

Traffic Forecast and Business Operation Optimization Strategy of Smart Tourist Attractions Driven by Big Data

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Abstract: In order to improve the competitiveness of smart tourist attractions in the tourism market, this paper selects a scenic spot in Shenyang and uses big data technology to predict the passenger flow of the scenic spot. Firstly, this paper introduces the big data-driven forecast model of scenic spot passenger flow. Based on the traditional autoregressive integral moving average model and artificial neural network model, it builds a big data analysis and forecast model. Through the analysis of data source, model building, scenic spot passenger flow accuracy, and modeling time comparison, it affirms the advantages of big data analysis in forecasting scenic spot passenger flow. Finally, it puts forward four commercial operation optimization strategies: adjusting the ticket pricing of scenic spots, upgrading the catering and accommodation services in scenic spots, planning and designing play projects, and formulating accurate scenic spot marketing strategies, in order to provide references for the optimization and upgrading of smart tourist attractions in the future.

Keywords: Big data; Smart tourist attractions; Passenger flow forecast; Commercial operation

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1. Introduction

With the rapid development of domestic tourism in recent years, how to predict the passenger flow of tourist attractions more accurately is a key task to build smart tourist attractions. The traditional method of forecasting passenger flow is to analyze historical data, which is difficult to accurately reflect the influence of some dynamic factors, such as weather and hot topics on the Internet. Based on this, the driving role of big data technology can be brought into play to build smart tourist attractions and predict passenger flow, so that tourist data can be collected in real time, and the business operation plan can be adjusted through the mining and analysis of big data to meet the diversified needs of tourists ^[1]. Based on this, this paper selects a scenic spot in Shenyang, uses big data to predict the passenger flow of smart tourist attractions, and optimizes the business operation strategy by building a

model to improve the economic benefits of scenic spots.

2. Big data-driven tourist forecast model for scenic spots

There have always been two types of models for predicting tourist attractions, namely qualitative modeling and quantitative modeling. The former is based on the overall analysis of tourist attractions' passenger flow changes, but the disadvantage is that the prediction results lack interpretability. The latter is a more mainstream modeling and forecasting method because of its more detailed prediction process and wide application scope. There are linear and nonlinear models commonly used in quantitative modeling technology, such as the autoregressive integrated moving average (ARIMA) model in linear models, which can clearly describe the changing characteristics of tourist attractions in different seasons, but there may be errors in the ARIMA model when the passenger flow is random ^[2]. Nonlinear models are mainly artificial neural networks, such as RBF and BP neural networks, which are more suitable for random passenger flow characteristics, but different from the ARIMA model, it is difficult to describe seasonal passenger flow, and the actual forecast results will be biased ^[3]. In view of this, this paper improves the passenger flow forecast of a scenic spot in Shenyang based on the above model, and applies big data technology to build a passenger flow forecast model to improve the forecast accuracy and shorten the forecast time.

3. Big data-driven smart tourist attractions passenger flow forecast

3.1. Forecast data sources

In order to ensure the validity of the passenger flow forecast of a scenic spot in Shenyang, the passenger flow of the scenic spot from July 1 to August 1, 2024 was selected as sample data, with a total of 150 samples; 90 training sample sets were used for model construction, and 60 samples were used to test the prediction ability of the model. The big data analysis technology is used to analyze the tourist data of scenic spots, and the factors with strong correlation are screened according to the characteristics of scenic spots. After preliminary screening, the independent variables are obtained as shown in **Table 1**. According to the independent variables sorted out in **Table 1**, this paper presents descriptive statistics on the passenger flow data of a scenic spot in Shenyang from July 1 to August 1, 2024, and the statistical results are also shown in **Table 1**.

Table 1. Independent variables and descriptive statistics

	Variable	Min	Max	Mean	SD
x1	Weather	-1	35	17.6	6.95
x2	Wind power	1	11	4.6	3.26
x3	Hotel booking rate	15	90	42.4	38.1
x4	Keyword index	242	978	410	174.6
x5	Holiday	2	10	3.3	2.4
x6	Economic climate index	94.2	95.3	95.4	0.38
x7	Consumer confidence index	100.1	109.4	101.7	1.15
y	Tourist flow in scenic spots	0.4	8.5	2.1	1.54

Note: The information comes from the public data of scenic spots, the same below.

After descriptive statistics, we can basically grasp the data overview in **Table 1** and randomly carry out correlation analysis. This link mainly uses the Pearson correlation coefficient to judge the linear correlation degree of corresponding variables and independent variables^[4]. Through analysis and judgment, it is found that the linear correlation between x6 and x7 economic factors and y is not significant, and the data change difference is also relatively small. Therefore, these two variables are no longer considered in the subsequent prediction.

3.2. Building a model

Based on the above analysis of scenic spot passenger flow data, a prediction model is constructed, and the Lasso regression algorithm is used to predict parameters and select variables. The regression optimization problem of the Lasso algorithm is expressed by Formula (1):

$$(\hat{\alpha}, \hat{\beta}) = \arg \min \left\{ \sum_{i=1}^N (y_i - \alpha - \sum \beta_j x_{ij})^2 \right\} \quad (1)$$

In the formula (1): $\sum \beta_j \leq t$, $t \geq 0$, this is a harmonic parameter. If $y = 0$, you do not need to consider α .

Then calculate the equation, and the equation solution is:

$$\hat{\beta}_j = \text{sign}(\beta_j^0) (\|\beta_j^0\| - \gamma)^+ \quad (2)$$

The γ in formula (2) is mainly calculated from $\sum |\beta_j| = t$.

3.3. Scenic spot passenger flow accuracy and modeling time comparison

3.3.1. Fitting accuracy

Based on the established prediction model, it is necessary to compare and test the fitting accuracy of scenic spot passenger flow. In this paper, the traditional ARIMA model is selected as the comparison object, and the comparison of fitting accuracy with a scenic spot in Shenyang is shown in **Figure 1**.

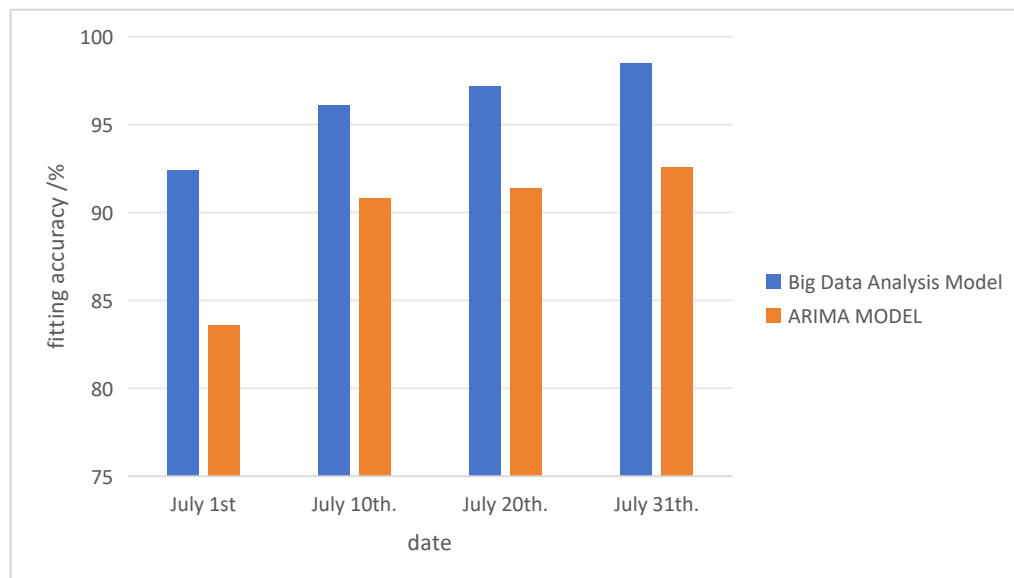


Figure 1. Comparison of fitting accuracy of passenger flow in a scenic spot in Shenyang

According to the numerical results of statistical fitting accuracy in **Figure 1**, the fitting accuracy of the big data prediction model constructed in this paper is higher than that of the ARIMA model, with an average of about 96%; while the average of ARIMA statistics is only 89%, and the fitting accuracy is improved by 7%, which can describe the changes of passenger flow in scenic spots in a more detailed and comprehensive way, thus reflecting the performance advantages of the smart tourist scenic spot passenger flow prediction model driven by big data technology^[5].

3.3.2. Prediction accuracy

During the construction of smart tourist attractions, the fitting results actually obtained by the scenic spot passenger flow prediction model can be used to describe the changes of historical passenger flow data, but it is difficult to describe the changes of passenger flow in the future^[6]. Considering this, this modeling focuses on testing the validation sample set. See **Figure 2** for the sample prediction accuracy of the ARIMA model and the big data passenger flow prediction verification model constructed in this paper.

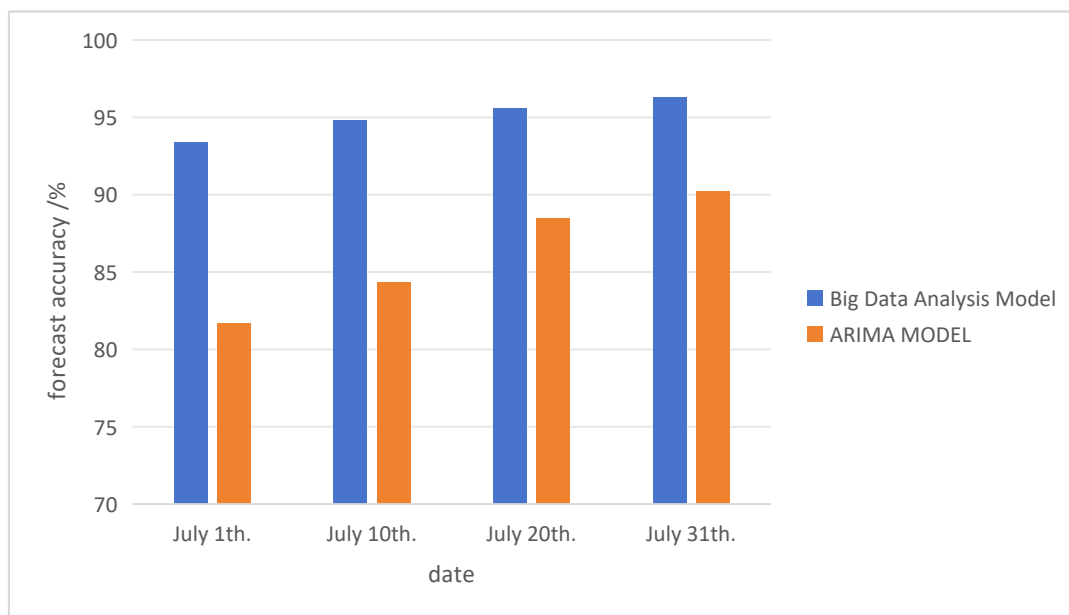


Figure 2. Sample prediction accuracy of scenic spot passenger flow verification model

According to the prediction accuracy sorted out in **Figure 2**, it is found that there is a big gap between the prediction results of the big data model and the ARIMA model. The average accuracy of big data analysis is 95%, while the average accuracy of the ARIMA model is only 86%. It can be seen that the big data model has high accuracy in predicting the passenger flow of smart tourist attractions, which can solve the problem of prediction error.

3.3.3. Modeling time

The construction time of the passenger flow forecast model in smart tourist attractions is also the focus of this analysis. Through the data of prediction time and average fitting time, it is found that the modeling time of building the big data model is better than the ARIMA model. See **Table 2** for a comparison of some modeling

time data. It can be seen that the application of big data analysis technology in the passenger flow modeling of smart tourist attractions can further shorten the passenger flow time and improve the efficiency of modeling and forecasting.

Table 2. Comparison of the construction time of the scenic spot passenger flow model

Data number	Fitting time		Forecast time	
	Big data analysis model	ARIMA model	Big data analysis model	ARIMA model
1	8.15s	12.38s	4.26s	7.32s
2	5.31s	7.66s	2.61s	4.57s
3	4.11s	8.36s	2.25s	4.38s
4	4.63s	5.17s	2.13s	4.46s
5	6.01s	8.06s	2.18s	4.59s

4. Business operation optimization strategies based on passenger flow forecast

4.1. Adjusting the ticket pricing of scenic spots

As a tourist attraction, one of the sources of income is tickets. If the ticket pricing can be guaranteed to be reasonable, it will certainly increase the income of tourist attractions and economic benefits. Especially in the process of upgrading to smart tourist attractions, the application of big data technology to build a scenic spot passenger flow prediction model, managers make dynamic adjustments to ticket prices according to the prediction results obtained by the model, which can improve tourists' satisfaction with the scenic spot on the one hand and increase income on the other^[7]. For example, after the Spring Festival every year to the middle and late March is the off-season. At this time, the ticket price can be appropriately lowered to attract more tourists to visit. After entering the peak season, the manager will raise the price to balance the relationship between supply and demand, and at the same time increase the income of tourist attractions. In the process of forecasting passenger flow, tourists' feedback on ticket pricing is collected through big data technology, and it is suggested to formulate differentiated pricing strategies and refine ticket pricing^[8]. For example, different ticket schemes can be formulated at different time periods, or differentiated fares can be formulated for multiple tourist groups such as students and families. Through the refined and differentiated management of ticket prices, it will give more flexibility to ticket sales, meet the needs of tourists, and give full play to the advantages of big data technology to improve the income of scenic spots.

4.2. Upgrading catering and accommodation services in scenic spots

An important part of the commercial operation of smart tourist attractions is to provide catering and accommodation services for tourists, and the service quality is the key measure of tourists' satisfaction with the scenic spots. By building a passenger flow forecasting model, managers can reconfigure catering and accommodation resources, and when they enter the peak period of tourism, they can still ensure sufficient supply capacity and prevent the waste of resources in the low season of scenic spots. After forecasting the passenger flow, a scenic spot in Shenyang described in this paper prepared catering ingredients in advance, and arranged service personnel at each post to shorten the waiting time of tourists after entering the scenic spot and provide them with high-quality catering and accommodation services^[9]. The forecast of passenger flow in this scenic spot applies big

data analysis technology, and also deeply collects the preference information of tourists in the scenic spot, such as eating habits and requirements for accommodation conditions, so that managers can provide personalized services for tourists. Based on the above analysis, driven by big data, the reconfiguration of catering and accommodation resources in smart tourist attractions can effectively improve the experience of tourists and the competitiveness of the scenic spots themselves in the tourism market.

4.3. Planning and designing play projects

The optimization of the business operation strategy of smart tourist attractions cannot ignore the importance of play items. The key is the opening time and frequency of play items, which is closely related to the experience of tourists after entering the scenic spot and the utilization rate of play items. According to the passenger flow forecast results of the big data analysis constructed in this paper, the managers re-plan the play projects, focusing on the play needs of tourists in different time periods^[10]. According to the forecast, it is found that 9:00 a.m.–12:00 p.m. and 2:00 p.m.–6:00 p.m. are the peak hours of daily passenger flow, so it is necessary to increase the opening frequency of some popular play items in the above two periods, and lower the frequency in other periods, and maintain the play equipment at this stage, which can not only improve the utilization rate of internal resources in the scenic spot, but also ensure the personal safety of tourists. In addition, the application of big data analysis technology to collect tourists' behavior data can also help scenic spots to upgrade the queue management system of each play project. The scenic spots described in this paper add two new functions in the system—intelligent reservation and dynamic adjustment of the queuing route, which greatly shortens the waiting time of tourists in line. To sum up, it is an effective means to improve tourist satisfaction and economic benefits of scenic spots by using big data technology to optimize the planning of play projects and adjust business operation strategies.

4.4. Developing an accurate scenic spot marketing strategy

Making accurate business marketing strategies in smart tourist attractions can improve the attraction to tourists. According to the predicted tourist flow of scenic spots by the model, diversified commercial marketing activities can also be formulated. For example, in the process of forecasting passenger flow in a scenic spot in Shenyang, managers put forward promotion activities for differentiated passenger flow levels. Among them, when the passenger flow is predicted to be low, the scenic spot specially launches several different preferential activities to attract tourists; In order to attract potential tourists, social media such as Xiaohongshu, Weibo, TikTok, and below-the-line are used to make a wide range of publicity when the passenger flow is predicted to be high. In order to locate the target consumer groups more accurately, the scenic spot uses geographic big data technology to collect the location information of tourists, analyze the behavior characteristics of tourists, and enhance the pertinence and personalization of the commercial marketing plan of the scenic spot. In this way, the commercial marketing strategy formulated by smart tourist attractions driven by big data can gain a more ideal publicity effect, and the cost is lower than that of traditional marketing methods, which can improve the utilization rate of scenic resources.

5. Conclusion

To sum up, this paper used big data analysis technology to build a tourist forecast model of smart tourist attractions. Through the analysis of the tourist forecast of a scenic spot in Shenyang, this model solves the problems of randomness, seasonality, and periodicity of the traditional single model, and also optimizes the

commercial operation strategy of the scenic spot. In the long run, it can not only improve tourists' satisfaction with the scenic spot, but also enhance the economic benefits of the scenic spot.

Disclosure statement

The author declares no conflict of interest.

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