Hindawi
Mathematical Problems in Engineering
Volume 2022, Article ID 4335718, 6 pages
https://doi.org/10.1155/2022/4335718

Research Article

Tourism Consumer Demand Forecasting under the Background of Big Data

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Received 17 March 2022; Revised 15 June 2022; Accepted 20 June 2022; Published 31 July 2022

Academic Editor: Wen-Tsao Pan

In recent years, the tourism industry has grown rapidly around the world as an emerging force, especially in China, which has become the world's leading tourism country in recent years, and its tourism revenue also occupies a good weight in the country's total income. The number of tourists every year shows a very high growth rate, which not only improves the tourism economy but also brings great pressure to the management of various tourist attractions. In this context, many tourist attractions are actively developing innovative applications of new technologies, hoping to effectively improve their management efficiency. In these experiments, the speech big data analysis technology has achieved remarkable achievements, so it is necessary to combine the speech big data analysis technology with the demand analysis of the tourism industry. The purpose of this paper is to study the effective model of tourism consumer demand prediction using big data analysis. In the process of completing this paper, we consulted a large number of research results of big data analysis technology, tourism-related books, and demand prediction models in HowNet, VIP, and other network databases as well as campus libraries, summarized the related concepts of tourism, and used big data analysis technology to predict the demand of tourism consumers. Understand the needs of tourism consumers on major tourism websites, and extract the indicators that will affect the forecast results of consumer demand, establish a demand forecast model based on the indicators, and analyze its forecast effects through comparative analysis to understand its advantages and disadvantages, in order to establish a tourism demand forecast models providing actionable advice. Through the practical application case of the demand forecasting model, this paper puts forward the development strategy of tourism. The experimental results show that the mean square error of the neural network model is less than 2.5, which is more suitable for predicting the number of tourists, indicating that different models are suitable for predicting different indicators. The main contribution of this research lies in the modeling and analysis of regional tourism characteristics and tourists' willingness, so as to achieve accurate prediction of tourists in scenic spots and formulate targeted plans.

1. Introduction

In the context of China's rapid economic development, the tourism industry has also shown a momentum of vigorous development [1]. However, the rapid development has also caused China's tourism industry to face many problems that need to be solved urgently. The most typical one is the dual pressure from the transformation of its own services and the surge of tourists. The diversified and centralized characteristics of tourists present more and more tourist attractions. China's tourism industry has reached the point where it has to seek new technologies to improve service levels [2, 3]. The rapid development of big data and its derived technologies has brought opportunities for breakthroughs in the dilemma of China's tourism industry. The rapid development of tourism has accumulated a large amount of relevant data, and the analysis of these data will further promote the development of tourism. At this stage, there have been many studies on tourism data analysis, and speech technology is an important branch of them. With the advancement of Internet of Things technology, voice technology has developed rapidly. By predicting the demand of tourism resource data in voice big data, it provides data information for tourist destinations to cope with the

current situation of diversification and concentration of tourists, so as to facilitate tourist destinations and make the right choice to enhance the local tourism value [4, 5].

Due to the increasing number of tourists year by year, especially on holidays, it has reached the level of empty lanes, which has attracted the attention of many scholars and studied the consumer demand forecast. For example, Wang Wei studied the application of ARIMA, multiple linear regression (MRL), and ADL_, the first mock exam of the Chinese mainland tourists to Macao is based on four single models of EC and VEC. It is concluded that the optimal combination forecasting linear model is suitable for the prediction of Macao inbound tourism and has been used to predict the result, achieving the expected effect of [6, 7]. Anisa and others believe that some factors in the demand forecast will affect the demand of the tourism industry [8]. The above research provides a theoretical basis for the writing of this paper.

Through big data analysis, scenic spots can accurately predict the trend of passenger flow, and then take corresponding measures. We can know what kind of products tourists like, and then develop products suitable for consumers. We can also know what kind of public services tourists need, so as to improve the tourism public services. Scenic spots constantly make changes to the needs and types of consumers according to big data, so as to facilitate consumers in service and alleviate consumers' distress [9, 10]. Through the analysis of big data on the needs of tourism consumers, it is not only beneficial to businesses and tourist attractions but also brings benefits to tourism consumers. For example, the tourism industry is easily affected by changes in policies, weather, transportation, social environment, and so on, which will lead to active or passive changes in the consumers' itinerary. Therefore, users in the online tourism industry have great pain in not cancelling hotel reservations. Big data analysis, starting from the pain point of users to the hotel, prompted the hotel to launch a time-sharing refund reform, innovative "ladder cancellation" mode, delayed the time that cannot be cancelled as far as possible, and cancelled free of charge due to flight changes [11–13]. This initiative benefited millions of tourists in one year [14–16].

This paper introduces the related concepts of tourism and models that use speech big data analysis technology and can forecast the demand of tourism consumers, and analyzes the advantages and disadvantages of these demand forecasting models. Firstly, the tourism data is preprocessed. Taking the tourism data of each city in the Shandong province as an example, through cluster analysis, the tourism industry in the Shandong province is preliminarily divided, and each important influence node of the tourism industry is set as the corresponding index. Next, the various indicators of the model are calculated, and according to the prediction results, the problems existing in Shandong's tourism industry are analyzed, and solutions are proposed.

2. Study on the Effective Model of Tourism Consumer Demand Forecast Using Big Data Analysis

2.1. Demand Forecasting

2.1.1. Role of Demand Forecasting. Demand forecasting is to estimate the demand of the whole product or some special products in a certain period of time in the future, to provide reference data for the relevant units, and to provide the basis for the planning of the future period of time. Therefore, demand forecasting has the following functions: making a development plan, improving economic benefit, and improving the management level [17–20].

2.1.2. Type of Forecast

(1) Classification by Predicted Methodological Nature. According to the nature of the prediction method, it can be divided into two categories: quantitative prediction and qualitative prediction. In this paper, quantitative prediction is studied with scientific calculation methods and mathematical models based on a large number of data. This provides a more objective and an accurate prediction result [21–25].

(2) Classification by Length of Forecast Time. According to the length of preforecast time, it can be divided into four categories: short-term forecast, medium-term forecast, and long-term forecast. In this paper, short-term forecast and medium-term forecast are mainly used, because, in China, there are differences between tourism off-season and tourism peak season, there may be different demand in different periods, and the relevant units should make different adjustments [26–29].

2.1.3. Basic Principles of Prediction. In order to reduce the error between the prediction results and the actual situation and to reduce the decision errors of the relevant units, the following principles should be followed in the demand prediction: the principle of measurable behavior, the principle of continuity, the principle of analogy, the principle of correlation, and the principle of systematicness [30, 31].

2.1.4. Steps for Demand Forecasting. In order to shorten the time of demand forecasting and ensure the timeliness of forecast results, it is best to predict according to the following procedures: first, to determine the purpose and use of forecasting; second, to select the object of forecasting; third, to analyze the factors and weights that affect demand forecasting; fourth, to collect and analyze current and past historical data; fifth, to select forecasting methods and models; sixth, to calculate and verify preliminary prediction results; seventh, to estimate the error of forecasting; and eighth, to make decisions based on predicted values [32, 33].

2.2. Prediction Model

2.2.1. ARIMA Model. Based on the time series prediction model, the real and limited data sequence of the prediction object arranged in the chronological order is regarded as the time series, and then, the sequence is described by a reasonable mathematical model. The later stage of this model can be recognized, and a future value can be predicted according to the past and present data sequences identified from the model [34].

2.2.2. Grey Prediction Model. Grey system prediction method is a kind of prediction method developed in recent years. It is suitable for solving the prediction problems of a small amount of data, large span of data growth, and uncertain data.

2.2.3. Index Smooth Prediction Model. Exponential smoothing method is a special weighted moving average method, which gives a larger weight to the recent historical data and a smaller weight to the longer historical data. The weight decreases from near to far with exponential law. Therefore, it is called an exponential smoothing method. The basic formula is as follows:

$$H_t = \mu m_t + (1 - \mu) H_{t-1}. \tag{1}$$

2.2.4. Neural Network Prediction Model. The Sigmoid function and linear function are usually used to predict the data of a certain index in the BP model. There are two kinds of Sigmoid functions, one is the tansig function, and the other one is the logsig function. The square error function is used as an error function. The formula is

$$F = \frac{1}{2} \sum_{i=1}^{N} \left(P_i + Q_i^3 \right)^2. \tag{2}$$

2.3. Introduction to Prediction Problems. After forecasting the demand of tourism in the Shandong Province, the forecast results are analyzed, and the problems existing in tourism in the Shandong Province are summarized: the brand consciousness is weak, the development of tourist attractions is unbalanced, the tourism products are still relatively single, and the tourism structure is unreasonable. Tourism services are not in place [35, 36].

3. Experimental Research on the Effective Model of Tourism Consumer Demand Prediction Using Big Data Analysis

3.1. Research Subjects. This paper mainly studies the tourism consumer demand forecasting model, takes the tourism data of the Shandong Province in recent years as the research object, selects the most suitable demand forecasting model for tourism, and analyzes the demand forecasting results. We need to summarize what consumer needs, Shandong tourism needs, to meet in recent years and to put forward development suggestions.

3.2. Research Methodology

3.2.1. Literature Survey. Through the investigation of the data in the literature database, we summarize the concept of tourism, we summarize and select the demand prediction model suitable for tourism, and we briefly summarize their principles.

3.2.2. Experimental Method. How to select the most suitable one from several demand prediction models is the best way to verify it. In this paper, the tourism data of the Shandong province in recent years will be taken as the experimental object. It can use multiple models to predict according to the data provided.

3.2.3. Comparative Law. The experimental method is usually used together with the comparative method. Comparing the results caused by different values of an influencing factor can clearly select which one is the best. In this paper, the errors of several prediction models are compared, and the advantages and disadvantages of several models are analyzed. It is found that the best choice is to combine multiple models to predict, and to select different models for different indicators is the optimal solution.

3.2.4. Comprehensive Analysis. The data obtained from the main model analysis of the comprehensive analysis method are summarized and analyzed, and finally the problems existing in the tourism industry in the Shandong Province are obtained and the solutions are put forward.

3.3. Data Preprocessing. Data preprocessing is to analyze the obtained data so that it can be input directly into the prediction model. In the research process of tourism data in the Shandong Province, the k-means clustering analysis method is mainly used. The basic steps of clustering analysis are as follows: first, generating variable matrix; second, data standardization; third, generating distance matrix; fourth, selecting clustering method; fifth, repeating steps until all samples are classified into one class; sixth, output clustering results and system clustering diagrams [37].

4. Experimental Research on the Effective Model of Tourism Consumer Demand Prediction Using Big Data Analysis

4.1. Error Analysis of Demand Forecasting Models. To evaluate the effectiveness of a prediction model, the most accurate method is error analysis. In this paper, the mean square error is mainly used. Taking the number of tourists in the Shandong Province from April to October 2019 as the simulation data, the mean square error of the four prediction models is analyzed. It is then verified with the data released by the Shandong Provincial Tourism Administration. The

smaller the error, the higher the accuracy of the model in this field, as shown in Table 1.

It can be seen from Figure 1 that in the experiment of human flow prediction in the Shandong Province from April to October 2019, the mean square error of the neural network model is relatively small, most of which are below 2.5, and the error of other models is not different. The neural network model is more suitable. The largest error is the GM model, not only the highest error is as high as 4.3 but the error value generally exceeds 2.5 for 5 months. Therefore, it is not recommended to use the GM model when predicting the number of tourists.

4.2. Demand Forecasting Results. The final purpose of demand forecasting is to forecast the value of a certain index of tourism at a certain time in the future, to analyze the present situation of tourism, and to provide suggestions for the future development. Table 2 is the forecast results of tourism income composition in the Shandong province in the next 6 months.

As can be seen from Figure 2, accommodation and catering will account for a relatively high proportion of the total tourism revenue in the Shandong Province in the next 6 months, and the combined share of the two will exceed 60%, and the profit margins of these traditional projects are already very limited. The additional profit of emerging projects such as shopping is relatively high, but the proportion is relatively insufficient. The desire to consume has made the Shandong province receive a large number of tourists, but tourism profits have not grown significantly.

5. Conclusions

With the rapid development of the era of big data, model prediction methods have become more and more popular. In the process of model prediction, data preprocessing, model selection, and model prediction will all have an important impact on the final result. However, the selected models are different, and the weight coefficients of each indicator are also different. Therefore, the most important thing is to select the appropriate model after determining the research objectives, and only by selecting the appropriate model we can have a good prediction effect. Based on previous studies, this paper first selects four models to predict many indexes of Shandong tourism, and finds that each model has its advantages and disadvantages, and for different indexes, their errors are also different. Different indicators are suitable for different models. This paper also selects the appropriate model to predict the composition of tourism income in the Shandong province in the next 6 months and puts forward the shortcomings and improvement strategies of the Shandong tourism industry.

Big data makes our analysis of things more intelligent and convenient. By extracting indicators and establishing complex mathematical models, we can make our analysis of things more realistic and accurate, so as to predict the trend of things in advance. This paper, through the extraction, sorting, and analysis of a large number of tourism

Table 1: Error analysis of the demand prediction model.

	4	5	6	7	8	9	10
ARIMA	2.3	4.1	1.8	3.8	3	2.4	4.1
GM	4.3	2.2	4	2.9	3.3	2.2	2.5
EXP	2.4	3.1	4.1	2.5	2	3.4	2.8
BP	1.8	2.6	1.5	2.3	1.5	1.8	2.6

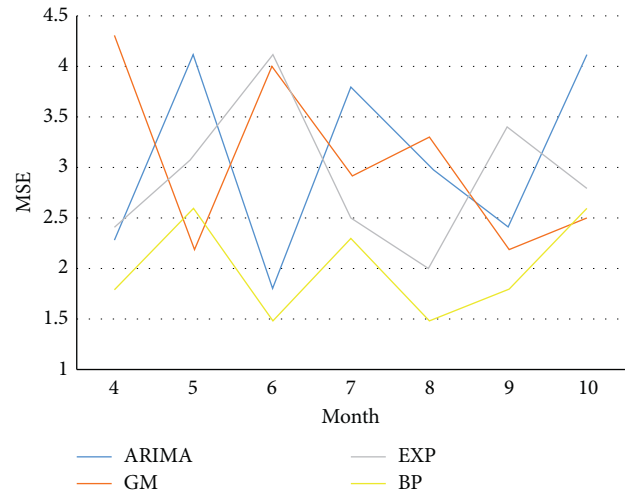

Figure 1: Error analysis of the demand prediction model.

Table 2: Forecast of tourism income composition in the next 6 months in the Shandong province.

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)
Visit	15.97	20.77	19.27	16.76	20.21	20.47
Stay	34.46	30.78	29.03	36.13	28.47	28.06
Shopping	13.93	9.8	14.63	14.89	10.46	11.55
Food	25.97	30.3	27.12	25.11	32.43	33.06
Other	9.65	8.56	10.05	7.16	8.45	7.97

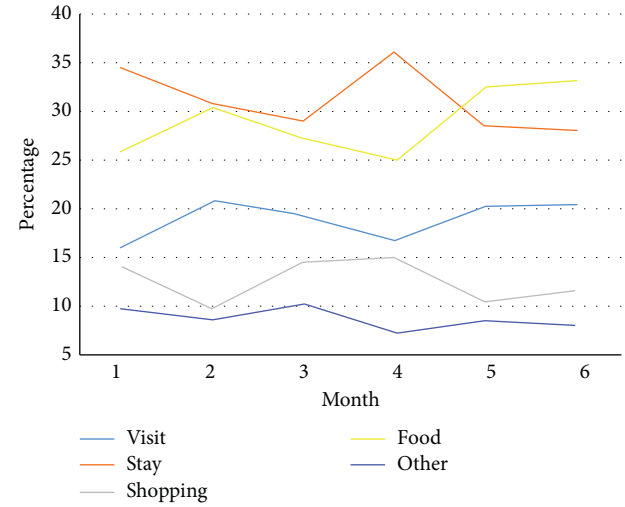

Figure 2: Forecast of tourism income composition in the next 6 months in the Shandong province.

consumers' big data, it establishes the prediction model and obtains the consumption expectation of the future tourism consumers, which has great significance to promote the development of the tourism consumption industry and promote the development of the tourism service industry in China. In the next step of research, the research plan selects several representative scenic spots in the Shandong province for case analysis and further optimizes the model through the combination of model prediction and practical comparison.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Acknowledgments

This paper was supported by Ph.D. Fund of Henan Polytechnic University (No: B2022-9).

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