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A Multi-factor Performance Evaluation Model of Tourism Resource of Tourism Scenic Area Based on Grey System Analysis

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Abstract

Tourism resource is fundamental to the development, promotion and marketing of tourism scenic areas. It is also a key concern of research on the development of the tourism industry. In this paper, factors that influence the analysis of tourism resource are discussed and analyzed. A multi-factor performance evaluation model of tourism resource of tourism scenic area is proposed based on grey system analysis. Firstly, tourism resources of tourism scenic area are categorized into social factors, economic factors, environmental factors, resource factors, historic factors, scientific and technological factors, regional factors and management and service factors. Secondly, evaluation indicators of different categories are standardized to have unified scale. Thirdly, on the basis of grey system analysis, grey clustering coefficients of tourism resource of tourism scenic area are computed and the performance of tourism resources are evaluated according to coefficients. Last but not least, the evaluation model of tourism resource of tourism scenic area is verified through a case study.

Keywords*: tourism scenic area; tourism resource; performance evaluation model; multi factors decision; Grey analysis method*

1. Introduction

Tourism resources are crucial to the development of the tourism scenic area. An effective evaluation of these tourism resources would on one hand, help to identify strengths of a tourism scenic area, which will yield market benefits by planning for marketing and promotion activities rationally. On the other hand, it reflects weaknesses of a tourism scenic area and how competitive it could be, thus enabling a full use of the resources timely and scientifically, increasing competitiveness and embracing more development opportunities [1-4]. However, the performance evaluation of tourism resource of tourism scenic area is influenced by many factors. Some of these factors are quantitative while others are qualitative; some are dynamic while some are static. It is a dynamic and complicated decision-making process with a multi-layered and multi-factor system [5-8].

The grey system theory was first put forth by Professor Deng Julong from Huazhong University of Science and Technology in 1980s. It is an emerging intelligent system subject and a system engineering subject which is based on mathematical theories. Theories, methods and models relevant to grey system are widely applied to solve problems in special field containing unknown factors [9-13]. This paper, on the basis of methods and models of grey system, proposes a multi-factor performance evaluation model of tourism resource of tourism scenic area.

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2. Multi-factor Performance Evaluation and Indicator System of Tourism Resource of Tourism Scenic

2.1. Multi-factor Performance Evaluation of Tourism Resource of Tourism Scenic Area

In the analysis, tourism resources are categorized into eight factors, namely social factors, economic factors, environmental factors, resource factors, historic factors, scientific and technological factors, regional factors, and management and service factors.

(1) Social factors: social factors mainly reveal links between the tourism scenic area and the society, including local government's policy support and financial assistance to the tourism scenic area, local people's p support to and participation in it, and benefits to local community from it.

(2) Economic factors: economic benefits are most considered and are reflected in different aspects, including the number, consumption level and consumption rate of tourists with direct benefits linking with the tourism scenic area and local government, and accommodation, catering and shopping with direct benefits linking with the service industry.

(3) Environmental factors: environmental factors emphasize on ecology, environment protection, greening and climate of the tourism scenic area. The scenic area would be very competitive if it boasts a sound ecological environment, greening and favorable climate, is able to wrestle with pollution and waste efficiently and is capable of recycling.

(4) Resource factors: resource factors mainly focus on natural resources and artificial resources of a tourism scenic area. Natural resource refers to natural landscape or scenic features, which are attractive to tourists. Artificial resource refers to man-made and developed landscape and facilities, which are also important to the development of the tourism scenic area.

(5) Historic factors: historic factors mainly focus on history, popularity, culture and education of the city where the tourism scenic area is located. The scenic area would be competitive if it has a long history and a splendid culture.

(6) Scientific and technological factors: scientific and technological factors evaluate the development of tourism resource with scientific and technological approaches or tools. With the advancement of the society and in today's scientific world, a tourism scenic area equipped with modern gadgets would keep up with the times. In particular, an ancient civilization integrated with scientific and technological methods would just make the scenic area more unique and fashion than otherwise.

(7) Regional factors: regional factors evaluate the influence of geographical environment on the competitiveness of the tourism scenic area. Regional environment includes location characteristics, geographical condition, traffic, etc. A sound geographical environment would make the scenic area more attractive.

(8) Management and service factors: management and service factors refer to management and service ability of management agency of the scenic area and local government, including setting up management agencies, promoting institutional construction, improving service approaches and methods, and satisfying the public, *etc*.

2.2. Performance Evaluation Indicator System of Tourism Resource of Tourism Scenic Area

The multi-factor performance evaluation indicator system of tourism resource of tourism scenic area is constructed based on the analysis of eight factors, as is shown in Table 1.

Table 1. Performance Evaluation Indicator System of Tourism Resource of Tourism Scenic Area

System layer	Criteria layer	Indicator layer
Performance evaluation indicator system of tourism resource of tourism scenic area R	Social factors R_1	Policy support r_{11}
		Participation of local residents r_{12}
		Social benefit of tourist attractions r_{13}
	Economic factors R_2	Earnings of tourist attractions r_{21}
		Fiscal revenue r_{22}
		Ancillary revenue r_{23}
	Environmental factors R_3	Ecological greening ability r_{31}
		Environmental protection ability r_{32}
		Climate conditions r_{33}
	Resource factors R_4	Natural resources r_{41}
		Human resource development r_{42}
	Historic factors R_5	Historic popularity r_{51}
		Cultural deposits r_{52}
		Educational development r_{53}
	Scientific and technological factors R_6	Technology r_{61}
		Technological integration r_{62}
	Regional factors R_7	Geographical features and regional conditions r_{71}
		Transportation r_{72}
	Management and service factors R_8	Scientific management organizations r_{81}
		Scientific management system r_{82}
		Service ability r_{83}
		Social satisfaction r_{83}

3. Multi-factor Performance Evaluation Model of Tourism Resource of Tourism Scenic Area

3.1. Grey Clustering Function

The traditional four-grey clustering functions are adopted in this paper, namely typical grey clustering function , grey clustering function of upper measure, grey clustering function of lower measure and grey clustering function of moderate measure. The multi-factor performance evaluation model of tourism resource of tourism scenic area is constructed based on grey system analysis. Suppose the grey clustering function of indicator j under s-th grey category is

$$f_j^s(x) = f_j^s\left[x_j^s(a), x_j^s(b), x_j^s(c), x_j^s(d)\right],$$

in which, $x_j^s(a)$, $x_j^s(b)$, $x_j^s(c)$ and $x_j^s(d)$ are the turning points of $f_j^s(x)$.

Thus, the grey clustering function of typical measure is:

$$f_j^s(x)=\begin{cases}0 & x\notin\left[x_j^s(a),x_j^s(d)\right]\\ \dfrac{x-x_j^s(a)}{x_j^s(b)-x_j^s(a)} & x\in\left[x_j^s(a),x_j^s(b)\right]\\ 1 & x\in\left[x_j^s(b),x_j^s(c)\right]\\ \dfrac{x_j^s(d)-x}{x_j^s(d)-x_j^s(c)} & x\in\left[x_j^s(c),x_j^s(d)\right]\end{cases} \quad (1)$$

The grey clustering function of upper measure is:

$$f_j^s(x)=\begin{cases}0 & x\in\left[0,x_j^s(a)\right]\\ \dfrac{x-x_j^s(a)}{x_j^s(b)-x_j^s(a)} & x\in\left[x_j^s(a),x_j^s(b)\right]\\ 1 & x\in\left[x_j^s(b),1\right]\end{cases} \quad (2)$$

The grey clustering function of lower measure is:

$$f_j^s(x)=\begin{cases}0 & x\in\left[x_j^s(d),1\right]\\ \dfrac{x_j^s(d)-x}{x_j^s(d)-x_j^s(c)} & x\in\left[x_j^s(c),x_j^s(d)\right]\\ 1 & x\in\left[0,x_j^s(c)\right]\end{cases} \quad (3)$$

The grey clustering function of moderate measure is:

$$f_j^s(x)=\begin{cases}\dfrac{x-x_j^s(a)}{x_j^s(b)-x_j^s(a)} & x\in\left[x_j^s(a),x_j^s(b)\right]\\ 0 & x\in\left[0,x_j^s(a)\right]\vee x\in\left[x_j^s(c),1\right]\\ \dfrac{x_j^s(c)-x}{x_j^s(c)-x_j^s(b)} & x\in\left[x_j^s(b),x_j^s(c)\right]\end{cases} \quad (4)$$

3.2. Standardization of Evaluation Indicators

In order to unify the measurement scale of indicators of grey clustering analysis, it is necessary to standardize indicators under the construction of different grey clustering functions.

If indicator j is a qualitative indicator, its value is expressed by membership degree. The membership degree ranges from 0-1, as shown in Table 2.

Table 2. Value of Qualitative Indicators

Value	Membership degree
0	Zero membership
0.2	Little membership
0.4	A little membership
0.6	Normal membership
0.8	Strong membership
1.0	Full membership
0.1, 0.3, 0.5, 0.7, 0.9	In between

If indicator j is a quantitative indicator, its measured value is u_j and the section domain is $u_j(o)=\left[u_j^a(o),u_j^b(o)\right]$. If it is a positive indicator, then the standardized value v_j is:

$$v_j=\frac{u_j-u_j^a(o)}{u_j^b(o)-u_j^a(o)} \tag{5}$$

If it is a negative indicator, then the standardized value is:

$$v_j=\frac{u_j^b(o)-u_j}{u_j^b(o)-u_j^a(o)} \tag{6}$$

If indicator j is a quantitative indicator, its measured value is $u_j=\left[u_j^a,u_j^b\right]$ and the section domain is $u_j(o)=\left[u_j^a(o),u_j^b(o)\right]$. If it is a positive indicator, then the standardized value v_j is:

$$v_j=\left[v_j^a,v_j^b\right]=\left[\frac{u_j^a-u_j^a(o)}{u_j^b(o)-u_j^a(o)},\frac{u_j^b-u_j^a(o)}{u_j^b(o)-u_j^a(o)}\right] \tag{7}$$

If it is a negative indicator, then the standardized value v_j is:

$$v_j=\left[v_j^a,v_j^b\right]=\left[\frac{u_j^b(o)-u_j^b}{u_j^b(o)-u_j^a(o)},\frac{u_j^b(o)-u_j^a}{u_j^b(o)-u_j^a(o)}\right] \tag{8}$$

3.3. Multi-factor Performance Evaluation Model of Tourism Resource of Tourism Scenic Area and its Realization

After consulting with experts in this field, the tourism resource performance is divided into four levels, namely excellent, good, mediocre and poor. After standardization of indicators and after the scale is unified, the performance evaluation model of tourism resource of tourism scenic area with four categories are able to construct based on grey clustering function, as shown in Fig.1.

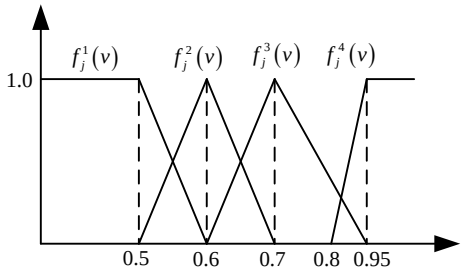

Figure 1. Grey Clustering Functions of the Performance Evaluation of Tourism Resource of Tourism Scenic Area with Four Categories

Therefore, the grey clustering function model for category "excellent" is:

$$f_j^4(v)=\begin{cases}0 & v\in[0,0.80]\\ \dfrac{v-0.80}{0.15} & v\in[0.80,0.95]\\ 1 & v\in[0.95,1.00]\end{cases} \tag{9}$$

Therefore, the grey clustering function model $f_j^3(v)$ for category "good" is:

$$f_j^3(v)=\begin{cases}\dfrac{v-0.60}{0.10} & v\in[0.60,0.70]\\ 0 & v\in[0,0.60]\vee x\in[0.95,1]\\ \dfrac{0.95-v}{0.25} & v\in[0.70,0.95]\end{cases} \tag{10}$$

The grey clustering function model $f_j^2(v)$ for category "mediocre" is:

$$f_j^2(v)=\begin{cases}\dfrac{v-0.50}{0.10} & v\in[0.50,0.60]\\ 0 & v\in[0,0.50]\vee x\in[0.70,1]\\ \dfrac{0.70-v}{0.10} & v\in[0.60,0.70]\end{cases} \tag{11}$$

The grey clustering function model $f_j^1(v)$ for category "poor" is:

$$f_j^1(v)=\begin{cases}1 & v\in[0,0.50]\\ \dfrac{0.6-v}{0.10} & v\in[0.50,0.60]\\ 0 & v\in[0.60,1]\end{cases} \tag{12}$$

If the weight of indicator j is w_j, the grey correlation coefficient ξ_i of indicator j under grey category i is:

$$\xi_i = \sum_{j=1}^{n} \left(w_j * f_j^i (v) \right) \tag{13}$$

According to grey correlation coefficient ξ_i , we can judge which grey category the object under evaluation belongs to. If it satisfies:

$$\xi_{max} = \max_{1 \le i \le m} (\xi_i) = \xi_k \tag{14}$$

It indicates that the tourism resource of tourism scenic area is under the k -th grey category.

4. Case Study

As is propelled by market demand, a tourism scenic area is planning for second-stage development. Tourism resources in the planning should be subject to effective evaluation and analysis, in order to make rational development goals. Analysis on tourism resources are conducted based on the abovementioned evaluation system and model. After an on-the-spot survey and consultation with experts, relevant data are acquired for evaluating tourism resource performance of this tourism scenic area.

Table 3. Data Analysis of Tourism Resource Performance

Criteria layer	Weight	Indicator layer	Weight	Value

According to the grey clustering analysis model proposed in this paper, grey correlation coefficients of indicators under different grey categories are available, as shown in Table 4.

Table 4. Grey Correlation Coefficients of Indicators

Indicator layer	Grey category			
	Excellent	Good	Mediocre	Poor

Similarly, the criteria layer is subject to the same treatment as the indicator layer does. And then we can obtain grey correlation coefficients under different grey categories, as shown in Table 5.

Table 5. Comprehensive Grey Correlation Coefficient

Criteria layer	Grey category			
	Excellent	Good	Mediocre	Poor
R_1	0. 020	0. 064	0	0
R_2	0. 0133	0. 016	0. 060	0
R_3	0	0.072	0	0.060
R_4	0.050	0.060	0	0
R_5	0	0. 088	0	0

R_6	0. 0501	0. 030	0	0
R_7	0.060	0.054	0	0
R_8	0.075	0.045	0	0
Comprehensive grey correlation coefficient	0.185	0.231	0. 060	0. 060

From Table 5, it is seen that tourism resources in the second-stage of development plan of the tourism scenic area are categorized to "good", which indicates that tourism resources are conductive to the development of the scenic area.

5. Conclusion

This paper draws merits from traditional grey clustering analysis and makes an improvement. It studies tourism resources of tourism scenic area and proposes a multi-factor performance evaluation model of tourism resource of tourism scenic area, thus providing a new method for evaluating tourism resources. Different indicators are standardized and the grey clustering analysis is analyzed in unified scale, making sure that the evaluation is accurate and reliable. The efficacy and operability of the model and the algorithm are verified through a case study.

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