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Abstract: In order to overcome the low accuracy of the traditional assessment methods, this paper proposed an assessment method based on set pair analysis. After establishing the evaluation system of ecotourism carrying capacity according to the influencing factors of ecotourism carrying capacity, the set pair analysis method was used to construct the evaluation matrix to determine the best and worst scheme of the evaluation index and the correlation degree, and then the corresponding evaluation results were obtained according to the correlation degree. Experimental results show that the calculation accuracy of the index weight of the proposed method is basically consistent with that of the theoretical weight, and there is only 0.01 error between them, and the maximum bearing capacity assessment accuracy is 96.6%, indicating that the proposed method has strong application advantages.

Keywords: set pair analysis; popular scenic spots; ecotourism; bearing capacity evaluation.

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1 Introduction

Since the 1980s, ecotourism industry has gradually sprung up. Due to people's advocacy of understanding, protecting and enjoying nature, ecotourism is recognised as an effective tourism model for sustainable development, which is widely recognised by tourism enthusiasts and eco-environmental protectors. However, due to the impact of industrial development, the ecological environment of tourism destination continues to deteriorate, resulting in the sustainable development of tourism becoming the focus of the tourism industry. Under this background, influenced by the concept of culture and ecological environment protection, ecotourism is based on natural culture and has become an important basis for the development of tourist destinations (Meng et al., 2020; Wei et al., 2021; Wang, 2019).

As people vigorously pursue ecotourism and participate in ecotourism, there are many popular ecotourism scenic spots, but the ecological carrying capacity of scenic spots is limited, resulting in the imbalance of the ecological carrying capacity of many popular scenic spots (Chen et al., 2021; Mou et al., 2019). Therefore, it is necessary to evaluate the ecological carrying capacity of popular scenic spots.

Wang and Liu (2019) proposed an assessment method of eco-tourism carrying capacity based on the PS-DR-DP theoretical model, constructed a comprehensive assessment framework of eco-environmental carrying capacity, and analysed the supporting capacity, capacity and self-repair capacity of the eco-environment respectively, so as to obtain the assessment results of carrying capacity. However, this method is difficult to calculate the weight of eco-environmental carrying capacity evaluation indicators, resulting in insufficient accuracy of carrying capacity evaluation. Liu et al. (2018) put forward the evaluation method of ecotourism carrying capacity based on big data analysis, designs the framework of scenic spot carrying capacity model, and uses big data analysis algorithm to analyse the environmental related information of scenic spot, so as to obtain the carrying characteristics of soil environment, water resource environment, biological environment and pollutant environment of scenic spot. According to the results of bearing characteristics, the evaluation results of bearing capacity of the scenic spot are obtained. However, this method has the problem of low calculation accuracy of ecological carrying capacity index. Li et al. (2018) proposed an ecotourism carrying capacity evaluation method based on machine learning algorithm, analyses the evaluation elements of ecotourism carrying capacity of popular scenic spots, extracts the main factors affecting the carrying capacity of ecotourism scenic spots, and constructs an ecotourism carrying capacity evaluation index system and evaluation model based on machine learning to complete the ecotourism carrying capacity evaluation. However, the evaluation process of this method is complex, the selection of indicators has a great impact on the evaluation results, and different evaluation indicators are not selected according to different scenic spots, resulting in low accuracy of the evaluation results.

In order to solve the problems existing in traditional evaluation methods such as low calculation accuracy of evaluation weight and low accuracy of carrying capacity index, this study designed a new evaluation method of ecotourism carrying capacity of popular scenic spots by using set pair analysis method, in order to improve the analysis effect of ecotourism carrying capacity of popular scenic spots. The design idea of this method is as follows:

1 Based on the analysis of the basic concept of ecotourism in popular scenic spots, this paper analyses the influencing factors of ecotourism carrying capacity, and then constructs the evaluation index system of ecotourism carrying capacity of scenic spots from the perspectives of ecological environment carrying capacity, tourism reception service carrying capacity and social carrying capacity.

2 Since set pair analysis is to analyse pairs composed of different sets according to a certain degree of connection, the degree of connection of different sets of indicators is calculated according to the degree of correlation, degree of identity, degree of difference, degree of opposition and coefficient of opposition between different indicators.

3 According to the connection degree of different index criteria, the bearing capacity evaluation matrix is constructed, and the best/worst evaluation scheme is divided.

4 Using the same degree, difference degree and opposition degree to calculate the connection degree of the carrying capacity evaluation index to the optimal scheme, and then using the benefit type and cost type index to analyse the comprehensive correlation degree of the ecotourism environment of popular scenic spots to the optimal scheme.

5 Calculate the weight of each carrying capacity evaluation index, and then substitute the weight calculation results into the calculation process of the connection degree of the optimal evaluation scheme, so as to judge the ecotourism carrying capacity.

2 Evaluation method of ecotourism carrying capacity of popular scenic spots

Because the environmental capacity of a scenic spot only takes the maximum number of people that the scenic spot can accommodate as the standard of tourism environment, there are high limitations in the evaluation of environmental carrying capacity. With the continuous improvement of the requirements for carrying capacity evaluation, the evaluation results obtained by simple evaluation methods can no longer meet the actual needs. Therefore, ecotourism carrying capacity has been given a new concept, the ecotourism carrying capacity of Jijing area refers to the economic volume threshold of tourism activities borne by the ecotourism environment of a scenic spot in a certain period of time and under certain conditions. Under this concept, more accurate results can be obtained by evaluating the ecotourism carrying capacity of popular scenic spots.

2.1 Construction of evaluation index system

In order to obtain correct and effective evaluation results, setting up scientific and reasonable evaluation index system is the key content of ecological tourism carrying capacity research in popular scenic spots.

When constructing the evaluation index system, we should strive to comprehensively and accurately describe the ecotourism carrying capacity of popular scenic spots (Rong et al., 2019; Shang and Wang, 2019; Zhao et al., 2020; Gao et al., 2021). Therefore, in the process of this study, this study follows the principle of comprehensiveness and systematicness, and adopts theoretical research analysis method, expert consultation method and questionnaire survey method to screen evaluation indicators.

This study makes a comprehensive analysis from three perspectives: ecological environment carrying capacity, tourism reception service carrying capacity and social carrying capacity, so as to make the analysis of the influencing factors of carrying capacity more comprehensive and systematic. The evaluation index system composed of evaluation indexes is shown in Table 1.

Table 1 Evaluation index system of ecotourism carrying capacity of scenic spots

Target layer	*Criterion layer*	*Domain layer*	*Index layer*
Evaluation index system of ecotourism carrying capacity of popular scenic spots A_1	Ecological environment carrying capacity B_1	Water resources C_1	Standard rate of surface water quality D_1
			Comprehensive pollution index of surface water body D_2
			Standard rate of groundwater quality D_3
			Comprehensive pollution index of groundwater D_4
		Land resources C_2	Cultivated land carrying capacity D_5
			Forest carrying capacity D_6
			Bearing capacity of built-up land D_7
		Atmospheric conditions C_3	Quality standard for environmental control in scenic spots D_8
			Air pollution index D_9
		Noise pollution index C_4	Noise limit standard D_{10}
		Biological resources C_5	Vegetation coverage D_{11}
			Animal diversity index D_{12}
			Plant diversity index D_{13}
	Tourism reception service carrying capacity B_2	Economic carrying capacity C_6	Economic development level of tourism area D_{14}
			Tourism input-output ratio D_{15}
			Support rate of tourist destination for tourism activities D_{16}
		Tourism infrastructure carrying capacity C_7	Capacity of accommodation facilities D_{17}
			Traffic carrying capacity D_{18}
			Catering facilities carrying capacity D_{19}
			Water supply capacity D_{20}
			Power supply capacity D_{21}
			Drainage capacity D_{22}
		Human carrying capacity C_8	Average education level of tourism practitioners C_{23}
			Staff training C_{24}
			Management level C_{25}
	Social carrying capacity B_3	Tourist psychological carrying capacity C_9	Landscape aesthetics C_{26}
			Landscape sensitivity C_{27}
			Tourists' perception of service level in tourist areas C_{28}
			Tourists' perception of the ecological environment of the tourist area C_{29}
			Tourists' perception of cultural customs in tourist areas C_{30}

Table 1 Evaluation index system of ecotourism carrying capacity of scenic spots (continued)

Target layer	*Criterion layer*	*Domain layer*	*Index layer*
Evaluation index system of ecotourism carrying capacity of popular scenic spots A_1	Social carrying capacity B_3	Residents' psychological carrying capacity C_{10}	Resident satisfaction C_{31}
			Local residents' perception of tourism cultural benefits C_{32}
			Local residents' perception of tourism economic benefits C_{33}
			Local residents' perception of tourism social benefits C_{34}
			Local residents' perception of tourism environmental benefits C_{35}

2.2 Evaluation of bearing capacity based on set pair analysis

According to the above-mentioned evaluation system of ecotourism carrying capacity of popular scenic spots, set pair analysis method is used to evaluate the carrying capacity.

2.2.1 The concept of set pair analysis

Set pair analysis is a system analysis method based on uncertainty theory. Its core idea is to regard the determined system as an uncertain system, analyse and study it from the positive aspects of the system, and analyse the pairs composed of different datasets according to a certain degree of connection. The calculation formula of contact degree is:

$$\mu = a + bi + cj \tag{1}$$

In the formula, μ represents the correlation degree, a represents the identity degree, b represents the difference degree, c represents the opposition degree, i represents the uncertainty coefficient and j represents the opposition coefficient.

According to the above parameter conditions, a, b and c need to meet the normalisation conditions, so there are:

$$a + b + c = 1 \tag{2}$$

Connection is an important concept in set pair analysis. In practical application, it can be determined according to the application environment and the convenience of calculation. Since the set pair analysis method comprehensively considers the deterministic and uncertain information in the application process, and can obtain objective and effective results when dealing with problems, the set pair analysis method is applied to evaluate the ecotourism carrying capacity of popular scenic spots (Wang et al., 2018).

2.2.2 Set pair analysis model of ecological carrying capacity

2.2.2.1 Construction of evaluation matrix

According to the bearing capacity evaluation index system established in Subsection 2.1, the bearing capacity evaluation matrix $D = (d_{rk})_{m\times n}$ is constructed. The matrix expression is:

$$D = \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2n} \\ \vdots & \vdots & \dots & \vdots \\ d_{m1} & d_{m2} & \dots & d_{mn} \end{bmatrix} \quad (3)$$

Formula (3) represents the evaluation of ecotourism carrying capacity for the m^{th} index of level n, and d_{rk} in the evaluation matrix represents the evaluation of the r^{th} index of level k.

2.2.2.2 Determine the best and worst scheme

According to the objectives of ecotourism carrying capacity evaluation and the uniqueness of each evaluation index, the optimal and worst schemes of the evaluation index are determined from the inside and outside of the evaluation index system shown in Table 1. It is defined that the optimal and worst evaluation schemes are represented by U and V respectively, then the optimal and worst schemes are:

$$U = (u_1, u_2, \dots, u_m)^T \quad (4)$$

$$V = (v_1, v_2, \dots, v_m)^T \quad (5)$$

2.2.2.3 Determine the degree of connection

Determining the connection degree is the key content of ecotourism carrying capacity evaluation by set pair analysis method, which is similar to the concepts of 'grey correlation degree' in grey evaluation and 'membership degree' in fuzzy evaluation (Wang et al., 2020).

For the evaluation index r of ecotourism carrying capacity level k of any popular scenic spot, the connection degree of d_{rk} to the scheme (optimal or worst) is:

$$\mu_{rk} = a_{rk} + b_{rk} i + c_{rk} j \quad (6)$$

In this evaluation process, the evaluation index types studied mainly include benefit type and cost type. Under the benefit of the two evaluation indexes, the calculation expressions of identity a_{rk}, difference b_{rk} and opposition c_{rk} are as follows.

1 Benefit type

$$a_{rk} = \frac{d_{rk}}{u_r + v_r} \quad (7)$$

$$c_{rk} = \frac{d_{rk}^{-1}}{u_r^{-1} + v_r^{-1}} = \frac{u_r v_r}{(u_r + v_r) d_{rk}} \quad (8)$$

$$b_{rk} = 1 - (a_{rl} + b_{rk}) = 1 - \left(\frac{d_{rk}}{u_r + v_r} + \frac{u_r v_r}{(u_r + v_r) d_{rk}} \right) = \frac{(u_r - d_{rk})(d_{rk} - v_r)}{(u_r + v_r) d_{rk}} \quad (9)$$

In the formula, $\frac{d_{rk}}{u_r + v_r}$, $\frac{d_{rk}^{-1}}{u_r^{-1} + v_r^{-1}} \in [0, 1]$ respectively represent the distance between d_{rk}, u_r and v_r. The smaller the value, the closer the indicators are.

Therefore, under the benefit evaluation index, the calculation expression of connection degree can be transformed into:

$$\mu(d_{rk}, u_r) = \frac{d_{rk}}{u_k + v_r} + \frac{(u_r - d_{rk})(d_{rk} - v_r)}{(u_r + v_r)d_{rk}} i + \frac{u_r v_r}{(u_r + v_r)d_{rk}} j \tag{10}$$

2 Cost type

It can be seen from the basic concept that the direction of identity and opposition of cost type evaluation indicators is opposite to that of income type indicators. Therefore, under cost type indicators, the calculation expressions of identity a_{rk}, difference b_{rk} and opposition c_{rk} can be written as follows:

$$a_{rk} = \frac{u_r v_r}{(u_r + v_r)d_{rk}} \tag{11}$$

$$c_{rk} = \frac{d_{rk}}{u_r + v_r} \tag{12}$$

$$b_{rk} = 1 - (a_{rk} + b_{rk}) = \frac{(u_r - d_{rk})(d_{rk} - v_r)}{(u_r + v_r)d_{rk}} \tag{13}$$

According to the calculation results of identity degree, difference degree and opposition degree, the connection degree of cost evaluation index can be formed. The process is as follows:

$$\mu(d_{rk}, v_r) = \frac{u_r v_r}{(u_r + v_r)d_{rk}} + \frac{(u_r - d_{rk})(d_{rk} - v_r)}{(u_r + v_r)d_{rk}} i + \frac{d_{rk}}{u_r + v_r} j \tag{14}$$

It can be seen from formulas (10) and (14) that identity and opposition are two opposite characteristics, while difference remains unchanged.

When $d_{rk} = v_r$ or u_r, the difference b_{rk} reaches the minimum value; when $d_{rk} = \sqrt{u_r v_r}$, the difference reaches the maximum. Combined with the calculation results of formulas (6), (10) and (14), the connection degree between ecotourism dataset pairs can be obtained:

$$\mu_k = a_k + b_k i + c_k j \tag{15}$$

In formula (15), μ_k represents the comprehensive correlation between the ecotourism environment of popular scenic spots and the optimal scheme, and the calculation formulas of parameters are as follows:

$$a_k = \sum_{r=1}^{m} \omega_r a_{rk} \quad (k = 1, 2, \ldots, n) \tag{15}$$

$$b_k = \sum_{r=1}^{m} \omega_r b_{rk} \quad (k = 1, 2, \ldots, n) \tag{16}$$

$$c_k = \sum_{r=1}^{m} \omega_r c_{rk} \quad (k = 1, 2, \ldots, n) \tag{17}$$

In the above formula, ω_r ($r = 1, 2, \ldots, m$) represents the weight of each evaluation index, which directly affects the final bearing capacity evaluation result. The calculation formula of evaluation index weight is:

$$\omega_r = \frac{(1 - H_r)}{\sum_{k=1}^{m} (1 - H_r)} \tag{18}$$

In the formula, $0 \le \omega_r \le 1$ and $\sum_{k=1}^{m} \omega_r = 1$.

The weight $W = (\omega_1, \omega_2, \ldots, \omega_m)^T$ of the ecotourism carrying capacity evaluation system of popular scenic spots is obtained by calculating the weight of each carrying capacity evaluation index.

The weight calculation result of the evaluation index is substituted into the connection degree calculation formula shown in formula (15), and the judgment of ecotourism carrying capacity is completed according to the connection degree calculation result. The value range of connection degree μ_k is [0, 1]. According to the calculation results of connection degree, the corresponding evaluation results of bearing capacity level can be obtained. The bearing capacity levels corresponding to different connection degrees are shown in Table 2.

Table 2 Evaluation results of bearing capacity

μ_k	*Bearing capacity class*
[0, 0.55]	Extreme imbalance of bearing capacity
[0.56, 0.80]	Serious imbalance of bearing capacity
[0.81, 0.93]	Bearing capacity imbalance
[0.94, 0.95]	Bearing capacity is on the verge of imbalance
[0.96, 0.97]	Basic coordination of bearing capacity
[0.98, 0.99]	Bearing capacity coordination
[0.99, 1]	The bearing capacity is very coordinated

To sum up, this study constructs the evaluation index system of ecotourism carrying capacity of scenic spots from the perspectives of ecological environment carrying capacity, tourism reception service carrying capacity and social carrying capacity, and then calculates the connection degree of different index sets according to the correlation degree, identity degree, difference degree, opposition degree and opposition coefficient between different indexes, Thus, the bearing capacity evaluation matrix is constructed and the best/worst evaluation scheme is divided. Based on this, the connection degree of the carrying capacity evaluation index to the optimal scheme is calculated by using the same degree, difference degree and opposition degree, and then the comprehensive correlation degree of the ecotourism environment of popular scenic spots to the optimal scheme is analysed by using the benefit type and cost type indicators. Finally, after calculating the weight of each carrying capacity evaluation index, the weight calculation results are substituted into the calculation process of the connection degree of the optimal evaluation scheme, so as to judge the ecotourism carrying capacity.

3 Experimental verification

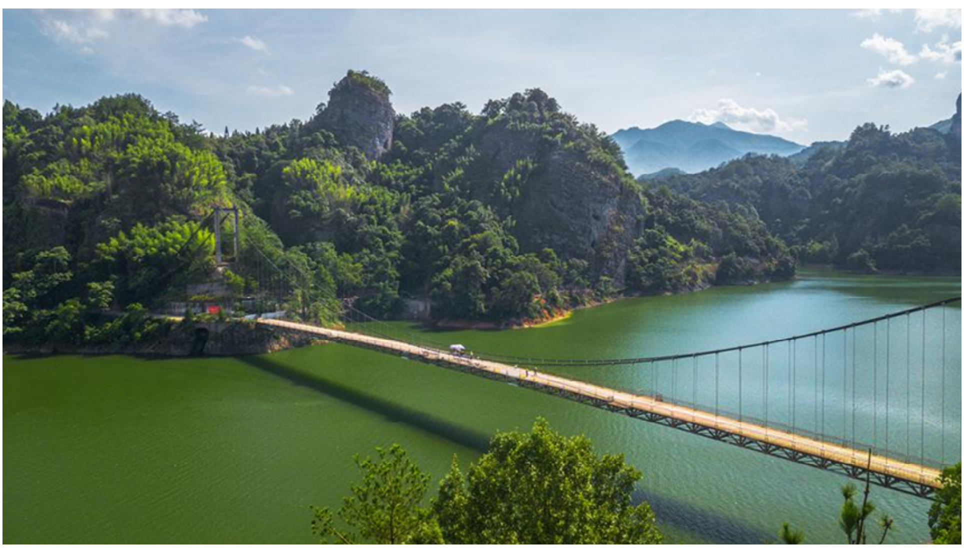
In order to verify the practical application effect of the evaluation method of ecotourism carrying capacity of popular scenic spots based on set pair analysis, the following comparative experiments are designed.

3.1 Experimental design

The experiment takes a popular natural ecological reserve as the research object to evaluate the ecotourism carrying capacity of the scenic spot.

The whole scenic spot is irregular rectangle. The total area of the scenic spot is 17,008.5 hm^2 and the total length from north to south is 26 km. The local environment of the experimental object is shown in Figure 1.

Figure 1 Local environment of the experimental object scenic spot (see online version for colours)



The natural environment protection area of the popular scenic spot is divided into core area, buffer area and experimental area. Among them, the core area is 7,759.0 hm^2, accounting for 45.6% of the total area of the scenic spot. With the unique geographical environment and the development of the core area, the scenic spot has become a popular ecotourism scenic spot in recent years. However, with the increase of the number of tourists and environmental pressure, the eco-environmental pressure of the scenic spot gradually increases. The tourism management part is studying the problem of ecological protection to improve the ecological environment of the scenic spot. Therefore, the popular scenic spot meets the requirements of ecotourism carrying capacity evaluation of popular scenic spots.

The evaluation index data of the scenic spot are collected, and the set pair analysis method is used to construct the evaluation model to obtain the evaluation results of the ecological carrying capacity of the popular scenic spot. The overall experimental scheme is set as follows: taking the calculation accuracy of evaluation index weight and the evaluation accuracy of ecotourism carrying capacity as experimental comparison indexes, this method is compared with the methods of Liu et al. (2018) and Li et al. (2018).

3.2 Experimental index

Evaluation index weight calculation accuracy: the evaluation index weight calculation accuracy refers to the consistency between the weight value calculation results of different methods and the actual results. The higher the evaluation index weight calculation accuracy, the higher the bearing capacity evaluation accuracy, and the stronger the evaluation performance of the method.

Accuracy of ecotourism carrying capacity evaluation: take the carrying index as the index to evaluate the accuracy of ecotourism carrying capacity evaluation of different methods, and judge the gap between the carrying index of the three methods and the actual carrying index. The smaller the difference between the carrying index, the higher the evaluation accuracy. The calculation formula of bearing index is:

$$CSf^{mv} = \sum_{i=1}^{n} S_{i=1}^{env} \times W_i^{env} \tag{19}$$

In the formula, $S_{i=1}^{env}$ represents each influence element of weight calculation, n represents the number of influence elements, and W_i^{env} represents the relevant weight of influence elements.

3.3 Experimental index

3.3.1 Index weight calculation accuracy

The calculation accuracy of bearing capacity evaluation index weight will directly affect the final evaluation accuracy. Therefore, it is necessary to verify the calculation accuracy of index weight of this method, and compare the results of this method with those of Liu et al. (2018) and Li et al. (2018) to prove the calculation performance of index weight of this method. The comparison results of index weight calculation accuracy of the three methods are shown in Table 3.

From the comparison results of index weight calculation accuracy shown in Table 3, it can be seen that the weight calculation accuracy of this method is basically consistent with the actual weight results of ecotourism in popular scenic spots, with only an error of 0.01, while the weight calculation results of Liu et al. (2018) and Li et al. (2018) are quite different from the actual weight values. Therefore, the above results show that this method can calculate the weight of the evaluation index more accurately, so as to ensure the accuracy of bearing capacity evaluation. The reason for this result is that this method calculates the connection degree between index sets according to the correlation degree, identity degree, difference degree, opposition degree and opposition coefficient between different indexes, so as to fundamentally improve the calculation accuracy of index weight.

Table 3 Comparison results of index weight calculation accuracy

Index layer	*Weight value*			
	Actual value	*Paper method*	*Liu et al. (2018) method*	*Li et al. (2018) method*
Standard rate of surface water quality D_1	0.23	0.23	0.46	0.26
Comprehensive pollution index of surface water body D_2	0.21	0.22	0.15	0.31
Standard rate of groundwater quality D_3	0.22	0.22	0.12	0.16
Comprehensive pollution index of groundwater D_4	0.20	0.20	0.23	0.25
Cultivated land carrying capacity D_5	0.16	0.16	0.14	0.16
Forest carrying capacity D_6	0.35	0.35	0.48	0.41
Bearing capacity of built-up land D_7	0.13	0.13	0.51	0.16
Quality standard for environmental control in scenic spots D_8	0.45	0.45	0.56	0.46
Air pollution index D_9	0.41	0.41	0.16	0.78
Noise limit standard D_{10}	0.11	0.11	0.52	0.19
Vegetation coverage D_{11}	0.76	0.76	0.61	0.45
Animal diversity index D_{12}	0.26	0.26	0.74	0.37
Plant diversity index D_{13}	0.36	0.36	0.23	0.47
Economic development level of tourism area D_{14}	0.44	0.44	0.48	0.44
Tourism input-output ratio D_{15}	0.32	0.32	0.61	0.41
Support rate of tourist destination for tourism activities D_{16}	0.56	0.56	0.52	0.32
Capacity of accommodation facilities D_{17}	0.13	0.13	0.26	0.45
Traffic carrying capacity D_{18}	0.28	0.28	0.46	0.33
Catering facilities carrying capacity D_{19}	0.09	0.09	0.11	0.18
Water supply capacity D_{20}	0.56	0.56	0.74	0.41
Power supply capacity D_{21}	0.48	0.48	0.49	0.51
Drainage capacity D_{22}	0.38	0.38	0.51	0.56
Average education level of tourism practitioners C_{23}	0.19	0.19	0.23	0.26
Staff training C_{24}	0.16	0.16	0.26	0.48
Management level C_{25}	0.48	0.48	0.47	0.51
Landscape aesthetics C_{26}	0.89	0.89	0.53	0.76
Landscape sensitivity C_{27}	0.71	0.71	0.76	0.49

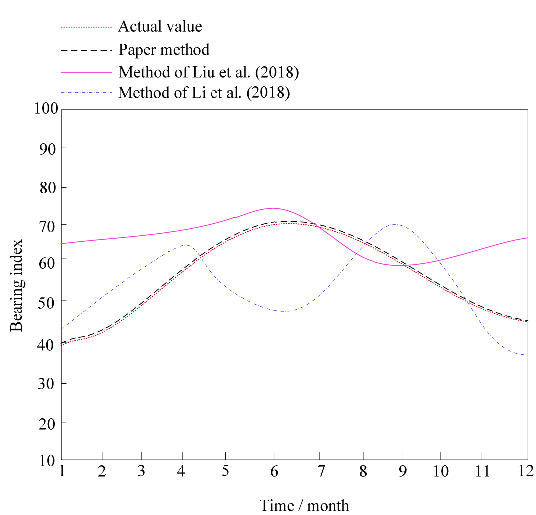
Table 3 Comparison results of index weight calculation accuracy (continued)

Index layer	*Weight value*			
	Actual value	*Paper method*	*Liu et al. (2018) method*	*Li et al. (2018) method*
Tourists' perception of service level in tourist areas C_{28}	0.56	0.56	0.48	0.59
Tourists' perception of the ecological environment of the tourist area C_{29}	0.49	0.49	0.51	0.58
Tourists' perception of cultural customs in tourist areas C_{30}	0.52	0.52	0.72	0.65
Resident satisfaction C_{31}	0.67	0.67	0.41	0.48
Local residents' perception of tourism cultural benefits C_{32}	0.72	0.72	0.45	0.41
Local residents' perception of tourism economic benefits C_{33}	0.75	0.75	0.79	0.72
Local residents' perception of tourism social benefits C_{34}	0.70	0.70	0.52	0.59
Local residents' perception of tourism environmental benefits C_{35}	0.41	0.41	0.52	0.55

3.3.2 Bearing capacity evaluation accuracy

The verification of the accuracy of ecological carrying capacity evaluation takes the carrying index as the performance evaluation index to verify the matching degree between the carrying index of the three methods and the actual carrying index. The closer the carrying index of the three methods is to the actual carrying index, the higher the accuracy of carrying capacity evaluation. The comparison results of bearing capacity evaluation accuracy of the three methods within one year are shown in Figure 2.

Figure 2 Comparison results of bearing capacity evaluation accuracy (see online version for colours)



It can be seen from the comparison results of bearing capacity evaluation accuracy shown in Figure 2 that within one year of evaluation, the calculation results of bearing index of this method are basically consistent with the actual results, indicating that this method can accurately evaluate the ecotourism bearing capacity of popular scenic spots and improve the ecological environment quality of popular scenic spots. The reason for this result is that this method divides the best/worst evaluation scheme based on the construction of bearing capacity evaluation matrix. Then the connection degree of the bearing capacity evaluation index to the optimal scheme is calculated by using the same degree, difference degree and opposition degree, so as to improve the accuracy of bearing capacity evaluation.

4 Conclusions

1 In order to improve the weight calculation accuracy and evaluation accuracy of ecotourism carrying capacity evaluation method, an ecotourism carrying capacity evaluation method of popular scenic spots based on set pair analysis method is proposed. Based on the analysis of the basic concept of ecotourism in popular scenic spots, an ecotourism carrying capacity evaluation system is constructed. Then, the set pair analysis method is used to construct the evaluation matrix to determine the optimal and worst scheme of the evaluation index and the connection degree, and then the corresponding bearing capacity grade evaluation results are obtained according to the calculation results of the connection degree.

2 After using this method to evaluate the ecotourism carrying capacity of popular scenic spots, it has high evaluation index weight calculation accuracy and carrying capacity evaluation accuracy. Compared with the method based on big data analysis, the calculation accuracy of evaluation index weight is significantly improved, and the maximum calculation error of this method is only 0.01; compared with the method based on machine learning algorithm, the accuracy of bearing capacity evaluation is significantly improved, and the calculation result of bearing index is basically consistent with the actual value. Therefore, it shows that the proposed evaluation method based on set pair analysis can better meet the requirements of ecotourism carrying capacity evaluation of popular scenic spots.

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