

# Research on Spatial Structure Evolution of A-Grade Scenic Spots in Jinan Based on GIS

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**Abstract.** This paper takes Jinan A-Grade scenic spots as the research object, uses the Baidu map to pick up the latitude and longitude coordinates of A-Grade scenic spots in Jinan in 2016, 2018, 2020 and 2022, uses ArcGIS software to study the spatial distribution of Jinan A-Grade scenic spots. Most of them are distributed in the central urban circle, and the scenic spots are distributed in agglomeration, while the scenic spots in other surrounding counties are distributed discretely and in small numbers. From 2016 to 2022, the spatial distribution of scenic spots in Jinan shows that the distribution of scenic spots in Jinan is gradually spreading outward from the central area.

**Keywords:** Geographic information system, Jinan City, spatial distribution, traffic accessibility

## 1. Introduction

The spatial structure of tourist attractions refers to the agglomeration state formed in a certain space by influencing and interacting with different tourism economies within a certain range of tourist attractions, from which the relationship between different tourism activities can be reflected, and it is the projection of tourism activities in spatial distribution[1]. Studying the spatial structure of Jinan A-Grade scenic spots can guide and plan the future development of tourism in Jinan according to the research results, so that the tourism industry has greater development space, so the optimization of spatial structure is also an important content of tourism development research. In order to achieve the sustainable development of Jinan scenic spots, it is necessary to study the changing law of Jinan's spatial structure and put forward a spatial structure optimization plan, which is very necessary for the development of Jinan's tourism industry.

## 2. Study the regional overview

Jinan is the capital of Shandong Province and one of the country's five sub-provincial cities. Jinan City is located in the central and western part of Shandong Province, the latitude is  $36^{\circ} 02'N \sim 37^{\circ} 54'N$  longitude is  $116^{\circ} 21'E \sim 117^{\circ} 93'E$ , the south is close to Mount Tai, the north is across the Yellow River, there are mountains and waters, surrounded by Zibo City, Dezhou City, Binzhou City, Liaocheng City, Tai'an City in Shandong Province. Jinan covers a total area of about 10,244 square kilometers,

including 12 districts and counties, with a total population of about 10.87 million.

## 3. Data sources

The data of Jinan A-Grade scenic spots comes from Jinan Municipal Bureau of Culture and Tourism, and the relevant information of Jinan A-Grade scenic spots is obtained from the data of Jinan A-Grade scenic spots compiled by the unit. The data mainly includes the name and level information of Jinan scenic spots, and then searches for the corresponding A-Grade scenic spots through Baidu map, determines its latitude and longitude coordinates, makes the latitude and longitude coordinates of A-Grade scenic spots into a table, and then converts the coordinates into geographic coordinates, and then imports them into ArcGIS to obtain the point-like elements of Jinan A-Grade area.

## 4. Research methods

### 4.1 Nearest neighbor index

The nearest neighbor index of A-Grade scenic spots can well reflect the spatial distribution characteristics of A-Grade scenic spots, and the calculation method is the ratio of the actual nearest neighbor distance to the theoretical nearest distance (that is, the theoretical value of random distribution), and the formula is as follows[9]:

$$R = \frac{\bar{r}_1}{r_E} = 2\sqrt{D} \times \bar{r}_1$$

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In the formula, R is the nearest neighbor index,  $\bar{r}_1$  is the average of the distance  $r_1$  between the nearest neighbors,  $\bar{r}_E$  is the theoretical nearest neighbor distance, and D is the density of A-Grade attractions in Jinan.

### 4.2 Kernel density analysis

Kernel density analysis uses kernel functions to calculate the magnitude per unit area from point or polyline features to fit individual points or lines to a smooth tapered surface[10]. Here, kernel density analysis is to calculate the density distribution of Jinan scenic spots according to the value of A-Grade scenic spots in Jinan, so as to reflect the distribution of A-Grade scenic spot points in Jinan space. The kernel density analysis is calculated as follows:

$$\hat{\lambda}_h(s) = \sum_{i=1}^n \frac{3}{\pi h^4} \left[ 1 - \frac{(s-s_i)^2}{h^2} \right]^2$$

Table 1: Nearest proximity index and distribution type of scenic spots in different years in Jinan

time	Mean observed distance/m	Expected observation distance/m	Nearest neighbor ratio R / %	Z value	P value	Distribution type
2016	5777.3437	8905.6222	0.648792	-4.845892	0.000001	Agglomeration type
2018	4485.4954	7874.6072	0.569615	-7.410208	0	Agglomeration type
2020	4517.6852	7642.2666	0.591145	-7.253536	0	Agglomeration type
2022	4342.6837	7687.0897	0.564932	-7.673569	0	Agglomeration type

Overall, the distribution of A-Grade scenic spots in Jinan City from 2016 to 2022, the nearest neighbor ratio R has been less than 1, Z score is also less than the cluster cut-off value -2.58, and the significance level P value is less than 0.01. Therefore, the results show that the Jinan A-grade scenic spots have been clustered and distributed in Jinan. Separately, from 2016 to 2018, the nearest neighbor ratio R of Jinan A-Grade scenic spots decreased from 0.648792 to 0.569615, and the Z score also decreased from -4845892 to -7.410208, indicating that Jinan A-Grade scenic spots tend to be more concentrated in Jinan in the past two years. From 2018 to 2020, the nearest neighbor ratio R of A-Grade scenic spots in Jinan increased from 0.5696152 to 0.591145, and the Z score also increased from -7.410208 to -7.253536, indicating that Jinan A-Grade scenic spots tend to be concentrated to a smaller extent in the Jinan City area in the past two years. From 2020 to 2022, the nearest neighbor ratio R of Jinan A-Grade scenic spots decreased from 0.591145 to 0.564932, and the Z score also increased from -7253536 to -7.673569, indicating that Jinan A-Grade scenic spots tend to be more concentrated in Jinan in the past two years.

### 5.2 Scenic spot distribution density

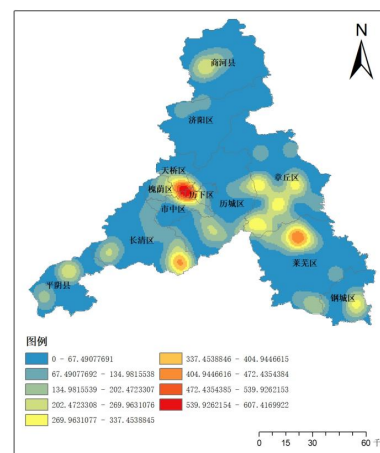
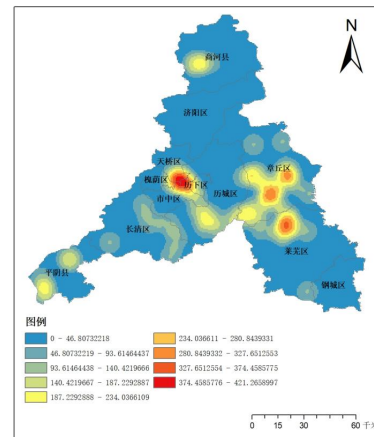
Using the kernel density analysis in the density analysis of the ArcGIS software toolbar, the kernel density analysis of the A-Grade scenic spot data in Jinan City in four time phases in 2016, 2018, 2020 and 2022 was analyzed, and the search radius was set to 0.1km and the natural fracture method was used for grading, and the result display figure is as follows:

In the above formula: S represents the A-grade scenic spot to be assessed in Jinan;  $s_i$  represents the scenic spot in Jinan City within a certain radius with S as the center of the circle; h indicates the specific location of the attraction within this radius.

## 5. Analysis of research results

### 5.1 Types of scenic spot distribution

From the analysis of the nearest neighbor index of A-Grade scenic spots in Jinan in 2016, 2018, 2020 and 2022, in order to compare the nearest neighbor values of different time phases more clearly, a table analysis was made, as shown in the following table.



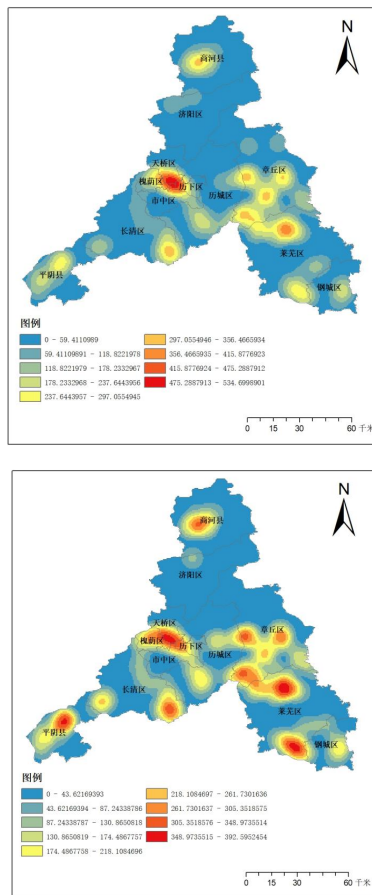


Fig. 1:Nuclear density analysis diagram of A-Grade scenic spots in Jinan.

According to the nuclear density analysis of A-Grade scenic spots in Jinan in four different years in 2016, 2018, 2020 and 2022, it is found that from 2016 to 2022, the density of A-Grade scenic spots in Jinan City shows a development pattern of "one circle and multiple points" aggregation and expansion. "One circle" refers to the central urban circle with the five districts of Lixia District, Tianqiao District, Huaiyin District, Shizhong District and Licheng District as the core, and from 2016 to 2022,as the color of "one circle"deepens, so does the scope. In addition to the "circle", Jinan A-Grade scenic spots also have gathering centers in other districts and counties, and as time goes by, the points of the gathering centers are increasing and the color is getting darker. The concentration of A-Grade scenic spots in Shanghe County, Gangcheng District, Laiwu District and Pingyin County is also getting higher and higher, and the dense centers of Zhangqiu District are increasing. By 2022, there will be a situation of "multi-point coexistence" in Jinan's A-Grade scenic spots, which is also the result of the continuous expansion of the gathering of A-Grade scenic spots in Jinan.

## 6. Conclusions

The study of the spatial distribution of scenic spots in Jinan City mainly compares the spatial distribution of four scenic spots with different time sections in 2016, 2018, 2020 and 2022, and obtains the change law of scenic spots.

From the nearest neighbor index, the distribution of scenic spots in Jinan City has been showing a cluster-type distribution in this research section, Jinan City A between 2016 and 2022, the nearest neighbor ratio showed a change of first decrease, then rise and then decrease, and there was no obvious law on the change of the distribution type of A-Grade scenic spots. From the perspective of nuclear density analysis, according to the nuclear density analysis of scenic spots in Jinan in four different years, it is found that from 2016 to 2022, the density of A-Grade scenic spots in Jinan City shows a development pattern of "one circle and multiple points" aggregation and expansion. "One circle" refers to the central urban circle with the five districts of Lixia District, Tianqiao District, Huaiyin District, Shizhong District and Licheng District as the core, and from 2016 to 2022, the color of "One Circle" is deepening and the scope is expanding. In addition to the "circle", Jinan A-Grade scenic spots also have gathering centers in other districts and counties, and as time goes by, there are more and more points and darker colors. The concentration of A-Grade scenic spots in Shanghe County, Gangcheng District, Laiwu District and Pingyin County is also getting higher and higher, and the dense centers of Zhangqiu District are increasing. By 2022, there will be a situation of "multi-point coexistence" in Jinan's A-Grade scenic spots, which is also the result of the continuous expansion of the gathering of A-Grade scenic spots in Jinan.

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