Measures” promulgated by the Taiwan Province of China in 2001, the concept of “B&Bs” is defined as: a family sideline business model to provide tourists with unique accommodation with local characteristics by optimizing and integrating idle residential space based on local unique humanities, ecology, resources, industries, etc. (Yang & Yin, 2012). In August 2017, the National Tourism Administration of China officially promulgated “Basic Requirements and Evaluation of Homestay Inn”, stipulating that B&Bs means investors make full use of various local idle resources and fully participate in tourists reception to provide tourists who come to stay with small-scale high-quality accommodation place for their experience of the unique natural, cultural and living modes of the local area (National Tourism Administration, 2017a). In conclusion, this paper defines B&Bs as the following: B&Bs means a “1 + X” (entertainment, catering, etc.) derivative product with local cultural characteristics in which local residents make full use of respective resources such as unoccupied dwellings, manage and design their vacant rooms based on actual conditions of local humanities, environment, resources, ecology, agricultural industry to provide tourists with a dwelling site different from previous living and culture.

By sorting out domestic- and foreign-related literature (Jiang & Li, 2014; Zhang & Meng, 2017), it can be seen that: scholars have paid much attention to B&Bs industry, there are abundant researches on B&Bs from different perspectives, mostly market demand, marketing management, problem policies and industry trends. Case analysis and qualitative description are the primary research methods. However, seen from geographical point of view, domestic and foreign scholars have relatively little research on spatial distribution of B&Bs industry. In recent years, exploratory spatial data analysis (ESDA) analysis has been gradually applied to fields like energy, logistics and medical treatment in China, with research literature gradually increased (Gao et al., 2019; Wang et al., 2019; Wang et al., 2019), but little research is made on B&Bs. In addition, scholars prefer to study and analyze a specific city rather than large areas or cluster areas.

This paper provides an ESDA on B&Bs spatial distribution in the Yangtze River Delta region amid 2013–2017. Arggis software is used to further investigate B&Bs spatial distribution in the Yangtze River Delta region and its influencing factors. B&Bs spatial distribution characteristics of Yangtze River Delta region are concluded from analysis (including the overall spatial layout, distribution structure of B&Bs opening time, B&Bs room rate distribution structure, B&Bs density distribution, aggregation and diffusion trend in B&Bs distribution, spatial autocorrelation analysis of B&Bs). Based on B&Bs number, scenic spots number, total passenger volume, policy conditions and disposable income of Yangtze River Delta region, factors influencing hotel spatial distribution characteristics are analyzed, thus revealing B&Bs distribution rules and spatial configuration in Yangtze River Delta region, so that better theoretical basis can be provided for B&Bs development.

**Overview of the research area, data sources and research methods**

**Research area**

The study area of this article is the Yangtze River Delta, with a total of 26 cities and a total soil area of about 211,700 km², accounting for 3.8% of China. It covers cities of Shanghai, Nanjing, Wuxi, Changzhou, Suzhou, Nantong, Yancheng, Yangzhou, Zhenjiang, Taizhou, Hangzhou, Ningbo, Jiaxing, Huzhou, Shaoying, Jinhua, Zhoushan, Taizhou, Hefei, Wuhu, Maanshan, Tongling, Anqing, Chuzhou, Chizhou and Xuancheng. In May 2010, the State Council clarified the strategic positioning of “two provinces and one city” in the development of the Yangtze River Delta region; in 2014, Anhui Province was listed as a part of the Yangtze River Delta region to participate in the integrated development policy of the Yangtze River Delta region. So far, it is one of the domestic regions with the most dynamic economy, the highest degree of openness and the most complete industrial system. In the latest government report in 2019, integrated development of the Yangtze River Delta region was raised as a national strategy. Moreover, the concept of “integrated development demonstration area of Yangtze River Delta” was raised in the hope of building it to a big platform that can serve the overall domestic development and participate in global cooperation and competition on behalf of China.

**Data sources**

Considering data availability, the research objects herein are all B&Bs officially opened before the end of 2017 in the Yangtze River Delta region (including a total of 26 cities). All data are mainly sourced from Ctrip.com, and 6,446 B&Bs registered in the Yangtze River Delta were accessed, but some data lack the minimum room rate and opening time. To supplement these data, inquiry was made on data sites such as “Qunar”, “Tuniu” and “eLong”. For missing information on opening time, we queried the contact information to consult with the owner. After removing all B&Bs closed down and those with inaccessible location information, 5,181 B&Bs were finally selected as the research objects. This paper takes the number of tourist attractions above 3A grade as the measurement index of tourism resources. This method is derived from Sun Gennian’s related research in 2011: inbound
tourists tend to choose tourist attractions of higher grade (Sun et al., 2011). There are five grades of scenic spots quality according to the national standard of “Classification and Evaluation of Quality Grades of Tourist Attractions”. Data on the number of scenic spots in the Yangtze River Delta region were derived from the 2017 “China Tourism Statistics Yearbook” (National Tourism Administration of the People’s Republic of China, 2017). The total passenger transport index refers to the number of passengers actually transported by various means of transportation within a certain period. The data are taken from the “Statistical Communiqué on National Economic and Social Development” of 26 cities in the Yangtze River Delta region amid 2013-2017 (National Tourism Administration of the People’s Republic of China, 2013-2017). Finally, disposable income index refers to the total after-tax income for household members to spend or save. The data are taken from the “Statistical Yearbook” of 26 cities in the Yangtze River Delta region amid 2013-2017.

Research methods

GIS spatial analysis means to access a series of related geographic information such as spatial position, layout, form and trend from spatial data, and make analysis via software, which involves: spatial graphic data analysis, data operations of nonspatial attributes, joint operations, etc. Its advantage is that it is possible to tap into potential spatial information from the perspective of geography and then solve practical problems. In this paper, Baidu map API Pick coordinate system is taken to access the geographical coordinates of all the B&Bs in the Yangtze River Delta region, and B&Bs spatial distribution map in the Yangtze River Delta region is plotted using ArcGIS software.

Standard deviation ellipse method

Standard deviation ellipse method is to describe directional shift of the point distribution and illustrate directional trend of the research object, which can be adopted to study the overall B&Bs spatial distribution in the Yangtze River Delta region. It consists of three parts: rotation angle θ, the gravity center O, standard deviation along the long axis and standard deviation along the short axis. The specific formula is:

\[
C = \begin{pmatrix}
\text{var}(x) & \text{cov}(x, y) \\
\text{cov}(x, y) & \text{var}(y)
\end{pmatrix} = \frac{1}{n} \begin{pmatrix}
\sum_{i=1}^{n} x_i^2 & \sum_{i=1}^{n} x_i y_i \\
\sum_{i=1}^{n} x_i y_i & \sum_{i=1}^{n} y_i^2
\end{pmatrix}
\]

Where:

\[
\begin{align*}
\text{var}(x) &= \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2 = \frac{1}{n} \sum_{i=1}^{n} x_i^2 \\
\text{cov}(x, y) &= \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y}) = \frac{1}{n} \sum_{i=1}^{n} x_i y_i \\
\text{var}(y) &= \frac{1}{n} \sum_{i=1}^{n} (y_i - \bar{y})^2 = \frac{1}{n} \sum_{i=1}^{n} y_i^2
\end{align*}
\]

The standard deviation of x axis and y axis is:

\[
\delta_{x,y} = \left( \frac{(\sum_{i=1}^{n} x_i^2 + \sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} x_i y_i)^2}{2n} \right)^{1/2}
\]

Formula (5), x and y are the coordinates of i element, \( \bar{x} \) and \( \bar{y} \) are the mean centers of the elements and n is the total number of elements.

Exploratory spatial data analysis (ESDA)

With the development of GIS, spatial data analysis has attracted widespread attention, and methods for resolving spatial data have become more and more perfect. ESDA is currently viewed as an ideal data-driven analysis method (Anselin, 1999). The purpose of ESDA is to test whether a spatial pattern is significant from the perspective of spatial statistics, and to make a deeper understanding of the spatial process being studied. Its core is to measure the degree of spatial correlation or dependence between things or phenomena (Su, 2008). ESDA spatial association analysis is divided into global and local ones.

Global spatial autocorrelation analysis. Global spatial autocorrelation analysis is used to measure the spatial distribution characteristics of related variables and the influencing factors in the field (Cliff & Ord, 1981). Global Moran’s I statistic is a commonly used global spatial autocorrelation measure index. The specific formula is:

\[
I = \frac{n}{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}} \times \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n} (x_i - \bar{x})^2}
\]

Where \( n \) is the total number of elements (that is, the number of research objects), \( w_{ij} \) means the matrix of spatial weight coefficients between elements \( i \) and \( j \), \( x_i \) and \( x_j \) represent the attribute values of \( i \) region and \( j \) region, \( \bar{x} \) is the mean value of \( x \) and \( x_j \). Positive I value indicates spatial similarity in the variable value; negative I value indicates spatial dissimilarity in the variable. Significance test on Moran
index adopts standardized $Z$ statistic for inference. The specific formula is:

$$Z = \frac{E(I)}{SD(I)}$$  \hspace{2cm} (7)

Where $E(I)$ is a theoretical mean value and $SD(I)$ is the theoretical standard deviation. Given a confidence level, significant and positive Moran’s $I$ indicates spatial aggregation. Conversely, significant and negative Moran’s $I$ means significant difference in space. Moran’s $I$ statistic only illustrates average difference in space, but does not reflect local spatial differences. To comprehensively analyze local spatial differences, local spatial autocorrelation measurement is a choice.

**Local spatial autocorrelation analysis.** By analyzing and measuring significance level of the Local Indicators of Spatial Association (LISA), local spatial autocorrelation analysis analyzes the degree of spatial difference between each area and the surrounding area using spatial distribution map of LISA significance. $H$ indicates that the variable value is higher than the average, while $L$ indicates that the variable value is lower than the average. The map consists of four types: high-high (HH), low-low (LL), high-low (HL), (HH): indicates that high-value areas are surrounded by high-value neighbors; (LL): indicates that low-value areas are surrounded by high-value neighbors; (HL): indicates that low-value areas are surrounded by low-value neighbors; (HH): indicates that the high-value areas are surrounded by low-value neighbors (Wu et al., 2015).

**B&Bs spatial distribution characteristics in the Yangtze River Delta region**

**Overall distribution pattern of B&Bs**

According to the final data of 5,181 B&Bs, sorting and classification were made for "three provinces and one city" and "26 cities", and the picture was obtained showing number and proportion of B&Bs opened before 2017 (including 2017) in 26 cities in the three provinces and one city in the Yangtze River Delta region, as shown in Table 1.

At the same time, using GIS software, B&Bs distribution points are spatially displayed on the map of the Yangtze River Delta region, as shown in Figure 1.

According to Table 1 and Figure 1:

1. B&Bs spatial distribution in the Yangtze River Delta region displays significant spatial agglomeration effect, with a trend of denseness in the middle and scattering on both sides, and the southeast region has significantly more B&Bs than the northwest region.

2. As far as each region is concerned, though incomparable with the other three major provinces, Shanghai municipality has considerable B&Bs, accounting for 7.87% of all B&Bs in the Yangtze River Delta region. This is also related to Shanghai’s rich tourism resources. Shanghai not only has ancient town resources such as Fengjing and Zhujiajiao, but also has green resources such as Fengxian, Sheshan Mountain and Jinshan, not to mention emerging cultural resources such as Dishui Lake and Shanghai Disneyland, which have provided a good foundation for its development of B&Bs industry.

3. In comparison with the other three major provinces, Zhejiang Province has much more B&Bs than Anhui and Jiangsu, accounting for 66.03% of all B&Bs, which is more than twice the number of B&Bs in Anhui and Jiangsu. Where Zhoushan, Jiaxing and Hangzhou are the three cities with higher B&Bs proportion in Zhejiang Province 20.15%, 14.73%, and 13.95%, respectively.

Zhejiang Province has very rich tourism resources, so many well-known B&Bs clusters are aggregated in Zhejiang Province, such as: Hangzhou West Lake B&Bs cluster, Mogan Mountain B&Bs cluster, Wuzhen B&Bs cluster, etc. “Classification and Evaluation of Rural B&Bs Service Quality Level” released by Deqing County, Zhejiang Province demonstrates that Zhejiang government attaches great importance to the development of B&Bs industry, which can also explain the reason for the great number of B&Bs in Zhejiang. B&Bs number in Jiangsu and Anhui accounts for 19.49% and 6.60% of the total, respectively, which is significantly lower than that in Zhejiang Province. Anhui (eight cities) even has fewer
B&Bs than Shanghai. Where only Suzhou has relatively more B&Bs, accounting for 11.95% of the total, while the remaining cities have about 1% B&Bs. Therefore, while vigorously developing B&Bs industry in Zhejiang Province, the government should also focus on B&Bs development in Jiangsu and Anhui Provinces.

Distribution structure of B&Bs opening time

On 31 December 2014, “Opinions on Pilot Work of Rural Land Acquisition, Collective Business Construction Land Marketization and Homestead System Reform” was issued (The General Office of the Communist Party of China Central Committee and the Office of the State Council, 2014). About 30 administrative districts in cities, counties are finally selected as pilot areas. This marks the country’s first step in developing land policies for B&Bs. Subsequently, in 2015, the State Council officially promulgated the “Guiding Opinions of the General Office of the State Council on Accelerating the Development of Consumer-oriented Service Industries to Promote Consumption Structure Upgrading”, which has promoted the legalization of B&Bs. In addition, in terms of local government, Deqing County issued the “Classification and Evaluation of Rural B&Bs Service Quality Level” on 7 May 2015, and Hangzhou City issued “Guidelines for Further Optimizing Services to Promote Rural B&Bs Industry Standards” on 19 August 2015.

To investigate whether relevant laws and regulations issued by the government affects B&Bs development, this paper further classifies the collected B&Bs data according to opening time, and draws a map showing number of B&Bs classified by opening time in the Yangtze River Delta, as shown in Figure 2.

Moreover, GIS software is used for spatial display of B&Bs distribution points in the Yangtze River Delta region in 2013, 2015 and 2017 on the map, as shown in Figure 3.

As can be seen from Figures 2 and 3:

1. Due to the promulgation of laws and regulations by the governments and regions, the number of B&Bs in the Yangtze River Delta region increases continuously from 2014 to 2016, and the number of new B&Bs in the Yangtze River Delta region reaches the peak in 2015.
2. As a whole, from 2013 to 2017, B&Bs in the Yangtze River Delta region become denser, and the area with more B&Bs is also growing.
3. From a local perspective, in 2013, most B&Bs gather in Hangzhou, Huzhou, Jiaxing and Suzhou in the Yangtze River Delta region. Since 2013 to 2017, this area has been radiated to the surrounding area as the center, driving B&Bs development in the surrounding areas.
(such as Shaoxing, Shanghai, Ningbo, Changzhou, Wuxi, etc.).

(4) At the same time, it can be seen from the figure that B&Bs number in Zhenjiang and Yangzhou is quite small in 2013, but grows substantially in 2017. These sufficiently demonstrate that only with the support and encourage of national and local government policies can B&Bs industry enjoy impressive development prospects.

**Distribution structure of B&Bs room rate**

Since the B&Bs data are mainly referenced from Ctrip.com, this paper refers to Ctrip’s room rate segment classification when selecting the room rate segment. That is, B&Bs room rate is divided into six segments: below ¥150, ¥150–300, ¥300–500, ¥500–800, ¥800–1,500 and above ¥1,500. It is found after data classification and integration that B&Bs in the two room rate segments of below ¥150 and ¥150–300 account for 76% of the total, while high-end boutique B&Bs at room rate segments of ¥800–1,500 and above ¥1,500 only account for 9%. It indicates that B&Bs industry in the Yangtze River Delta region is mainly dominated by low-end B&Bs such as youth hostels and agritainment, while middle and high-end B&Bs have a much smaller proportion compared to low-end ones. GIS software is then further used for spatial display of B&Bs distribution points on the map of the Yangtze River Delta region based on room rate classification, as shown in Figure 4.

B&Bs with room rate above ¥1,500 mostly gather in Shanghai, a few of which are scattered in Hangzhou, Shaoxing, Ningbo and Nanjing in a manner matching with respective higher GDP. B&Bs with room rate below ¥150 are scattered throughout the Yangtze River Delta region, with its number far beyond that of B&Bs in other room rates, which indicates that it is urgent to develop boutique high-end B&Bs in the Yangtze River Delta region.

GIS was used to draw a contour map of room rates in the Yangtze River Delta region. Contour map is a smooth curve that connects points with equal phenomenon values. The depth and density of the displayed colors can more clearly reflect the laws in quantity change and regional differences. Figure 5 shows changes in the distribution of B&Bs room rates in the Yangtze River Delta based on this method.

The high-value clusters are distributed at Shanghai, Suzhou, Ningbo as well as the intersections of the three cities of Hangzhou, Shaoxing and Huzhou.
of economic data of the cities in the Yangtze River Delta reveals that these cities are economically developed regions. It suggests that more economically developed urban areas have higher B&Bs room rate. Compared with low-value clusters, high-value clusters cover a smaller area. As can be seen from the figure, low-value clusters still occupy most of the area.

In summary, higher-priced B&Bs are highly concentrated in the eastern region of the Yangtze River Delta region, with a few concentrated in the northwestern region. Taking it as the center, the distribution radiates to the surrounding areas with room rate gradually decreased. At the same time, B&Bs industry in low-value cluster areas demands government’s focused development in the future.

**B&Bs density distribution**

To study B&Bs density distribution in the Yangtze River Delta region, this paper takes B&Bs number per square kilometer as a standard. Using GIS software, map was plotted for B&Bs distribution density in the Yangtze River Delta region in 2013, 2015 and 2017, as shown in Figure 6.

It can be intuitively found from Figure 6 that:

1. In 2013, number of B&Bs per square kilometer is relatively small in the Yangtze River Delta region, mostly 0–0.5 B&Bs per square kilometer, and the area with the largest number of B&Bs merely have more than 1.5 B&Bs per square kilometer.
2. Number of B&Bs per square kilometer in the Yangtze River Delta area grows continuously from 2015 to 2017, with B&Bs covering almost half of the area of the Yangtze River Delta. Regions with the most B&Bs are similar to those in 2013, but the number per square kilometer grows from more than 1.5 in 2013 to more than 3 in 2015 and then to more than 4 in 2017.

Figure 5. Contour map of B&Bs room rate in the Yangtze River Delta region.

Figure 6. B&Bs density distribution in the Yangtze River Delta region in 2013, 2015 and 2017.
At the same time, from 2013 to 2017, number of B&Bs in the four major regions of the Yangtze River Delta gradually increases, and a table is obtained showing the number of B&Bs in the four major regions: Northeast, Northwest, Southeast, and Southwest regions, as shown in Table 2.

At the same time, B&Bs number is calculated for four major regions, and a table is obtained showing B&Bs number in the four major regions of the Yangtze River Delta in 2013, 2015 and 2017 (Table 3).

Combining Figure 6, Tables 2 and 3, it is not difficult to see that:

(1) B&Bs number in each region is increasing as a whole. Where B&Bs number is much higher in the southeast region than in the other three regions, which grows exponentially from 2013 to 2017. The same growth trend also occurs in southwestern region where B&Bs number grows from 371 in 2013 to 1,433 in 2017. Although B&Bs number in the Northeast and Southeast regions is relatively small compared to the other two regions, it is also on the rise.

(2) Recent years witness gradually increasing B&Bs number in the Yangtze River Delta. B&Bs number is higher in the Southeast and Southwest regions than in the Northwest and Northeast regions as a whole. In the future, B&Bs industry development in the Yangtze River Delta will need gradually extend from the Southeast region to the Northwest region.

(3) At the same time, from 2013 to 2017, number of areas with more B&Bs per square meter in the Yangtze River Delta region increases from 1 to 3. To draw a more intuitive conclusion, this paper divides the Yangtze River Delta region into four regions: Northeast, Northwest, Southeast and Southwest regions, as shown in Table 2.

As shown in Figure 7 and Table 4, the following related information can be seen:

(1) From 2013 to 2017, the ellipse area of B&Bs spatial distribution in the Yangtze River Delta region reaches its peak in 2015, and then shrinks slightly in 2017.

(2) The short axis becomes longer to some extent, while the long axis gradually becomes shorter.

(3) The ellipse direction angle does not change much, while space-intensive index grows.

### Trend of agglomeration and diffusion in B&Bs distribution

The growth direction of B&Bs industry in spatial layout in the Yangtze River Delta region can be analyzed by using two-dimensional spatial variables of the gravity center and standard deviation ellipse. The indicator of the gravity center characterizes metric space layout for analysis on the shifting trend and distance of the gravity center, so that it is possible to have an overall grasp of the direction and intensity of B&Bs layout in the Yangtze River Delta.

In the discipline of statistics, standard deviation refers to the difference between the observed value and the average value. Based on this reasoning, standard deviation can be used in space to measure the extent to which B&Bs distribution in the Yangtze River Delta region deviates from the gravity center. Based on comprehensive consideration of deviation degree in direction, standard deviation ellipse is taken for illustration: with the gravity center as the center of the ellipse, the rotation angle reflects the overall B&Bs distribution trend in the Yangtze River Delta, and the long axis reflects the degree of B&Bs deviation from the gravity center in the Yangtze River Delta. The short axis reflects the degree of B&Bs deviation from the gravity center in the Yangtze River Delta in the secondary direction.

Using GIS software, this paper obtains detailed spatial statistical results on the overall B&Bs growth in the Yangtze River Delta region (Table 4), and spatially displays changes the gravity center and standard deviation ellipse of B&Bs industry in the Yangtze River Delta region amid 2013–2017 (Figure 7).

As shown in Figure 7 and Table 4, the following related information can be seen:

(1) From 2013 to 2017, the ellipse area of B&Bs spatial distribution in the Yangtze River Delta region reaches its peak in 2015, and then shrinks slightly in 2017.

(2) The short axis becomes longer to some extent, while the long axis gradually becomes shorter.

(3) The ellipse direction angle does not change much, while space-intensive index grows.

### Table 2. The four major regions in the Yangtze River Delta by classification.

| Region        | City                                      |
|---------------|-------------------------------------------|
| Northeast     | Yancheng, Yangzhou, Taizhou, Nantong, Nanjing, Zhenjiang, Changzhou, Wuxi |
| Northwest     | Luzhou, Maanshan, Hefei, Wuhu, Tongling, Anqing, Chizhou, Xuancheng |
| Southeast     | Suzhou, Shanghai, Jiaxing, Ningbo, Zhoushan |
| Southwest     | Hangzhou, Shaoxing, Huzhou, Jinhua, Taizhou |

### Table 3. B&Bs number in the four major regions of the Yangtze River Delta in 2013, 2015 and 2017.

| Region       | Number in 2013 | Ratio in 2013 | Number in 2015 | Ratio in 2015 | Number in 2017 | Ratio in 2017 |
|--------------|----------------|---------------|----------------|---------------|----------------|---------------|
| Northeast    | 79             | 5.12%         | 238            | 6.94%         | 391            | 7.55%         |
| Northwest    | 110            | 7.12%         | 247            | 7.21%         | 342            | 6.60%         |
| Southeast    | 984            | 63.73%        | 2,014          | 58.77%        | 3,015          | 58.19%        |
| Southwest    | 371            | 24.03%        | 928            | 27.08%        | 1,433          | 27.66%        |
| Total        | 1,544          |               | 3,427          |               | 5,181          |               |

### Table 4. Spatial statistical results on the overall B&Bs growth in the Yangtze River Delta.

| Spatial statistical index | Year 2013 | Year 2015 | Year 2017 |
|--------------------------|-----------|-----------|-----------|
| Ellipse circumference (km) | 1,063.7   | 1,078.3   | 1,056.0   |
| Ellipse area (km²)       | 76,879.7  | 82,361.7  | 81,325.0  |
| Ellipse center point CenterX | 13,438,465.3 | 13,426,899.3 | 13,427,328.4 |
| Ellipse center point CenterY | 3,574,206.1 | 3,576,865.0 | 3,578,313.8 |
| x-axis length (km)       | 217.7     | 214.8     | 205.3     |
| y-axis length (km)       | 112.4     | 122.1     | 126.1     |
| Ellipse direction angle  | 100.3     | 99.0      | 100.2     |
This shows that the core B&Bs distribution area in the Yangtze River Delta area is expanding. On the whole, spatial distribution of B&Bs in the Yangtze River Delta area is dominated by diffusion effect. The core area extends to the southeast, and the overall space presents a balanced development structure. In recent years, the Chinese government focuses on investment in B&Bs in the Yangtze River Delta, which has led to a rapid growth in B&Bs size in the Yangtze River Delta.

Spatial autocorrelation analysis on B&Bs

Using GIS software, this paper makes global spatial autocorrelation and local spatial autocorrelation analysis on B&Bs spatial clustering characteristics in the Yangtze River Delta region. In terms of global spatial autocorrelation, Moran’s I spatial autocorrelation analysis was performed on 5,181 B&Bs data in the Yangtze River Delta region with its 26 cities in the three provinces and one city as the unit. Where Moran’s I index usually ranges from −1 to 1. A positive Moran’s I index indicates positive correlation of spatial objects, while a negative Moran’s I index indicates negative correlation of spatial objects. Z score represents times of the standard deviation; P value represents probability and reflects probability of occurrence. Table 5 shows the critical Z score and critical P value under different confidence levels.

The results of spatial autocorrelation analysis on B&Bs in the Yangtze River Delta are shown in Table 6. The analysis results are shown in Table 6. Moran’s I index of B&Bs in the Yangtze River Delta region passes the significance test for all the three time periods, all of which exceed 0 in a decreasing trend, with the figures at 0.706170, 0.701269 and 0.693326. It suggests that spatial distribution of B&Bs in the Yangtze River Delta region has positive spatial correlation, but the correlation between neighboring cities is weakening. In terms of Z score and P value, Z scores are above 2.58 for all the three time periods, and P values are all below 0.01, indicating that the model has a confidence of 99%.

In order to visually describe the spatial distribution pattern of B&Bs in the Yangtze River Delta region, local spatial autocorrelation was adopted to further analyze spatial correlation between the cities. Therefore, a LISA significance map on spatial distribution was drawn to demonstrate B&Bs cluster types in the Yangtze River Delta region, as shown in Figure 8.

From the analysis results of 3 years, it is found that the concentration degree of the eastern part of the B&Bs is significantly higher than the west in the Yangtze River Delta region, and it gradually shows a gradual decreasing pattern from the east to the west, forming a significant high concentration of eastern cities and a low
concentration of western cities. By comparing the results of the 3 years, Huzhou and Shanghai showed a significant high concentration from 2013 to 2015, and neighboring cities such as Suzhou, Jiaxing and Hangzhou have shown a high approaching trend, indicating that in recent years, the development awareness of the industry is converging. The Yangtze River Delta integrated development continued to make efforts to build a convenient transportation network, jointly create high-quality tourist routes, explore and build regional tourism service systems and industry standards, and jointly cultivate tourism talent to accelerate the development and agglomeration of the eastern region with good location conditions, developed economy and profound cultural heritage. Ma’anshan, Yangzhou and other cities in the western region have also changed from low-low agglomeration to high-low agglomeration, indicating that the development of B&Bs in these cities is also accelerating.

Analysis on factors influencing spatial distribution
Spatial distribution of B&Bs is the result of a combination of multiple influencing factors. Due to data limitations, this paper will investigate the factors influencing spatial distribution of B&Bs from four aspects: tourism resource endowment, transportation convenience, policy conditions and residents’ living standards (Liu, 2018).

Tourism resource endowment
Tourism resource endowment refers to all varieties of objective things in the tourist destinations that attract tourists, including resources such as tourist attractions and ecological landscapes. Richer tourist resources and ecological landscape resources will attract more tourists, driving the market demand for accommodation and catering. Therefore, tourism resource endowment is an important factor affecting B&Bs number in a region.

In terms of tourist attraction resources, the Yangtze River Delta area accounts for 3.8% of the country’s land. Its 5A-level, 4A-level and 3A-level scenic spots, respectively, account for 17.1%, 15.2% and 13.9% of the corresponding national scenic spots. It can be seen that Yangtze River Delta region has rich tourism resources. Figure 9 is given to intuitively display the relationship between B&Bs number and tourist attractions. Where cities with rich scenic spots above 3A level include Shanghai, Suzhou, Hangzhou, Huzhou, Jiaxing and Xuancheng. In addition, unique geographical location of Zhoushan enables its rich ecological landscape resources. These cities enjoy comparative edge in B&Bs number and distribution, indicating that tourism resource endowment has an important impact on B&Bs number.

Transportation convenience
Transportation convenience and accessibility is another major factor influencing location selection of B&Bs industry. With the deepening of integration
concept and the advancement in policy implementation in the Yangtze River Delta, the idea of integrated transportation development in the Yangtze River Delta region (that is, transportation integration) is proposed. At present, the integrated transportation network in the Yangtze River Delta has a total scale of about 51,500 km, with its density per unit area exceeding that of many developed cities such as the United States, Germany and France. The expressways have a total mileage of about 9,544 kilometers, with a density of about 4.4 km/100 km², exceeding that of some developed cities such as Germany and Japan. The high-speed railways have a unit area density of 1.6 km/100 km², exceeding that of some developed countries such as France, Germany, etc. (Geng et al., 2019). Therefore, seen from the perspective of integrated transportation network, expressways, high-speed railways, etc., transportation convenience in the Yangtze River Delta is comparable to that of some developed countries, that is, Yangtze River Delta region enjoys high transportation convenience.

The core of B&Bs industry lies in people. Whether it is tourist lodgers or B&Bs operators, B&Bs development is inseparable from people, while the level of transportation convenience will directly affect the volume of passengers in and out of the destination. Linking B&Bs number in the Yangtze River Delta region with its passenger volume. Zhejiang Province with a high passenger volume has a good lead in B&Bs number, while Anhui Province with a small passenger volume has fewer B&Bs. Transportation convenience level has a great impact on B&Bs number, that is, more developed places with better transportation convenience have more B&Bs.

Policy conditions

With the continuous development of B&Bs industry, the national and local governments then issue related policies favorable to B&Bs industry. This paper briefly summarizes the state’s supportive policies for B&Bs and supportive policies for B&Bs in Zhejiang, Anhui, Jiangsu and Shanghai governments. So far, the state has issued a total of nine supportive policies, while the Yangtze River Delta region governments have issued a total of seven favorable policies (Tourism Research Center, Chinese Academy of Social Sciences, 2017; Zhejiang Tourism Administration, 2018). The earliest policy was issued in December 2014. Regardless of national or local government supportive policies, the release is relatively concentrated in the 2015–2016 periods. Comparison of Figure 1 (distribution of B&Bs opened before the end of 2017 in the Yangtze River Delta) and Figure 2 (number of B&Bs classified by opening time in the Yangtze River Delta) reveals that: in the 2015–2016 periods when the government intensively introduce relevant favorable and supportive policies, B&Bs in the Yangtze River Delta region demonstrate the highest growth in the past 5 years. At the same time, local governments in Zhejiang and Shanghai have issued more policies than Jiangsu and Anhui provinces, and the former two have a quantitative advantage in B&Bs development, which indicates that policy conditions also have an important impact on B&Bs development layout in the Yangtze River Delta.

Residents’ living standards

Higher living standards of residents in a region means residents in the region have greater consumption potential or potential travel rate. For residents of the Yangtze River Delta who have lived in the city for a long time, suburbs and characteristic attractions around the city are their preferred destination for short-distance leisure travel, which will in turn affect B&Bs demand and distribution in the Yangtze River Delta. Therefore, disposable income of residents in the Yangtze River Delta is taken to measure the residents’ living standards. SPSS software was used to analyze the correlation between B&Bs number in the Yangtze River Delta and living standards of the residents here in 2017, finding that the correlation coefficient between the two was 0.403, which indicates a high correlation between B&Bs number in the Yangtze River Delta and living standards of residents in the area. Figure 10 shows the relationship between B&Bs number and disposable income in the Yangtze River Delta. It is found that cities with higher disposable income (such as Shanghai, Suzhou, Hangzhou, Jiaxing, Zoushan, Xuancheng, etc.) also have a comparative advantage in B&Bs distribution. In addition, for Zoushan and Jiaxing with a large number of B&Bs but low disposable income, residents in the surrounding cities (such as Shanghai, Ningbo, Shaoxing, etc.) have higher disposable income and would like to travel in neighboring cities like Zoushan and Jiaxing, leading to an increase in B&Bs number in Zoushan and Jiaxing. Hence, residents’ living standards in the Yangtze River Delta region have an important impact on its B&Bs development layout.

Conclusion

This paper studies B&Bs spatial distribution characteristics and evolution trajectory in the Yangtze River Delta region based on ESDA and GIS. The following conclusions are drawn:

B&Bs in the Yangtze River Delta region are mainly concentrated in municipalities directly under the Central Government and provincial capitals. Showing a clear agglomeration effect in spatial
distribution, B&Bs tend to gather in the middle and disperse on both sides. Driven by B&Bs policies, B&Bs become denser from 2013 to 2017, gradually extending from southeast region to northwest region in the Yangtze River Delta. Areas with abundant B&Bs are also expanding, but the distribution pattern remains basically the same: B&Bs tend to radiate to the surrounding areas with Hangzhou, Huzhou, Jiaxing and Suzhou as the center, driving B&Bs development in surrounding cities such as Shaoxing, Ningbo, Changzhou and Wuxi.

There are fewer high-value clusters in the Yangtze River Delta region in terms of B&Bs room rate, while low-value clusters occupy most of the area. That is, number of B&Bs with lower room rate far exceeds that with higher room rate in the Yangtze River Delta region. B&Bs with higher room rate are highly concentrated in the eastern region of the Yangtze River Delta, with few concentrated in the northwestern region. Radiating to the surrounding areas with the two as the center and exhibiting gradually decreased room rate, B&Bs in more economically developed cities and regions have higher room rate.

B&Bs spatial distribution in the Yangtze River Delta area is dominated by diffusion effect. From 2013 to 2017, the gravity center in B&Bs spatial distribution tends to shift to the southeast. Due to the rapid expansion of B&Bs scale in the Yangtze River Delta, B&Bs spatial distribution has shown balanced development trend of extending to the southeast.

From spatial autocorrelation analysis, it is concluded that B&Bs spatial distribution in the Yangtze River Delta has a positive correlation. From the perspective of local spatial autocorrelation analysis, it shows a gradual decreasing pattern from the east to the west, forming a significant high concentration of eastern cities and a low concentration of western cities. By comparing the results of the 3 years, Huzhou and Shanghai showed a significant high concentration from 2013 to 2015, and neighboring cities such as Suzhou, Jiaxing and Hangzhou have shown a high approaching trend.

B&Bs development layout in the Yangtze River Delta is affected by factors such as tourism resource endowment, transportation convenience, policy conditions and residents’ living standards. More popular tourist attractions, higher accessibility and convenience of transportation and higher residents’ living standard in a certain area of the Yangtze River Delta will lead to B&Bs aggregation, that is, a bigger B&Bs number. In addition, good supportive policy is also an important factor affecting B&Bs development layout in the Yangtze River Delta.

With the rapid development of tourism, B&Bs will gradually demonstrate tourism function, further highlighting the relationship between B&Bs and tourism. This study makes exploratory investigation on B&Bs spatial distribution in the Yangtze River Delta and its influencing factors from a geospatial perspective, which enriches B&Bs research contents to a certain extent, and means certain reference value for B&Bs development and spatial decision making. In the next research, we need to carry out in-depth research on B&Bs dynamic changes and its influence mechanism.

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