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Spatial Distribution and Agglomeration Characteristics of Catering Service Industry based on POI Data Taking Suzhou City as an Example

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Abstract

This paper studies the overall spatial distribution and agglomeration of catering service enterprises in Suzhou at the scale of townships and streets, based on the data of catering service enterprises in Suzhou, using spatial measurement methods such as kernel density estimation method, average nearest neighbor index and hot spot analysis. The results show that the catering service industry in Suzhou presents an obvious spatial distribution characteristic of "center-periphery", which is concentrated in Gusu District and spreads to the surrounding areas in terms of geographical location. The catering service industry in Suzhou presents the agglomeration characteristics of "regional agglomeration and type clustering" in terms of spatial units.

Keywords

Catering Service Industry; Spatial Distribution; Agglomeration Characteristics.

1. Introduction

The development of the catering service industry reflects the regional economy to a certain extent and represents the comprehensive influence of the region. With the continuous improvement of the level of social and economic development, people's demand for diversified catering has increased significantly. Mastering the spatial distribution of the catering service industry plays an important role in urban planning and the establishment of catering facilities.

For the data acquisition methods of the catering service industry, from the initial questionnaire [1], business statistics [2] to online reviews [3] and so on. POI data can reduce the problems of small data samples and poor timeliness. In recent years, it has been used by scholars in the study of the spatial distribution of urban catering services. For example, Shan Xin et al. (2019) found that the catering industry in the urban area of Kunming formed a multi-center spatial distribution pattern based on a street-scale study, and there was a huge gap in the development of the catering industry between the new and old urban areas [4]. Zhang Ying et al. (2019) based on The street scale identifies the spatial distribution of the catering industry in the main urban area of Wuhan, and further finds that the distribution of the catering industry is well coupled with the dynamic population [5]. Tang Jinyue et al. Through the investigation, it is found that the Shanghai catering industry presents the characteristics of multi-center development and massive agglomeration, and further identifies the influencing factors of the distribution of the catering industry [6].

The use of POI data provides a favorable opportunity to further investigate the spatial distribution and agglomeration characteristics of the catering service industry. Therefore, this paper uses the POI data of Suzhou catering service industry obtained from AutoNavi Map, uses ArcGis10.6 to convert the location of enterprises into spatial point files, and uses spatial measurement methods such as kernel density analysis, average nearest neighbor index and hot spot analysis. The spatial distribution and agglomeration characteristics of the catering service

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industry in Suzhou are analyzed, which enriches the research on the spatial distribution pattern of the catering service industry in Suzhou, and also provides some help for the rational development of the catering service industry.

2. Research Content and Methods

2.1. Overview of the Study Area

As a central city in the Yangtze River Delta city group, Suzhou City enjoys an advantageous geographical location and a strong economic development trend. In this paper, the study area is selected as the urban area of Suzhou City. Suzhou urban area covers an area of 4482.62km^2, including five urban areas: Xiangcheng District, Wuzhong District, Wujiang District, Gusu District and Huqiu District.

2.2. Data Sources and Processing

Based on AutoNavi map software, use phython to crawl the POI data of Suzhou catering service industry in 2021, including company name, address, type, business status, catering category, longitude and latitude, etc., and use ArcGis10.6 software to pick up the geographic coordinates of the company, and finally get 46,119 spatial point data files. In order to accurately analyze the spatial distribution of enterprise locations, this paper takes townships, towns and streets as the research units. Among them, there are 24 towns and 37 streets in Suzhou urban area, as well as Suzhou High-speed Railway New City, Yangcheng Lake Ecological Leisure Tourism Resort, Development Zone, Qionglong Mountain Scenic area, Oriental Silk Market, Wujiang Economic and Technological Development Zone, Suzhou High-tech Entrepreneurship Service Center, Suzhou Science and Technology City, High-tech Zone Hushuguan Development Zone and Suzhou High-tech Zone Comprehensive Bonded Zone.

Table 1. Classification of catering service industry

Category	Number of companies
Hotel	54
Food service industry related establishments	9996
Tea house	491
Bakery	1316
Cafe	986
Fast food shop	6131
Cold drink shop	1791
Dessert shop	373
Foreign food	1135
Chinese restaurant	23845

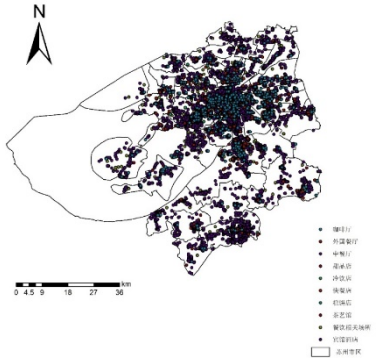

Figure 1. Distribution map of catering service enterprises in Suzhou in 2021

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10 categories, including hotels, catering-related establishments, tea art halls, bakeries, coffee shops, fast food restaurants, cold drink shops, dessert shops, foreign catering, casual catering establishments, and Chinese restaurants. In 2021, theclassification and quantity of the catering service industry in Suzhou See Table 1, and the distribution of catering service enterprises in Suzhou is shown in Figure 1.

2.3. Research Methods

2.3.1. Spatial Distribution Measurement of Catering Service Industry

(1) Kernel density estimation. The use of kernel density estimation can intuitively reveal the spatial distribution of the catering service industry in Suzhou. Its calculation formula is:

$$f_h(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x-x_i}{h}\right) \quad (1)$$

In the formula, f(x) is the kernel density calculation function of the spatial position x, $K\left(\frac{x-x_i}{h}\right)$ is the kernel function, h is a smoothing parameter called bandwidth, n is the number of feature points whose distance from the position x is less than or equal to h, $(x-x_i)$ represents the distance from the estimated point to the feature point [7].

(2) Average nearest neighbor. Using the average nearest neighbor index can reveal the level of agglomeration of various food service industries. Where, the formula for average nearest neighbor is:

$$NNI = \frac{\overline{D_0}}{\overline{D_e}} \quad (2)$$

$$\overline{D}_e = \frac{0.5}{\sqrt{n/_A}} \quad (3)$$

Among them, NNI is the nearest neighbor index, $\overline{D_0}$ and $\overline{D_e}$ are the nearest neighbor distance average and expected average value of the spatial point elements of the catering industry enterprises in Suzhou, respectively, n is the number of enterprises, and A is the area of the study area.

The significance judgment of the average nearest neighbor is usually the Z test, and its formula is:

$$Z = \frac{\overline{D_0}-\overline{D_e}}{SE(\overline{D_e})} \quad (4)$$

$$SE(\overline{D_e}) = \frac{0.26136}{\sqrt{n^2/_A}} \quad (5)$$

Among them, $SE(\overline{D_e})$ represents the error term of the expected distance, and the larger the Z, the better the saliency.

(3) Hot spot analysis method. The hot-spot analysis method can intuitively reveal the spatial agglomeration area of catering enterprises. Its calculation formula is as follows:

$$G_i^*(d) = \frac{\sum_{j=1}^{n} w_{ij}(d)x_j}{\sum_{j=1}^{n} x_j} \quad (6)$$

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$G_i^*(d)$ is the hotspot analysis value, d is the distance, w_{ij} is the spatial weight matrix, and n is the number of research units. Standardize Equation (6) to get:

$$Z[G_i^*(d)] = \frac{G_i^*(d) - E[G_i^*(d)]}{\sqrt{Var[G_i^*(d)]}} \quad (7)$$

Among them, $Z[G_i^*(d)]$, $E[G_i^*(d)]$ and $E[G_i^*(d)$ are the standardized hot spot analysis value, mean and variance, respectively.

3. Spatial Distribution of Catering Service Industry in Suzhou Urban Area

Based on the street level, the distribution of catering service industry in Suzhou is investigated. Using the nuclear density analysis method, the results obtained are shown in Figure 2. It can be seen from Figure 2 that the catering service industry in Suzhou generally presents the spatial distribution characteristics of "center-periphery". In 2021, Suzhou catering service enterprises will mainly be concentrated in Gusu District, Huqiu District and Xiangcheng District. The area with the highest concentration is Gusu District, which is located in Lingering Garden Street, Shuangta Street, Taohuawu Street, Wumen Bridge Street, Shilu Street, Guanqian Street, Baiyangwan Street, Chengbei Street, Xujiang Street, Sujin Street, Fumen Street, Huqiu Street, Pingjiang Street, Canglang Street, Loumen Street and Jinchang Street, etc. 16 area. The reason is that Gusu District has a large number of tourist attractions, such as Suzhou Garden, Humble Administrator's Garden, Lingering Garden, Hanshan Temple, etc., which attract a large number of tourists and also open catering service stores; there are 2, 3 and 2 in this area. The passage of Metro Line 5 has led to a large flow of people in the area and a greater demand for catering services. At the same time, the area has business districts such as Huqiu, Baiyangwan, Youxin, and Nanmen, attracting a large number of young people to come here for leisure consumption. Followed by Fengqiao Street, Hengtang Street and Shishan Street in Huqiu District and Guoxiang Street, Hengjing Street, Longxi Street and Suyuan Street in Wuzhong District. They are adjacent to the high agglomeration area of Gusu District. As a receiving area, they can attract many people to spend there. At the same time, Huqiu District and Wuzhong District have the Suzhou Industrial Park Jinji Lake Central Business District, Yushan Road, Fengqiao and Tongan respectively. As well as Changqiao, Yuexi, Mudu and Guoxiang business districts. Finally, Yuanhe Street and Huangqiao Street in Xiangcheng District and Guangfu Town in Wuzhong District also have obvious agglomeration phenomenon.

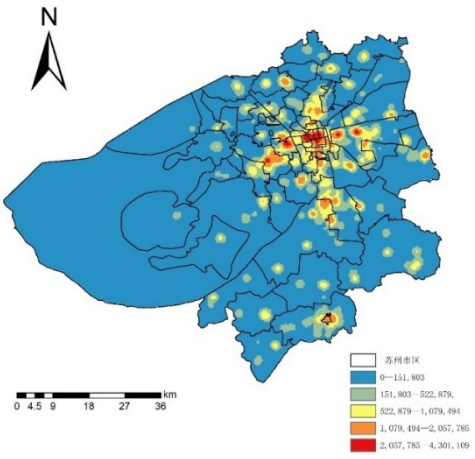

Figure 2. The core density map of Suzhou's catering service industry in 2021

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4. The Spatial Evolution of the Catering Service Industry in Suzhou

4.1. Trend of Spatial Agglomeration Level of Various Industries

The average nearest neighbor index is used to measure the spatial agglomeration level of the catering service industry and its sub-industries in Suzhou. The analysis of the average nearest neighbors of the catering service industry in Suzhou (Table 2) shows that the NNI value of the catering service industry as a whole is 0.16, which has passed the significance test. The average observation distance and expected average distance are 25.73m and 159.99m respectively, indicating that Suzhou There is a significant level of agglomeration in the city's catering service industry. From the perspective of various industries, the NNI values of hotels, catering-related establishments, tea houses, pastry shops, coffee shops, fast food restaurants, cold drink shops, dessert shops, foreign catering, casual catering establishments, and Chinese restaurants are respectively 0.664, 0.220, 0.397, 0.258, 0.313, 0.213, 0.211, 0.442, 0.249 and 0.180, and all passed the significance test, which shows that each sub-industry also presents a state of agglomeration. However, the agglomeration intensity of different types of catering service industries is different. The agglomeration level of coffee shops, tea houses, dessert shops and hotels is higher than 0.3, and the agglomeration level is relatively high, while the agglomeration levels of other types of catering service industries are relatively low.

Table 2. Analysis of the average nearest neighbor results of the catering service industry in Suzhou

Category	Average observation distance/m	Expected average distance/m	NNI value	Z score	P value
Catering service	25.73	159.99	0.161	-344.758	<0.01
Hotel	2333.05	3512.67	0.664	-4.721	<0.01
Food service industry related establishments	73.81	336.23	0.220	-149.284	<0.01
Tea house	570.83	1436.95	0.397	-25.551	<0.01
Bakery	218.32	847.56	0.258	-51.523	<0.01
Cafe	315.24	1007.11	0.313	-41.269	<0.01
Fast food shop	88.30	413.82	0.213	-117.832	<0.01
cold drink shop	162.62	771.22	0.211	-63.890	<0.01
Dessert shop	660.81	1495.81	0.442	-20.625	<0.01
foreign food	207.37	834.46	0.249	-48.434	<0.01
Chinese restaurant	39.49	218.95	0.180	-242.127	<0.01

4.2. The Overall Agglomeration Status of the Catering Service Industry

Using the average nearest neighbor index, the NNI value of the catering service industry in Suzhou is calculated to be 0.161, and it has passed the significance test, indicating that the catering service industry enterprises are clustered in the spatial distribution. In order to further reveal the spatial agglomeration characteristics of the catering service industry, the hot-spot analysis method is used to identify the high and low value agglomeration centers with the streets as the research unit, and the Z value is divided into 5 grades by the natural breakpoint method, so as to obtain the catering service industry enterprises. See spatial agglomeration pattern for specific results (Fig. 3). The spatial agglomeration of the catering service industry in Suzhou presents the agglomeration characteristics of "regional agglomeration and type clustering" [8]. Among them, the hot spots are mainly concentrated in Wujiang Economic and Technological Development Zone, Shengpu Street, Yongzhi Town, Tongli Town, Taihu New Town, Hengjing Street and Pingwang Town. In addition, Weiting Street is also a hot spot; Distributed in Fengqiao Street, Shishan Street, Mudu Town, Baiyangwan Street, Huangqiao Street, Yuanhe Street and Dongzhu Town, the remaining streets are transition areas.

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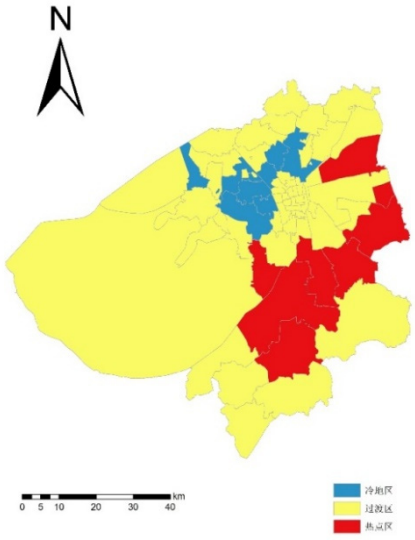

Figure 3. Analysis of hot and cold spots in the catering service industry in Suzhou

5. Conclusions and Suggestions

This paper uses the POI data of the catering service industry in Suzhou in 2021, takes the streets as the research unit, adopts the kernel density analysis, the average nearest zero and the hot spot analysis methods to investigate the spatial distribution and agglomeration characteristics of the catering service industry in Suzhou, and draws the following conclusions. (1) The catering service industry in Suzhou presents the distribution characteristics of "center-periphery". Catering enterprises are mainly concentrated in the city center, such as Taohuawu Street and Guanqian Street in Gusu District, and the sub-concentration area is around the city center, Shishan Street and Fengqiao Street in Huqiu District, etc., and the final concentration area is in the central street of each district. (2) The catering service industry in Suzhou has various types, but the spatial distribution is uneven and there is a certain degree of agglomeration. The average observation distance and predicted observation distance of each type of food service industry are different, which can reflect the uneven spatial distribution of the food service industry. (3) The regional agglomeration area of the catering service industry in Suzhou City has obvious differences in local space, showing the agglomeration characteristics of “regional agglomeration and type clustering”. Based on the research conclusions, the following countermeasures and suggestions are put forward:

(1) Give full play to the economic spillover effect of Suzhou as a tourist city. High-star scenic spots are more attractive to tourists, and a large number of tourists can serve as the source of customers for the catering service industry. The government should reasonably regulate the type and quantity distribution of the catering service industry around the scenic spot, so that the scenic spot and the catering service industry can be closely related in space. On the coupling, improve the tourist catering one-stop service industry for tourists, and improve the satisfaction of tourists. (2) Realize the balance of various catering service industries. Various types of catering services are distributed in agglomeration, and the development of east and west is uneven. In the future development process, the east and west should be actively linked to realize the coordinated development of the east and the west.

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