Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 9, No. 1, 2023

Big Data Leads the Construction of Commercial Center

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Abstract: Nowadays, with the rapid development of information technology, big data has been widely used to promote all aspects of social development. Using big data for business analysis is efficient, and can ensure the objectivity of information, and can provide effective suggestions for new business centers and assist business centers to accurately attract investment. The third phase project of Dongguan Citizen Service Center is under construction and is expected to be completed in April 2024. The project is located in the most prosperous area of Dongguan city center, aiming at creating a new benchmark for consumer humanities business in Dongguan. In this paper, by collecting all kinds of POI (Point of Interest) data in Dongguan, using arcgis10.8 to analyze the kernel density, five kinds of POI data heat maps are obtained, and finally, according to the heat maps, the analysis and conclusions are drawn, which provide suggestions for attracting investment in the commercial center under construction.

Keywords: POI data, Kernel density analysis, Commercial center.

1. Introduction

With the rapid development of information technology, people's daily life is inseparable from the application of big data, and the traditional business model has quietly changed under the background of big data. Big data is a new type of information technology. By using the characteristics and advantages of big data technology reasonably, it can improve the efficiency of data analysis, accurately reflect the laws of people's consumption demand and purchase behavior, ensure the objectivity of information, and have universality. At the same time, with the help of big data and science and technology, it can help new commercial centers to accurately attract investment, thus effectively improving the vitality of cities and promoting economic development.

At present, the third phase project of Dongguan Citizen Service Center is under construction. The project is aimed at domestic famous commercial pedestrian streets such as Taikoo Li, Chengdu and is expected to be completed in April 2024. With its excellent geographical location, the project will be rooted in culture, gather leading domestic consumption patterns such as tipsy economy, cross-border bookstores, Cantonese cuisine, flagship stores and trendy entertainment, and create a new benchmark for consumer humanities business in Dongguan with an open space.

POI, that is, point of Interest, in a geographic information system, a POI can be a shop, a school, a bus stop, etc. POI data has the advantages of large quantity, wide information coverage and low acquisition cost. Based on previous studies, it is found that POI data can be effectively used to identify urban functional areas. Therefore, based on POI data in Dongguan, this paper explores the clustering characteristics of various types of POI data in Dongguan by using kernel density analysis, thus providing effective suggestions for attracting investment in the third phase of Dongguan Citizen Service Center under construction, which has great practical significance.

2. Literature Review

In recent years, the research on business center identification based on POI data has gradually increased. Kernel density estimation and other methods can be used to study the location characteristics of business centers and business hotspots, and analyze the influencing factors of spatial distribution of various types of business formats. Behind the layout of commercial space is the difference of consumers' behavior and the similarity of functions between different commercial formats. The connection and difference between these commercial types jointly affect the layout of urban commercial space [1]. In addition, identifying the boundaries of commercial centers, respectively studying the distribution characteristics of different types of commercial centers, and summarizing the patterns of commercial spatial structure are of great reference for further understanding the functional spatial differentiation characteristics of commercial centers and guiding urban commercial spatial planning [2]. Previous studies have far-reaching significance for the construction of different types of commercial centers, and can provide some reference for urban planning. However, there is still a lack of in-depth analysis of commercial influencing factors, which requires in-depth study of the mechanism of commercial spatial layout, and the empirical analysis of commercial centers is mostly based on other cities, and there are few related studies on Dongguan commercial centers.

However, the research on Dongguan using POI data mostly focuses on the identification of urban spatial structure and urban functional space. Research shows that POI-based data can effectively reflect the urban spatial characteristics. POI data is a kind of point data with accurate positioning function, but it can't accurately reflect the spatial distribution of areal geographical entities. Combined with the POI data of kernel density analysis, it weakens the error of reflecting areal geographical entities [3]. More, the functional space of a city can be quickly and effectively identified based on POI data. At the municipal level, the five types of urban functions all show strong central agglomeration characteristics in space. At the community level, the leading functions of each community are different, forming different urban functional areas. The urban function compound of the central city presents the spatial structure characteristics of "center-outer

periphery" Urban system is comprehensive and complex, and the data source is single, which is easily limited by many factors of POI samples. Therefore, it is necessary to expand the data source in the comprehensive analysis of urban production and living space [4]. Previous studies focused on the identification of urban functional space in Dongguan, and some other cities were taken as research objects to make empirical analysis of commercial centers, which provided a theoretical basis for this paper to effectively and rationally use POI data to provide suggestions for attracting investment in commercial centers under construction. However, there is little research on this commercial center, so it is of great practical significance to effectively analyze the consumer demand of this commercial center and improve the investment efficiency by obtaining the clustering characteristics of various types of data in Dongguan.

3. Method

3.1. Research area and research data

The research area of this paper is the whole city of Dongguan, which has four streets and 28 towns, with a total area of 2,542.67 square kilometers, ranging from 113 31 ′-114 15 ′ east longitude to 22 39 ′-23 09 ′ north latitude.

After collecting POI data, removing duplicates and classifying the data, and filtering out the data irrelevant to the commercial center under construction, a total of 346411pieces of data were obtained. Each piece of data includes name, category and latitude and longitude. Table 1 divides the finally applicable POI data into five categories, and counts the number of POI data in each category.

Table 1. The category classification of POI data

Main category	Amount
Shopping and consumption	180241
Transportation facilities	30111
Hotel and accommodation	22318
Medical care	17598
Catering gourmet	96173

3.2. Research method

Kernel density analysis refers to the use of kernel function to calculate the value per unit area according to the point or polyline elements, so as to fit each point or polyline into a smooth conical surface. The input is point data and the output is raster data.

Kernel density analysis method is based on the law of distance attenuation, and estimates the distribution of spatial point elements with the help of a regular moving quadrat, reflecting the relative concentration of POI data points in spatial distribution. Kernel density analysis can macroscopically check the characteristics of data distribution, explore urban hotspot data gathering areas.

The formula of kernel density estimation

$$f(s) = \frac{1}{nr^2}\sum_{i=1}^{n} k(\frac{d_i}{r})$$

Where f(s) is the kernel density calculation function at s, k is a kernel function given in advance, r is the bandwidth, that is, the search radius centered on s, $d_i$is the distance between s and the i-th observation point within the search range, n is the number of POI points within the search range.

Use arcgis10.8 to analyze the kernel density, add xy data, set the latitude as y field and the longitude as x field, and then use the spatial analyst tool in ArcToolbox to analyze the kernel density by taking each main data as a point element. After analyzing the image, all zero values are excluded, and the data are divided into nine categories by using the natural discontinuous point classification method. Finally, clear color bands are selected to get an intuitive heat map.

4. Result and Discussion

Through the analysis, five main categories of heat maps are finally obtained, and a conclusion is drawn through the comprehensive analysis of each heat map, and further suggestions are put forward according to the conclusion.

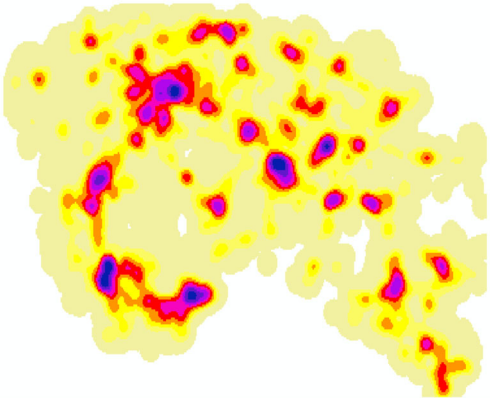

Figure 1. Shopping and consumption

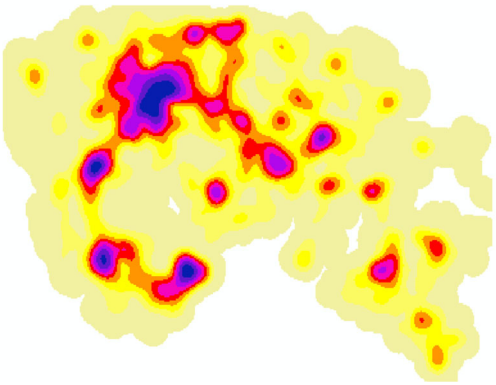

Figure 2. Transportation facilities

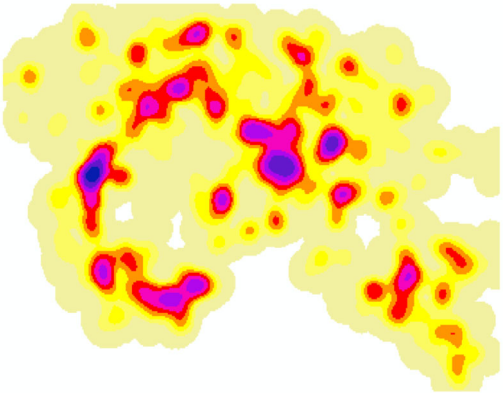

Figure 3. Hotel and accommodation

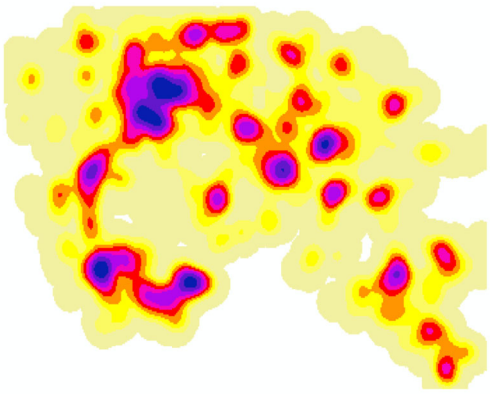

Figure 4. Medical care

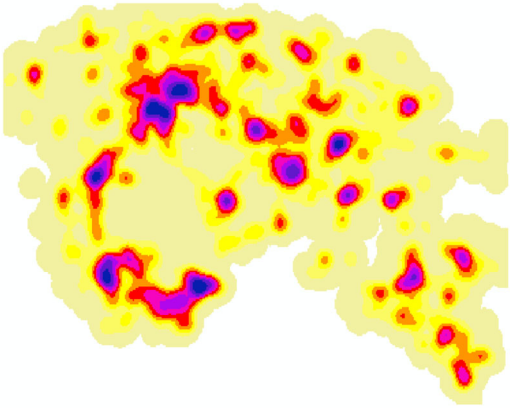

Figure 5. Catering gourmet

Kernel density estimation can be understood as that in a certain spatial range, an event can occur anywhere, but the probability of occurrence in different geographical locations is different. If there are many events in a certain area, it is considered that the frequency of this event is high, and vice versa. The closer the distance, the closer the relationship between things, and the greater the density expansion value obtained by the position closer to the core elements. If every incident is regarded as a core element, the correlation between the core elements will be stronger in areas with more incidents. Therefore, the probability density distribution can be clearly displayed on the heat map through kernel density estimation. The darker the color of the heat map, the higher the value, and the more POI points distributed here.

Generally speaking, except for the low kernel density of hotel and accommodation in Figure 3, the other four main categories have high kernel density values in Dongcheng Street, Nancheng Street and Guancheng Street, that is, the main urban areas of Dongguan. In addition, the kernel density values of Humen Town, Chang 'an Town, Songshan Lake High-tech Zone and the neighboring areas of Shenzhen, Huizhou and Guangzhou are also relatively high.

As Humen Town, which is close to Guangzhou and along the Pearl River and backed by the main urban areas of Dongguan, is the only regional comprehensive transportation hub in Dongguan, which integrates high-speed railway, intercity rail, subway, expressway and Guangdong-Hong Kong route, the commodity economy, especially port trade, is very developed, so Humen's various categories are as developed as the main urban areas. On the other hand, the kernel density in the non-main areas of Dongguan is relatively low in Figure 1 and 5, so we can confirm that the commodity economy along the river is more developed. As the third phase of the Citizen Service Center is located at the junction of Nancheng Street and Dongcheng Street in the center of Dongguan, it is an efficient and high-quality choice to cooperate closely with Humen Town and combine Humen's unique geographical advantages with convenient transportation to transport goods to the newly-built commercial center more efficiently and turn them into economic advantages.

Similarly, nowadays, the high-tech in Songshan Lake area is developing rapidly, and from Figure 1 to 5 we can see that the kernel density values of all major categories are at a high level. Huawei has established a Huawei town in Songshan Lake area through a large amount of investment for research and development, therefore, commercial center can cooperate with High-tech Zone, which is developing rapidly. And first Songshan Lake High-tech Zone can develop cutting-edge scientific and technological products, and later a science and technology area will be set up in the newly-built commercial center, which will not only introduce the latest scientific and technological product research results from the High-tech Zone to the public, but also build a sales industrial chain and sell various scientific and technological products. As the commodity economy in the city center has been developed, highly homogeneous products can't attract more people's attention. Only by innovative thinking and establishing new sales methods can the commercial center have a unique attraction and at the same time help the high-tech zone to develop to a high quality level through public feedback.

From the aspect of transportation facilities, from Figure 2 we can see the kernel density in the main urban areas is significantly higher than that in other areas, and it has the characteristics of diverging from the urban areas to the surrounding areas and continuously decreasing. Obviously, there are more public transportation and private vehicles in the main urban areas. It is worth mentioning that there are not only many bus stops but also a subway station near the commercial circle of the third phase of the Citizen Service Center, so it is very convenient for citizens to use public transportation to go to the commercial center. However, due to the increasing number of private vehicles and the fact that the commercial center is located in the center of Dongguan, congestion will be inevitable. How to build the most parking spaces in a limited area is a problem that needs to be solved. Perhaps making a three-dimensional parking lot will help solve the parking problem to some extent. Moreover, the commercial center can try to visually identify and guide passing private vehicles and vehicles that need to enter the commercial center, effectively divert vehicles, and select multiple entrances and exits that have little impact on traffic, so as to provide convenience for citizens, minimize the traffic pressure in the city center, and be conducive to commercial development.

As for medical care, the main urban areas includes many large hospitals, and now people pay more attention to their own health, so many private medical institutions have begun to grow and develop, which are the reasons for the high kernel density in the main urban areas in Figure 4. The joining of medical institutions can make the business center more diversified and meet the needs of the public. Medical institutions can cooperate with the surrounding communities and commercial centers to provide free physical examinations and other projects for citizens while ensuring their own profit

margins, which can not only indirectly create more profit margins for themselves, but also enhance their reputation and attract more citizens, which is also conducive to the development of commercial centers.

5. Conclusion

In the future research, we can try to continue to subdivide the categories of POI data, and each main category can contain multiple sub-categories to obtain more specific results. At the same time, more other methods can be used to analyze the commercial center under construction, so as to reduce the error, and the results obtained by various analysis methods can be compared, so as to provide more accurate suggestions. However, all in all, with the development of data processing technology and the emergence of various types of urban geographic information big data, the heat map is obtained through kernel density analysis, and on this basis, suggestions are provided for the new commercial center, which provides more possible research ideas for the next step of accurate investment promotion in cities and detailed development of commercial centers.

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