Analysis of Satisfaction with China's Song Dynasty Culture (Song Culture) Based on Confirmatory Factor Analysis and The analytic hierarchy process

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Abstract: *Hangzhou has a long southern Song dynasty culture and a rich cultural heritage. Recently, Hangzhou has focused on the development and construction of China's Song Dynasty Culture (Song Culture). Under the guidance of Hangzhou Municipal Party Committee, Hangzhou has excavated Song Culture and tried to build an important town in the East. In this analysis designs the satisfaction scale and adopts factor analysis, which is divided into three dimensions: content richness, convenience and activity facilities, and then uses hierarchical analysis to calculate the weight of each factor, so as to establish the satisfaction evaluation system and get the total satisfaction score.*

Keywords: *confirmatory factor analysis; hierarchical analysis; China's Song Dynasty Culture (Song Culture)*

1. Satisfaction evaluation system based on confirmatory factor analysis

We usually adopt the factor analysis method to establish a satisfaction evaluation system, and the factor analysis is divided into exploratory factor analysis and confirmatory factor analysis. In actual social science social surveys, the relationship between indicators reflected in the scale is often complex. Therefore, to achieve better results, we used confirmatory factor analysis to establish a satisfaction evaluation system[1].

1.1 Reliability test

Table 1: Table of clonal Bach-α coefficients

Cronbach's coefficient alpha	Number of terms
0.935	12

The Cronbach's coefficient alpha of the available samples from Table 1 is 0.935> 0.8. This indicates that the internal reliability of the scale is very good, and the questionnaire has a certain reliability.

Table 2: Comprehensive statistical tables of the variables

	mean	minima	maxima	scope	maxima/ minima	variance
Mean of terms	4.129	3.788	4.375	0.587	1.155	0.029
The variance of the terms	0.687	0.438	1.059	0.621	2.416	0.024
The covariance between the terms	0.281	0.157	0.559	0.402	3.566	0.005
Correlation between the terms	0.432	0.182	0.716	0.533	3.929	0.008

Table 2 shows that the difference in the mean between the scores of each factor is not large, between 3.788~4.375, and the variance is 0.438~1.059,the variance of the 12 factors was only 0.029, the variance was 0.024, and the correlation between the factors was 0.008.It can be seen that the difference between the items of the satisfaction scale is small, which is suitable for factor analysis, and there is no extreme factor in the data.

In the table 3, the first part includes the richness of cultural activities, the protection of the site, the professionalism of the interpreter, the convenience of transportation, the convenience of booking, and the reasonable arrangement of activity time; The second part includes security guarantee, personnel

service situation, activity place situation, infrastructure improvement situation, ticket price. The resulting Spearman-Brown coefficient in the number of factors is 0.904> 0.7 and 0.905> 0.7, respectively, the Gertman fold half coefficient is 0.895> 0.7, and the three values are greater than 0.7, indicating that the fold half reliability of the scale is high.

Table 3: Half-fold coefficient table

Clone of Bach, Alpha	The first part	price	0.874
		number of terms	6[a]
	The second part	price	0.963
		number of terms	5[b]
	Total number of items		11
Correlation between the morphology			0.872
The Spearman-Brown coefficient	equilong		0.904
	Not the same long		0.905
Gertman fold half-coefficient			0.895

Based on the above reliability test results, we believe that all the data collected this time are true and effective, and have certain research value. Thus each influence factor should be considered in the following analysis[2].

1.2 Brief description of the confirmatory factor analysis

Confirmatory factor analysis is a method for analyzing the data. It tests whether the relationship between a factor and the corresponding measure term conforms to the theoretical relationship designed by the researcher to attempt to test whether the number of factors and the factor loading of the observed variables agree with expectations based on the pre-established theory. The confirmatory factor analysis makes full use of the prior information to test whether the collected data works in a predetermined structure.

We use the method of confirmatory factor analysis to construct the satisfaction evaluation structure of Song Yun cultural activities, which ensures that the established satisfaction evaluation system meets the actual requirements and is reasonable.

1.3 Construct the satisfaction evaluation structure of Song Yun cultural activities

Before the factor analysis, the KMO test and the Bartlett small ball test are required first.

Table 4: Table of test results for KMO and Bartlett

The Kaiser-Meyer-Olkin test		0.967
Bartlett Sphelicity test	Approximate chi square	4284.359
	free degree	66
	conspicuousness p	0.000

KMO test is used to check the correlation and partial correlation between variables, taking values between 0 and 1, the closer to 1, the stronger the correlation between variables, the weaker the partial correlation, the better the factor analysis effect. It can be seen from Table 4 that the KMO test is 0.967> 0.7, so the satisfaction factor of this question is suitable for factor analysis. While the Bartlett small ball test is an independent case between the test variables, it can be seen from Table 4 that Sig. value =0.000 <0.05, so this sample is suitable for the method of factor analysis.

According to the above 11 factors, we refer to the professional knowledge and classify them according to the common sense of life. However, because the provisions are greatly influenced by subjective factors, we still need to test them to ensure their rationality. We collated the data collected in the questionnaire and imported them into Amos for confirmatory factor analysis. According to the fitting index of the software, the evaluation structure is reasonable. If the fitting index does not meet the standard, the structure of satisfaction will be slightly adjusted. After many adjustments, the first-level indicators we established are: content richness, convenience, and activity facilities.

Application software Amos, we can obtain the software fitting parameters as shown in Table 5.

As shown in the table5, each fitting index reached the fitting standard. Therefore, we can think that the evaluation structure of the satisfaction of Hangzhou citizens on the cultural activities of Song Yun is reasonable.

Table 5: Parameter values fitted to the Amos software

test statistic	Standard or critical value of the fit	Test results data	Model fit judgment
x^2	>0.05	14.218	yes
RMR	<0.05	0.043	yes
RMSER	<0.05	0.028	yes
GFI	>0.90	0.914	yes
AGFI	>0.80	0.861	yes
NFI	>0.90	0.937	yes
TLI	>0.90	0.945	yes
CFI	>0.90	0.907	yes

2. A Satisfaction Evaluation System Based on AHP(Analytic Hierarchy Process)

Based on confirmatory analysis, we have divided 11 factors into three categories, namely content richness, convenience level and activity facilities, which constitute the final satisfaction indicators for evaluating China's Song Dynasty Culture (Song Culture) activities. However, each factor has a different degree of impact on final satisfaction. Therefore, we construct an AHP model to obtain the weights of each factor in the three indicators and the weights of these three indicators in the overall satisfaction evaluation model. Thus, we established a satisfaction evaluation model[2] ultimately. The model structure is shown in the following figure1 [3]:
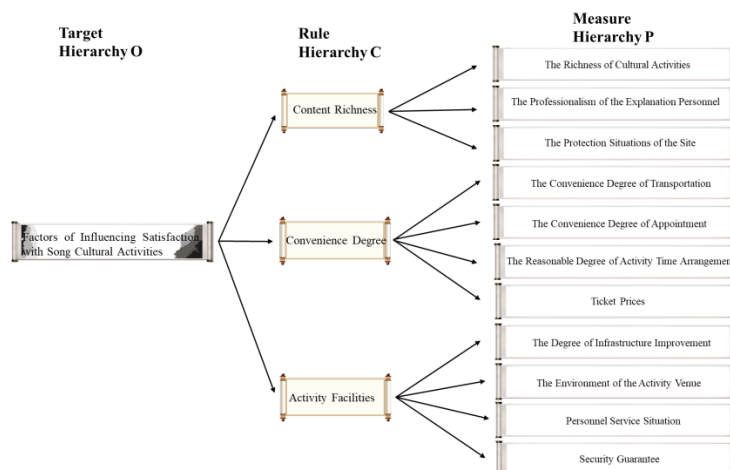

Figure 1: AHP Model Structure Diagram

When considering the weight of each factor, it should not be taken for granted to consider the impact of each factor on the considered factor. Otherwise, subjective errors may occur and affect the accurate data used to derive actual importance. Therefore, in order to analyze better, we need to establish a judgment matrix between the rule hierarchy and the target hierarchy. Firstly, represent n factors with $\alpha_1, \alpha_2, \ldots, \alpha_n$ respectively and use b_{ij} to represent the ratio of the influence degree of α_i and α_j on the previous layer. The specific scale of impact is shown in the table 6

Table 6: Scale Annotation Values

Scale	Meaning
1	Indicates that two factors are equally important compared to each other
3	Indicates that one factor is slightly more important than the other
5	Indicates that one factor is significantly more important than the other
7	Indicates that one factor is strongly more important than the other
9	Indicates that one factor is extremely more important than the other
2,4,6,8	The median of the two adjacent judgments mentioned above
Reciprocal	The judgment for comparing factor i and j is denoted as a_{ij}, and the judgment for comparing factor j and i is denoted as $a_{ji} = 1/a_{ij}$

Based on the scale values and AHP model structure mentioned above, the comparison matrix between the rule hierarchy C and the target hierarchy O can be obtained as follows:

$$A = \begin{pmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/2 \\ 1/2 & 2 & 1 \end{pmatrix}$$

Through R software calculation, we can obtain that the maximum eigenvalue of the matrix is:

$$\lambda_{max} = 0.30092$$

The corresponding eigenvector is:

$$\omega = (\omega_1, \omega_2, \omega_3)^T = (0.5396, 0.1634, 0.2970)^T$$

The indicators used to determine the consistency of a matrix are:

$$CI = 0.0046, RI = 0.58, CR = 0.0088$$

Because of $CR < 0.1$, it passed the consistency test. The normalized eigenvector can serve as the weight of the rule hierarchy to the target hierarchy. In addition, the judgment matrices of the measure hierarchy on the rule hierarchy are:

$$B_1 = \begin{pmatrix} 1 & 3 & 3 \\ 1/3 & 1 & 1/2 \\ 1/3 & 2 & 1 \end{pmatrix}, \quad B_2 = \begin{pmatrix} 1 & 4 & 3 & 2 \\ 1/4 & 1 & 1/2 & 1/3 \\ 1/3 & 2 & 1 & 1/2 \\ 1/2 & 3 & 2 & 1 \end{pmatrix}, B_3 = \begin{pmatrix} 1 & 3 & 1 & 1/2 \\ 1/3 & 1 & 1/2 & 1/3 \\ 1 & 2 & 1 & 1/2 \\ 2 & 3 & 2 & 1 \end{pmatrix}$$

Similarly, through R software, we can obtain the following results:(Table 7)

Table 7: Results of the Judgment Matrix of the Measure Hierarchy to the Rule Hierarchy

	B_1	B_2	B_3
The Maximum Eigenvalue	3.0000	4.0104	4.0458
Eigenvector	$\begin{pmatrix} 0.1396 \\ 0.5278 \\ 0.3325 \end{pmatrix}$	$\begin{pmatrix} 0.4673 \\ 0.0954 \\ 0.1601 \\ 0.2772 \end{pmatrix}$	$\begin{pmatrix} 0.2497 \\ 0.1096 \\ 0.2226 \\ 0.4181 \end{pmatrix}$
CI	0.0268	0.0153	0.0170
RI	0.58	0.90	0.90
CR	0.0462	0.0170	0.0152

Because the CR of B_1, B_2, B_3 were both< 0.1, they both passed the consistency test. But in order to prevent non consistency in the final result, which may be caused by the accumulation of non consistency at every level, we conducted a consistency check on the overall ranking of the levels. Calculate the random consistency ratio of the overall ranking as[5]:

$$CR = \frac{\sum_{j=1}^{3} CI_j \omega_j}{\sum_{j=1}^{3} RI_j \omega_j} = 0.0234 < 0.1$$

The above results indicate that the consistency test has been passed, namely the weights obtained earlier can be used as weights for the evaluation system. Based on this, a satisfaction evaluation system

can be established, as shown in the table 8:

Table 8: Satisfaction Evaluation System of Hangzhou Citizens towards China's Song Dynasty Culture (Song Culture) Activities

The Target Hierarchy O	Indicator y_i And Weight b_i of The Rule Hierarchy	Indicator x_{ij} And Weight a_i of The Measure Hierarchy
The satisfaction level of Hangzhou citizens with the development of Song culture	Content Richness(0.5396)	The Richness of Cultural Activities(0.1396)
		The Protection Situations of The Site(0.5278)
		The Professionalism of The Explanation Personnel(0.3325)
	Convenience Degree(0.1634)	The Convenience Degree of Transportation(0.4673)
		The Convenience Degree of Appointment(0.0954)
		The Reasonable Degree of Activity Time Arrangements(0.1601)
		Ticket Prices(0.2772)
	Activity Facilities(0.2970)	The Degree of Infrastructure Improvement(0.2497)
		The Environment of The Activity Venue(0.1096)
		Personnel Service Situation(0.2226)
		Security Guarantee(0.4181)
Satisfaction Score	$$Z = \sum_{i=1} b_i (\sum_{j=1} a_j x_{ij})$$	

Based on this, we calculated the average score and evaluation score of various measurement indicators, as shown in the table 9:

Table 9: Scoring results of the evaluation of various measurement indicators in the satisfaction scale

The Measure Hierarchy Factor	Average Score of the Measure Hierarchy	Indicators of the Rule Hierarchy	Score of the Rule Hierarchy	Score of the Target Hierarchy
The Richness of Cultural Activities	4.00	Content Richness	4.035	4.11
The Protection Situations of The Site	4.20			
The Professionalism of The Explanation Personnel	3.79			
The Convenience Degree of Transportation	3.79	Convenience Degree	4.0010	
The Convenience Degree of Appointment	4.00			
The Reasonable Degree of Activity Time Arrangements	4.10			
Ticket Prices	4.30			
The Degree of Infrastructure Improvement	4.24	Activity Facilities	4.308	
The Environment of The Activity Venue	4.29			
Personnel Service Situation	4.26			
Security Guarantee	4.38			

From the above table, it can be seen that the overall satisfaction of Hangzhou citizens with China's Song Dynasty Culture (Song Culture) activities reached 4.11, which is close to relatively satisfactory. It indicated that Hangzhou citizens have a high overall satisfaction with China's Song Dynasty Culture (Song Culture) activities.

3. The Summary of Hangzhou Citizens' Satisfaction with China's Song Dynasty Culture (Song Culture) Activities

3.1 Overview of Hangzhou Citizens' Satisfaction

We conducted a study on the satisfaction of Hangzhou citizens with China's Song Dynasty Culture (Song Culture) activities.

Firstly, we conducted visual and descriptive statistics on the scores of 11 satisfaction influencing factors, and found that the majority of citizens had a high level of satisfaction with China's Song Dynasty Culture (Song Culture) activities. On the average, the satisfaction level with the safety guarantee, the environment of the activity venue and ticket prices of China's Song Dynasty Culture (Song Culture) activities is relatively high, all around 4.30.The satisfaction level of personnel service situation, the degree of infrastructure improvement, the reasonable degree of activity time arrangements,

the protection situations of the site, the convenience degree of appointment, and the richness of cultural activities for China's Song Dynasty Culture (Song Culture) activities is above 4.00.However, the satisfaction level with the convenience degree of transportation and the professionalism of the explanation personnel is relatively low, at around 3.9.From the perspective of the standard deviation, all factors' standard deviations are around 0.8, indicating that citizens' satisfaction with China's Song Dynasty Culture (Song Culture) activities is relatively uniform. In addition, from the perspective of the mode and the median, the mode of most factors is 4 and the median is 4, indicating that most citizens are relatively satisfied with China's Song Dynasty Culture (Song Culture) activities.

3.2 Analysis on Various Satisfaction Weights and Overall Satisfaction Scores of Hangzhou Citizens

Firstly, we divided 11 factors into three categories based on common life knowledge. The content richness includes the richness of cultural activities, the protection situations of the site and the professionalism of the explanation personnel. The convenience degree includes the convenience degree of transportation, the convenience degree of appointment, the reasonable degree of activity time arrangements and ticket prices. The activity facilities include security guarantee, the personnel service situation, environment of the activity venue and the degree of infrastructure improvement. Then we conducted confirmatory factor analysis using Amos software and concluded that the satisfaction evaluation structure we established was reasonable.

Secondly, we assigned weights to 11 factors based on the analytic hierarchy process. Among them, the weights of the protection situations of the site (0.5278), the convenience degree of transportation (0.4673), and security guarantee (0.4181) are relatively high. The weights of the protection situations of the site (0.3325), ticket prices (0.2772), the degree of infrastructure improvement (0.2497), and personnel service situation (0.2226) are average. The weights of the richness of cultural activities (0.1396), the convenience degree of appointment (0.0954), the reasonable degree of activity time arrangements (0.1601), and the environment of the activity venue (0.1096) are relatively low.

Then, based on the weights and the respective average scores of each factor, we obtained an overall satisfaction rate of 4.11 among Hangzhou citizens with China's Song Dynasty Culture (Song Culture) activities, indicating that Hangzhou citizens have a high overall satisfaction rate with China's Song Dynasty Culture (Song Culture) activities. Among them, security guarantee (4.38), personnel service situation (4.26), the environment of the activity venue (4.29), the degree of infrastructure improvement (4.24), ticket prices (4.30), and the protection situations of the site (4.20) are higher than overall satisfaction. The reasonable degree of activity time arrangements (4.10), the richness of cultural activities (4.00), the professionalism of the explanation personnel (3.79), the convenience degree of appointment (4.00), and the convenience degree of transportation (3.79) are lower than overall satisfaction.

Thus, we can conclude that the weight of The Richness of Cultural Activities is relatively low, and the score of this factor is relatively low. This indicates that Hangzhou citizens attach great importance to the richness of cultural activities, but their satisfaction in this regard is relatively low. Therefore, the organizers should adopt innovative and integrated methods to enrich cultural activities. Due to the influence of the location of China's Song Dynasty Culture (Song Culture) activities and the large passenger flow during holidays, traffic is easily congested. Thus satisfaction in this regard is relatively low. Therefore, for these two aspects, China's Song Dynasty Culture (Song Culture) activities need to be improved[4].

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