aggregates several aspects: sex, age, education, marital status, annual income, and so on. Studies examining the differences in functional, emotional, and social values that are perceived by the different social groups, which will have an impact on the new evaluation of the consumer groups within the tourism industry and the development of the theory of social stratification, have been created recently. The importance of an application of the classification point of view of the social class of tourists may not be equally important for the investigation of all processes in the field of tourism. The study by Ying et al. (2016) confirmed that the study of tourist consumption according to social groups is only relevant for the consumption of certain products and activities. This is because many forms of the tourist experience define the different value frameworks and thus influence tourists' different attitudes (Song et al., 2015). These facts give us a picture of the need for a systematic investigation of tourists' satisfaction with reflection on the selected classification aspects. The complexity of the relations between these aspects confirms the methodological difficulty of the processes of measuring and evaluating tourist satisfaction.

Measuring tourist satisfaction related to accommodation as well as to the other aspects of tourism is also procedurally very demanding, and it is associated with the growing demands on strategic management and decision-making processes (Andriotis et al., 2008; Dmitrović et al., 2009). The methodological shortcomings of the available models encourage the search for new innovative tools to improve the measurement and evaluation of tourist satisfaction. It is obvious that different approaches in measuring tourist satisfaction will always produce different results with ambiguous consequences for tourism management (Fuchs and Weiermair, 2003).

Previous research studies have focused on an investigation of tourist satisfaction evaluation with an application of the classification aspects of the separate demographic and socioeconomic determinants. The influence of social classes on tourist satisfaction ratings has not been investigated thus far, and thus, it represents a significant research gap. An elimination of this research gap will support the discovery of the new dimensions and the determinants influencing the evaluation process as well as its outcome and highlight the importance of individual and collective psychology in the study of tourist consumer behavior and the other social aspects related to it.

Our research aims to support decision-making regarding the assessment of tourist satisfaction with accommodation according to social class, which reflects the individual and collective psychology of consumers. At the first stage of the model, according to the selected criteria, the level of satisfaction of tourists with accommodation establishments in the region is evaluated, taking into account the social class of the tourist. In the second stage, the degree of satisfaction with visiting accommodation establishments by a potential social class (tourist) in a specific region is predicted. The essence of the model is that it derives the level of satisfaction of those tourists who are closest to the potential tourist in terms of social class. This allows us to analyze the region from the point of view of tourists' satisfaction with accommodation establishments in terms of different social strata. On the other hand, it is important to predict the degree of satisfaction with the destination when planning a trip.

In response to all the facts, it was decided to conduct a scientific study, the main purpose of which is to develop a fuzzy model for assessing the level of satisfaction of tourists with regard to accommodation establishments according to social class, using the example of V4 countries.

The scientific hypothesis of this study is formulated as follows.

If in the selected region, participants of the tourist movement belonging to a certain social class highly rate the level of accommodation facilities, then there will also be a high level of satisfaction with accommodation facilities within the region by a potential tourist belonging to the same social class, and this level is obtained on the basis of the developed fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class.

2. Overview of domestic and foreign research studies

The evaluation of tourist satisfaction is an important process when measuring the performance of a destination because of the close association between tourist satisfaction level and their future behavior and loyalty. The results of tourist satisfaction evaluations are very important for the marketing of tourism products and services, and thus, they influence the strategic decision-making processes of tourism entities (**Kozak, 2001; Castro et al., 2017; Correia et al., 2013**). The different groups of tourists choose different accommodation facilities as well as tourist attractions, and many factors influence their decisions. Particular social class is one of the most important factors influencing tourists' decision-making process, and it expresses an individual's position in society (**Zhao et al., 2020**). It includes multiple items: education, income, occupation, and education; thus, it possesses a clustering effect (**Ying et al., 2016**). The research field is dominated primarily by studies investigating the differences between the social classes of tourists linked to tourism activities (culture, shopping, attractions, consumption), but few studies have examined the influence of the relationship between perceived value and social stratification on tourist satisfaction thus far.

2.1. Consumer behavior and the social stratification of tourists

Social stratification expresses the differences between social members and groups that arise as a result of different ownership of social resources (**Grusky, 2019**). In the research processes focused on the different population groups, several dimensions of social stratification are applied, such as economic indicators, social prestige, lifestyle, demographic characteristics, consumption and cultural indicators.

Tourism is associated not only with consumer behavior but also with the process of creating and consolidating the social positions of individuals (**Zhao et al., 2020**). The social values of individuals are also reflected in consumer behavior. In the past, social stratification was applied mainly in the study of tourism consumption, but the effects of combined factors such as education, sex, working position, and income on the behavior of tourists have been more intensively investigated in recent years. Income is a major determinant in travel, and thus, it influences economic thoughts in decision-making as well as in the evaluation of tourist destinations, with income being related to expenditure (**Nicolau and Más, 2005**). Sex along with income can also be an important factor in tourist decision-making and consumption behavior, while we also see a strong relation between working position and education (**Floyd et al., 2006**). This justifies the importance of an examination of the triad of factors - working position, education, and income -because a higher income level and a tourist education level are associated with greater tourist activity and staying in more luxury accommodation facilities. Income is also generally related to working position, while these factors influence tourist values, lifestyles, and

consumer habits (**Mothersbaugh and Hawkins, 2016**). These consistent facts justify the importance of an examination of these attributes as the elementary parameters of the social class.

For an investigation of tourist satisfaction, it is important to understand the structure of perceived value and, within it, several causal relations of its aspects. According to **Rasoolimanesh et al. (2016)**, perceived value represents an integrated determinative concept consisting of functional, social, and emotional aspects of value. According to **Jamal et al. (2011)**, the tourist perception of value depends not only on the functional aspects of value but also on the emotional and experiential aspects of value. Perceived value is considered a multidimensional perspective, while in the context of tourism, some authors classify it as a postconsumption concept consisting of several perspectives of the value dimensions (**Jamal et al., 2011; Pandža Bajs, 2015**). Different tourists have different perceived values of destinations, while earlier research studies have confirmed the differences in the levels of overall perceived value mainly based on demographic and socioeconomic indicators such as sex, residence location, age, income, and education (**Chhabra et al., 2003**). Nevertheless, we find strong associations between the social and emotional aspects of tourist behavior and the emotional aspects directly linked to demographic indicators in the study by **Budruk et al., 2008**.

The definition of social classes as an elementary classification aspect of tourists and an investigation of these social classes in relation to the different evaluations of tourist satisfaction with accommodation are absent in research studies. This resulted in an elimination of the possibilities of discovering new determinants affecting the processes and the outcomes of the evaluation of tourist satisfaction, the low rate of penetration of the other scientific disciplines into tourism marketing and the development of new evaluation tools.

2.2. Fuzzy approaches for measurement of the consumer behavior of tourists

The relatively new approaches for measuring and evaluating tourist satisfaction are represented by fuzzy models that offer a new perspective in solving issues within a wide range of management processes in the sectors. Their importance increases, especially when investigating the satisfaction of tourists within intangible concepts such as the quality of service. Since the input data for the fuzzy evaluation model are obtained from tourists, it is therefore fuzzy and subjective. In addition, a set of criteria for evaluating accommodation establishments is evaluated by a participant in the tourist movement with the help of linguistic variables. In this case, the input data are ambiguous. Since the investigated problem refers to intellectual systems, the knowledge is not reliable, let alone complete. In this regard, the use of various statistical approaches does not allow for taking into account the subjectivity of experts and the formation of a qualitative knowledge base of the subject area for making adequate decisions. Therefore, it is appropriate to use fuzzy set theory, linguistic variables, multidimensional membership functions, and system analysis to represent knowledge in this study. It is well known that the theory of fuzzy sets and fuzzy logic increases the accuracy of the evaluation for decision-making. According to **Ngyuen (2021)**, accommodation facilities should focus on sequential and organized priority factors to increase the quality of service, and fuzzy models represent the optimal tool to explore them. The significance of fuzzy approaches has also been confirmed in benchmarking processes in the tourism industry (**Luštický and Bína, 2014**). **Benitez et al. (2007)** see the significant advantages in an application of the fuzzy multiattribute decision-making approach for dynamic evaluation of the quality of service of various hotels. They also consider the fuzzy approach optimal for evaluating the performance of hotel services.

Martín et al. (2019) employed a fuzzy multicriteria decision-making model to evaluate tourist satisfaction according to many segments based on sex, age, and mother tongue, and the sex

differentiation in the satisfaction results was confirmed. Li et al. (2017) recommend the application of a fuzzy comprehensive evaluation algorithm for tourism researchers to understand tourist preferences and to evaluate hotel performance to improve the quality of service. Fuzzy approaches are also employed for an evaluation of the effectiveness of policies and strategies aimed at increasing tourist satisfaction, while in this research line, we can also observe efforts to quantify the impact of tourist satisfaction on tourist spending behavior. As noted in the study by **D'Urso et al. (2020)**, this issue is only minimally addressed, and the authors suggest an application of the fuzzy double-hurdle model to investigate it. Many research studies recommend exploration through fuzzy approaches and systems to eliminate the ambiguities and inaccuracies of rating data in the evaluations of individuals (**Calcagni et al., 2022; Mehdiabadi et al., 2021**) or in solving problems related to the optimization of tourism systems (**Shojatalab et al., 2022**).

Despite the strong development of fuzzy methods in solving optimization and decision-making tasks and their use in various evaluation mechanisms, fuzzy approaches have not yet been applied in the evaluation of tourist satisfaction categorized according to social classes, while a view of the significance and influence of aggregated socioeconomic aspects has not been explored for a long period.

This article consists of the following parts. *Part 2* describes the formal formulation of the problem and the mathematical fuzzy level estimation model satisfaction of tourists regarding accommodation in terms of its components: the first stage of the model is an information model and a fuzzy method of assessing the level of satisfaction of tourists from accommodation establishments; the second stage of the model is a fuzzy method of predicting the level of satisfaction with accommodation establishments by a potential tourist of the corresponding region, based on social class. *Part 3* provides an example of evaluating research results on real data, as well as the verification and testing of a fuzzy model. *Part 4* discusses the results of the research. *Part 5* concludes the study and presents the main results obtained for the first time. It identifies ideas for future work, namely, the development of information technology and software to support decision-making in the tourism industry, based on the individual and collective psychology of tourist marketing.

3. Materials and methods

3.1. Formal formulation of the evaluation problem

Let $R = \{R_1; R_2; \dots; R_n\}$ be considered - a set of regions for evaluating the level of satisfaction of tourists of the destination about accommodation establishments. Participants of the tourist movement (tourists) $E = \{e_1; e_2; \dots; e_m\}$ have visited the destination and evaluated the level of its accommodation establishments based on the selected criteria. The set of such criteria is denoted by $K = \{K_1; K_2; \dots; K_l\}$, which, together with its evaluation system, represents the KSC information model for evaluating the level of tourist satisfaction from accommodation establishments relative to social classes S . M_S is a fuzzy method for evaluating the level of satisfaction of tourists regarding accommodation establishments. M_P is a fuzzy method of predicting the level of satisfaction with accommodation establishments by potential tourists of the corresponding region based on social class.

In the form of an operator, a fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class is presented:

$$\Delta(R, E, K_{SC}, S, M_S, M_P) \rightarrow f(m_{SC}, p_{SC}). \quad (1)$$

Δ - an operator that matches a set of output values f , with input variables $R, E, K_{sc}, S, M_s, M_p$. The output of the fuzzy model is obtained: m_{sc} - level assessment satisfaction of tourists regarding accommodation establishments based on social class; p_{sc} - projected assessment of the level of satisfaction with accommodation establishments by potential tourists (social class) of the respective region.

As a result, an output estimate is obtained m_{sc} , containing the content of the satisfaction of tourists regarding accommodation establishments based on social class. Based on such an assessment, an analysis of the level of accommodation establishments at the destination in the studied regions, in terms of satisfaction of social classes, is carried out. In the second stage, a predicted aggregate assessment of the level of satisfaction with accommodation establishments at the destination by potential tourists in the respective region is obtained. Such predictive assessment can be used for various future decision-support scenarios by various management entities. Example:

- on the part of the tourist - to improve the quality of travel planning;
- on the part of commercial companies (tour operators, tour agencies, booking platforms, and other companies) - to improve the quality of their services;
- on the part of state authorities - to understand the level of development of accommodation establishments as one of the key elements of the development of the tourism industry in the region.

Fuzzy model evaluation is based on expert opinions. In this connection, the following management subjects are defined: respondents - participants of the tourist movement, who expressed their satisfaction with accommodation establishments in the visited destination; a system analyst is a person who configures all processes for fuzzy model level assessment satisfaction of tourists regarding accommodation according to social class; and a decision-making person (*DM*) is a person who makes further management decisions based on output assessments.

To illustrate a fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class, a structural diagram is presented in **Fig. 1**.

Fig. 1 shows the structure diagram of the fuzzy-level estimation model satisfaction of tourists regarding accommodation establishments. Processed input expert data with information about their social class form a database of the researched task. After the evaluation procedures, an assessment of the level of satisfaction is obtained separately for the participant of the tourist movement, taking into account his social class and the ranking series of the participants of the tourist movement. This information forms a knowledge base. Additionally, after the assessment, one aggregate assessment of the level of satisfaction with regard to accommodation facilities for the region is constructed. On the basis of the knowledge base, a predicted assessment of the level of satisfaction with accommodation facilities by a potential tourist of the respective region is derived based on the "vector of social class. Based on the output data, the *DM* decision is made regarding future scenarios to support the decisionmaking of interested parties, such as tourists, businesses, and state authorities. If the obtained results do not satisfy the *DM*, then there is an opportunity to revise the assessment, for example, to choose another region or social class of the potential tourist.

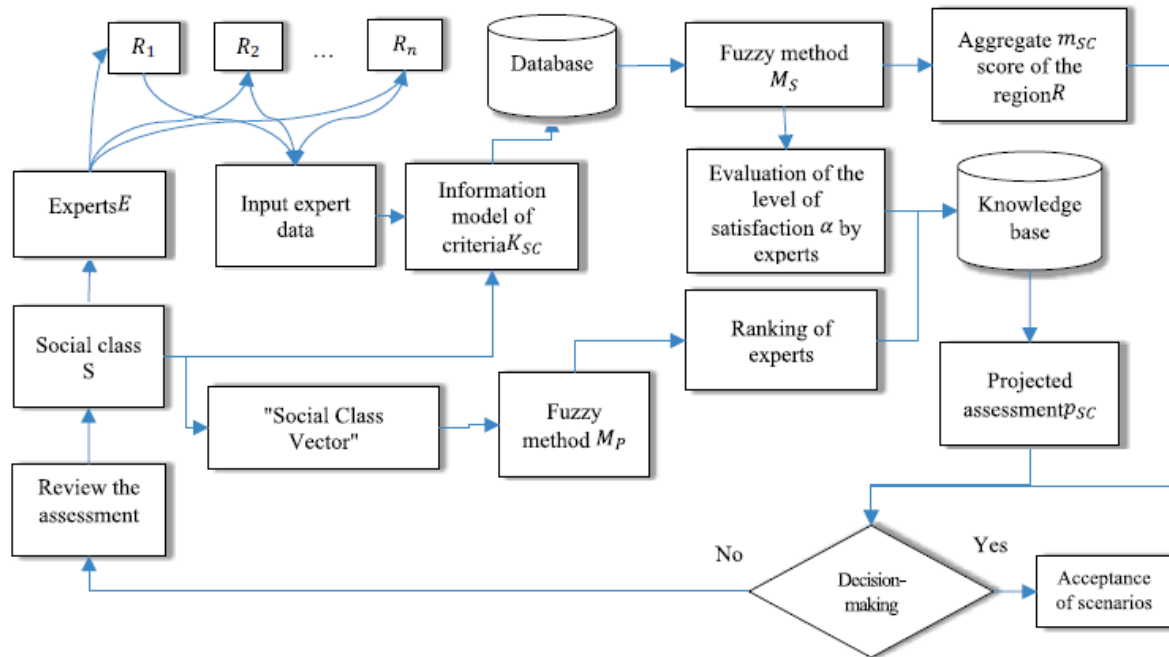


Fig. 1. Structural diagram of the fuzzy model for evaluating the level of satisfaction of tourists.

A fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class

The fuzzy model is illustrated in the form of two stages. In the first stage, the information model is presented K_{SC} , based on which the level assessment takes place satisfaction of tourists regarding accommodation establishments relative to social classes. In the second stage, based on the “social class vector”, as a potential tourist, the degree of his satisfaction with accommodation establishments in the destination of a certain region is predicted.

The first stage of the model is considered.

An informational evaluation model is given K_{SC} the level of satisfaction of tourists regarding accommodation establishments relative to social classes. A set of criteria for evaluating accommodation establishments is proposed $K = \{K_s; s = 1, I\}$, which are evaluated by the participant of tourist movement e using linguistic variables $T = \{t_1; t_2; t_3; t_4; t_5\}$. Moreover: t_1 - «Strongly disagree»; t_2 - «Disagree»; t_3 - «Neither agree nor disagree»; t_4 - «Agree»; t_5 - «Strongly agree».

The set of criteria includes the attitudes and impressions of the participants of the tourist movement regarding accommodation establishments at the destination. The set of proposed criteria consists of statements arising from the question: How do you feel about the following statements about the accommodations where you stayed during your last vacation or multiday stay? It is open, and the model does not depend on their number. The following statements are formulated for the interpretation of the information model:

K_1 - the room was equipped with modern equipment;

K_2 - the material equipment was visually attractive;

- K_3 - the workers were dressed appropriately and looked pleasant;
- K_4 - the appearance of physical premises corresponded to the type of services provided;
- K_5 - when employees promised to do something by a certain time, they did it;
- K_6 - staff were friendly and reassuring when customers had problems;
- K_7 - the staff was reliable;
- K_8 - employees provided their services at the time they promised;
- K_9 - employees kept accurate records (records/administration);
- K_{10} - employees can be expected to tell customers exactly when services will be provided;
- K_{11} - customers could truly count on fast service;
- K_{12} - employees can be expected to help customers at all times;
- K_{13} - staff were not too busy to respond quickly to customer requests;
- K_{14} - customers could trust employees;
- K_{15} - customers could feel safe during their transactions (payments) with employees;
- K_{16} - the staff was polite;
- K_{17} - in my opinion, the employees had adequate support from the management so that they could do their jobs well;
- K_{18} - employees approached customers individually;
- K_{19} - employees paid special attention to customers;
- K_{20} - employees knew what their customers' needs were;
- K_{21} - the employees' focus was on customers;
- K_{22} - the work schedule was acceptable for all clients.

Every participant in tourist movement $E = \{e_1; e_2; \dots; e_m\}$ belongs to some social class - S . We will understand a certain set of values by social class $S = (sc_1, sc_2, \dots, sc_5)$, representing the demographic characteristics of the respondents (participants of the tourist movement).

The demographic characteristics of the respondents include the following:

- S_1 - the age of the respondent (sc_1 - indicator estimated in years).
- S_2 - primary socioeconomic status.

Linguistic assessment sc_2 consists of one term $sc_2 = \{\text{Student; Employed; Unemployed; Maternity leave/guardianship; Retiree}\}$. The transition from linguistic to quantitative evaluation occurs by assigning some quantitative evaluation with the help of the following function:

$$\mu_{sc_2} = \begin{cases} 0.2 & \text{if } sc_2 = \text{"Unemployed"}; \\ 0.4 & \text{if } sc_2 = \text{"Maternity leave/guardianship"}; \\ 0.6 & \text{if } sc_2 = \text{"Student"}; \\ 0.8 & \text{if } sc_2 = \text{"Retiree"}; \\ 1 & \text{if } sc_2 = \text{"Employed"} \end{cases} \quad (2)$$

S_3 - education.

Linguistic assessment sc_3 consists of one term $sc_3 = \{\text{Elementary}; \text{High School}; \text{College/University}\}$. The transition from linguistic to quantitative assessment occurs similarly by assigning some quantitative assessment with the help of the following function:

$$\mu_{sc_3} = \begin{cases} 0.2 & \text{if } sc_3 = \text{"Elementary"}; \\ 0.6 & \text{if } sc_3 = \text{"High School"}; \\ 1 & \text{if } sc_3 = \text{"College/University"} \end{cases} \quad (3)$$

S_4 - average monthly net income. Indicator sc_4 is estimated in Euro currency units, and the following intervals are offered: less 221 EUR; 222-330 EUR; 331-430 EUR; 431-540 EUR; 541-720 EUR; 721-1090 EUR; 1091-1810 EUR; 1811-2540 EUR; more 2540 EUR. The transition from linguistic to quantitative evaluation occurs with the help of the following function:

$$\mu_{sc_4} = \begin{cases} 0.2 & \text{if } sc_4 = \text{"< 221 EUR"}; \\ 0.3 & \text{if } sc_4 = \text{"221-330 EUR"}; \\ 0.4 & \text{if } sc_4 = \text{"331-430 EUR"}; \\ 0.5 & \text{if } sc_4 = \text{"431-540 EUR"}; \\ 0.6 & \text{if } sc_4 = \text{"541-720 EUR"}; \\ 0.7 & \text{if } sc_4 = \text{"721-1090 EUR"}; \\ 0.8 & \text{if } sc_4 = \text{"1091-1810 EUR"}; \\ 0.9 & \text{if } sc_4 = \text{"1811-2540 EUR"}; \\ 1 & \text{if } sc_4 = \text{"> 2540 EUR"} \end{cases} \quad (4)$$

S_5 - marital status.

Linguistic assessment sc_5 consists of one term $sc_5 = \{\text{Single}; \text{Married}; \text{Divorced}; \text{Widower/Widow}\}$. The transition from linguistic to quantitative evaluation occurs with the help of a function:

$$\mu_{sc_5} = \begin{cases} 0.6 & \text{if } sc_5 = \text{"Widower/Widow"}; \\ 0.7 & \text{if } sc_5 = \text{"Divorced"}; \\ 0.8 & \text{if } sc_5 = \text{"Single"}; \\ 0.9 & \text{if } sc_5 = \text{"Married"} \end{cases} \quad (5)$$

Note that our model will predict social class satisfaction using proximity measures. This means that the transition from a linguistic assessment to a quantitative one does not reflect a substantive meaning, and the comparison made is used only for the purpose of making calculations. In other words, the quantification value does not evaluate the respondents and does not make any inferences about their demographic characteristics. We are interested in the level of satisfaction of tourists with accommodation establishments according to social class and, based on this, derive the predicted level of satisfaction for various combinations of demographic characteristics.

Further representations of the fuzzy model are made in general terms with respect to the number of criteria and demographic characteristics.

Thus, after visiting some region R , input expert data from respondents will be as follows, **Table 1**.

Where t_{si} - variable from the term set $T_{30s} - M$ criterion, for the i -th expert;

$(SC_{1(i)}, SC_{2(i)}, \dots, SC_{g(i)})$ - a set of values of respondents' demographic

characteristics for the i -th expert, $h = \overline{1, g}, s = \overline{1, l}; i = \overline{1, m}$.

Suggested M_5 is a fuzzy method for evaluating the level of satisfaction of tourists regarding accommodation establishments.

Using the fuzzy method will output m_{SC} - assessment of the level of satisfaction of tourists regarding accommodation establishments based on social class. For this purpose, the input linguistic conclusions are first fuzzified. After that, there is a transition to one normalized assessment of the level of satisfaction of tourists with accommodation establishments according to experts. At the final stage, one aggregated assessment of the level of satisfaction of tourists with accommodation establishments within the region is obtained. Based on such an assessment, a ranking series of regions can be built.

The following approach is used to fuzzify incoming linguistic inferences.

A transition is made from the linguistic conclusions of the respondents for each criterion to a quantitative assessment by assigning some quantitative assessment τ , example: (τ_1 «Strongly disagree» - $\tau_1 = 1$; τ_2 «Disagree» - $\tau_2 = 2$; τ_3 «Neither agree nor disagree» - $\tau_3 = 3$; τ_4 «Agree» - $\tau_4 = 4$; τ_5 «Strongly agree» - $\tau_5 = 5$).

The value of quantitative assessment t increases with increasing level satisfaction of tourists regarding accommodation.

Next, a transition is made to one normalized assessment of the level of satisfaction of tourists with accommodation establishments according to experts, according to the following formula:

$$\alpha_i = \frac{1}{5l} \sum_{s=1}^l t_{si}, i = \overline{1, m}. \quad (6)$$

In this way, an aggregated assessment of the level of satisfaction of tourists with accommodation establishments is obtained $\alpha_i \in [0; 1]$ separately by experts, which determines the level of the

destination based on the satisfaction of the respondents, based on the information model of criteria for evaluating the level of satisfaction of tourists from accommodation establishments.

At the final stage, one aggregated assessment of the level of satisfaction of tourists with accommodation establishments within the region is obtained.

To do this, one generalized value will be derived based on aggregated ratings of the level of satisfaction of tourists at accommodation establishments $\alpha_i \in [0; 1]$ in the studied region R . If the system analyst knows the weighting coefficients for the participants of the tourist movement, then one of the convolutions can be used, for example, depending on the psychosomatic mood of the DM. Since in the presented study, we consider all respondents to be equally important, we will use the following formula:

$$m_{SC}(j) = \frac{1}{m(R_j)} \sum_{i=1}^{m(R_j)} \alpha_{i,j} = \overline{\alpha}, n. \quad (7)$$

where $m(R_j)$ is the number of respondents in region R_j . Aggregate assessment within the region $m_{SC}(j) \in [0; 1]$ characterizes the level of satisfaction of tourists from accommodation establishments, which was evaluated by their real experience.

The second stage of the model.

In the second stage, a predicted aggregate assessment of the level of satisfaction with accommodation establishments at the destination by a potential tourist in the relevant region is obtained based on social class.

Table 1 Input expert data from respondents in region R .

		e_1	e_2	...	e_m
Name criterion	K_1	t_{11}	t_{12}	...	t_{1m}
	K_2	t_{21}	t_{22}	...	t_{2m}

	K_l	t_{l1}	t_{l2}	...	t_{lm}
Social class	S	$(sc_{1(1)}, sc_{2(1)}, \dots, sc_{g(1)})$	$(sc_{1(2)}, sc_{2(2)}, \dots, sc_{g(2)})$...	$(sc_{1(m)}, sc_{2(m)}, \dots, sc_{g(m)})$

Table 2 Input data for the second stage of the model in the region R .

R	e_1	e_2	...	e_m
α	α_1	α_2	...	α_m
S	$sc_{1(1)}$	$sc_{1(2)}$...	$sc_{1(m)}$
	$sc_{2(1)}$	$sc_{2(2)}$...	$sc_{2(m)}$

	$sc_{g(1)}$	$sc_{g(2)}$...	$sc_{g(m)}$

For this, M_P is proposed - a fuzzy method of predicting the level of satisfaction with accommodation establishments by potential tourists of the corresponding region, based on social class.

Each participant of the tourist movement who belongs to a certain social class, after visiting an accommodation facility in some region R , receives a normalized assessment of the level of satisfaction

with accommodation establishments a_i . The input data for the second stage of the model will be presented in the form of **Table 2**.

Next, the “social class vector” of a potential tourist $U^* = (u_1, u_2, \dots, u_g)$ is considered, in which the coordinate estimates could satisfy the DM. In other words, it is an imaginary tourist or social class for which the level of satisfaction with accommodation establishments in some selected region is predicted R .

Let us denote the decision matrix consisting of elements of demographic characteristics of respondents in some selected region R as follows:

$$S = \begin{pmatrix} SC_{1(1)} & SC_{1(2)} & \dots & SC_{1(m)} \\ SC_{2(1)} & SC_{2(2)} & \dots & SC_{2(m)} \\ \dots & \dots & \dots & \dots \\ SC_{g(1)} & SC_{g(2)} & \dots & SC_{g(m)} \end{pmatrix}. \quad (8)$$

We will build a ranking of participants in tourist movement $\{e_1, e_2, \dots, e_m\}$ in some region R , where the first place will be the participants of the tourist movement, which are closest to the “social class vector”; for this, the following approach is used.

Assume that the decision matrix (8) and the given “social class vector” of a potential tourist are known $U^* = (u_1, u_2, \dots, u_g)$. A set of values is determined, which are relative estimates of the proximity of the matrix element (8) to the corresponding element of the “social class vector”:

$$z_{hi} = 1 - \frac{|u_h - SC_{h(i)}|}{\max\{u_h - \min_i(SC_{h(i)}); \max_i(SC_{h(i)}) - u_h\}}, \quad h = \overline{1, g}, i = \overline{1, m}. \quad (9)$$

The matrix is defined in this way $Z = \{z_{hi}\}$ characterizes the relative evaluations of the proximity of the participant of the tourist movement by columns e_i to the “social class vector” of a potential tourist $U^* = (u_1, u_2, \dots, u_g)$ for each specific demographic characteristic of the respondents, while removing the issue of different rating scales.

Let the DM know or be able to assign weighting factors to each demographic characteristic $\{v_1, v_2, \dots, v_g\}$ from some interval $[0; 10]$. Then, normalized weighting factors for each demographic characteristic are determined:

$$w_h = \frac{v_h}{\sum_{h=1}^g v_h}, \quad h = \overline{1, g}; w_h \in [0; 1]. \quad (10)$$

which meets the condition $\sum_{h=1}^g w_h = 1$.

The next step is the construction of a ranking series of the participants of the tourist movement relative to the “social class vector”. For this purpose, a membership function is built, as one of the proposed convolutions, depending on the psychosomatic mood of the DM:

$$m_1(e_i) = \frac{1}{\sum_{h=1}^s \frac{w_h}{z_{hi}}} - \text{pessimistic}; \quad (11)$$

$$m_2(e_i) = \prod_{h=1}^s (z_{hi})^{w_h} - \text{careful}; \quad (12)$$

$$m_3(e_i) = \sum_{h=1}^s w_h \bullet z_{hi} - \text{average}; \quad (13)$$

$$m_4(e_i) = \sqrt{\sum_{h=1}^s w_h \bullet (z_{hi})^2} - \text{optimistic}. \quad (14)$$

The following subordination exists between the original aggregated scores: $m_1(e_i) \leq m_2(e_i) \leq m_3(e_i) \leq m_4(e_i)$, $i = \overline{1, m}$.

Based on the evaluations $m(e_i)$, a ranking list of participants in the tourist movement is being built: $A = \{A_1, A_2, \dots, A_m\}$. To improve the quality of the decision, the first three positions of the respondents and their corresponding standardized assessments of the level of satisfaction with accommodation establishments are selected from this series α . We denote it accordingly: $\alpha(A_1), \alpha(A_2), \alpha(A_3)$.

To derive a predicted estimate P_{sc} of the level of satisfaction with accommodation establishments by a potential tourist of the corresponding region R , based on social class, an intellectual analysis of knowledge based on multidimensional functions of belonging is used. In three-dimensional space, it is necessary to model uncertainties of the "average value" type. A cone-shaped or pyramidal membership function can be used for this type of uncertainty. Where the value of the center of the base will be a unit vector, and the scaling will be based on the coordinates (3;3;3). The conical membership function will have the form:

$$p_{sc}(R) = \begin{cases} 1 - \mu, & \text{when } \mu < 1, \\ 0, & \text{in the other case.} \end{cases} \quad (15)$$

where $\mu = \frac{1}{3} \bullet \sqrt{(\alpha(A_1) - 1)^2 + (\alpha(A_2) - 1)^2 + (\alpha(A_3) - 1)^2}$.

The pyramidal membership function is described by the formula:

$$p_{sc}(R) = \max \left\{ \left(1 - \frac{1}{3} (|\alpha(A_1) - 1| + |\alpha(A_2) - 1| + |\alpha(A_3) - 1|) \right); 0 \right\}. \quad (16)$$

The choice of the type of membership function depends on the system analyst and may lead to minor ambiguities in the result, but in general, this does not affect the reliability of the obtained results.

The presented fuzzy model for evaluating the level of tourist satisfaction with accommodation establishments according to social class is developed in such a way that it does not depend on the number of evaluation criteria and regions. At the output, we receive the following: at the first stage, for some regions, an assessment of the level of satisfaction of tourists about accommodation establishments based on social class; at the second stage, for some regions, a projected assessment of the level of satisfaction with accommodation establishments by a potential tourist (social class). The model can be easily replicated by other researchers by drawing on their database of respondents and expanding the geography of the study.

4. Results

The fuzzy model for assessing the level of satisfaction of tourists regarding accommodation establishments according to social class has been verified and tested on real data in the countries of the Visegrad Group (Czech Republic, Hungary, Poland, Slovakia) (**Data from 2343 participants**). For nine months in 2021, we collected data from 2343 respondents for the period from 2017 to 2021. Respondents completed a research questionnaire containing 132 questions aimed at studying attitudes toward selected areas related to tourism. The creation of such an extensive questionnaire, as well as the entire procedure of implementing data collection, became possible thanks to the cooperation of various organizations. All 132 questions were classified into 16 groups, including general information about the respondent; information about recreation; the quality of services provided at the accommodation facility; culture, habits, traditions; attitude to local cuisine; sports and free time; business services and purchases; the attitude of residents to tourists, etc.

Table 3 Fragments of incoming expert data in the region Prešov.

Name criterion	e_1	e_2	e_3	...	e_{310}	e_{311}
K_1	t_4^a	t_5^a	t_2^a	...	t_3^a	t_5
K_2	t_4	t_5	t_3	...	t_2	t_5
K_3	t_4	t_5	t_5	...	t_2	t_5
K_4	t_4	t_5	t_5	...	t_2	t_5
K_5	t_5	t_5	t_5	...	t_2	t_5
K_6	t_5	t_5	t_5	...	t_2	t_5
K_7	t_5	t_5	t_5	...	t_2	t_5
K_8	t_5	t_5	t_5	...	t_2	t_5
K_9	t_4	t_5	t_5	...	t_1^a	t_5
K_{10}	t_4	t_5	t_5	...	t_2	t_5
K_{11}	t_4	t_5	t_5	...	t_2	t_4
K_{12}	t_4	t_5	t_5	...	t_2	t_5
K_{13}	t_4	t_5	t_4	...	t_2	t_4
K_{14}	t_4	t_5	t_5	...	t_2	t_4
K_{15}	t_5	t_5	t_5	...	t_3	t_4
K_{16}	t_5	t_5	t_5	...	t_2	t_5
K_{17}	t_4	t_5	t_5	...	t_2	t_4
K_{18}	t_5	t_5	t_5	...	t_2	t_4
K_{19}	t_5	t_5	t_5	...	t_2	t_4
K_{20}	t_5	t_5	t_5	...	t_2	t_4
K_{21}	t_4	t_5	t_5	...	t_2	t_4
K_{22}	t_4	t_5	t_5	...	t_2	t_4

^a t_1 - "strongly disagree"; t_2 - "disagree"; t_3 - "neither agree nor disagree"; t_4 - "agree"; t_5 - "strongly agree".

Demographic characteristics are correlated with the proposed set of social classes. From 2343 respondents, we have that their age is in the range [20; 76], with an average age of 29 years. A total of 1155 respondents had a university or college education, 1091 had a high school education, and the rest had an elementary education. The primary socioeconomic status is made up of students and the working population. For the indicator of average monthly net income, we have the following sample: 698 respondents have an income of <221 EUR; 222-330 EUR - 279 respondents; 331-430 EUR - 206 respondents; 431-540 EUR - 161 respondents; 541-720 EUR - 245 respondents; 721-1090 EUR - 410 respondents; 1091-1810 EUR - 252 respondents; 1811-2540 EUR - 57 respondents; 35 respondents have an income of >2540 EUR. As seen, the majority of the sample of respondents consists of active

people of working age, who represent the vast majority of tourists who use accommodation facilities. Therefore, the obtained statistical data meet the requirements for the formation of a qualitative sample of data, and the selected respondents covered the full set of elements of the investigated issues and corresponded to various demographic characteristics.

Experiments were conducted based on the entire dataset using the developed fuzzy model for evaluating the level of satisfaction of tourists from accommodation establishments according to social class.

The following is an example of an evaluation of data fragments, for example, for the region of Presov (Slovakia), with the aim of being able to reproduce the experiment by other scientists and business managers. The available sample covers that during the period 2017-2020, the Presov region was visited by 311 participants of the tourist movement (**Data from 2343 participants**). Fragments of input expert data from respondents are shown in **Table 3**, and fragments of data on the social class of respondents are shown in **Table 4**.

Table 4 Fragments of data on the social class of respondents.

Demographic characteristics	e_1	e_2	e_3	e_{310}	e_{311}
sc_1	22	22	22	44	41
sc_2	Student	Student	Student	Employed	Employed
sc_3	High School	College/ University	College/ University	College/ University	College/ University
sc_4	<221 EUR	<221 EUR	<221 EUR	1091-1810 EUR	1091-1810 EUR
sc_5	Single	Single	Single	Married	Married

Table 5 Fragments of the standardized assessment of the level of satisfaction of accommodation establishments and quantitative assessments of demographic characteristics.

		e_1	e_2	e_3	e_{310}	e_{311}
α		0.882	1	0.945	0.409	0.909
Demographic characteristics	sc_1	22	22	22	44	41
	sc_2	0.6	0.6	0.6	1	1
	sc_3	0.6	1	1	1	1
	sc_4	0.2	0.2	0.2	0.8	0.8
	sc_5	0.8	0.8	0.8	0.9	0.9

The calculation is carried out according to the mathematical model proposed above, which consists of two stages.

The first stage of the model

First, the calculation is carried out according to M_S - the fuzzy method of assessing the level of tourist satisfaction with accommodation establishments. For this, in the first step, we move from the linguistic conclusions of the respondents for each criterion to a quantitative assessment by assigning some quantitative assessment: $t_1=1$; $t_2=2$; $t_3=3$; $t_4=4$; $t_5=5$. Next, there is a transition to one normalized assessment of the level of satisfaction with accommodation establishments separately by experts, according to **Formula (6)**. There is also a transition from linguistic assessments of respondents' demographic characteristics to quantitative assessments, using **Formulas (2)-(5)**, respectively. Fragments of these results are presented in **Table 5**.

At the final stage of the fuzzy method - M_S using **Formula (7)**, one aggregated estimate of the level of satisfaction of tourists with regard to accommodation establishments within the region is obtained:
 $m_{sc}(\text{Prešov}) = \frac{1}{311}(0.882 + 1 + 0.945 + \dots + 0.409 + 0.909) = 0.816$.

Based on this assessment, $m_{sc}(\text{Prešov})$ the *DM* can conclude that the accommodation establishments in the Presov region are at a high level, and the participants of the tourist movement are satisfied with them.

The second stage of the model

In the second stage, a predicted aggregate assessment of the level of satisfaction with accommodation establishments at the destination by a potential tourist or social class in the relevant region is obtained.

The calculation is carried out using a fuzzy method M_p .

For example, let *DM* consider the "social class vector" of a potential tourist as follows (35; "Employed"; High School; 721-1090 EUR; Married). In this case, using **Formulas (2)-(5)**, the "social class vector" will have the form $U^* = (35; 1; 0.6; 0.7; 0.9)$.

Next, a set of values is determined, which are relative estimates of the proximity of elements of demographic characteristics to the corresponding element of the "social class vector" according to **Formula (9)**. Fragments of the calculation are given in **Table 6**.

Next, let *DM* set the weighting coefficients for each demographic characteristic from the interval [1; 10] as follows: {8;10;9;10;6}. The normalized weight coefficients are then determined by **Formula (10)**: $w_1 = 0.186$; $w_2 = 0.233$; $w_3 = 0.209$; $w_4 = 0.233$; $w_5 = 0.14$.

The next step is the construction of a ranking series of the participants of the tourist movement relative to the "social class vector". For this, let the average convolution according to **Formula (13)** be used.

Table 6 Fragments of the matrix of relative assessments of the proximity of the participant of the tourist movement to the "social class vector".

Demographic characteristics	e_1	e_2	e_3	e_{310}	e_{311}
sc_1	0.594	0.594	0.594	0.719	0.813
sc_2	0.5	0.5	0.5	1	1
sc_3	1	0	0	0	0
sc_4	0	0	0	0.8	0.8
sc_5	0.667	0.667	0.667	1	1

Fragments of calculations are as follows: $m_3(e_1) = 0.529$; $m_3(e_2) = 0.32$; $m_3(e_3) = 0.32$; ...; $m_3(e_{310}) = 0.693$; $m_3(e_{31111}) = 0.711$.

Then, based on the grades $m_3(e)$, a ranking list of participants in the tourist movement is built: $A = \{A_1(e_{190}); A_2(e_{126}); A_3(e_{301}); A_4(e_{85}); \dots, A_{310}(e_{131}) A_{311}(e_{89})\}$. The first three positions of respondents are selected from this row $A_1(e_{190}); A_2(e_{126}); A_3(e_{301})$ and their corresponding normalized ratings of satisfaction with accommodation establishments α : $\alpha(A_1) = \alpha_{190} = 0.382$; $\alpha(A_2) = \alpha_{126} = 0.973$; $\alpha(A_3) = \alpha_{301} = 0.955$.

In the final step, the predicted score is calculated as the pSC level of satisfaction with accommodation establishments by a potential tourist of the relevant Presov region, taking into account social class,

$$\text{Formula (15): } \mu = \frac{1}{3} \sqrt{(0,382 - 1)^2 + (0,973 - 1)^2 + (0,955 - 1)^2} = 0,2067.$$

$$P_{sc}(\text{Prešov}) = 0.7933.$$

Thus, the predicted level of satisfaction with accommodation establishments by a potential tourist (who is 35 years old, married, working, without higher education, and with a monthly income of 721-1090 EUR) in the Presov region is at the level of 0.7933, which is lower than the overall assessment of the level of satisfaction of tourists with accommodation establishments by 2.27 %.

Next, we will analyze the entire Presov region regarding the level of tourist satisfaction with accommodation establishments according to social class. We will divide the result into four groups: low satisfaction $\alpha \in [0; 0.4]$; average satisfaction $\alpha \in [0.4; 0.6]$; satisfaction is above average $\alpha \in [0.6; 0.8]$; high satisfaction $\alpha \in [0.8; 1]$.

Low satisfaction: they include 18 respondents (5.8 % of the sample), whose average age is 33 years, working (50 %), and the rest are students and unemployed, with an average income of 431-540 EUR, the vast majority Single (60 %) with a High Education School (78 %).

Average satisfaction: They include 20 respondents (6.4 % of the sample), whose average age is 30 years, the vast majority are students and on maternity leave/guardianship, the average income of 431-540 EUR, single (70 %), married (30 %), with high school (65 %) and col-lege/university education (35 %).

Above average satisfaction: They include 68 respondents (21.9 % of the sample), whose average age is 30 years, working (31 %) and students (69 %), average income 331-430 EUR, Single (72 %), Married (27 %), Widower/Widow (1 %) with High School and Elementary education (50 %) and College/University (50 %).

High satisfaction: they include 205 respondents (65.9 % of the sample), whose average age is 32 years, working (38 %) and students (56 %), average income 221-330 EUR, Single (54 %), Married (46 %) with High School (24 %) and Elementary (46 %) and College/University Education (30 %).

From this, we can conclude that income, age, type of activity, or education clearly do not affect the level of satisfaction with accommodation, but this can be predicted on the basis of the developed fuzzy model.

5. Discussion, implications and limitations

In this work, a fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class has been developed using the example of V4 countries. For this purpose, an information model was developed for assessing the level of satisfaction of tourists with accommodation establishments relative to social classes; a fuzzy method of assessing the level of tourist satisfaction with accommodation establishments has been developed; a fuzzy method of predicting the level of satisfaction with accommodation establishments by potential tourists of the respective region, based on social class, was developed; the model was verified and adjusted on real data in the countries of the Visegrad group, which were collected from 2343 respondents for the period 2017-2021; an approbation example of a fuzzy model for assessing the level of tourist

satisfaction with accommodation establishments for the Presov region (Slovakia) is given on fragments of data from 311 respondents for the period 2017-2020.

5.1. Theoretical implications

In the previous period, the main goal of the enterprises providing services to tourists was the implementation of the effective marketing methodology integrated into the tools of the marketing mix in the context of a set marketing philosophy based on the creation and distribution of values for specific markets. This strategy is currently insufficient, so the main trend is the integration of psychological knowledge into marketing theory and corporate practice. Individual and collective psychology will increasingly enter performance management systems, quality management processes, and the effectiveness of the services provided in the tourism industry (**Oh et al., 2007; Latiff and Imm, 2015; Assaf and Tsionas, 2015**). Understanding the consumer, consumer behavior, and revealing the determinants influencing the tourist-consumer decision-making process remains a very challenging task in psychology as well as in the marketing sciences.

The results of our study will significantly support the further development of methodological procedures in the field of measuring and evaluating tourist satisfaction as well as the development of a potential database. They will also support the development of benchmarking methods, thus enabling the analysis of competition at different levels and finding optimal procedures to increase the attractiveness of destinations (**Cole and Scott, 2004**). Many methodological problems arise from the incorrect timing of the satisfaction assessment, as much research is carried out before the end of the stay; therefore, we recommend investigating the persistence of a high level of satisfaction, monitoring declines and retention of the evaluations (**Pearce and Packer, 2013; González-Rodríguez et al., 2020**). Fuzzy models perform as a suitable tool to plan and forecast processes, so they can be an effective tool for the creation of demanding development policies (Mehdiabadi et al., 2021). Policy-makers should pay close attention to the consumer preferences of tourists defined by individual social classes and their differences, especially in the modernization process of consumer products, innovations in accommodation products, and guide providers of accommodations and other services in the tourism industry in the context of these findings. Researching tourist satisfaction according to social classes is also greatly important for understanding the relationship between individual tourist satisfaction and the satisfaction of other members of their travel group (**Wu and Li, 2017**), which will support the creation of new models of probable repeat visits or consumption as well as investigating the association between satisfaction and loyalty with transferred loyalty (**Pearce and Packer, 2013; Christou, 2011; Domínguez-Quintero et al., 2019**). This highlights the need for more intensive research into individual and collective psychology in marketing and the creation of new approaches for more effective destination marketing and market segmentation strategies. In the future, we can expect a strong association of marketing research focused on tourist satisfaction with psychological research that emphasizes the importance of selecting the optimal ways, forms, time, and techniques of obtaining ratings from respondents with regard to multiple categorization aspects (**Tang, 2022**). This will also influence the further development of methodologies in the field of measurement and evaluation of tourist satisfaction and tools for decision-making processes and the development of policies.

5.2. Managerial implications

The research uses the modern theory of fuzzy sets, linguistic variables, multidimensional membership functions, and system analysis, which together make it possible to increase the degree of reasonableness of management decisions. The peculiarity of the fuzzy model is that it takes into account expert evaluations of the satisfaction of tourists regarding accommodation; all parameters of the model are obtained by verifying it on real data. Based on output evaluations, the level of accommodation establishments at the destination is analyzed at the destination in the studied regions in terms of the satisfaction of social classes. Additionally, a predicted aggregated assessment of the level of satisfaction with accommodation establishments in the place of destination by a potential tourist in the respective region is obtained. Based on quantitative assessments, the degree of validity of the use of various decision-support scenarios by various management subjects is increased. Such scenarios can be as follows: on the part of the tourist to improve the quality of travel planning, on the part of commercial companies to improve the quality of their services, and on the part of state authorities to understand the level of development of accommodation establishments. In addition, with the help of the developed model, it is possible to study different social classes and predict their level of satisfaction regarding accommodation. Based on such a study, a knowledge base can be constructed, and its introduction into a neuro-fuzzy network will improve the quality of forecasting.

The advantages of the fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class derive from the fact that the model is based on real expert data of respondents, taking into account their social classes; the set of evaluation criteria and demographic characteristics of the social class is open, and the formal presentation of the model does not depend on their number; the “social class vector” of a potential tourist for which the level is predicted is considered satisfaction regarding accommodation in some selected regions; social class is an open concept, and the developed model does not impose strict restrictions on it.

5.3. Limitations and further research

A limitation of our study was the selection of participants of the tourist movement of the research questionnaire, as well as the use of various types of membership functions and characteristic functions to process the results and convolution to build a ranking series of participants of the tourist movement relative to the “social class vector”. The next limitation can be seen in the geography of the study. Such a study needs to be replicated in other countries to be able to compare the raw data. Such limitations lead to ambiguity in the final results, but at the same time, the rationality of the fuzzy model was experimentally proven. The reliability of the obtained results is confirmed by the results of research and verification of the model on real data and is also ensured by the justified use of the mathematical theory of fuzzy sets, linguistic variables, multidimensional membership functions and system analysis. In addition, the obtained research results fully prove the formulated scientific hypothesis.

The developed mathematical model can be applied to other regions by other researchers outside the V4 countries. For this, it is necessary to have feedback from the participants of the tourist movement of the studied regions, to process them with the given information model and to form an appropriate database. After that, use the developed fuzzy models, and if necessary, carry out verification and form a knowledge base to obtain adequate results in the studied region.

Further research on the problem can be seen in the development of other fuzzy models and methods of assessing the level of tourism in selected regions through the psychology of consumers. The research presented and the models and methods developed in the future will serve as the basis of decision-

making support information technology for the innovative development of the tourism industry based on the individual and collective psychology of tourist marketing. For the practical use of this information technology, web-based software will be developed to support decision-making by all interested parties, including tourists, businesses, and state authorities. Together, the developed information technology and software allow adaptation to the new global economy through the analysis of data and knowledge.

6. Conclusions

The main goal of the conducted research is to develop a fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class on the example of V4 countries, and the following results were obtained.

First, an information model of level assessment was developed for the first-time satisfaction of tourists regarding accommodation relative to social classes. For this, a set of criteria regarding the attitude and impressions of the participants of the tourist movement regarding accommodation establishments at the destination, consisting of 22 statements, is proposed. Participants of the tourist movement, as consumers of individual and collective psychology, are considered through the prism of social class. Five demographic characteristics are proposed for this purpose. The set of criteria and demographic characteristics are open, so the formalized fuzzy model does not depend on their number.

Second, a fuzzy model for evaluating the level of satisfaction of tourists regarding accommodation establishments according to social class was developed for the first time. The general model consists of two fuzzy methods that represent separate stages. In the first stage, there is a fuzzification of incoming linguistic conclusions and the level of assessment satisfaction of tourists regarding accommodation relative to social classes. At the end of the first stage, one standardized assessment of the level of satisfaction with accommodation establishments is obtained separately for participants of the tourist movement. Additionally, one aggregate level assessment is displayed separately for the region's satisfaction of tourists regarding accommodation. In the second stage, a predicted aggregate assessment of the level of satisfaction with accommodation establishments at the destination by potential tourists (social class) in the relevant region is obtained. To predict the level of satisfaction with accommodation establishments in some selected regions, the "social class vector" is first considered. The "social class vector" uses measures of proximity and allows us to derive the predicted level of satisfaction for various combinations of demographic characteristics. At the output of the model, an intellectual analysis of knowledge is used to derive a projected assessment of the level of satisfaction with accommodation establishments by a potential tourist of the respective region. The obtained output estimates increase the degree of validity of the decisions made.

Third, the model was verified and adjusted on real data in the countries of the Visegrád Group, which were collected from 2343 respondents for the period 2017-2021. At the same time, an approbation example of a fuzzy-level assessment model is given the satisfaction of tourists regarding accommodation establishments in the Presov Region (Slovakia) on fragments of data from 311 respondents for the period 2017-2020. The adequacy of the mathematical fuzzy model developed in the work was experimentally confirmed and proven, which demonstrates the scientific and applied value of the conducted research.

The study of tourist satisfaction is a critical issue not only for research teams, managers, and policy-makers but also for the individuals and the society in which they live. The globalization processes and the development changes of the economic and social systems in the countries require an increasingly

intensive investigation of this issue and the development of knowledge in the consumer psychology of tourism.

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