Analysis of the public satisfaction index of public cultural services based on the Grey Correlation AHP method

Liping Fu[1], Juan Li[1, 2*]

[1]*Public Resource Management Research Center, College of Management and Economics Tianjin University, Tianjin, China*

[2]*Hebei United University, 46 Xinhua Road, Tangshan, Hebei, China*

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Abstract

The public is the service object of the public cultural services while the public satisfaction index is the main indicator in the judgment of the public cultural service effect. The Grey Correlation Method is applied to selecting the main factors which influence the public satisfaction index of public cultural services, and the number of public library, the public cultural activities of organizations, and the number of staff in the public cultural service institutions is the most three important factors. After that, the paper builds public satisfaction model based on grey correlation AHP, applies the method to evaluating the current public satisfaction of public cultural services in China, and proposes the specific measures to improve and promote public cultural services in China on the basis of the evaluation result.

Keywords: public cultural services, public satisfaction index, Grey Correlation AHP method

1 Introduction

The system of public cultural services is an important part of the governmental public services as well as a significant way to realize citizens' cultural rights. Public satisfaction is an exclusive criterion for judging whether the public cultural services are effective or not. Only the satisfaction level of public cultural services obtained from the objective measurement and analysis can inspect whether the public services provided are effective or not, and only the corresponding suggestions based on public needs can improve public cultural services, so as to serve the public better.

The public satisfaction evaluation originated from the enterprise's customer satisfaction index. In 1989, Sweden took the lead in establishing the evaluation model of Swedish Customer Satisfaction Barometer (SCSB) [1], followed by the European countries, USA and other developed countries, which made various improvements and innovations on the basis of the original model and in combination with the actual conditions and applied it to the government, bank , hospital and other fields [2-6]. In 2004, You Jianxin and other public administration scholars formally introduced the concept of Public Satisfaction into the field of the Chinese Public Administration [7] and they believed that the government performance evaluation, based on public satisfaction, is an inevitable requirement for the construction of a modern and efficient government [8], which required the government to attach great importance to the public service satisfaction and adopt the down-top assessment and measurement method [9]. The assessment of public satisfaction of the Chinese government services were of great importance to guide the construction of standardized performance standards for the public services of the Chinese government and promoted the reform of the governmental administrative system and the government construction [10]. The research on public satisfaction was mainly focused on the concrete application of the research methods [11-14], the construction of public satisfaction evaluation system taking the city or community as the research object, and the main factors of influencing the results through the research methods and proposing the policies and suggestions based on the main factors [15-18]. In recent years, more and more researches have been conducted on rural public service satisfaction. Li Yanling made an analysis on the satisfaction with the rural public goods supply and agricultural information and their influence in Hunan province by means of questionnaire survey [19-20]. Yang Weijing constructed the evaluation index system of the rural public goods supply and established a corresponding fuzzy synthetic evaluation model to evaluate the satisfaction level and put forward the corresponding countermeasures and suggestions [21].

The public satisfaction index model based on Grey Correlation Analytic Hierarchy Process was established in this paper. Based on the research on the public cultural services and the use of the improved grey correlation method, the quantitative analysis of the public cultural services was carried out to achieve the public's satisfaction degree for the current China's public cultural services, so as to evaluate the current China's public cultural services and pinpoint the problems existing in the development of China's public cultural services in the days to come.

* ***Corresponding author*** e-mail: lijuanzw@126.com

2 Selection of the main factors by the Grey Correlation Method

Covering a wide range of contents, the public cultural services are involved in multiple factors that influence the satisfaction degree of the public cultural services. The factors include the public cultural venues and facilities, the public cultural service contents, the public cultural service quality, other primary influence factors and the corresponding secondary influence factors. The factors divided into primary evaluation index and secondary evaluation index are as shown in Figure 1:

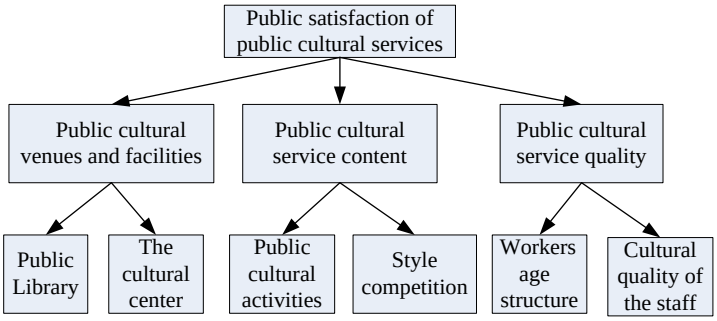

FIGURE 1 Public cultural services evaluation index

The secondary indexes, in close relations to primary indexes above, were selected, according to the multiple factors above, by means of the Grey Relation Method and further improved model. Thus the public satisfaction index based on the Grey Correlation AHP Method can be analysed.

In the public satisfaction index system of public cultural services, there are many factors that influence different primary evaluation indexes. The grey correlation degree of above factors will be analysed respectively to determine an index which has the largest correlation with the system.

2.1 THE FACTORS OF PUBLIC CULTURAL VENUES AND FACILITIES

The public cultural venues and facilities are the factors of direct influence and the basis of evaluating public cultural services. The venue construction quality is relevant to the numbers of visitors and subsequently influences the public satisfaction index. The number of library, cultural centre and museum constructed and the total number of visitors' circulation in China from 2008 to 2012 are as shown in Table 1.

TABLE 1 Public cultural venues and facilities from 2008 to 2012

Year	Total number of circulation(10,000)	Library	Cultural centre(station)	Museum
2008	31295.7	2820	41156	1893
2009	31468.7	2850	41959	2252
2010	32167.5	2884	43382	2435
2011	32823.3	2952	43675	2650
2012	38151.0	3076	43876	3069

*Source: Statistical Yearbook 2013

1) The characteristic behaviour sequence of influence factor is as follow:

$$x_i^{'} = \left(x_i^{'}(1), x_i^{'}(2)\right)^T, i = 1,2,3, \quad (1)$$

in which the behaviour sequences of related factors are as follows:

$$x_1^{'} = (2820, 2850, 2884, 2952, 3076),$$

$$x_2^{'} = (41156, 41959, 43382, 43675, 43876),$$

$$x_3^{'} = (1893, 2252, 2435, 2650, 3069),$$

$$x_i^{'} = \begin{pmatrix} 2820 & 41156 & 1893 \\ 2850 & 41959 & 2252 \\ 2884 & 43382 & 2435 \\ 2952 & 43675 & 2650 \\ 3076 & 43876 & 3069 \end{pmatrix}.$$

2) Determination of reference sequence – take the sequence of the total number of circulation $x_0^{'}$ as the reference sequence:

$$x_0^{'} = (31295.7, 31468.7, 31267.5, 32823.3, 38151).$$

3) Data processing by initialization method – the behaviour sequence of related factors is processed by Equation (2) as follow:

$$x_i(k) = \frac{x_i^{'}(k)}{x_i^{'}(1)} \quad (2)$$

and the calculation result is as follows:

$$x_1(k) = \frac{x_1^{'}(k)}{x_1^{'}(1)} = \frac{(2820, 2884, 2850, 2952, 3076)}{2820} =$$

$$(1, 1.02, 1.01, 1.05, 1.09),$$

$$x_2(k)=\frac{x_2^{'}(k)}{x_2^{'}(1)}=\frac{(41156,41959,43382,42675,43876)}{41156}=$$
$$(1,1.02,1.05,1.04,1.07),$$

$$x_3(k)=\frac{x_3^{'}(k)}{x_3^{'}(1)}=\frac{(1893,2252,2435,2650,3069)}{1893}=$$
$$(1,1.19,1.29,1.40,1.62).$$

4) Calculate.

$$\min_{1\le i\le 3}\min_{1\le k\le 3}\left|x_0^{'}-x_i(k)\right|,\ \max_{1\le i\le 3}\max_{1\le k\le 3}\left|x_0^{'}-x_i(k)\right|, \quad (3)$$

$$\min_{1\le i\le 3}\min_{1\le k\le 3}\left|x_0^{'}-x_i(k)\right|=21118.11,$$

$$\max_{1\le i\le 3}\max_{1\le k\le 3}\left|x_0^{'}-x_i(k)\right|=74410.2.$$

5) Calculate the correlation coefficient.
The calculation formula of correlation coefficient is shown as follows:

$$\zeta_i(k)=\frac{\min\limits_{1\le i\le n}\min\limits_{1\le k\le m}\left|x_0^{'}(k)-x_i(k)\right|+\rho\times\max\limits_{1\le i\le n}\max\limits_{1\le k\le m}\left|x_0^{'}(k)-x_i(k)\right|}{\left|x_0^{'}(k)-x_i(k)\right|+\rho\times\max\limits_{1\le i\le n}\max\limits_{1\le k\le m}\left|x_0^{'}(k)-x_i(k)\right|}, \quad (4)$$

where ρ is resolution ratio, $\rho\in(0,1)$ and $\rho=0.5$. The higher value is ρ, the closer relation is.

Calculate Equation (4) with different values of $\left|x_0^{'}(k)-x_i(k)\right|$ and then get:

$$\zeta_1=(0.851,\ 0.849,\ 0.841,\ 0.833,\ 0.774)$$
$$\zeta_2=(0.850,\ 0.837,\ 0.840,\ 0.829,\ 0.767).$$
$$\zeta_3=(0.847,\ 0.835,\ 0.841,\ 0.827,\ 0.756)$$

6) Calculation of correlation degree – take above calculation result into the following formula of correlation degree calculation:

$$r_i=\frac{1}{m}\sum_{k=1}^{m}\zeta_i(k), \quad (5)$$

Then get $r_1=0.8296, r_2=0.8246, r_3=0.8212$, the details are as shown in Table 2.

TABLE 2 Value of the grey correlation degree

	Library	Cultural centre (station)	Museum
Correlation degree	0.8296	0.8246	0.8212

The correlation degree sheet above shows that the correlation degree value of library is the largest, and that of cultural centre (station) and museum are the second and the third. The difference among them is slight, which means that they are all closely related to the construction of venues and facilities for public cultural services; however, the library has the relatively closest relation. Therefore, the factor of the largest correlation degree value-the library, is selected as the factor of model analysis, for the improvement of the following model.

2.2 THE FACTORS OF PUBILC CULTURAL SERVICE CONTENTS

The public cultural service contents involves in rich and colourful activities of many forms, including artistic performance, public cultural activities, skill training, popular science propaganda, entertainment, and so on. The frequency of citizen participation in the public cultural activities is the indirect influencing factor of the citizen's satisfaction degree for the public cultural services. Select two representative factors: public cultural activities and artistic performance, as the main analysis factors, the relevant data is shown in Table 3.

TABLE 3 Forms of public cultural services

Year	Person-time of participation	Public cultural activities (times)	Artistic performance hall
2008	307529000	41814	1944
2009	308746000	41828	2137
2010	308769000	42749	2112
2011	318745000	42958	1956
2012	319580000	43876	2364

Source: China Statistical Yearbook 2013

The correlation degree values of public cultural activities and artistic performance are calculated by the Grey Correlation Method following the same procedures in 2.1.1, calculation results are as shown in Table 4 below:

TABLE 4 Correlation degree value

	Public cultural activities (times)	Artistic performance
Correlation degree	0.8275	0.8223
Correlation degree	0.8275	0.8223

According to the analysis of the data above, the public cultural activities of the organization have the largest correlation degree value as 0.8275 and the correlation degree value of artistic performance is 0.8223, so the difference is also slight. However, for the purpose of further establishment of the following models, the index with a large correlation degree, that is, the public cultural activities of the organization, is selected as the main factor for future model analysis.

2.3 THE FACTORS OF PUBLIC CULTURAL SERVICE QUALITY

As a public cultural service spreader, the public cultural servicer should have good image, professional qualification and higher cultural level to spread the

positive information to the public, and to enhance the possibility of selecting the service of the public. The servicer has a direct contact to the public, whose working attitude, working enthusiasm; age structures and so on will become the key factors of influencing the public satisfaction index gradually and affect the served people to a certain extent.

According to the document literature and previous research results, the public's requirements for public services, demands for participating in public cultural activities, and needs for promoting spiritual life are becoming higher and higher. However, China is in the shortage of public cultural servicers. According to China's Statistical Yearbook 2013, the number of staff in the Chinese public cultural service institutions is shown as follows:

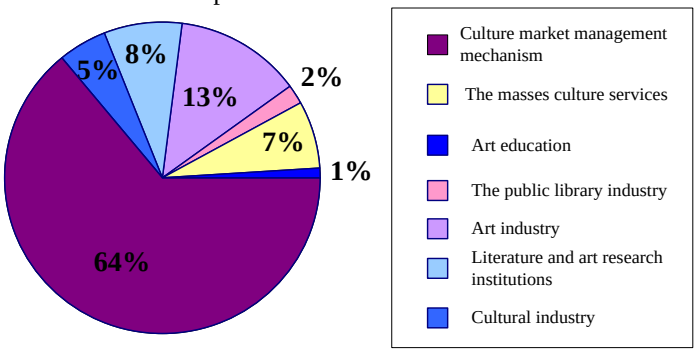

FIGURE 2 Public Cultural Service Personnel

Figure 2 shows that in the Chinese public culture market, the number of people in marketing organization is the largest, accounting for 64% of the total one, thus the number of people in other public cultural service institutions, such as public library, art education institution, social media institution, etc is relatively small, which restricts the development of public cultural services and influences the public satisfaction index to a certain extent. Therefore, the number of people in public cultural servicers was selected as another main factor for the analysis of subsequent model establishment.

3 Public satisfaction index model based on the Grey Correlation AHP Method

On the basis of the grey correlation degree model of the public satisfaction indexes above, the main factors of influencing the public satisfaction index are the number of public library on the number of pavilion, public cultural activities of the organization, and the number of public cultural services. Moreover, the model is improved and the public satisfaction index model based on the grey correlation analytic hierarchy process is established on the footing of the analysis above.

3.1 INITIAL MODEL ESTABLISHMENT

Target layer: public satisfaction index (PSI):

Criterion layer: scheme influence factor C_1 is the public library on the number of pavilion; C_2 is the public cultural activities of the organization; and C_3 is the number of public cultural services.

Scheme layer: A_1 is great satisfaction; A_2 is ordinary and A_3 is not very satisfied.

TABLE 5 Implication of 1~9 ratio scales

The layers of relevant influence factors may be separated from top to bottom and the upper layer is influenced by the lower layer, but the factors in various layers are relatively independent. The hierarchical structure is shown as follows:

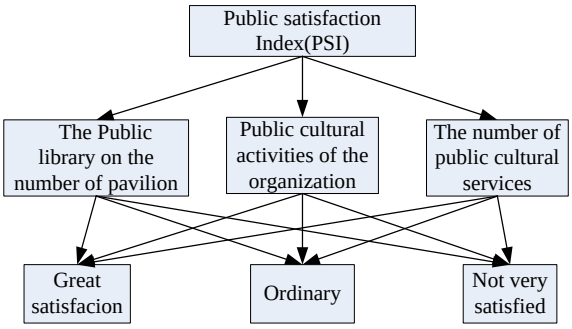

FIGURE 3 Hierarchical structural model

3.2 FACTOR ANALYSIS

An analysis by the Grey Correlation Method shows that the public library on the number of pavilion, the public cultural activities of the organization and the number of public cultural services are the principal indexes which influence the public cultural services, so they are selected as the scheme influence factors for further judgment of the public satisfaction index of the public cultural services.

3.3 CONSTRUCTION OF COMPARATIVE MATRIX

Take the pair-wise comparison of factors respectively and express the importance degree of each factor in layers corresponding to the factors in upper layer by matrix. The 1~9 ratio scales proposed by the operational research experts are quoted in this paper.

Scale a_{ij}	Definition
1	Factor i is equally important to factor j.
3	Factor i is slightly important than factor j.
5	Factor i is more important than factor j.
7	Factor i is quite important than factor j.
9	Factor i is absolutely important than factor j.
2,4,6,8	The scale values in the intermediate state between the judgments above
Reciprocal of various values above	If factor i is compared with factor j, the judgment value: $a_{ji}=1/a_{ji}$, $a_{ij}=1$

According to the scale table above, set the judgment matrix as A:

$$A=\begin{pmatrix} 1 & 1 & 5 \\ 1 & 1 & 3 \\ \frac{1}{5} & \frac{1}{3} & 1 \end{pmatrix},$$

where A is a positive reciprocal matrix obviously. The judgment matrix of scheme layers corresponding to the different criterion layers is constructed as follows:

TABLE 6 Judgment matrix of criterion layer of C_1

C_1	A_1	A_2	A_3
A_1	1	3	5
A_2	1/3	1	4
A_3	1/5	1/4	1

Consistency ratio: if $CR=\frac{CI}{RI}<0.1$, the pair-wise comparison matrix constructed passes the consistency check.

2) Weight calculation:

At first, $A=\begin{pmatrix} 1 & 1 & 5 \\ 1 & 1 & 3 \\ \frac{1}{5} & \frac{1}{3} & 1 \end{pmatrix}$ shall be processed as follows:

$$\xrightarrow{\text{Column vector normalization}}\begin{pmatrix} 0.699 & 0.670 & 0.845 \\ 0.699 & 0.670 & 0.507 \\ 0.140 & 0.228 & 0.169 \end{pmatrix}$$

$$\xrightarrow{\text{According to the row sum}}\begin{pmatrix} 2.214 \\ 1.876 \\ 0.537 \end{pmatrix}\xrightarrow{\text{Normalized}}\begin{pmatrix} 0.738 \\ 0.625 \\ 0.179 \end{pmatrix}=W^0.$$

TABLE 7 Judgment matrix of criterion layer of C_2

C_2	A_1	A_2	A_3
A_1	1	3	5
A_2	1/3	1	4
A_3	1/5	1/4	1

TABLE 8 Judgment matrix of criterion layer of C_3

C_3	A_1	A_2	A_3
A_1	1	2	3
A_2	1/2	1	3
A_3	1/3	1/3	1

3.4 CALCULATION OF THE RELATIVE WEIGHT OF COMPARED FACTOR TO THE CRITERION

1) Consistency check, consistency index:

$$CI=\frac{\lambda_{\max}-n}{n-1}. \tag{6}$$

Random consistency index: generate many matrixes at random, add the consistency index of each matrix and then get the following average RI in Table 9.

TABLE 9 Random consistency index

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Then $A\times W^0=\begin{pmatrix} 2.258 \\ 1.900 \\ 0.533 \end{pmatrix}$.

So $\lambda^0{}_{\max}=3.02610$.

In the same way, the maximum eigenvalue and eigenvector corresponding to the judgment matrix of criterion layer are shown as follows:

$$\lambda^{(1)}{}_{\max}=2.874, \omega_1^1=\begin{pmatrix} 0.883 \\ 0.413 \\ 0.140 \end{pmatrix},$$

$$\lambda^{(2)}{}_{\max}=2.874, \omega_2^1=\begin{pmatrix} 0.883 \\ 0.413 \\ 0.140 \end{pmatrix},$$

$$\lambda^{(3)}{}_{\max}=2.865, \omega_3^1=\begin{pmatrix} 0.875 \\ 0.406 \\ 0.141 \end{pmatrix}.$$

According to the calculation, the maximum eigenvalue of pair-wise comparison matrix $\lambda_{\max} = 3.026$, $RI = 0.58$.

According to consistency index $CI = \frac{\lambda_{\max} - n}{n-1}$, take the result calculation into Equation (7) to get $CI = \frac{3.026-3}{3-1} = 0.013$.

Consistency ratio $CR = \frac{CI}{RI} = \frac{0.013}{0.58} = 0.022 < 0.1$, so the pair-wise comparison matrix A constructed passes the consistency check. In the same way, the judgment matrix of criterion layer passes the consistency check too.

3) Combined weight vector calculation:

$W^1 = (\omega_1, \omega_2, \omega_3)$ and:

$$W = W^1 \times W^0, \tag{7}$$

$$W = \begin{pmatrix} 0.507 \\ 0.273 \\ 0.220 \end{pmatrix}.$$

3.5 RESULT ANALYSIS

According to the calculation results of the combined weight above, for the evaluation of public cultural services, the "great satisfaction" is 50.7%, the "ordinary satisfaction" is 27.3%, and the "not very satisfied" is 22.0%. It can be concluded that most of the public are satisfied with the current Chinese public cultural services and only a small part of them are not satisfied, so the government should still keep a high enthusiasm for work, strengthen the construction of public cultural facilities, make efforts to solve the problems reflected by the public in the process of public cultural services, try to improve public cultural services and better serve the public for the purpose of further promoting the public satisfaction level.

4 Conclusions

The public is the service object of the public cultural service and the public satisfaction index is the main indicator in the judgment of the effect of public cultural services. In this paper, the Grey Correlation Degree Method was applied to selecting the main factors which influence the public satisfaction index of public cultural services. The public satisfaction model of the Grey Correlation AHP Method was established to evaluate the public satisfaction of the current public cultural services in China and the specific countermeasures are also put forward.

1) Three main factors from many evaluation indexes of the public cultural services involved are selected in this paper and the Grey Correlation Method is applied to analysing the correlation degree among different primary indexes and secondary indexes, concluding that the numbers of public library, the public cultural activities of organizations, and the number of staff in public cultural service institutions are the most three important factors.

2) The public satisfaction index model based on the Grey Correlation AHP Method can be improved and reconstructed to evaluate the current public cultural services in China, drawing a conclusion that most of the public are satisfied with the current public cultural services and only a small part of them are not satisfied with it.

3) Reliable and convincing suggestions based on the quantitative evaluation results are raised, recommending that the government should strengthen the support for public cultural services, improve the management mechanism; increase the number of services and promote the construction of public cultural venues and facilities, such as public library, cultural centre and museum and so forth; and actively organize various public cultural activities to enhance the public satisfaction degree to the maximum extent.

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Authors

Fu Liping, born in February, 1963, Tianjin City, China

Current position, grades: Professor of College of Management and Economics, Tianjin University, China.
University studies: B.Sc. in political economics at Beijing Normal University in China. M.Sc. and Ph.D. in world economy from Nankai University in China.
Scientific interest: public management, technological innovation.
Publications: More than 50 papers published in various journals.
Experience: Teaching experience of 29 years, more than 10 scientific research projects.

Li Juan, born in March, 1979, Tangshan City, Hebei Province, China

Current position, grades: Associate professor of College of Yisheng, Hebei United University, China.
University studies: B.Sc. in industrial analysis at Jilin Institute of Chemical Technology in China. M.Sc. from Yanshan University in China.
Scientific interest: public management, technological innovation.
Publications: More than 20 papers published in various journals.
Experience: Teaching experience of 8 years, 3 scientific research projects.