RANKING ALTERNATIVES USING PIPRECIA METHOD: A CASE OF HOTELS' WEBSITE EVALUATION

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Abstract: The article presents the application of the PIvot Pairwise RElative Criteria Importance Assessment (PIRECIA) method for ranking alternatives. The PIPRECIA method is primarily intended for determining the significance (weight) of criteria, but it can also be used for completely solving decision-making problems. So far, this method has not been used for completely solving multiple criteria decision-making problems, which is why this article presents the application of the PIPRECIA method for the evaluation and ranking alternatives. The process of evaluating alternatives using the PIPRECIA method is shown on an example of evaluating the websites of some hotels located in Southern and Eastern Serbia.
Keywords: PIPRECIA, website evaluation, websites

1. Introduction

The PIvot Pairwise RElative Criteria Importance Assessment (PIPRECIA) method is a relatively new multiple criteria decision making (MCDM) method, and it was proposed in 2017 (Stanujkic et al., 2017). The primary purpose of this method is determining the significance (weights) of the evaluation criteria, but it can also be successfully applied for solving MCDM problems, i.e. for evaluating alternatives and selecting the best one.

Although it is a relatively new-proposed method, it has been successfully used for solving some decision-making problems such as: evaluating hotels' websites (Stanujkic et al., 2018), quality control manager selection (Popovic, 2019), ranking of the sustainable indicators for cultural heritage sites (Popovic et al., 2019), assessing the quality of e-learning materials (Jauković-Jocić et al., 2020), personnel selection (Ulutaş et al., 2020), operational performance evaluation in the airline industry (Bakir et al., 2020), and so on.

However, it should be noted that in the aforementioned articles, the PIPRECIA method was used only for determining criteria weights, while other MCDM methods were used for the

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evaluation of alternatives and selecting the best one. Therefore, in the rest of this article, the application of the PIPRECIA method for the evaluation of the alternative is presented, which is why the rest of the article is organized as follows: Section 1 presents the calculation procedure of the PIPRECIA method, while in section 3 some articles related to the evaluation of the quality of hotels' websites were considered and the criteria used were identified. The use of the PIPRECIA method for determining the quality of hotels' websites is presented in Section 4. Finally, conclusions are given at the end of the article.

2. The PIPRECIA Method

The procedure of the PIPRECIA method for determining criteria weights can be accurately presented as follows (Stanujkic et al., 2017):

Step 1. Determine the set of the relevant evaluation criteria and sort them in descending order, based on their expected significance. However, sorting of the criteria is not mandatory and can be omitted.

Step 2. Starting from the second criterion, set the relative significance s_j as follows:

$$s_j = \begin{cases} > 1 & if\ C_j > C_{j-1} \\ 1 & if\ C_j = C_{j-1}, \\ < 1 & if\ C_j \prec C_{j-1} \end{cases} \quad (1)$$

where C_j denotes the significance of criterion j and C_{j-1} denotes the significance of the previous j-1 criterion.

Step 3. Calculate the coefficient k_j as follows:

$$k_j = \begin{cases} 1 & if\ j = 1 \\ 2 - s_j & if\ j > 1 \end{cases}. \quad (2)$$

Step 4. Calculate the recalculated weight q_j as follows:

$$q_j = \begin{cases} 1 & if\ j = 1 \\ \frac{q_{j-1}}{k_j} & if\ j > 1 \end{cases}. \quad (3)$$

Step 5. Determine the relative weights of the criteria w_j as follows:

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k}. \quad (4)$$

where n denotes the number of the criteria.

2.1. The usage of the PIPRECIA methods for ranking alternatives

The PIPRECIA method can be used for evaluating, i.e. ranking, alternative as in AHP (Saaty, 1980) and SWARA (Kersuliene et al., 2010) methods. In such cases, it is necessary to determine the relative importance of the alternatives concerning each criterion, using the following procedure:

Step 1. Starting from the second alternative, set the relative significance s_i of alternative i as follows:

$$s_i = \begin{cases} > 1 & if\ A_i > A_{i-1} \\ 1 & if\ A_i = A_{i-1}, \\ < 1 & if\ A_i \prec A_{i-1} \end{cases} \quad (5)$$

where A_i denotes the significance of alternative i, and A_{i-1} denotes the significance of the previous i-1 alternative.

Step 3. Calculate the coefficient k_i as follows:

$$k_i = \begin{cases} 1 & if\ i = 1 \\ 2 - s_i & if\ i > 1 \end{cases}.$$ (6)

Step 4. Calculate q_j as follows:

$$q_i = \begin{cases} 1 & if\ i = 1 \\ \frac{q_{i-1}}{k_i} & if\ i > 1 \end{cases}.$$ (7)

Step 5. Determine the relative importance of alternatives concerning the criteria, as follows:

$$i_{ij} = \frac{q_i}{\sum_{k=1}^{m} q_k}.$$ (8)

where i_{ij} denotes relative importance of alternative i concerning the criterion j, and m denotes the number of the alternatives.

Steps 1 to 5 are repeated cyclically for each criterion. After that, the utility of each alternative u_i is determined as follows:

$$u_i = \sum_{j=1}^{n} i_{ij}\ w_j.$$ (9)

After that, the alternatives are ranked according to the value of u_i, and the alternative with the highest value of u_i is declared the best one.

3. Criteria for Evaluating Websites in the Tourism Industry

There are numerous studies dedicated to determining the quality of websites in tourism and hospitality. As one of the first studies dedicated to the quality of websites in tourism and hospitality can be mentioned study conducted by Murphy et al. (1996). In their study, they examined many websites at the time and investigated that some of the features available on them.

Chung and Law (2003) proposed an information quality evaluation model for measuring the performance of hotel websites. Their model was based on the use of six evaluation criteria: Facilities information, Customer contact information, Reservation information, Surrounding area information, and Management of websites; as well as the use of their sub-criteria. Law and Cheung (2005) identified five criteria that are important for determining the quality of hotel websites: Reservations information, Facilities information, Contact information, Surrounding area information, and Website management.

Based on a survey of Greek hotel websites, Zafiropoulos and Vrana (2005) identified the following six criteria relevant for determining the quality of hotels' websites: Facilities information, Guest contact information, Reservation and prices information, Surrounding area information, Management of the website and Company profile. For each of these criteria, Zafiropoulos and Vrana (2005) also defined the relevant sub-criteria.

4. A Numerical Illustration

In this numerical illustration, the PIPRECIA method was used for determining the criteria weights for evaluating hotels' websites as well as evaluation of the websites of three hotels from Southern and Eastern Serbia.

4.1. Determining the weights of the criteria selected for evaluating hotel websites

In this research, the criteria proposed by Zafiropoulos and Vrana (2005) were used for evaluating the quality of hotel websites, i.e.:
- Facilities information (C_1),

- Guest contact information (C_2),
- Reservation and price information (C_3),
- Surrounding area information (C_4)
- Hotel website (C_5), and
- Company profile (C_6)

Calculation details obtained during determining criteria weights, using Eqs. (2) to (4), are summarized in Table 1.

Table 1. Calculation details obtained during determining the criteria weights

	Criteria	s_j	k_j	q_j	w_j	Rank
C_1	Facilities information		1	1	0.16	3
C_2	Guest contact information	0.9	1.1	0.91	0.15	6
C_3	Reservation and price information	1.2	0.8	1.14	0.19	1
C_4	Surrounding area information	0.95	1.05	1.08	0.18	2
C_5	Hotels website	0.9	1.1	0.98	0.16	4
C_6	Company profile	1	1	0.98	0.16	4

Source: authors' calculation

From Table 1 it can be seen that the criterion C_3 - Reservation and price information has the highest weight, as well as that the criterion C_5 - Hotels website is the fourth-ranked criterion. It should be noted that, in this case, the criteria weights are determined for evaluating websites of hotels located in well-known tourist destinations in Southern and Eastern Serbia.

4.2. Evaluation of hotels' websites

Three hotels from Southern and Eastern Serbia were selected for the evaluation of hotels' websites[†]:

- Hotel Balasevic (https://hotelstaraplanina.com/)
- Hotel RAMONDA (https://ramondahotel.com/) i
- Hotel Stara Planina (https://ramondahotel.com/)

The websites of these hotels were evaluated concerning the six criteria mentioned in the previous subsection, using the procedure given in subsection 2.1. Calculation details, calculated using Eqs. (5) to (8), are shown in Tables 2 to 7.

Table 2. The relative importance of alternatives concerning the first criterion

Alternatives	s_i	k_i	q_i	i_{i1}
A_1		1	1	0.35
A_2	0.95	1.05	0.95	0.34
A_3	0.9	1.1	0.87	0.31

Source: authors' calculation

[†] Note: The indices of the alternatives used in this subsection do not match the order in which the hotels are listed.

Table 3. The relative importance of alternatives concerning the second criterion

Alternatives	s_i	k_i	q_i	i_{i2}
A_1		1	1	0.34
A_2	1	1	1.00	0.34
A_3	0.9	1.1	0.91	0.31

Source: authors' calculation

Table 4. The relative importance of alternatives concerning the third criterion

Alternatives	s_i	k_i	q_i	i_{i3}
A_1		1	1	0.34
A_2	1.2	0.8	1.25	0.43
A_3	0.9	1.1	1.14	0.39

Source: authors' calculation

Table 5. The relative importance of alternatives concerning the fourth criterion

Alternatives	s_i	k_i	q_i	i_{i4}
A_1		1	1	0.34
A_2	1.4	0.6	1.67	0.57
A_3	0.5	1.5	1.11	0.38

Source: authors' calculation

Table 6. The relative importance of alternatives concerning the fifth criterion

Alternatives	s_i	k_i	q_i	i_{i5}
A_1		1	1	0.34
A_2	1.2	0.8	1.25	0.43
A_3	0.6	1.4	0.89	0.31

Source: authors' calculation

Table 7. The relative importance of alternatives concerning the fifth sixth criterion

Alternatives	s_i	k_i	q_i	i_{i6}
A_1		1	1	0.34
A_2	1.1	0.9	1.11	0.38
A_3	0.8	1.2	0.93	0.32

Source: authors' calculation

Based on the data from Table 1 and Tables 2 to 7, an initial decision matrix was formed which contains the weights of the criteria and the relative importance of alternatives concerning the criteria. The initial decision matrix was shown in Table 8.

Table 8. Initial decision matrix

	C_1	C_2	C_3	C_4	C_5	C_6
w_j	0.16	0.15	0.19	0.18	0.16	0.16
A_1	0.35	0.34	0.34	0.34	0.34	0.34
A_2	0.34	0.34	0.43	0.57	0.43	0.38
A_3	0.31	0.31	0.39	0.38	0.31	0.32

Source: authors' calculation

Finally, the utility of each alternative is calculated using Eq. (9), as is shown in Table 9.

Table 9. Utility and ranking order of alternative

	C_1	C_2	C_3	C_4	C_5	C_6	u_i	*Rank*
A_1	0.058	0.051	0.064	0.061	0.055	0.055	0.346	2
A_2	0.055	0.051	0.080	0.102	0.069	0.062	0.420	1
A_3	0.050	0.047	0.073	0.068	0.050	0.051	0.339	3

Source: authors' calculation

From Table 9 it can be seen that the hotel denoted as A_2 has the best website. In a competitive environment, a website can provide certain advantages, such as getting guests and online booking, which is why hotels denoted as A_1 and A_3 should improve their presentations. We intentionally ddid not emphasize wich hotel has the best website presentation to avoid its promotion.

Conclusion

The use of the PIPRECIA method for the evaluation and ranking of alternatives is presented in this article. The evaluation is shown on an example of evaluation and ranking websites of some hotels located in Southern and Eastern Serbia.

From the presented example, it can be concluded that the process of evaluating alternatives using the PIPRECIA method is not complex and can therefore be applied for solving similar problems. In addition, the evaluation process using the PIPRECIA method is based on pairwise comparisons, which can make it easier for decision-makers, or respondents, to express their attitudes. Proposed method facilitates a decision-making process and enables decision-makers to find an optimal solution regarding to the existing conditions. In this case, the PIPRECIA is applied in the case of the selection the best website of the hotel, but its potential should be observed and tested in other business fields, as well.

Acknowledgments

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