THE EVALUATION MODEL OF TOURISM DEVELOPMENT BASED ON UNCERTAIN LINGUISTIC INFORMATION

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Abstract

In decision-making problems, including tourism, there are many situations in which information cannot be estimated directly in numerical values but may be in linguistic variables, as words or sentences in a natural or artificial language. In case of a high complexity of problems, decisions are usually made in terms of uncertainty or the information may be unquantifiable due to its nature in regards to a particular problem. On the other hand, collecting information and processing it can lead to high costs, so the use of approximate values in the evolution process is tolerated. In this research, decision-making problems for evaluating tourism management are investigated and numerical examples with uncertain linguistic information are presented.

Key Words: *MCDM techniques, making a decision in tourism, aggregation operators, OWA operator, UWLA operator, linguistic information*
JEL classification: *C02, C3, C65, Z3*

Introduction

Tourism is the world's fastest growing industry and the largest service sector industry. It is also considered to be one of the biggest industries in Serbia's economy (Milutinović & Vasović, 2017). As a very complex system which is practically connected to many aspects of modern life, tourism must be observed through interdisciplinary studies.

In this paper, we consider techniques for decision-making in tourism. A wide spectrum of statistical and non-statistical decision-making techniques have been proposed in the literature to model complex business or

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engineering processes (Radović-Stojanović & Vasović, 2016). Statistical methods are useful in modeling processes with incomplete or inaccurate data because of the lack of precise data in real-world problems. However, non-statistical methods are useful for modeling complex systems with imprecise, ambiguous, or vague data. Multiple-criteria decision-making (MCDM) methods are among the techniques that have recently been reaching extraordinary popularity and wide applications (Mardani et al., 2015a).

Fuzzy MCDM techniques and their applications are constantly developing (Mardani et al., 2015b; Kahraman et al., 2015). Recent studies have shown that imprecise information that is inherent in real life problems cannot be effectively addressed by classical MCDM techniques (Paunović et al., 2019). In decision-making processes, including tourism, decisions are usually made in terms of uncertainty or absence of information or knowledge of a particular problem, so it is necessary to make different assessments and to make proper solutions to the problem.

In this work, for decision-making process we have used the method where the best solution is selected among the alternatives by taking into account individual opinions of multiple experts. This type of method has been extensively studied and already proven to be valuable in various areas such as society, economy, management, engineering etc. The main target in this method is to find a solution accepted by all the experts in a group, i.e., to reach a broad consensus among experts (Bryson, 1996; Chiclana et al., 2013). However, a consensus is usually impacted by many factors in practice. For example, experts could come from different areas and have a limitation of knowledge, expression abilities, evaluation levels and preferences as well as practical experience, so that they may have different opinions for the same problem and different perceptions for the importance of various factors therein. Consequently, if the decision maker integrates various experts' opinions straightforwardly, it is hard to get a final result as expected (Pang et al., 2017).

Here we want also to emphasize that the mathematical basis of criteria analysis can be described as a selection of one from the final series m alternative A_i (i = 1,...,m) based on n criteria X_j (j = 1,...,n). Each of the alternatives is the vector A_i ($x_{i1} \ldots x_{ij} \ldots x_{in}$) where x_{ij} is a value of j attribute for i alternative. In order to formulate mathematically the model of multi-criteria decision making, we need the information on all the alternative embodiments of the process for which the decision is made (Gajović et al, 2018).

This paper is organized as follows. In the Introduction, we give some reasons why we have focused on this type for decision making and give some mathematical explanation about the model of multi-criteria decision making. Further, we give a definition of aggregation operators. In this work, we have focused on two operators OWA and UWLA, and we give two models where we have used these operators for decision-making in the tourism area. In the last part of our paper, we offer some discussion and conclusions about these MCDM techniques, the two proposed models and operators.

Aggregation operators

Aggregation of information takes a significant place in many knowledge-based systems, where aggregation of data or values is needed. In general, it can be said that by aggregation simultaneously, different parts of information from different sources are used, in order to make a conclusion or a decision. Aggregation operators are used in theoretical and applied mathematics, informatics, engineering, finance and other applied sciences. Aggregators are mathematical models with the function of reduction the set of numbers to the unique meaningful number. In most cases, aggregation operators are purely axiomatic defined and could be interpreted as logical conjunction (as t-norms and t-conorms) or as median operators.

Definition 1. Aggregation function is a function $A:\bigcup_{n\in N}[0,1]^n \to [0,1]$ where:

i) $A(0,...,0)=0$ *i* $A(1,...,1)=1$ (boundary condition).

ii) $A(u_1,...,u_n)\le A(v_1,...,v_n)$ when $u_i \le v_i$ for all $i\in\{1,...,n\}$ (A is a monotonous non-decreasing function for each of its arguments).

iii) $A(u)=u$ for all $u\in[0,1]$ (A is an idempotent function for *n*=1).

Condition $A(0,...,0)=0$ means that that if we consider only completely bad, false or unsatisfactory criteria, the aggregation must also be completely bad, false, or unsatisfactory. The interpretation of condition $A(1,...,1)=1$ means that if we consider only completely correct or completely satisfactory criteria, then the total aggregation must also be completely correct or completely satisfactory.

When a problem is solved using linguistic information, it implies the need for computing with words (Zadeh & Kacprzyk, 1999a; 1999b). How to fuse the input linguistic information is an interesting and important research topic. Linguistic aggregation operators are a powerful tool to deal with linguistic information. Many scholars have focused their investigation on linguistic aggregation techniques and various linguistic aggregation operators have been proposed (Xu, 2007).

Let $(a_1, a_2, \dots, a_n)$ be a collection of linguistic arguments, and $a_j \in S_1, (j = 1,2,..n)$ Yager (1996; 1992) introduced a linguistic max operator:

$$LM1(a_1, a_2, \dots, a_n) = \max_j\{a_j\}.$$

and a linguistic min ($LM2$) operator:

$$LM2(a_1, a_2, \dots, a_n) = \min_j\{a_j\}.$$

Yager (1996) developed a linguistic median ($LM3$) operator:

$$LM3(a_1, a_2, \dots, a_n) = \begin{cases} b_{\frac{n+1}{2}}, & n \text{ is odd}, \\ b_{\frac{n}{2}}, & n \text{ is even}, \end{cases}$$

where b_j is the $j$the biggest of a_i.

These three operators are the simplest linguistic aggregation operators, which are usually used to develop some other operators for aggregating linguistic information.

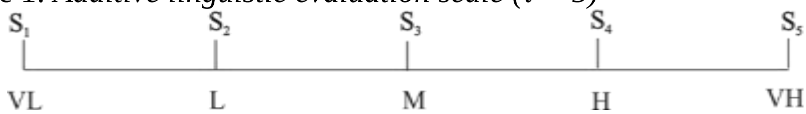
Sometimes the input linguistic arguments may not match any of the original linguistic labels, and they may be located between two of them. To solve this issue, Xu (2004a) introduced the concept of an uncertain linguistic variable and defined some operational laws of uncertain linguistic variables.

Scale

A linguistic evaluation scale should be predefined and carefully chosen when a decision maker needs to provide his/her preferences over an object with linguistic labels. Linguistic evaluation scales are classified into two types: additive linguistic evaluation scales and multiplicative linguistic evaluation scales (Xu, 2012).

Totally ordered finite discrete additive linguistic evaluation scale is $S_1 = \{s_\alpha \mid \alpha = 0,1,\cdots,\tau\}$, where s_α represents a possible value for a linguistic label. The cardinality value of the scale is odd, and it is usually 5, 7 or 9. Scale must be small enough so as not to impose useless precision on the decision makers, and it must also be rich enough in order to allow a discrimination of the performances of each object in a limited number of grades (Bordogna et al., 1997). In this research, 5 elements linguistic scale, defined as in Figure 1, will be used. Linguistic labels are: very low (VL), low (L), medium (M), high (H) and very high (VH).

Figure 1: *Additive linguistic evaluation scale (τ = 5)*



Source: Original

Another type of scale, that we will use in this research, is subscript-symmetric linguistic evaluation scale $S_1 = \{s_\alpha \mid \alpha = 0,1,\cdots,\tau\}$, where linguistic labels are s_{-4} = extremely poor, s_{-3} = very poor, s_{-2} = poor, s_{-1} = slightly poor, s_0 = fair, s_1 = slightly good, s_2 = good, s_3 = very good, s_4 = extremely good.

It is very important to define the negation of the linguistic terms within the scale S_1, for example for terms as *not high* or *not low*, etc. The usual way of defining a negation operator for the scale S is

$$neg(S_i) = S_{m-i+1}. \quad (1)$$

Ordered weighted averaging (OWA) operator

An extremely important class of aggregation operations, which is extensively used in various branches of applied science, has been defined by Ronald R. Yager (1988). Yager introduced an ordered weighted averaging (OWA) operator to provide a method for aggregating several numerical inputs that lie between the max and min operators. The main aspect of the OWA operator is the re-ordering step.

Let $w=(w_1, w_2, \ldots, w_n) \in [0,1]^n, \sum_{i=1}^{n} w_i = 1$ be a weight vector and $u_{p1} \geq u_{p2} \geq \ldots \geq u_{pn}$, for each permutation $(p_1, \ldots, p_n)$. Than OWA operation is defined with

$$A(u_1, \ldots, u_n) = w_1 u_{p1}, \ldots, w_n u_{pn}.$$

This class of operations was introduced in order to provide aggregation of results associated with the realizing the multiple criteria. It has been proven that this operator is very useful because it defines a diverse parameterized family of aggregation operators. OWA aggregation operations are continuous, symmetric and idempotent.

Using an ordinal form of the OWA operator, Yager (1992) defined the OOWA operator.

Definition 1. A mapping $A: S_1^n \rightarrow S_1$ is called an ordinal OWA (OOWA) operator of dimension n, if it has an associated weighting vector $w=(w_1, w_2, \ldots, w_n)^T$, such that

i) $w_j \in S_1$

ii) if $j > i$, then $w_j \geq w_i$

iii) $\max_j \{w_j\} = s_\tau$.

Furthermore,

$$A(u_1, \ldots, u_n) = \max_j \{\min\{w_j, b_j\}\},$$

where b_j is the *j*th largest of the linguistic arguments $u_i \ (i = 1, 2, \ldots, n)$.

Uncertain linguistic operators

Very useful uncertain linguistic operators are uncertain linguistic averaging (ULA) operator and uncertain linguistic weighted averaging (ULWA) operator to aggregate the uncertain linguistic information defined by (Xu, 2004b).

Uncertain linguistic averaging operator is defined as

$$ULA(\tilde{s}_1, \tilde{s}_2, \cdots, \tilde{s}_n) = \frac{1}{n}(\tilde{s}_1 \oplus \tilde{s}_2 \oplus \ldots \oplus \tilde{s}_n).$$

Uncertain linguistic weighted averaging operator is defined as

$$ULWA(\tilde{s}_1, \tilde{s}_2, \cdots, \tilde{s}_n) = w_1\tilde{s}_1 \oplus w_2\tilde{s}_2 \oplus \ldots \oplus w_n\tilde{s}_n),$$

where $w = (w_1, w_2, \ldots, w_n) \in [0,1]^n, \sum_{i=1}^{n} w_i = 1$ is the weighted vector of $s_i\,(i = 1, ..., n)$.

Model 1

In this section, we present an empirical case study of evaluating the relative importance of each pair of business processes with sub elements in order to plan the implementation of improvements, using defined linguistic information. There is a panel with five possible processes $p_i(i = 1, 2, 3, 4, 5)$ that the management of the hotel select. The team of experts must take a decision according to the criteria $c_i(i = 1, 2, 3)$. Modeling of linguistic statements is based on the theory of fuzzy sets. Aggregated values of the considered information are obtained by applying the OWA operator.

Each expert evaluates each of the criteria using the S scale, i.e. expresses his/her subjective opinion on the importance of particular attributes. Alternatives are presented in the rows of the table, and in the columns the criteria. Each element of the table contains the value of a specific criterion for a given alternative.

The total result R is calculated for each alternative and for each expert as follows:

$$R = \min_j \left(neg\left(I_j\right) \vee s_j \right), \quad (2)$$

where:

- I_j is the importance of the *j*th criterion;
- s_j is the estimated value of the *j*th criterion given by a particular expert.

For each alternative, there are *e* total results R.

For combining the experts' assessments and integrating different linguistic rating scales, a technique of the ordered weighted averaging (OWA) operators is developed. Let W_i is the level of importance of the *i*th attribute (criterion), then

$$W_i = \max_j \left(Q_j \wedge B_j \right) \quad (3)$$

where:
- Q_j is an aggregation function (the level of importance from the support of at least *j* experts,
- B_j is the *j*th highest scale among experts rating scales for the attribute.

Aggregation function is defined as

$$Q(j) = S_{b(j)} \quad (4)$$

$$b(j) = \mathrm{int}\left[1 + \left(j \cdot \frac{\tau - 1}{e} \right) \right], \quad (5)$$

where:
- *e* is a number of experts participating;
- τ - is a number of the rating scales;
- int[a] define numeric variables holding whole numbers closest to the number a.

Example 1. The top management of a hotels chain wants to improve certain business processes. Here we have listed the processes and via their detailed elaboration, the management determines the priority directions of development investment. The three experts are engaged and we have used the scale with five elements (Figure 1).

The unprecedented development of hotel-branded mobile applications (apps) has been

Processes to be improved:
- Improving the quality control process (p1): The advantages of introducing TQM in all sectors, like a new concept of organizational culture, for the tourism and hotel industry are big, both economically and socially (Holjevac Avelini, 1996.)
- Customer Relationship Improvements (p2): The conceptually explore and improve customer-to-customer interaction (CCI) in across-cultural context; and to identify research opportunities in the field of cross-cultural CCI (Nicholls, 2011). The unprecedented development of

hotel-branded mobile applications (apps) has been instrumental in facilitating the rich guest–hotel interactions, thus contributing to a high personalization of services (Lei et al., 2019).
- Improvement of ITC system (p3): The unprecedented development of hotel-branded mobile applications (apps) has been instrumental in facilitating the rich guest–hotel interactions, thus contributing to a high personalization of services (Morosan & DeFranco, 2016). The most often noticed advantage from ICT usage is improving service quality, employee work efficiency (for example: self-check in, self-check out, booking process etc).
- Improving the process of developing and adapting services (p4): The proliferation of complex service systems raises new challenges for service design and requires new methods. MSD (Multilevel Service Design) synthesizes contributions from new service development, interaction design, and the emerging field of service design (Patrício et al., 2011).
- Improving the process of human resources management (p5): The top management should establish green human resource management policies. Nearly every industry has embraced environmental protection practices. Most manufacturing companies have aimed to eliminate the waste created during the production and disposal of their products and, therefore, have improved corporate performance (Kim et al. 2019). Luxury hotels should choose talent management practices that fit the organizational culture with a focus on retention strategies that are tailor-made to the individual or groups of individuals (Marinakou & Giousmpasoglou, 2019).

Each process is described via three criteria attributes:
- Needed time to implement the improvements (c1);
- Cost of implementing improvements (c2);
- The importance of the process (c3).

Experts give the evaluation of the importance of criteria (Table 1), as evaluations of each individual process according to given criteria (Table 2-4).

Table 1: *Assessment of criteria importance*

	c1	**c2**	**c3**
e1	M	M	VH
e2	M	H	H
e3	H	M	VH

Source: *Author's own research*

Table 2: *Evaluation of the process by the first expert*

	c1	c2	c3
p1	H	H	H
p2	M	H	H
p3	VH	H	VH
p4	L	L	M
p5	H	M	H

Source: *Author's own research*

Table 3: *Evaluation of the process by the second expert*

	c1	c2	c3
p1	H	M	VH
p2	M	M	VH
p3	H	VH	H
p4	M	H	H
p5	M	L	VH

Source: *Author's own research*

Table 4: *Evaluation of the process by the third expert*

	c1	c2	c3
p1	M	M	H
p2	M	L	L
p3	H	H	VH
p4	M	M	M
p5	M	L	L

Source: *Author's own research*

Step1. In the first step, using formulas (1) and (2) for each expert the total score is calculated for each process.

For example, the evaluation for expert e1, for process p1 (e1p1) was calculated as follows:

$$\min\left\{\max\left(neg\left(M\right),H\right),\max\left(neg\left(M\right),H\right),\max\left(neg\left(VH\right),H\right)\right\}$$

$$\min\left\{\max\left(M,H\right),\max\left(M,H\right),\max\left(VL,H\right)\right\}$$

$$\min\left\{H,H,H\right\}=H.$$

The expert evaluation e1 for the process p2 (e1p2) was calculated as follows:

$$\min\{\max(neg(M),M),\max(neg(M),H),\max(neg(VH),H)\}$$
$$\min\{\max(M,M),\max(M,H),\max(VL,H)\}$$
$$\min\{M,H,H\}=M.$$

The expert evaluation e3 for the process p5 (e3p5) was calculated as follows:

$$\min\{\max(neg(H),M),\max(neg(M),L),\max(neg(VH),L)\}$$
$$\min\{\max(L,M),\max(M,L),\max(VL,L)\}$$
$$\min\{M,M,L\}=L.$$

In Table 5, the results of the experts' evaluations of each individual process are shown.

Table 5: *Results of step1 (R values)*

	e1	**e2**	**e3**
p1	H	M	M
p2	M	M	L
p3	H	H	H
p4	M	M	M
p5	M	L	L

Source: *Author's own research*

Step 2. The formation of an aggregation functions $Q(j)=S_{b(j)}$
Using the formula (5), it is

Q(0)=S1=VL, Q(1)=S2=L, Q(2)=S3=H, Q(3)=S5=VH.

Step 3. $R=\max(Q_j \wedge B_j)$

$$p1:\max\{\min(L,H),\min(H,M),\min(VH,M)\}=M,$$
$$p2:\max\{\min(L,M),\min(H,M),\min(VH,L)\}=M,$$

$$p3:\max\left\{\min\left(L,H\right),\min\left(H,H\right),\min\left(VH,H\right)\right\}=H,$$
$$p4:\max\left\{\min\left(L,M\right),\min\left(H,M\right),\min\left(VH,M\right)\right\}=M,$$
$$p5:\max\left\{\min\left(L,M\right),\min\left(H,L\right),\min\left(VH,L\right)\right\}=L.$$

The analysis of the obtained results has shown the following situation. Evaluating of each individual process in the company, based on their knowledge and experience, experts gave priority to the implementation of the third process- Improvement of the ITC system (p3). We can also see that processes Improvement of the quality control process (p1), Improvement of customer relations (p2) and Improvement of process of development and adaptation of services (p4) have equal priority to implementation. The analysis of the results showed that the Improvement of HR Management Process (p5) was set as the last one for the implementation.

Model 2

Having in mind specific features of hospitality services, which comprise of a set of tangible and intangible factors, as well as technical solutions and skills, the assessment of service quality is based on objective and subjective standpoints (Kerkez & Milutinović, 2018). The experts evaluate problem to their best knowledge, intuition and experience. With some problems experts are able to provide only uncertain linguistic information, because of time pressure, lack of knowledge or data, and their limited expertise related to the problem domain (Xu, 2012). In this model, it is shown the group decision-making problem involves the evaluation of five hotels and with one criteria "service quality". There are three experts e_k (k =1, 2, 3) involved, with weight vector $\omega=\left(0,5;\ 0,2;\ 0,3\right)^T$. The decision maker uses subscript-symmetric linguistic evaluation scale S2 and construct, respectively, the uncertain additive linguistic preference relations $\tilde{A}_i\ \left(i=1,\ 2,\ 3\right)$, using the approach given by (Xu & Da, 2002) called complementary matrices.

$$\tilde{A}_1=\begin{pmatrix} [s_0,s_0] & [s_{-3},s_0] & [s_1,s_2] & [s_{-1},s_0] & [s_{-2},s_{-1}] \\ & [s_0,s_0] & [s_1,s_2] & [s_0,s_1] & [s_{-1},s_0] \\ & & [s_0,s_0] & [s_{-2},s_{-1}] & [s_0,s_1] \\ & & & [s_0,s_0] & [s_{-1},s_0] \\ & & & & [s_0,s_0] \end{pmatrix}$$

$$\tilde{A}_2=\begin{pmatrix} [s_0,s_0] & [s_{-2},s_0] & [s_{-1},s_1] & [s_{-1},s_0] & [s_1,s_2] \\ & [s_0,s_0] & [s_{-2},s_{-1}] & [s_0,s_1] & [s_1,s_2] \\ & & [s_0,s_0] & [s_0,s_1] & [s_{-2},s_{-1}] \\ & & & [s_0,s_0] & [s_{-1},s_1] \\ & & & & [s_0,s_0] \end{pmatrix}$$

$$\tilde{A}_3=\begin{pmatrix} [s_0,s_0] & [s_{-1},s_0] & [s_{-2},s_{-1}] & [s_{-1},s_1] & [s_0,s_1] \\ & [s_0,s_0] & [s_0,s_2] & [s_{-1},s_0] & [s_{-1},s_1] \\ & & [s_0,s_0] & [s_0,s_3] & [s_{-2},s_0] \\ & & & [s_0,s_0] & [s_{-1},s_0] \\ & & & & [s_0,s_0] \end{pmatrix}$$

Step 1. First to use the ULWA operator to aggregate all the uncertain additive linguistic preference relations $\tilde{A}_k=\left(\tilde{a}_{ij}^{(k)}\right)_{5\times5},(k=1,2,3)$ into the collective uncertain additive linguistic preference relation $\tilde{C}=\left(\tilde{c}_{ij}\right)_{5\times5}$.

$$\tilde{C}=\begin{pmatrix} [s_0,s_0] & [s_{-2,2},s_{0,0}] & [s_{-0,3},s_{0,9}] & [s_{-1},s_{0,3}] & [s_{-0,8},s_{0,2}] \\ & [s_0,s_0] & [s_{0,1},s_{1,4}] & [s_{-0,3},s_{0,7}] & [s_{-0,6},s_{0,7}] \\ & & [s_0,s_0] & [s_{-0,7},s_{0,6}] & [s_{-1},s_{0,3}] \\ & & & [s_0,s_0] & [s_{-1},s_{0,2}] \\ & & & & [s_0,s_0] \end{pmatrix}$$

Step 2. We next utilize the ULA operator to aggregate the preference information in the *i*th of the collective uncertain additive linguistic preference relation C into the averaged uncertain preference $\tilde{c}_i$ of the alternative *xi* over all the alternatives.

$$\tilde{c}_1 = \left[s_{-0,86}, s_{0,28} \right], \quad \tilde{c}_2 = \left[s_{-0,16}, s_{1,00} \right], \quad \tilde{c}_3 = \left[s_{-0,80}, s_{0,22} \right], \; \tilde{c}_4 = \left[s_{-0,52}, s_{0,44} \right],$$
$$\tilde{c}_1 = \left[s_{-0,28}, s_{0,68} \right].$$

Step 3. In this step, we need to compare each pair of the uncertain preferences $\tilde{c}_i$ (i = 1, 2, · · ·,5) by using the possibility degree formula (6) and to construct a possibility degree matrix $P = \left(p_{ij} \right)_{5\times5}$.

$$p\left(\tilde{s}_1 \geq \tilde{s}_2\right) = \frac{\max\left(0, len\left(\tilde{s}_1\right) + len\left(\tilde{s}_2\right) - \max\left(\beta_2 - \alpha_1 0\right)\right)}{len\left(\tilde{s}_1\right) + len\left(\tilde{s}_2\right)} \quad (6)$$

Possibility degree matrix:

$$P = \begin{pmatrix} 0,5 & 0,191 & 0,5 & 0,381 & 0,267 \\ 0,809 & 0,5 & 0,826 & 0,717 & 0,604 \\ 0,5 & 0,174 & 0,5 & 0,374 & 0,253 \\ 0,619 & 0,283 & 0,626 & 0,5 & 0,375 \\ 0,733 & 0,396 & 0,747 & 0,625 & 0,5 \end{pmatrix}$$

Step 4. To derive the priority vector $\xi = (\xi_1, \; \xi_2, \ldots, \; \xi_n)^T$ of the possibility degree matrix P, we use ranking formula (7) given by Xu (2001):

$$\xi_i = \frac{1}{n\left(n-1\right)}\left(\sum\nolimits_{j=1}^{n} p_{ij} + \frac{n}{2} - 1\right), \; i = 1, 2, \ldots, n, \quad (7)$$

and we get priority vector

$$\xi = \left(0,167; 0,248; 0,165; 0,195; 0,225\right)^T$$

Step 5. Rank all hotels x_i (i = 1, 2, 3, 4, 5) in accordance with the values $\tilde{c}_i$ (i = 1, 2, 3, 4, 5) and vector ξ:

$$x_2 > x_5 > x_4 > x_1 > x_3.$$

Thus, the most desirable hotel in relation to "service quality" is x_2.

Conclusion

This study has presented two mathematics models based on the decision-making technique. Both models deal with quantifying certain elements relative to the tourism processes using uncertain linguistic information. First, we proposed a model for improving certain business processes, such as: Quality control process, Improvement of customer relations, Improvement of process of development and adaptation of services, Improvement of HR Management Process and Improvement of the ITC system. The analysis of Model 1 results and evaluation of each individual process in the company showed that priority in implementation should be to the third process - Improvement of the ITC system, for the observed company.

In Model 2, it is shown the group decision-making problem for the service quality evaluation of five hotels. The assessment of service quality is based on objective and subjective standpoints. In this model, uncertain additive linguistic preference relations, ULWA and ULA aggregation operator are used. Results show the most desirable hotel in relation to "service quality".

The quantitative approach presented in the present study helps rectify the situation caused by the domination of qualitative assessment methods in current studies of tourism related assessment. This approach helps decision-makers in extracting and keeping expert knowledge in the system with the opportunity to choose different operators, which leads to flexibility in the decision-making process.

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