

Research on the Influencing Factors of Tourism Revenue in Tai'an City Based on Grey System Theory

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Abstract – According to the data of the 2010-2018 Tai'an Statistical Yearbook, the gray correlation analysis method in the gray system theory is applied, and the relevant factors affecting tourism revenue are analyzed with the gray comprehensive correlation measure as the measurement indicator, and the leading factors affecting the tourism income of Tai'an City are: the consumption expenditure of rural residents in Tai'an City, the total retail sales of social consumer goods in Tai'an City, and the number of tourists in Tai'an City. At the same time, from the empirical point of view, the degree of correlation between tourism revenue and various influencing factors is revealed, so as to provide a basis for the government to make scientific decisions in formulating tourism development plans and adjusting industrial structure.

Keywords – Tai'an City, Tourism Revenue, Grey System Theory, Influencing Factors, AMS Classification Numbers: 15A69, 97B10.

I. INTRODUCTION

A. Research Background and Significance

Tai'an is a famous cultural tourism city in Shandong Province, China, and was listed by the State Council as one of the first tourist cities to open to the outside world in 1982. Taishan in Tai'an is a key scenic spot in China, known as "the first of the five mountains" and "the first mountain in the world", and is a world natural and cultural heritage. Taishan was listed as one of the first batch of national key scenic spots by the State Council of the People's Republic of China in 1984, listed by UNESCO as a world natural and cultural heritage in 1987, listed as one of the top 40 tourist resorts in China in 1991, identified as the first batch of civilized scenic tourism demonstration sites in China in 1998, and was rated as a global geopark in 2006; With its profound history and culture, majestic and magnificent natural scenery, Taishan attracts tens of millions of domestic and foreign tourists to come to visit every year [1].

Regional economic imbalances are a pervasive socio-economic phenomenon. After decades of development, tourism from scratch, from small to large, has become one of the fastest growing industries in the national economy [2], but due to the differences in tourism resource endowments, social economy, transportation conditions, and degree of opening up in various regions, the development of tourism income has shown a spatial imbalance, and understanding and studying the spatial differences in the development level of tourism revenue in China is important for correctly understanding the role of tourism in regional economic development, optimizing the spatial layout of tourism resources and production factors, and improving the regional economic structure. It is of great theoretical and practical significance to formulate well-targeted and effective policies for regulating regional economic differences and to promote the sustained and coordinated development of China's tourism industry [3].

China's tourism industry has entered a period of rapid development, and has formed an industrial pattern of a-

-attaching equal importance to domestic tourism and inbound tourism, but the development of tourism is highly dependent on the influence of foreign population, and is closely related to the political situation, economic development, transportation mode, price index, hotel industry development and weather changes, etc., not a single factor can be scientifically explained. Therefore, the government should consider many related factors in formulating tourism development plans. Guided by Professor Deng Julong's gray system theory, more scholars in China use gray correlation analysis to compare various factors affecting the development of the tourism industry, observe the degree of correlation between various factors through quantification, and develop the key elements and trends affecting the development of the tourism industry, and have a high degree of accuracy in predicting the dynamic development and change of the tourism industry [4]. This analysis method is different from various regression analysis methods and other digital processing methods, with unlimited sample size, unlimited typical distribution, etc., and the quantitative analysis results are highly accurate, it has been widely used in various fields of social and economic life, especially in recent years in the tourism industry research booming.

Gray system refers to some of the information is clear, part of the information is not clear system, gray system theory is the view and method of cybernetics extended to the product of the economic system, it is from the perspective of the system to study the relationship between information, that is, to study how to use known information to reveal unknown information, that is, the system bleaching problem [5]. It is characterized by "less data modeling", and unlike fuzzy mathematics, gray system theory focuses on the object of "clear extension and unclear connotation" [4].

B. Research the Current Situation

Yamei Liu (2017) used the gray system theory proposed by Professor Deng Julong to empirically conclude that the gray correlation coefficients between tourism revenue, number of tourists and gross national product in Jiangsu Province were 0.69 and 0.92, respectively, that is, the number of tourists, tourism income and gross national economic product were basically changing simultaneously, and further suggestions were put forward for the development of tourism in Jiangsu Province [6].

Linheng Li et al. (2016) used Henan Province's tourism revenue statistics and correlation analysis from 2009 to 2014, and gray correlation dynamic analysis to select 20 indicators of economic support, tourism reception, tourism transportation, environmental resources, tourism demand and other factors, and identified the relevant factors and core factors affecting Henan Province's tourism revenue; The results show that the primary factors affecting the tourism revenue of Henan Province are economic support and tourism demand factors, and the coefficients are 0.959 2 and 0.931 1, respectively. Tourism traffic and tourism reception factors are the key factors currently increasing tourism revenue; Environmental resource factors and soft environment are the short-board factors that restrict the potential of tourism revenue [7].

Ruixia Li et al. (2013) selected 14 factors such as per capita GDP, tertiary industry GDP, and disposable income of urban residents, and divided them into six aspects, such as economy, transportation, and tourism publicity factors, and correlated analysis of the impact factors of tourism development in Shanxi Province. The study shows that the main factors affecting the development of tourism in Shanxi Province are tourism promotion, education and culture and tourism services, and the correlation and ranking of factors in the same region will change over time; At the same time, the leading factors restricting the development of tourism in

different regions are different. Adhering to the purpose of providing scientific decision-making reference for the healthy development of local tourism, suggestions and countermeasures are proposed [8].

Jianming Yang et al. (2009) used the gray correlation analysis to obtain that the rapid growth of the national economy, the high degree of social civilization and the rapid development of tourism transportation have made great contributions to the development of inbound tourism in Fuzhou, compared with the relatively weak tourism services, ecological environmental protection and tourism publicity work [9].

At present, the grey correlation analysis method is widely used in the study of China's tourism industry, and many mature research results have emerged. From the studies of various scholars using grey correlation analysis to predict the development of tourism, it is found that these studies basically follow the following analysis steps: First, the research data is time-sensitive. Among the influencing factors of research and tourism development, the degree of correlation needs to collect a large number of statistical data as research support, and the gray system theory mainly uses statistical data as raw data, and its research is time-sensitive. Therefore, the larger and newer the data collected, the more accurate prediction data can be obtained according to the law of data research. According to the gray system theory pioneered by Professor Deng Julong, step-by-step analysis of some phenomena in the field of social sciences, for the original data acquisition is insufficient, not comprehensive, etc., the theory uses its own scientific analysis system to solve the problems caused by data defects, can be in the case of insufficient information, uncertain related links, the various influencing factors affecting the development of tourism are analyzed, and a more accurate prediction result is obtained. Second, the research data is mainly derived from statistical yearbooks. In view of the multiple influencing factors and the difficulty of determining the main influencing indicators, the grey correlation analysis method effectively solves this problem, thus becoming the main research method for many scholars to study the development of tourism. In short, the grey correlation analysis method highlights the research advantages in the research and application of the tourism industry, and reflects the strength of the association between the dependent variable and the explanatory variable with the complex variables and factors with the correlation value, which has the characteristics of high data utilization and high model accuracy, and can clearly explain the impact on the dependent variable when the variable changes.

II. GREY CORRELATION ANALYSIS OF INCOME INFLUENCING FACTORS IN THE TOURISM INDUSTRY

A. Data picking

In this study, limited data are selected as samples, which are in line with the scope of gray system theory research, and the influencing factors of tourism revenue in Tai'an City are predicted through fuzzy data. Using the grey correlation degree analysis method, the tourism related data of Tai'an City from 2010 to 2018 was used as a sample, and the data of tourism revenue, number of tourists, per capita expenditure, gross domestic product, total retail sales of social consumer goods, per capita disposable income of urban residents, consumption expenditure of urban residents, per capita disposable income of rural residents, and consumption expenditure of rural residents were selected from Tai'an. All data are from the Tai'an Statistical Yearbook.

B. Gray Correlation Data Calculation

a. Data Presentation

In economics, the derivative of a function is called its marginal function, and the value at a specific point is called the marginal value of the function at that point, that is, the marginal refers to the degree to which the dependent variable changes with the change of the independent variable, that is, the amount that the dependent variable will change as the independent variable changes by one unit. List the reference and comparison series that affect the development of the tourism industry [3]. X_0 represents the tourism income of Tai'an City (unit :100 million yuan), it is a reference series, X_1 to X_8 respectively represents the number of tourists in Tai'an City (unit : 10,000 people), the per capita expenditure of tourists in Tai'an City (unit : yuan), the GDP of Tai'an City (unit :100 million yuan), the total retail sales of social consumer goods in Tai'an City (unit :100 million yuan), the per capita disposable income of urban residents in Tai'an City (unit: yuan), the consumption expenditure of urban residents in Tai'an City(unit : yuan), the per capita disposable income of rural residents in Tai'an City (unit : yuan)and the consumption expenditure of rural residents in Tai'an City(unit: yuan), which is a comparative series, and the specific data are shown in Table 1 [10].

Table 1. Tai'an tourism tourism gray associated reference series and comparison series.

	2010	2011	2012	2013	2014	2015	2016	2017	2018
X_0	241.1	304.6	371.3	427.3	486.6	553.7	629.6	695.1	790.0
X_1	3021.2	3692.6	4316.5	4791.8	5275.2	5753.4	6239.7	6855.4	7549.4
X_2	797.9	824.8	860.1	892.0	922.4	962.4	1009.1	1054.2	1046.4
X_3	2071.93	2330.62	2580.42	2830.44	3046.82	3207.83	3364.59	3578.39	3651.53
X_4	687.42	806.73	928.34	1053.79	1188.15	1331.61	1462.77	1608.31	1593.79
X_5	19953	22687	25659	28201	30715	28132	30299	32739	35196
X_6	13421	14888	16734	18201	19714	16524	17900	19376	20862
X_7	7592	8974	10194	11547	12913	13322	14428	15674	16959
X_8	4273	4855	5588	6319	7158	8588	9297	10100	10942

b. Gray Relevance Calculation Step

Step 1: Find the initial value image of each sequence [5], $X_i' = \frac{X_i}{X_0} = (x_i'(1), x_i'(2), \dots, x_i'(n)), i = 0, 1, 2, \dots, m$.

Step 2: Find the sequence of absolute values of the initial value like the difference between the corresponding components, $\Delta_i(k) = |x_0'(k) - x_i'(k)|, \Delta_i = (\Delta_i(1), \Delta_i(2), \dots, \Delta_i(n)), i = 1, 2, \dots, m$.

Step 3: Maximum and Minimum. Credited as $M = \max_i \max_k \Delta_i(k), m = \min_i \min_k \Delta_i(k)$.

Step 4: Calculate the correlation coefficient, $\gamma_{0i}(k) = \frac{m + \xi M}{\Delta_i(k) + \xi M}, \xi \in (0, 1), k = 1, 2, \dots, n; i = 1, 2, \dots, m$.

Step 5: Calculate the average of the correlation coefficients $\gamma_{0i} = \frac{1}{n} \sum_{k=1}^n \gamma_{0i}(k), i = 1, 2, \dots, m$.

c. *The Result of the Gray Correlation Calculation*

If $\xi = 0.5$, the correlation coefficients are calculated as follows:

γ_{0i}	γ_{01}	γ_{02}	γ_{03}	γ_{04}	γ_{05}	γ_{06}	γ_{07}	γ_{08}
Outcome	0.7883	0.5850	0.6525	0.8294	0.5734	0.5121	0.7195	0.8871

From the calculation results, it can be seen that the factors that have a greater impact on the tourism income of Tai'an City from 2010 to 2018 are the consumption expenditure of rural residents in Tai'an City, the total retail sales of social consumer goods in Tai'an City and the number of tourists in Tai'an City, followed by the per capita disposable income of rural residents in Tai'an City and the GDP of Tai'an City, and the less influential factors are the consumption expenditure of urban residents in Tai'an City, the per capita disposable income of urban residents in Tai'an City, and the per capita expenditure of tourism in Tai'an City. It can be seen that with the increase in the income of rural residents, the consumption expenditure of rural residents, the per capita disposable income of rural residents and the tourism income of Tai'an City have the highest correlation, which has the greatest impact on the tourism income of Tai'an City.

III. CONCLUSION

When dealing with the impact of many comparative sequences on China's urban tourism revenue, gray correlation analysis can better express the relative comparative advantage of the degree of influence of each comparison sequence on the reference sequence and quantify the degree of impact. Through the above analysis, the following two conclusions can be drawn:

- (1) From the research results, the leading factor affecting the change of tourism income in Tai'an City is the consumption expenditure of rural residents and the per capita disposable income of rural residents, rather than the number of tourists as considered by some scholars, which indirectly confirms from the empirical perspective that the per capita disposable income of residents is the main factor affecting the development of domestic tourism. It shows that the traditional development model of extensive expansion tourism that simply aims at the number of tourists is no longer suitable for the law of the development and change of China's tourism market, and it is necessary to speed up the transformation of China's tourism economic development model, take the road of intensive development, organically combine the expansion of the scale of the tourism industry with the improvement of industrial quality and the acceleration of industrial structure upgrading, and strive to achieve the overall leap of China from a big tourism country to a tourism power.
- (2) From the perspective of analysis methods, when conducting multi-factor analysis of research objects, we should first judge from the theoretical point of view, consider the size of the selected sample size, and then select the corresponding model or theory for research. When the sample size is large and follows a typical probability distribution, multiple regression models can be considered for analysis. Once the sample size is small, or the distribution of sample data is unknown or irregular, it is a good choice to use gray correlation theory to explore the main factors affecting the behavior characteristics of the system.

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