Prediction of the Spatial Structure of Cruise Market Based on Spatial Gravity Model—A Case Study of Shanghai Cruise Port

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Abstract. Spatial interaction between tourist originating region and destination is one of the key factors affecting tourism industry. Based on classical gravity models, this paper constructed a cruise market spatial gravity model to predict the cruise market demand. It is found that cruise tourism is rather and its elasticity is much higher than other tourism activities and cruise tourism is more easily to be replaced. Meanwhile the search index of cruise tourism in most regions is proportional to the overall tourism propensity, and the cruise tourism penetration rate decreases with distance from the cruise port studied. The largest market of Shanghai cruise tourism comes from the Yangtze River Delta region. Additionally, Cruise tourism and other tourism are positive correlated. Exotic cultures and the new modes of tourism are more attractive to tourists. However, the attraction for Midwest and North China and distance register a negative correlation with the share of the Shanghai cruise passenger market.

1 Introduction

According to the 2018 China Cruise Development White Paper, Shanghai Cruise Port dominates with the largest number of cruise tourism reception and enjoys the earliest development in China with the largest reception scale in Asia and ranking the fourth in the world. The cruise economy extremely depends on tourism demand. Therefore, it’s very urgent to carry out research on the market demand prediction from a theoretical level, so as to provide necessary reference for its development strategy and region marketing plan.

Cruise tourism is a comprehensive industrial cluster involving cruise ship operations, port services, cruise ship repairs, ship supply, and cross-border consumption. Since the reception of the first foreign cruise ship in 1976, the number of international cruise ships and tourist arrivals has increased year by year in China. At the same time, the increasing travel demand of middle-class and wealthy families in China in recent years has promoted the rapid development of the cruise market.
2 Theory and gravity model modification

2.1 Cruise forecast literature review.

The research on tourist market forecasting began in the 1960s and became a hotspot of tourism research in the 1980s[1]. Tourism demand forecasting models are divided into qualitative research methods, quantitative research methods, and artificial intelligence methods[2], such as OLS, SUR[3], neural network model[4], multiple regression analysis[5] and tourism gravity models[6] etc.

In 2013, Jia Peng and others established a three-layer structure BP neural network and found that per capita GDP, per capita disposable income, cruise capacity, number of people of appropriate age, and outbound tourism preferences exerted a greater impact on cruise tourism demand, which can be used as a model Input variable [7]. In 2014, Murat Cuhadar and others used neural networks to predict the port reception in Izmir and concluded that the radial basis neural network model is the most effective to predict demand[8].

2.2 Gravity model review

In 1966, Crampon used the Newton model in tourism research for the first time to measure the origin market[9]. Then, with a group of scholars’ work (Zipf [10], Stewart [11], Taylor [12], Wolfe [13], Edwards, and Dennis [14], Newton-type Spatial gravity model was formed. However, Newton's model has two loopholes: lacking of strict theoretical basis [15] and breakpoint paradox [16].

In 1969, British geographer Wilson used the idea of statistical mechanics to establish a maximum entropy model [17,18], and then derived a Wilson-type spatial gravity model.

Then, Li Shan [19] established a tourism gravity model based on the Wilson model. The model uses the attraction of destinations, the emissiveness of tourist origin, and the spatial damping between the two places as three basic explanatory variables.

\[
T = K A_k P_j C_j^\alpha \exp(-\beta r_{jk})
\]

where \(T_{jk}\) represents the strength of the spatial interaction between the origin region \(j\) and the destination \(k\); \(A_k\) represents the attraction of destination \(k\); \(P_j C_j^\alpha\) represents the emissiveness of tourist origin region \(j\); \(P_j\) is the population size of \(j\); \(C_j\) is the per capita income level of \(j\); \(A\) is the income level parameter; \(\exp(-\beta r_{jk})\) represents the spatial damping from the origin region \(j\) to the destination \(k\), where \(r_{jk}\) represents spatial distribution between the origin region \(j\) and the destination \(k\); \(\alpha\) is the income elasticity of tourist; \(K\) is a normalized parameter.

2.3 Gravity model modification

The distance between tourist origin region and destination affects the size of the damping coefficient \(\beta\) that calculated from the mouth particle model in this paper[16]. The formula is composed of three factors: the average migration-residence time scale, the domain element scale of the interaction domain, and the age of the maximum diffusion rate of diffusing elements. Besides, the modification of the tourism spatial gravity model needs to pay attention to some factors: the attractiveness of the destination and the travel potential of the origin region.

(1) Calculate the tourist attractiveness \(A_k\) from the demand. The attractiveness of the tourist origin region focuses on the supply side, which cannot reflect the different aesthesia
and interests of tourists on the attractiveness of destination [20]. In view of those considerations, to calculate the tourist attractiveness from the demand side which involves emotions, beliefs, and other factors may be more appropriate. Cruise tourism involves leisure, entertainment, vacation, food and other activities. Considering the overall measurement method that treats cruises as a whole is more appropriate to calculate the attractiveness $A_k$. In view of the popularity of the Internet in China and the current model of cruise travel ticket sales, this paper considers that the opportunities for obtaining cruise travel in different regions are equal. The difference in the number of tourists in different regions is regarded as the difference in attractiveness.

(2) Replace the total population with the urban population. The overall demand for tourism remains relatively stable over a period of time[21]. Compared with traditional tourism, cruise tourism demands highly in economy conditions. Additionally, urban population often has better economy conditions for participating in cruise tourism under China's urban and rural structure.

From the demand side and the search growth rate of the Baidu index to measuring the attractiveness of destination. The tourism gravity model is modified as follows:

$$T = K A_{jk} P_j C^a_{jk} \exp(-\beta r_{jk})$$

(2)

where $A_{jk}$ is the attractiveness of destination $k$ to tourist origin region $j$, which is characterized by the Baidu index; $P_j C^a_{jk}$ is the emissiveness of tourist origin region $j$ to destination $k$; $P_j$ is the urban population size of the tourist origin region; $C^a_{jk}$ is the per capita emissiveness of the tourist origin region $j$ to the destination $k$; other variables and parameters are the same as (1).

2.4 Modeled equation

The attractiveness of destination to tourist origin has regional differences, that affected by the law of distance attenuation that the attractiveness of the destination and the travel rate will be weaken with the distance increasingly. The attractiveness of Cruise tourism from different regions needs to be subdivided. As a result, the formula as follow:

$$P_j^{(k)} = \frac{T_{jk}}{\sum_j T_{jk}} = \frac{K A_{jk} P_j C^a_{jk} \exp(-\beta r_{jk})}{\sum_j A_{jk} P_j C^a_{jk} \exp(-\beta r_{jk})} = \frac{A_{jk} P_j C^a_{jk} \exp(-\beta r_{jk})}{\sum_j A_{jk} P_j C^a_{jk} \exp(-\beta r_{jk})}$$

(3)

where $k$ is Shanghai Port; $P_j$ is the percentage of tourist origin region $j$ in the tourist market share of Shanghai Port $k$; $A_{jk}$ is the attractiveness of destination $k$ to origin region $j$ (use the Baidu index to characterize); $P_j C^a_{jk}$ is the emissiveness of tourist origin region $j$ to Shanghai Port $k$; $P_j$ is the urban population of tourist origin $j$; $C^a_{jk}$ is the per emissiveness of tourist origin region $j$ to Shanghai Port $k$; $C_j$ is the level of per capita income of the origin region $j$ (use GDP to characterize); $\alpha$ is the income elasticity of tourist; $\exp(-\beta r_{jk})$ is the spatial damping coefficient between the origin region $j$ to Shanghai Port $k$, $r_{jk}$ is the spherical distance between the origin $j$ and Shanghai; $\beta$ is the spatial damping coefficient, use the mouth particle model method [20] to calculate.
3 Variable determination and parameter estimation

3.1 Variable determination

There are 4 variables in the spatial distribution of the domestic market of Shanghai Port: the urban population of the origin region; the attractiveness of Shanghai Port to origin regions; per capita GDP of the origin region; the distance between the origin region and Shanghai.

Table 1. Spherical distance between Shanghai and other provinces in China.

| Provinces and cities | Spherical distance(km) | Provinces and cities | Spherical distance(km) | Provinces and cities | Spherical distance(km) |
|----------------------|------------------------|----------------------|------------------------|----------------------|------------------------|
| Anhui                | 402.3                  | Heilongjiang         | 1675.1                 | Shandong             | 728.9                  |
| Beijing              | 1064.7                 | Hubei                | 683.7                  | Shanxi               | 1099.4                 |
| Fujian               | 611                    | Hunan                | 886.4                  | Shaanxi              | 1223.2                 |
| Gansu                | 1717.9                 | Jilin                | 1444.4                 | Shanghai             | 0                      |
| Guangdong            | 1213.3                 | Jiangsu              | 266.2                  | Sichuan              | 1659                   |
| Guangxi              | 1602.9                 | Jiangxi              | 610.8                  | Tianjin              | 962.8                  |
| Guizhou              | 1527.5                 | Liaoning             | 1190.9                 | Xinjiang             | 3268.8                 |
| Hainan               | 1630.5                 | Inner Mongolia       | 1374.3                 | Yunnan               | 1950                   |
| Hebei                | 991.2                  | Ningxia              | 1912.8                 | Zhejiang             | 169.1                  |
| Henan                | 826.6                  | Qinghai              | 1595.2                 | Chongqing            | 1445.3                 |

Note: coordinate comes from the National Basic Geographic Information Center, spherical distance is calculated by formula (4)

(1) The Attractiveness of Destination to Origin. User interests and needs within a specific time period reflect on Baidu index[22]. Based on the background of big data, this paper used Baidu (http://index.baidu.com/v2/index.html#/ ) to conduct "cruise travel" in 30 provinces and cities in China (Tibet is not counted due to missing data) from January 1st 2011 to December 31st 2015. To reasonably explain the physical meaning of the variables, the data are expressed as percentages.

(2) Urban Population \( P_j \). This data comes from China Statistical Yearbook.

(3) Per Capita Gross Domestic Product \( C_j \). It can be obtained that the per capita GDP of the origin region and the per capita GDP of China from the official website of the National Bureau of Statistics.

(4) The Distance between the Origin and Shanghai \( \Gamma_{jk} \). Cruise tourism requires the threshold for the development of the cruise industry is the per capita GDP more than 8,000 dollars. In China, provincial capital cities are usually the best in economy and they are also one of the major tourism distribution centers in each province. Therefore, the spherical distance between the provincial capital and Shanghai can be regard as the distance between the origin region and Shanghai for:

\[
\Gamma_{jk} = R \arccos(\sin \varphi_j \sin \varphi_k + \cos \varphi_j \cos \varphi_k \cos(\lambda_k - \lambda_j ))
\]

\( \pi \) is the PI (value 3.14); \( R \) is the radius of the earth (value 6371 km); \( j,k \) in \( (\lambda_j, \varphi_j) \) and \( (\lambda_k, \varphi_k) \) is the provincial capital coordinates of the origin region, and the geographical coordinates of Shanghai (Where \( \varphi \) is latitude and \( \lambda \) is longitude). Substituting the latitude and longitude coordinates of each provincial capital city (latitude and longitude come from the National Basic Geographic Information Center) into equation (5), the spherical distance can be calculated. (Table 1)
3.2 Parameter estimation

The income level parameter $\alpha$ and the spatial damping coefficient $\beta$ as two core parameters in the spatial distribution prediction model of the domestic passenger origin region $j$ in the tourist market share of Shanghai Pork.

(1) Parameters of Income Level $\alpha$. In equation (2), it is easy to know that the total output $E_{jk}$ of the tourist origin $j$ to destination $k$ is mainly restricted by two factors: urban population and per capita income level, so $E_{jk} \propto P_j C_j^{\alpha} \gamma_k$, and per capita travel power $EE_{jk}$ for:

$$EE_{jk} = k C_j^{\alpha}$$  \hspace{1cm} (5)

Chinese cruise travel itinerary is generally 5-7 days. This paper values 6 days into the equation (6). Tourist consumption on cruise covered tickets, onboard and others. Genting Hong Kong Group, whose main service market is the Asia-Pacific region, was used to calculate revenue parameters. Its Financial Statements (2009-2016) provided the annual total operating income and the passenger days. And their quotient is the average spend per visitor per day on ship (include tickets), which is used in this paper to represent the per capita travel of China tourists. Since the author has less data on available per capita disposable income, in order to effectively estimate the income elasticity of tourism demand for China tourists, this paper uses the per capita GDP of tourists to represent the level of per capita income (Table 2).

Table 2. Per capita consumption of genting Hong Kong cruise tourists and per capita GDP of mainland tourists.

| Year | Income (thousand dollars) | Passenger days | Daily per capita consumption (thousand dollars) | Exchange rate | Per capita consumption (yuan) | China per capita GDP (yuan) |
|------|--------------------------|----------------|-----------------------------------------------|---------------|-------------------------------|---------------------------|
| 2008 | 422607                   | 2106071        | 0.2                                           | 6.8346        | 8201.52                       | 24121                     |
| 2009 | 345,507                  | 1,504,480      | 0.23                                          | 6.8282        | 9422.92                       | 26222                     |
| 2010 | 360,962                  | 1,556,477      | 0.23                                          | 6.6227        | 9139.33                       | 30876                     |
| 2011 | 488,519                  | 1,699,736      | 0.29                                          | 6.3009        | 6.3009                        | 36403                     |
| 2013 | 542,167                  | 2,007,503      | 0.27                                          | 6.0969        | 6.0969                        | 4352                      |
| 2015 | 652,848                  | 2,207,493      | 0.3                                           | 6.2284        | 6.2284                        | 50251                     |
| 2016 | 908,111                  | 2,922,480      | 0.31                                          | 6.6423        | 6.6423                        | 53980                     |

Note: Passenger days is the number of passengers by the number of days of their travel itinerary; 2012 and 2014 were affected by the Diaoyu Island incident and Sade incident, so not take into account. The annual revenue of Genting Hong Kong Cruise Line and the passenger days come from "Genting Hong Kong Limited's Performance" (2009-2016); the exchange rate of the USD against the CNY comes from the "Statistical Bulletin of National Economic and Social Development" (2008-2016); China Per capita GDP is derived from China Statistical Yearbook (2017).

Analyzing the data in Table 2, it can found a power function relationship between per capita consumption and per capita GDP, and the results according to model formula (6) are shown in Table 3. From this, we get the regression equation between per capita expenditure and per capita GDP: $EE_{jk} = 176.168 C_j^{0.385}$.

The equation has a good fitting effect, and the complex correlation coefficient $R^2 = 0.771$, and $F=16.794$ when the parameter estimation results are at the level of 0.1; The income elasticity $\alpha \approx 0.385$ ranging from 0 to 1 and lack of elasticity.
The independent variable is China Per capita GDP

(2) Spatial damping coefficient \( \beta \). Spatial damping coefficient \( \beta \) is a landmark parameter of the tourism gravity model, and it reflects the decay rate of the intensity of space interaction. As the tourists have obvious characteristics in the age and income, the mouth particle model method is more suitable. Wang Zheng proposed a formula for calculating the space damping coefficient \( \beta \) based on mouth particle model method [16]:

\[
\beta = \sqrt{\frac{2T}{t_{\text{max}}D}}
\]

where \( T \) represents the average migration-residence time scale of the diffusive element; \( D \) represents the domain element scale of the interaction domain; \( t_{\text{max}} \) represents the age corresponding to the maximum diffusion rate of the diffusing element. In this paper, \( T \) is the Travel cycle (Reciprocal of annual travel rate), \( t_{\text{max}} \) is the maximum travel rate of the residents corresponding to age; \( D \) is the spatial scale of the interaction destination and the origin.

(3) Estimate \( T \). According to the annual travel rate provided by the China Tourism Statistical Bulletin (2009-2016), it is possible to calculate the travel cycle and the multi-year average travel cycle of China residents. (Table 4) At the provincial level, prefecture level, county level, rural level, and the average damping coefficients of tourism spatial interactions are 0.000244, 0.000773, 0.002443, 0.007727 and 0.002797 respectively. This coefficient is close to 0.00229 from Liu Shao jiu [6] and 0.00322 from Li Shan [19], which are both on the order of \( 10^{-3} \).

(4) Estimate \( t_{\text{max}} \). According to the reports of online cruise companies and companies such as Tuniu and Big data Consulting in recent years, it can be found that the age of the current traveling population is mostly distributed between 30 and 59 years old. For the convenience of calculation, \( t_{\text{max}} \) value 45 years old in this paper.

(5) Estimate \( D \). The size of the domain element changes with the spatial distance. In China, the domain at the provincial level, prefecture level, county level, and rural level, which the approximate value can be estimated as 300000km², 30,000km², 3000km², 300km². (table 5)

### Table 3. Estimated results of the relationship between the per capita consumption of genting Hong Kong cruise tourists and the per capita GDP of mainland tourists (2008-2016).

| Equation | Dependent Variable: Per capita consumption (yuan) |
|----------|-----------------------------------------------|
| Power    | Parameter Estimates                           |
|          | R Square | F        | df1 | df2 | Sig. | Constant | b1  |
| Power    | 0.771    | 16.794   | 1   | 5  | 0.009 | 176.680  | 0.385 |

### Table 4. Annual Travel Rate and Cycle of China Mainland Residents (2008-2016).

| Year | Total population (Unit: thousand) | Number tourists (Unit: thousand) | Annual travel rate | Travel cycle(T,year) |
|------|----------------------------------|---------------------------------|-------------------|---------------------|
| 2008 | 132802                           | 171200                          | 1.289             | 0.776               |
| 2009 | 133450                           | 190200                          | 1.425             | 0.702               |
| 2010 | 134091                           | 210300                          | 1.568             | 0.638               |
| 2011 | 134735                           | 264100                          | 1.960             | 0.510               |
| 2012 | 135404                           | 295700                          | 2.184             | 0.458               |
| 2013 | 136072                           | 326200                          | 2.397             | 0.417               |
| 2014 | 136782                           | 361100                          | 2.640             | 0.379               |
| 2015 | 137462                           | 400000                          | 2.910             | 0.344               |
| 2016 | 138271                           | 444000                          | 3.211             | 0.311               |
| Average | 135452.1                        | 295866.7                        | 2.176             | 0.504               |

Note: Data comes from China Tourism Statistical Bulletin bring the values into equation (6) and calculate the data in Table 6.
Table 5. Domain area of four administrative regions in China mainland.

| Administrative area scale | Provincial level | Prefecture level | County level | Rural level |
|---------------------------|------------------|------------------|--------------|-------------|
| The number of administrative area | 31               | 334              | 2850         | 39789       |
| Average area of administrative | 308483          | 28632            | 3355         | 240         |
| Domain element area       | 300000           | 30000            | 3000         | 300         |

Note: The number of administrative divisions is from China Statistical Yearbook (2016). The average area of the administrative region is calculated. Domain element area is approximated.

Table 6. Spatial distribution of domestic tourists to Shanghai from 2008 to 2009.

| Province         | 2008 | 2009 | Province         | 2008 | 2009 |
|------------------|------|------|------------------|------|------|
| Anhui            | 6.48%| 7.12%| Jiangsu          | 17.81%| 18.42%|
| Beijing          | 1.78%| 1.44%| Jiangxi          | 3.28%| 2.88%|
| Chongqing        | 0.71%| 0.96%| Liaoning         | 0.71%| 0.55%|
| Fujian           | 2.71%| 1.85%| Inner-Mongolia   | 0.50%| 0.34%|
| Guangdong        | 2.85%| 3.29%| Ningxia          | 0.14%| 0.21%|
| Guangxi          | 1%   | 1.23%| Qinghai          | 0%   | 0.07%|
| Gansu            | 0.50%| 0.48%| Shanghai         | 28.75%| 31.30%|
| Guizhou          | 0.78%| 1.30%| Sichuan          | 2%   | 1.78%|
| Hebei            | 0.93%| 0.68%| Shandong         | 2.98%| 2.19%|
| Heilongjiang     | 0.57%| 0.48%| Shanxi           | 1.21%| 0.89%|
| Henan            | 2.64%| 3.01%| Shaanxi          | 0.93%| 0.68%|
| Hunan            | 2.85%| 2.88%| Tianjin          | 0.64%| 0.55%|
| Hubei            | 2.71%| 2.47%| Xinjiang         | 0.21%| 0.48%|
| Hainan           | 0.29%| 0.14%| Yunnan           | 0.64%| 0.89%|
| Jilin            | 0.57%| 0.34%| Zhejiang         | 12.83%| 11.10%|

Note: Data comes from a case study of Shanghai Disneyland on spatial structure forecast for proposed scenic spot market: Modification and its application of gravity model.

Table 7. A typical cruise company in Shanghai in 2015.

|                  | Midwest | Jiangsu and Zhejiang | Shanghai | North China | South China | Other areas |
|------------------|---------|-----------------------|----------|-------------|-------------|-------------|
|                  | 12%     | 21%                   | 48%      | 13%         | 3%          | 3%          |

4 Empirical Test

To ensure the accuracy of the prediction, the scientificity of the model and the rationality of the parameters need to be guaranteed. Since only found the spatial distribution of the domestic tourist origin market in Shanghai in 2009 and 2010 [6], and data on the travel hinterland of a typical cruise company in Shanghai in 2015 [23]. So this paper uses the model to calculate and compare the real and model data from Shanghai Port in 2008, 2009 and 2015 (Table 6, Table7, Figure1, Figure2, and Figure3). The data required in formula (3) are shown in Tables 1 and 3. According to formula (5), the income elasticity of domestic tourists in 2007 is 0.385. The damping coefficient $\beta$ is 0.003128 by using formula (6). Theoretical value of the provincial tourist origin market in 2007, 2008 and 2015 can be calculated based on the revised model (Table 8).
Table 8. Urban Population, per capita GDP and Baidu index from origin to Shanghai (2008 -2009).

| origin region | Urban population(2008) | GDP per capita(2008) | Urban population(2009) | GDP per capita(2009) | Urban population(2015) | GDP per capita(2015) | Baidu Index(2011) | Baidu Index(2015) |
|---------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|--------------------|--------------------|
| Anhui         | 2485                   | 14448               | 2581                   | 16408               | 3103                   | 35997               | 11.14%             | 11.82%             |
| Beijing       | 1504                   | 64491               | 1581                   | 66940               | 1877                   | 106497              | 22.83%             | 20.57%             |
| Chongqing     | 1419                   | 20490               | 1475                   | 22920               | 1838                   | 52321               | 11.14%             | 11.14%             |
| Fujian        | 1929                   | 29755               | 2020                   | 33437               | 2403                   | 67966               | 15.49%             | 14.89%             |
| Guangdong     | 6269                   | 37638               | 6423                   | 39436               | 7454                   | 67503               | 20.38%             | 22.39%             |
| Guangxi       | 1838                   | 14652               | 1904                   | 16045               | 2257                   | 35190               | 10.87%             | 11.70%             |
| Gansu         | 856                    | 12421               | 891                    | 13269               | 1123                   | 26165               | 2.99%              | 4.89%              |
| Guizhou       | 1047                   | 9855                | 1057                   | 10971               | 1483                   | 29847               | 5.71%              | 6.59%              |
| Hebei         | 2928                   | 22986               | 3077                   | 24581               | 3811                   | 40255               | 13.59%             | 13.86%             |
| Heilongjiang  | 2119                   | 21740               | 2123                   | 22447               | 2241                   | 39462               | 10.33%             | 10.57%             |
| Henan         | 3397                   | 19181               | 3577                   | 20597               | 4441                   | 39123               | 14.40%             | 13.98%             |
| Hunan         | 2689                   | 18147               | 2767                   | 20428               | 3452                   | 42754               | 11.14%             | 12.61%             |
| Hubei         | 2581                   | 19858               | 2631                   | 22677               | 3327                   | 50654               | 14.95%             | 14.32%             |
| Hainan        | 410                    | 17691               | 425                    | 19254               | 502                    | 40818               | 9.78%              | 8.30%              |
| Jilin         | 1455                   | 23521               | 1461                   | 26595               | 1523                   | 51086               | 8.97%              | 9.43%              |
| Jiangsu       | 4215                   | 40014               | 4343                   | 44253               | 5306                   | 87995               | 17.93%             | 19.55%             |
| Jiangxi       | 1820                   | 15900               | 1914                   | 17335               | 2357                   | 36724               | 8.15%              | 10.23%             |
| Liaoning Inner Mongolia | 2591    | 31739               | 2620                   | 35149               | 2952                   | 65354               | 15.76%             | 13.86%             |
| Ningxia       | 1264                   | 34869               | 1313                   | 39735               | 1514                   | 71101               | 5.43%              | 6.59%              |
| Qinghai       | 1278                   | 28853               | 1398                   | 34308               | 1822                   | 50032               | 10.33%             | 10.57%             |
| Shanghai      | 226                    | 18421               | 234                    | 19454               | 296                    | 41252               | 0.54%              | 0.91%              |
| Sichuan       | 1897                   | 69165               | 2116                   | 103796              | 24.46%                 | 22.73%             |
| Shandong      | 3044                   | 3168                | 3168                   | 37339               | 3912                   | 67754               | 14.13%             | 14.43%             |
| Shanxi        | 4483                   | 4576                | 5614                   | 64168               | 17.39%                 | 16.82%             |
| Shaanxi       | 1539                   | 21506               | 2552                   | 36724               | 2161                   | 34919               | 9.24%              | 10.34%             |
| Tianjin       | 1565                   | 19700               | 2620                   | 35149               | 2952                   | 65354               | 15.76%             | 13.86%             |
| Xinjiang      | 908                    | 58656               | 968                    | 62574               | 1278                   | 107960              | 14.67%             | 13.75%             |
| Yunnan        | 845                    | 19978               | 860                    | 19942               | 1115                   | 40036               | 3.53%              | 5.11%              |
| Zhejiang      | 1499                   | 12570               | 1554                   | 13539               | 2055                   | 28806               | 7.07%              | 9.20%              |

Note: The data of the total urban population and per capita GDP are from the China Statistical Yearbook (2016). Using the Baidu Index from 2011.1.1 to 2011.12.31 instead of the data at 2008 and 2009 because the Baidu Index hasn’t launched.

Figure 1. The Theoretical and Actual Value of Shanghai Port Tourist Market Share in 2008.
note: the Development Path of Shanghai Cruise Industry from the Perspective of Passenger Sources. Midwest: Shanxi, Henan, Hubei, Hunan, Anhui, Jiangxi, Chongqing, Sichuan, Guangxi, Guizhou, Yunnan, Shaanxi, Gansu, Inner Mongolia, Ningxia, Xinjiang, Qinghai. North China: Beijing, Tianjin, Hebei. South China: Guangdong, Hainan, Other areas: Fujian, Shandong, Liaoning, Jilin, Heilongjiang.

Figure 2. The Theoretical and Actual Value of Shanghai Port Tourist Market Share in 2009.

Figure 3. The theoretical and actual value of Shanghai port tourist market share in 2015.

5 Conclusion

This paper draws on previous scholars' study, adopts the method of gravity model, and uses the new research tools and data sources such as Internet big data to predict the domestic passenger cruise market of Shanghai Port. It is found that although the coefficient of demand elasticity of cruise tourism is between 0 and 1, which is inelastic, it's much higher than other tourism activities and is more easily to be replaced.

Judging from the Baidu search index in most regions, it is proportional to the travel propensity rate. The largest market of Shanghai cruise tourism comes from the Yangtze River Delta region. However, with completion of more cruise ports and competition increased in some areas, the proportion of cruise tourists choosing to depart from Shanghai in these areas decreased. The central and western regions, especially the northwest region, are far from the oceans and the cruise ports, so cruise tourism reveals a very low penetration rate in these regions.

Cruise tourism and other tourism are positively correlated. Due to data limitation, it uses multiple sources statistics. In particular, Shanghai's domestic tourist origin market number in 2008 and 2009 and the actual tourist data in 2015 from a real Shanghai cruise company are used to stand for the spatial distribution, and they are consistent with the theoretical value.

Different cultures and modes of tourism are more attractive to cruise tourists. However, assuming the income elasticity $\alpha$ and the damping coefficient $\beta$ are same, the attraction for Midwest and North Chinese tourists and distance have a negative correlation with the share of the Shanghai cruise passenger market. Further study may concentrate on how to exert the
positive effect of attractiveness to potential cruise tourists, and how to weaken the negative effect of distance over cruise tourism etc.

Any predicted value can only be infinitely close to the actual value. This paper adopted the perspective of demand instead of supply perspective to calculate the attractiveness, and replaced the total population of the origin region with the urban population. Despite the theoretical value is fit with the actual value, there are still differences. The reason is that data is limited, which represents the Shanghai cruise origin region market, but it is still not exact data. Next, for Chinese tourists, cruise tourism started from Shanghai doesn’t require visas, so this paper uses the domestic travel rate instead. Additionally, the income elasticity $\alpha$ and damping coefficient $\beta$ are different in different origin regions. In order to facilitate calculation, this paper uses a uniform value.

Due to the lack of data, some data are obtained by collecting, sorting, and analyzing network big data, which show strong trend characteristics.

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