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The Evaluation Analysis of Tourism Public Service based on the Grey Matter Element Method

Yong Ding

Weifang University of Science and Technology,
Shandong, China,(ddy2004@126.com)

Abstract

The scientific and effective evaluation of tourism public service could promote the construction of tourism public service. According to the basic characteristics of tourism public service to construct the evaluation index system of tourism public service, using matter element analysis and grey theory to establish the evaluation model of tourism public service, the evaluation results of tourism public service are divided into 4 grey clusterings, which provides a professional, scientific and reasonable evaluation method for tourism public service.

Key words

Tourism; grey element; whitening value; public service; weight

1. Introduction

Tourism public service is provided by government or other social organizations, satisfying the demands of tourists as the core, and not for the purpose of making profits. It is the general name of the products and services with obvious publicity (Shuang Li, Fucai Huang, Jianzhong Li, 2010).With the advent of mass tourism era, the position and the role of tourism public service are becoming more and more important. In view of this, constructing the evaluation index system of tourism public service, carrying on the reasonable and scientific evaluation becomes a very important basic work.

2. The evaluation factor analysis and the evaluation system of tourism public service

2.1 The selection principle of tourism public service evaluation indexes

In the process of selecting tourism public service evaluation indexes, some principles should be followed.

(1) The combination of comprehensiveness, systematicness and emphasis factors

In the selection process of tourism public service evaluation factors, we should not only comprehensively consider the actual situation in our country, but also form a system. At the same time, according to the evaluated area, the local emphasis factors should be considered, achieving the combination of comprehensiveness, systematicness and emphasis factors.

(2) The combination of accuracy and fuzziness

Tourism public service evaluation should be based on a large amount of data as support. Therefore, the selected influencing factors should collect accurate data. At the same time, some factors just need to evaluate the general direction, which means, achieving the combination of accuracy and fuzziness.

(3) The combination of diversity and changeability

China is a large country with big regional differences of natural geography and geological environment. Tourism conditions are also different. At the same time, the data under the same index of tourism public service of the same area may be also changing. Therefore, in the selection process of evaluation indexes, the diversity and changeability should be combined.

2.2 The evaluation indexes and its influence of tourism public service

The specific evaluation indexes, its influence and its expression forms of tourism public service are shown in table 1.

Table 1 The influencing factors and its expression forms of tourism public service

Target	first-level indexes	second-level indexes	index influence and its expression forms
The evaluation of tourism public service P	Function value A	Tourism public traffic facilities	the facilities of tour expressway, tourism traffic joints
		Tourism public recreational facilities	Leisure green space, public landscape facilities
		General tourism amenities	financial service, communications, medical care, health facilities
		Tourism public	tourism government information,

		information	tourism enterprise information, tourism consulting object facilities, virtual platform
	Emotional value B	Tourism public security service	Tourism public security facilities, Tourism public security mechanism
		Tourism monitoring guarantee service	The sanitation, security, service quality, price, environment monitoring of tourism enterprises, tourism destination and scenic spot
	Social value C	Tourism regulations and policies	Tourism regulations, local tourism management regulations, tourism industry standard, industry service standard
		Tourism public welfare service	Tourism education and vocational training, poverty alleviation, tourism consumption promoting
		Tourism environmental protection and planning and exploitation	Tourism ecological environment protection, heritage development and management, regional tourism planning compilation
		Tourism marketing promotion	Tourism destination marketing, tourism festival activities
	Perceived price D	money capital	The proportion of tourism administrative expenditure in fiscal expenditure
		Time cost	The number and duration of tourism administrative examine approval items
		physical strength cost	Tourist complaints and proper handling

2.3 The analytic hierarchy process (AHP) is used to calculate the weight of each influencing factor of tourism public service

The analytic hierarchy process (AHP) is used to calculate the weight of each influencing factor of tourism public service. The results are shown in table 2. (Quanliang Ye,Hao Rong,2011).

Table 2 the weight of each evaluation index of tourism public service

Target	first-level indexes	weight	second-level indexes	weight
The evaluation of tourism public service P	Function value A	0.2009	Tourism public traffic facilitiesA_1	0.3507
			Tourism public recreational facilities A_2	0.1893
			General tourism amenities A_3	0.1093
			Tourism public information A_4	0.3507
	Emotional value B	0.2009	Tourism public security service B_1	0.5000
			Tourism monitoring guarantee serviceB_2	0.5000
	Social value C	0.0788	Tourism regulations and policies C_1	0.3507
			Tourism public welfare service C_2	0.1093
			Tourism environmental protection and planning and exploitation C_3	0.3507
			Tourism marketing promotion C_4	0.1893
	Perceived price D	0.5194	money capital D_1	0.5000
			Time cost D_2	0.2500
			physical strength cost D_3	0.2500

3. The grey matter element model of tourism public service evaluation

3.1 Determine the grey number whitening value of tourism public service evaluation

According to the analysis of the main influencing factors of tourism public service, tourism public service is divided into 4 levels, that is, excellent, good, general, poor. The specific classification is shown in table 3.

Table 3: The level classification table of tourism public service (10 points system is used.)

The evaluation level of tourism public service	scale (no unit)
excellent	8~10
good	6~8
general	4~6
poor	1~4

Using the expression of grey elements to describe tourism public service, N indicates tourism public service, c indicates the characteristics of tourism public service, $\tilde{\otimes}$ indicates the grey number whitening value corresponding to the characteristics of tourism public service c, therefore, the expression of grey elements of tourism public service evaluation could be written as follows: $\tilde{\otimes}R=\begin{bmatrix} & N \\ c & \tilde{\otimes} \end{bmatrix}$.

As a result, the whitenization weight functions of the four levels of tourism public service evaluation are as follows:

$$f_1(d)=\begin{cases} \dfrac{d}{8}, & 0\le d\le 8 \\ 1, & d>8 \\ 0, & d<0 \end{cases}, f_2(d)=\begin{cases} \dfrac{d}{8}, & 0\le d\le 8 \\ 2-\dfrac{d}{8}, & 8<d\le 16 \\ 0, & d>16, d<0 \end{cases},$$

$$f_3(d)=\begin{cases}\dfrac{d}{6}, & 0\le d\le 6\\ 2-\dfrac{d}{6}, & 6<d\le 12\\ 0, & d>12, d<0\end{cases}, f_4(d)=\begin{cases}1, & 0\le d\le 4\\ 2-\dfrac{d}{4}, & 4<d\le 8\\ 0, & d>8, d<0\end{cases},$$

Expert scoring method is used to evaluate the tourism public service, we could get D_{ji}, and $D_{ji}^{(A)}$ indicates the evaluation matrix the evaluation expert i gives to the j th second-level factor of the main influencing factors of certain tourism public service. Integrated $D_{ji}^{(A)}$ and $f_k(d_{ji})$ to calculate, we could get the grey evaluation coefficient that certain second-level factor j is relative to the main factor of tourism public service evaluation A which belongs to the k th grey clustering as follows: $\tilde{\otimes}_{ji}^{(A)}=\sum_{i=1}^{n} f_k(d_{ji})$.

3.2 Determine the grey matter elements of the main factors of tourism service management evaluation.

$\tilde{\otimes}_{ji}$ $(j=1,2,\cdots,m;i=1,2,\cdots,n)$ is the corresponding grey number whitening value of n main factors of tourism public service under j th evaluation level, therefore we could get n -dimension grey element of j th evaluation level.

$$\tilde{\otimes}R_{jn}=\begin{bmatrix} & M_j\\ c_1 & \tilde{\otimes}_{j1}\\ c_2 & \tilde{\otimes}_{j2}\\ \vdots & \vdots\\ c_n & \tilde{\otimes}_{jn}\end{bmatrix},$$

M_j indicates the j th evaluation level, c_j indicates the i th tourism public service main factor of the j th evaluation level, $\tilde{\otimes}_{ji}$ $(j=1,2,\cdots,m;i=1,2,\cdots,n)$ indicates the corresponding grey number whitening value. Gather the n-dimension grey elements of m evaluation levels, write the n -dimension composite grey element of m-evaluation levels.

$$\tilde{\otimes}R_{mn}=\begin{bmatrix} & M_1 & M_2 & \cdots & M_m\\ c_1 & \tilde{\otimes}_{11} & \tilde{\otimes}_{21} & \cdots & \tilde{\otimes}_{m1}\\ c_2 & \tilde{\otimes}_{12} & \tilde{\otimes}_{22} & \cdots & \tilde{\otimes}_{m2}\\ \vdots & \vdots & \vdots & & \vdots\\ c_n & \tilde{\otimes}_{1n} & \tilde{\otimes}_{2n} & \cdots & \tilde{\otimes}_{mn}\end{bmatrix}$$

m indicates the number of evaluation level, n indicates the number of the main factors of tourism public service.

3.3 Construct the n-dimension grey elements of tourism public service ideal risk set

Find out the optimal value from m evaluation levels, form the ideal risk set, and then construct n-dimension grey elements of the ideal risk set.

$$\tilde{\otimes}R_0 = \begin{bmatrix} & M_0 \\ c_1 & \tilde{\otimes}_{01} \\ c_2 & \tilde{\otimes}_{02} \\ \vdots & \vdots \\ c_n & \tilde{\otimes}_{0n} \end{bmatrix}.$$

3.4 The index correlation degree analysis of tourism public service

Carry on the dimensionless processing to the original data. There are 3 processing methods.

(1)The smaller the optimal type: $\tilde{\otimes}'_{ji} = \dfrac{\max\tilde{\otimes}_{ji} - \tilde{\otimes}_{ji}}{\max\tilde{\otimes}_{ji} - \min\tilde{\otimes}_{ji}}$;

(2)The moderate type : $\tilde{\otimes}'_{ji} = \dfrac{\min(\tilde{\otimes}_{ji} - u_{ji})}{\max(\tilde{\otimes}_{ji} - u_{ji})}$;

(3)The bigger the optimal type: $\tilde{\otimes}'_{ji} = \dfrac{\tilde{\otimes}_{ji} - \min\tilde{\otimes}_{ji}}{\max\tilde{\otimes}_{ji} - \min\tilde{\otimes}_{ji}}$,

And $j = 1,2,\cdots,m$, $i = 1,2,\cdots,n$.

According to the structured n- dimension correlation coefficient of m evaluation levels, the composite grey element $\tilde{\otimes}R_\xi$ is as follows:

$$\tilde{\otimes}R_\xi = \begin{bmatrix} & M_1 & M_2 & \cdots & M_m \\ c_1 & \tilde{\otimes}\xi_{11} & \tilde{\otimes}\xi_{21} & \cdots & \tilde{\otimes}\xi_{m1} \\ c_2 & \tilde{\otimes}\xi_{12} & \tilde{\otimes}\xi_{22} & \cdots & \tilde{\otimes}\xi_{m2} \\ \vdots & \vdots & \vdots & & \vdots \\ c_n & \tilde{\otimes}\xi_{1n} & \tilde{\otimes}\xi_{2n} & \cdots & \tilde{\otimes}\xi_{mn} \end{bmatrix},$$

$\tilde{\otimes}\xi_{ji}$ indicates the correlation coefficient whitening value of i th tourism public service evaluation main factor under the j th evaluation level after the standardization transformation, $j=1,2,\cdots,m;i=1,2,\cdots,n$,and: $\tilde{\otimes}\xi_{ji}=\dfrac{\Delta\min+\rho\Delta\max}{\Delta_{ji}+\rho\Delta\max}$

Δ_{ji} is the absolute value of grey element whitening value after the i th tourism public service evaluation main factor under the j th evaluation level is carried on the data standardization and the ideal risk set data standardization, that is, $\Delta_{ji}=\left|\tilde{\otimes}'_{0i}-\tilde{\otimes}'_{ji}\right|$, $\Delta\max$ indicates the maximum value of absolute error Δ_{ji}, $\Delta\min$ indicates the minimum value of absolute error Δ_{ji}, ρ indicates the resolution coefficient, normally, $\Delta\min=0$, $\rho=0.5$.

According to each evaluation index weight of tourism public service calculated by the analytic hierarchy process (AHP), carry on the weighted calculation to the tourism public service evaluation, and we could get: $\tilde{\otimes}A_k=\omega_k\cdot\tilde{\otimes}R_\xi$.

And ω_k indicates the weight of the main factors, ω_{kn} indicates the weight of n th second-level index under k th main factor. $\tilde{\otimes}A_k$ indicates the overall grey correlation degree tourism public service to level k.

Finally, according to the maximum membership degree principle, the evaluation level of tourism public service could be determined.

4. The tourism public service evaluation of Shouguang

After the investigation to the tourism public service of Shouguang, four experts give their scores. The detailed results are shown in table 4.

Table 3 the scoring results experts give to the tourism public service of Shouguang

Second-level factors	expert 1	expert 2	expert 3	expert 4
Tourism public traffic facilities A_1	4.3	5.8	5.5	6.8
Tourism public recreational facilities A_2	4.3	4.8	3.8	4.2

General tourism amenities A_3	5.2	5.5	4.8	3.8
Tourism public information A_4	6.6	5.6	5.2	4.4
Tourism public security service B_1	5.1	6.2	6.8	4.2
Tourism monitoring guarantee service B_2	6.2	5.4	4.2	4.8
Tourism regulations and policies C_1	4.5	5.6	4.8	6.0
Tourism public welfare service C_2	4.0	3.2	4.1	3.9
Tourism environmental protection and planning and exploitation C_3	8.2	7.8	8.3	7.5
Tourism marketing promotion C_4	8.1	8.5	8.8	7.6
money capital D_1	3.5	5.2	4.3	3.0
Time cost D_2	4.2	3.8	3.6	4.5
physical strength cost D_3	3.8	4.3	4.8	3.2

Therefore, we could get

$$D^{(A)}=\begin{pmatrix}4.3 & 5.8 & 5.5 & 6.8\\ 4.3 & 4.8 & 3.8 & 4.2\\ 5.2 & 5.5 & 4.8 & 3.8\\ 6.6 & 5.6 & 5.2 & 4.4\end{pmatrix}, D^{(B)}=\begin{pmatrix}5.1 & 6.2 & 6.8 & 4.2\\ 6.2 & 5.4 & 4.2 & 4.8\end{pmatrix},$$

$$D^{(C)}=\begin{pmatrix}4.5 & 5.6 & 4.8 & 6.0\\ 4.0 & 3.2 & 4.1 & 3.9\\ 8.2 & 7.8 & 8.3 & 7.5\\ 8.1 & 8.5 & 8.8 & 7.6\end{pmatrix}, D^{(D)}=\begin{pmatrix}3.5 & 5.2 & 4.3 & 3.0\\ 4.2 & 3.8 & 3.6 & 4.5\\ 3.8 & 4.3 & 4.8 & 3.2\end{pmatrix}.$$

Calculate the 4 grey clustering's evaluation coefficients of the first second-level factor of the main factor A, namely:

$$\tilde{\otimes}_{111}=\sum_{l=1}^{4} f_1(d_{1l})=f_1(4.3)+f_1(5.8)+f_1(5.5)+f_1(6.8)=2.8;$$

$$\tilde{\otimes}_{211}=\sum_{l=1}^{4}f_2(d_{1l})=f_2(4.3)+f_2(5.8)+f_2(5.5)+f_2(6.8)=2.8;$$

$$\tilde{\otimes}_{311}=\sum_{l=1}^{4}f_3(d_{1l})=f_3(4.3)+f_3(5.8)+f_3(5.5)+f_3(6.8)=3.5;$$

$$\tilde{\otimes}_{411}=\sum_{l=1}^{4}f_4(d_{1l})=f_4(4.3)+f_4(5.8)+f_4(5.5)+f_4(6.8)=2.4.$$

In the same way, we could get the 4 grey clustering evaluation coefficient of the second, third and fourth second-level factors of the main factor A as follows:

$\tilde{\otimes}_{112}=2.8$, $\tilde{\otimes}_{212}=2.8$, $\tilde{\otimes}_{312}=3.7$, $\tilde{\otimes}_{412}=3.6$;

$\tilde{\otimes}_{113}=2.1$, $\tilde{\otimes}_{213}=2.1$, $\tilde{\otimes}_{313}=2.9$, $\tilde{\otimes}_{413}=3.7$;

$\tilde{\otimes}_{114}=2.4$, $\tilde{\otimes}_{214}=2.4$, $\tilde{\otimes}_{314}=3.2$, $\tilde{\otimes}_{414}=3.1$.

Therefore, the grey evaluation coefficient matrix $\tilde{\otimes}R$ of the main factor A could be obtained, namely:

$$\tilde{\otimes}R_A=\begin{pmatrix}2.8 & 2.8 & 3.5 & 2.4\\ 2.8 & 2.8 & 3.7 & 3.6\\ 2.1 & 2.1 & 2.9 & 3.7\\ 2.4 & 2.4 & 3.2 & 3.1\end{pmatrix}.$$

Using the bigger the optimal principle, the optimal solution of main factor A could be determined as follows:

$$\tilde{\otimes}R_0^{(A)}=\begin{bmatrix} & M_0\\ c_1 & 3.5\\ c_2 & 3.7\\ c_3 & 3.7\\ c_4 & 3.2\end{bmatrix}.$$

Using the bigger the optimal criterion to carry on the standardized processing to $\tilde{\otimes}R_A$, calculate the correlation grey matter element of the main factor A, which is obtained as follows:

$$\tilde{\otimes}R_\xi^{(A)}=\begin{pmatrix}0.36 & 0.36 & 1 & 0\\ 0 & 0 & 1 & 0.89\\ 0 & 0 & 0.50 & 1\\ 0 & 0 & 1 & 0.88\end{pmatrix}.$$

According to the weight to calculate, we could get:

$$\tilde{\otimes}A = (0.3507, 0.1893, 0.1093, 0.3507)\begin{pmatrix} 0.36 & 0.36 & 1 & 0 \\ 0 & 0 & 1 & 0.89 \\ 0 & 0 & 0.50 & 1 \\ 0 & 0 & 1 & 0.88 \end{pmatrix} = (0.1263, 0.0681, 0.9491, 0.5864)$$

In the same way, we could get:

$\tilde{\otimes}B = (0.60, 0.60, 0.50, 0.50)$; $\tilde{\otimes}C = (0.54, 0.0186, 0.609, 0.3821)$; $\tilde{\otimes}D = (0, 0, 0.5813, 1)$.

Finally, we could get the overall correlation coefficient of Shouguang tourism public service is as follows:

$\tilde{\otimes}P = (0.1357, 0.6410, 0.7678, 0.1885)$.

5. Results and discussion

According to the maximum membership degree principle, the evaluation level of Shouguang tourism public service could be judged as general.

Using the matter element analysis method and the grey theory, the evaluation results of tourism public service could be divided into four gray clustering. And the evaluation model of tourism public service is then set up, which provides a professional, scientific, reasonable and fair evaluation method for tourism public service.

6. Conclusion

In recent years, tourism public service has been a widespread social concern. And its evaluation research is also actively being developed. Currently, the evaluation methods of tourism public service are not perfect enough. The common methods are analytic hierarchy process (AHP) and fuzzy comprehensive evaluation method. The matter element analysis method and grey theory is combined to evaluate tourism public service. This is a new evaluation method, which has a certain guiding significance to the construction of tourism public service.

Reference

1. Li S., Huang F.C., Tourism public service connotation, characteristics and classification framework, travel journal, no. 4, pp. 20 – 26, 2010.

2. Ye Q.L., Rong H., Evaluation of the public service of tourism based on analytic hierarchy process (ahp), Journal of at Zhongnan university of economics and law, no. 3,pp.47-54,2011.
3. Sheng G.,The section is activities of tourism public service, the government's point of view. Wuxi vocational college journal, no. 6, pp.67-69, 2008.
4. Chu H.B., Hai D., Wang J.Z., Analytic hierarchy process (ahp) application of geologic hazard risk division in Taihang mountain, Chinese journal of geological hazards and prevention, vol 14 no. 3.
5. Hong J, Liu Z.G., Fuzzy mathematics comprehensive evaluation method in the application of the regional geological environmental quality evaluation. Engineering geological, hydrogeological, vol 6. pp. 44-55, 1996.
6. Mao T.X, Shi H.R., Zhang L.J., Quantitative evaluation and prediction of regional geological environment, Geological front, vol. 3, pp. 1-2., 1996.
7. Zong H., Hazard risk assessment method of semi-quantitative evaluation, Geological hazards and environmental protection, vol. 14 no. 2, 2003.
8. Fei Y.M., Dr. Huang, GIS and its application in geological hazard research the first three national youth engineering geological symposium corpus, chengdu university of science and technology press, pp.510-519, 1992.
9. Zhang J., Du D., such as regional geological hazard environment system and the basic idea of comprehensive evaluation model, Chinese journal of geological hazards and prevention, vol. 5 no. 4, pp.26-32. 1994.
10. Jang Y., Geological hazard risk evaluation theory and method,Geology and mineral resources of China economy, no. 4, pp.40-45,1996
11. Jiang L.K., The application of the fuzzy consistent matrix in the analytic hierarchy process (ahp), Journal of Shanghai maritime university, vol. 12 no. 2, pp.55- 60, 1998.
12. Zhang J.J., Fuzzy analytic hierarchy process quantificating. Fuzzy sets and systems, vol. 14 no. 2, pp .80-88. 2000.
13. Lv Y.J., Sort of fuzzy analytic hierarchy process (ahp) based on fuzzy consistent matrix, Fuzzy sets and systems. no.2, pp. 79-85, 2002.
14. Han Z.G., Mathematical Modeling and Its Application. Beijing, Higher Education Press, 2005.
15. Bu H.B. i, Bu S.Z., Two-Layer Fuzzy Comprehensive RSA-ANP-DSS Evaluation Model of Emergency Management Capacity about Enterprise Value Network, Systems Engineering Procedia, vol.5, pp.93-98,2012.