Optimization of Spatial Structure of Tourist Attractions in Binzhou City under the Background of Regional Tourism

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Abstract Using the GIS spatial analysis tool, the spatial distribution situation and spatial network structure of 56 tourist attractions graded AAA and above in Binzhou City were studied through the nearest distance, connectivity, accessibility, and compactness analysis. In view of the existing problems, some measures to optimize the spatial structure of the tourist attractions in Binizhou were put forward to ensure the development of regional tourism in Binzhou City. The results show that the spatial distribution of tourist attractions graded AAA and above in Binizhou City is uniform. The β index and γ index are respectively 1.36 and 0.47, and the average accessibility is 45.26 km. Binzhou has a weak tourism traffic connection and the accessibility is not high. The compactness index C of the tourist attractions is 0.74, and the compactness degree of the tourist attractions in Binizhou is above the average.

Key words Tourist attraction; Structure analysis; Spatial optimization; Binzhou City

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Tourist attractions are one of the core elements of local tourism development, an important source of tourism development, and an indispensable part of a regional tourism system. Tourist attractions mainly refer to the spatial areas where tourism and related activities are carried out in a region, and they are the main carrier of tourism supply[1]. In order to better guide the construction of national attractions, the National Tourism Administration issued the *Methods for the Assessment and Management of Quality Grades of Tourist Attractions* in 2005. Tourist attractions are mainly divided into five grades according to their development quality, including grades A, AA, AAA, AAAA, and AAAAA. The tourist attractions graded above AAA play an important role in the development of regional tourism, and reflect the prosperity degree and level of regional tourism market to some extent[2]. Therefore, under the background of global tourism development, optimizing and analyzing the spatial distribution structure of tourist attractions graded above AAA plays a positive driving role in grasping the basic conditions and development trends of regional tourism development and rationalization of tourism space structure, and promoting the implementation of regional tourism development concept.

The spatial structure of tourist attractions mainly refers to the spatial connection formed by the interaction of tourist attractions at various levels, and is a hot spot in the research of tourism geography. Since 2003, domestic scholars have analyzed the distribution characteristics and formation mechanism of spatial structure of grade A attractions mainly on the national scale, regional scale and provincial scale, and considered the spatial distribution of grade A attractions is closely related to regional economic development level, source market, population distribution, and transportation convenience[3-6]. In summary, there are relatively few studies on the spatial structure of grade A tourist attractions in cities and counties based on the global tourism background at present. In this paper, based on the macro-background of regional tourism development, under the premise of creating a national regional tourism demonstration zone in Binzhou City, the spatial distribution characteristics of tourist attractions graded AAA and above in Binzhou City will be analyzed to provide a scientific basis for the optimization of the spatial structure of tourist attractions in Binzhou City and then determine a reasonable spatial structure for the development of regional tourism in Binzhou City.

1 Data and methods

1.1 Overview of the study area Binzhou City is located in the north of Shandong Province, the hinterland of the Yellow River Delta, and the southwestern coast of the Bohai Bay. It is the regional core city in the high-efficiency ecological economic zone of the Yellow River Delta. At present, Binzhou City has jurisdiction over 10 regions, including Bincheng District, Zhanhua District, Economic and Technological Development Zone, High-tech Industrial Development Zone, Beihai New District, Wudi County, Yangxin County, Huimin County, Boxing County and Zouping City. The total area is 9 600 km^2. As of January 1, 2019, there were 56 tourist attractions graded AAA and above in Binzhou, including 47 grade AAA tourist attractions and 9 grade AAAA tourist attractions (Table 1).

1.2 Data source and processing

1.2.1 Data source. In this paper, the tourist attractions gra-

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ded AAA and above in Binzhou City were studied. The number of tourist attractions graded AAA and above in Binzhou City and their distribution in various regions were obtained mainly from Binzhou Culture and Tourism Consulting Network (http://www.bzlyzxw.com/), and the actual nearest distance and its coordinates of various grades of tourist attractions were calculated by the Shandong map world software. Afterwards, the database of grade AAA attractions in Binzhou City was established by GIS software to facilitate the check and screening of the relevant data, and the spatial analysis function of GIS software was used to calculate relevant indicators.

Table 1 Spatial distribution of tourist attractions graded AAA and above in Binzhou City

Region	AAAA	AAA	Total number	Proportion %
Bincheng District	1	8	9	16
Zhanhua District	1	5	6	11
Economic and Technological Development Zone	1	3	4	7
High-tech Industrial Development Zone	0	2	2	4
Beihai New District	0	1	1	2
Wudi County	2	8	10	18
Yangxin County	0	4	4	7
Huimin County	2	7	9	16
Boxing County	1	3	4	7
Zouping City	1	6	7	13

1.2.2 Data processing. At first, GIS software was used to conduct vectorization treatment of the administrative map of Binzhou City and then establish the digital map of Binzhou City. Vectorization treatment of information of tourist attractions graded AAA and above in Binzhou City was carried out to establish the database and spatial distribution map of tourist attractions graded AAA and above in Binzhou City. Correspondence between spatial database and attribute database is shown in Fig. 1. Secondly, based on the Shandong Tian map or GIS spatial analysis function, the actual nearest distance between various grades of tourist attractions was measured in the spatial distribution map of the tourist scenic spot. Using the Shandong map world or spatial analysis function of GIS, the actual nearest neighbor distance between various grades of tourist attractions was measured on the spatial distribution map of the tourist attractions. Thirdly, relevant indicators were calculated according to corresponding research methods.

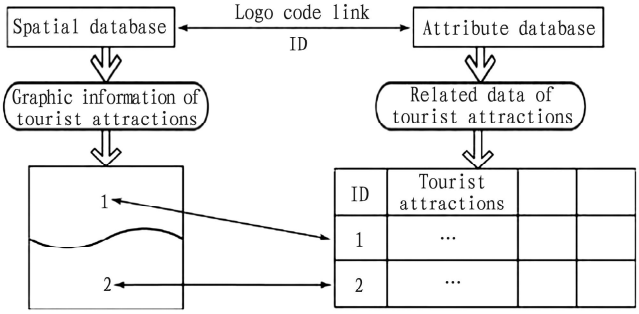

Fig. 1 Correspondence between spatial database and attribute database

1.3 Research methods The main content of this paper is the spatial distribution characteristics of tourist attractions graded AAA and above in Binzhou City and the reasonable optimization of the spatial structure of next regional tourism development in Binzhou City. Therefore, in order to more accurately and reasonably analyze the spatial distribution characteristics of the tourist attractions, the nearest point, connectivity, accessibility and compactness analysis were conducted based on the spatial analysis function of GIS software. The meaning and formula of each analytical method were shown in Table 2.

Table 2 Models for research on the spatial distribution of tourist attractions graded AAA and above in Binzhou City and their significance

Research method	Formula	Definition	Geographical significance
The nearest point analysis	$r_E=\frac{1}{2\sqrt{\frac{n}{A}}}=\frac{1}{2\sqrt{D}}$, $R=\frac{r_i}{r_E}$	r_E is the theoretical nearest distance; A is the area of the study area; n is the number of points; D is the density of points; R is the nearest distance index, and $R>1$, $R=1$ and $R<1$ stand for uniform distribution, random distribution, and condensation distribution respectively; r_i is the actual nearest distance.	It is used to study the proximity degree of point things in geographic space.
Connectivity analysis	$\beta=\frac{m}{n}$ $Y=m/[3(n-2)]$	β is the connectivity of traffic network, $\beta\in(0,3)$, and the larger the value is, the better the connectivity is; γ is the connection development of traffic network, $\gamma\in(0,1)$; m is the number of sides; n is the number of vertices.	It is used to study the traffic contact between various tourist attractions.
Accessibility analysis	$A_i=\frac{\sum_{i=1}^{n}D_{ij}}{n}$	A_i is the accessibility index of vertex i in the network, and the smaller the value is, the higher the accessibility is; D_{ij} is the shortest distance from point i to j; n is the number of vertices.	It is a quick way to study the connection between tourist attractions.
Compactness analysis	$C=\frac{T}{D}$	C is compactness, $C\in[0,1]$, and $C=0$ and $C=1$ stand for straight lines and circles; the larger the C value is, the more compact the region is; T is the diameter of the circle with the same area as the study area; D is the distance between the two nodes farthest from each other in the study area.	It is used to study the compactness of regional shape.

2 Spatial distribution characteristics of tourist attractions graded AAA and above in Binzhou City

Due to the differences in development conditions of various levels of tourist attractions and the level of social and economic development in the urban areas[7], there are still certain spatial differences in the development level of tourist attractions graded AAA and above in Binzhou City. In order to accurately grasp the spatial distribution of tourist attractions graded AAA and above in Binzhou City, according to the above research methods and indexes, the spatial structure of the tourist attractions in Binzhou City was studied from the perspective of spatial distribution, spatial network structure and existing problems of the tourist attractions.

2.1 Spatial distribution From the macroscopic perspective of a region, tourist attractions as point targets have three types of spatial distribution pattern, including random distribution, uniform distribution and condensation distribution. In general, the spatial distribution of point elements can be intuitively understood on a map, but the three types of spatial distribution pattern are often presented at the same time. The spatial distribution pattern of tourist attractions graded AAA and above in Binzhou City was analyzed based on the nearest point analysis model.

According to the statistics, there were 56 tourist attractions graded AAA and above in Binzhou, and the total area is 9 600 km^2, namely $A=9\ 600$, and $n=56$. Therefore, the theoretical nearest distance r_E between tourist attractions graded AAA and above in Binzhou City is 6.54 km. The actual nearest distance ri between tourist attractions graded AAA and above in Binzhou City was calculated, averaging 8.81 km. The nearest distance index $R\approx1.35>1$, showing that the tourist attractions graded AAA and above in Binzhou City are mainly evenly distributed. Under the background of regional tourism development, it is beneficial to take Binzhou as a complete tourist destination, proceed from the overall development of Binzhou City, unify planning, integrate resources, create a new model of regional tourism in Binzhou, and form a distinctive Binzhou tourism with "seven tourism modes and two new formats". However, the scattered layout of tourist attractions is not conducive to the joint creation of tourist attractions and increases the cost of tourism transportation.

In order to better analyze the spatial distribution of tourist attractions in different counties and districts of Binzhou City, the nearest distance index R of tourist attractions graded AAA and above in various counties and districts of Binzhou City is calculated based on the nearest point analysis model (Table 3). The nearest distance index R of the tourist attractions in High-tech Industrial Development Zone, Yangxin County, Huimin County and Zouping City is less than 1, that is, the spatial aggregation of tourist attractions graded AAA and above in the four regions is strong, and the distribution is concentrated, so the space competition is fierce. In order to facilitate the integration and development of tourism resources in the four regions, a tourism area with local and regional characteristics should be formed. For example, Huimin County creates a tourism area with the theme of military culture, and Zouping County creates a tourism area with the theme of mountain experience. The nearest distance index R of the tourist attractions in Bincheng District, Zhanhua District, Economic and Technological Development Zone, Wudi County and Boxing County is greater than 1, indicating that the tourist attractions in the above five regions are evenly distributed, which is conducive to the overall tourism development of the regions. However, it is necessary to pay attention to the integration of tourism resources to form the integrated development of spatial structure of tourist attractions.

Table 3 The nearest distance index of tourist attractions graded AAA and above in various counties and districts of Binzhou City

Region	Theoretical nearest distance r_E	Actual nearest distance r_i	The nearest distance index R
Bincheng District	4.40	8.97	2.04
Zhanhua District	9.39	12.67	1.35
Economic and Technological Development Zone	3.44	8.15	2.36
High-tech Industrial Development Zone	3.24	2.67	0.82
Beihai New District	7.84	–	–
Wudi County	7.01	16.30	2.32
Yangxin County	7.04	6.81	0.96
Huimin County	6.15	5.78	0.94
Boxing County	7.50	12.78	1.70
Zouping City	6.68	5.15	0.77

2.2 Spatial network structure

2.2.1 Connectivity analysis. The existing traffic network of Binzhou City was as the main reference object to integrate tourist attractions graded AAA and above in Binzhou City. The spatial distribution maps of various traffic nodes, expressways, national highways, provincial highways and railways in Binzhou City were drawn using GIS technology. The topological index analysis method was used to map the spatial plane topology of tourist attractions in Binzhou City.

The connectivity of traffic network and the connection development of traffic network were used to study the degree of traffic contact between tourist attractions in the study area[8]. Based on the connectivity analysis model shown in Table 2 and the spatial plane topology of tourist attractions in Binzhou City, β index is 1.36 because n is 56 and m is 76. It shows that the connectivity of traffic network of tourist attractions graded AAA and above in Binzhou City is low. The connectivity of tourist attractions in the north and west of Binzhou City is low, and they

are mainly connected through county and township roads. The road conditions are poor, and the accessibility is weak, which limits the development of tourist attractions and introduction of tourists to a certain extent. γ index is 0.47, indicating that the loop connection level of tourist attractions graded AAA and above in Binzhou City is not high, and the distribution of the tourist attractions was relatively uniform; the connection of traffic network is not strong. It will increase the tourist cost of tourists to a certain extent, reduce the market competitiveness of tourism products, and it is difficult to generate tourism competition. This is also consistent with the current situation that the tourist lines of Binzhou City is not perfect and the tourism traffic network is unreasonable.

2.2.2 Accessibility analysis. According to the accessibility analysis model in Table 2, the accessibility index refers to the average distance of the shortest path from one vertex to all other vertices in the network, and reflects to some extent the convenience of connection between various point elements in the regional network[9]. According to the formula of accessibility, the accessibility of 56 tourist attractions graded AAA and above in Binzhou City was calculated, and the average accessibility is 45.26 km (Fig.2a). According to the calculation results, it can be seen that the accessibility index of 13 tourist attractions graded AAA and above in Binzhou City is higher than the city's average, and they are mainly concentrated in the north of Binzhou City (Fig.2b). That is, the accessibility of the tourist attractions is low, and the development level of the tourist attractions is poor, which has certain regional limitations on the development of regional tourism and affects the accessibility level of traffic network of regional tourism in Binzhou City.

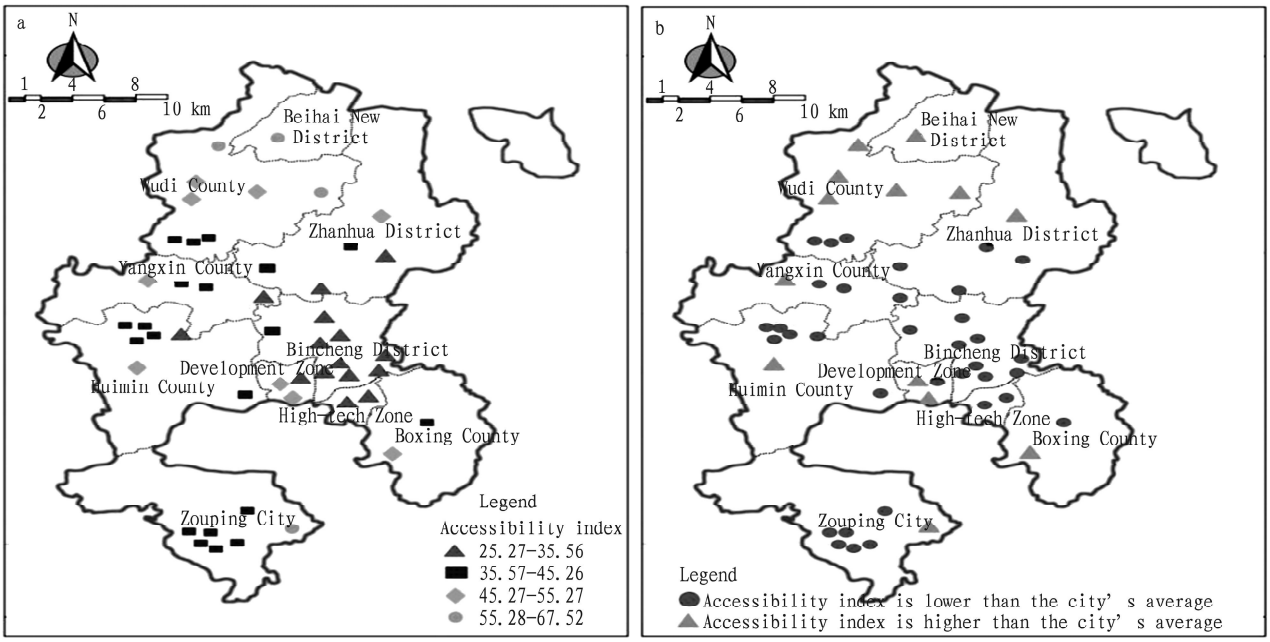

Fig.2 Accessibility of tourist attractions graded AAA and above in Binzhou City

2.2.3 Compactness analysis. In order to ensure the high-quality and high-efficiency development of economy of tourist attractions, accessibility is an indispensable condition, that is, the flow of tourism between various tourist attractions and within a tourist attraction can circulate normally, and the simple and effective factor affecting the internal accessibility of tourist attractions is the shape of tourist attractions. Under the same development conditions, the more compact the shape of tourist attractions is, the easier the flow of tourism circulates, and the better the accessibility is. According to the compactness analysis model in Table 2, the diameter T of the circle with the same area as Binzhou City was calculated to be 110.56 km, and the distance D between the two points farthest from each other is 148.83 km. The compactness index C of tourist attractions graded AAA and above in Binzhou City is 0.74, indicating that the compactness degree of tourist attractions graded AAA and above in Binzhou City is high, which provides a certain foundation for the setting of regional tourism traffic network and the layout of the spatial structure in Binzhou City.

2.3 Existing problems

2.3.1 The distribution of tourist attractions is too scattered, and it is difficult to generate competitiveness. The nearest distance index of tourist attractions in Binzhou City is 1.35, greater than 1, indicating that the tourist attractions graded AAA and above in Binzhou City are evenly distributed, which is beneficial to the promotion of regional tourism in Binzhou City to a certain extent. However, the distribution is too uniform, and the lack of weal strength and weak influence of various tourist attractions will be infinitely magnified, which is not conducive to the joint development of various tourist attractions and it is difficult to generate tourism synergies to form a unique tourist area. At the same time, the too uniform distribution of tourist attractions increases the transportation cost of entering the tourist attractions to a certain extent, weaken the competitiveness of tourist source market, and is not conducive to the sustainable development of the tourist attractions. Therefore, the spatial structure of tourist attractions in Binzhou City needs further optimization

to highlight key points, mainly build engine projects.

2.3.2 The tourist traffic network is imperfect and the accessibility is poor. According to the calculation results of traffic network connectivity of tourist attractions graded AAA and above in Binzhou City, β index and γ index are 1.36 and 0.47 respectively, showing that the tourism traffic connectivity of Binzhou City has not yet reached the ideal state and needs to be improved further. The accessibility of some tourist attractions in the west and north of Binzhou is inferior, and visitors must go back to the road when they visit, which increases the cost of tourism transportation to a certain extent. Moreover, the traffic connection between some tourist attractions is relatively inconvenient. For instance, the traffic network of some grade A tourist attractions (such as Shandong Beihai Fengming Bird Wetland Park, Huaxia Haiyan Cultural Industry Park, Wuying Muslim Culture Tourist Area, Lingxiu Hot Spring Forest Park and Jinyang Wanmu Pear Orchard Scenic Area) needs to be improved, and the traffic comfort is poor. These problems have adversely affected the development of tourist attractions graded AAA and above in Binzhou City. Therefore, the tourism traffic network of Binzhou City needs further optimization and upgrading, and a special traffic line for tourism should be set up.

2.3.3 The homogenization of tourism development is serious and market attraction is weak. The homogenization of development of tourism resources is serious, and it is difficult to attract tourists for a continuous tour to a certain extent, which is not conducive to the increase in the attraction of scenic spots to tourists. Binzhou City lacks a guiding plan for the development of tourism resources throughout the city, and there are problems of the same development of tourism resources in various counties and districts and serious homogenization of tourism projects. The same setting of tourism projects is easy for visitors to experience aesthetic fatigue. The competition between regions or tourist attractions is fierce, and they perform marketing for tourists, which is not conducive to the publicity of overall tourism image and the maintenance of tourism market and in turn affects the development of regional tourism in Binzhou City.

3 Optimization strategy of spatial structure of tourist attractions in Binzhou City

3.1 Integrating tourism resources and optimizing spatial layout Under the concept of "regional tourism", according to the endowment characteristics, spatial distribution characteristics and tourism development goals of tourist attractions graded AAA and above in Binzhou City, starting from the characteristics of socio-economic development and spatial structure, based on the spatial development strategy of core focus, block development, and characteristic driving, group development and transportation linkage, Binzhou City will form an overall development pattern of "one center, two cores, three belts and four zones". That is, one heart is the Urban Leisure Service Center of Binzhou Central Urban Areas; two cores are Sunzi Cultural Creative Tourism Core, Bohai Revolutionary Cultural Tourism Core; three belts are Yellow River Scenic Tourism Belt, Tuhai River Ecological Recreation Belt, and Seashore Original Ecotourism Belt; four zones are Landscape Tourism Resort, Yuanxiang Leisure Tourism Zone, Ecological Wetland Tourist Zone, and Forest Fruit Leisure Tourism Zone. Under this overall development pattern, it is necessary to implement point-axis development, optimize the structure of "one center and two cores" to enter the coordinated development of point, line and surface, accelerate the development of tourism throughout the region, and narrow regional gap to realize the comprehensive utilization and scientific layout of tourism resources graded AAA and above in Binzhou City.

3.2 Building a traffic network and enhance the contact of scenic spots Infrastructure, especially tourism traffic, is the key to the development of regional tourism. In order to promote the development of regional tourism in Binzhou City, facilitate the integration of tourism resources in the city, promote the joint development and promotion of tourist attractions in all counties and districts, and form a regionally integrated tourism spatial pattern, improving tourism traffic network is a crucial prerequisite. Convenient tourism traffic network and tourism traffic landscape avenues with local characteristics can greatly improve tourists' comfort, enhance tourists' experience and travel intentions. To improve regional tourism traffic network in Binzhou City, it is necessary to build and repair the passages of tourist attractions, improve the connection degree of traffic network, and plan the network of "two vertical and four horizontal" highways and the network of "four vertical and five horizontal" main trunk roads in Binzhou City to form a convenient and smooth traffic network for regional tourism. A slow-moving road system for regional tourism in Binzhou City should be built, and mainly relying on the Tuhai River, the Yellow River, seashore and the national roads, provincial roads and county roads connecting main scenic spots, five characteristic slow-moving scenic byways (Tuhai River Tonghai Scenic Road, Northern Coastal Scenic Road, Central Scenic Area along the Yellow River, Southern Mountain Scenic Road, Rural Tourism Scenic Road) should be built to further enhance the accessibility of tourist attractions and the diversity and specialization of regional tourism traffic.

3.3 Making differential positioning clear and strengthening the spatial cooperation of tourist attractions Under the background of regional tourism development, each county, district and tourist attraction should fully consider their role positioning and functional division in the regional tourism system of Binzhou City, and closely link their tourism development with the development of regional tourism in Binzhou City, clarify the differences in tourism functions and products, reduce competition, form a relatively independent tourism industry structure and spatial structure, and finally form the joint spatial development of regional tourism in Binzhou. At the same time, in the future project construction process of grade AAA tourist attractions in Binzhou City, according to local economic, social, and resource environment and historical folk customs, it is necessary to effectively select the space, direction and cultural heritage suitable for tourism development, and pursue the differentiation of tourism development instead of repeating construction or replicating tourism development. The government departments at all levels in Binzhou City should strengthen the macro-control of

tourism development, plan and coordinate the tourism development of the city, and coordinate the spatial layout of tourism, development of tourism projects, and the differential development of tourism in counties and districts to promote the differential positioning and spatial cooperation of tourist attractions based on the regional tourism development of Binzhou City and enhance the attraction of Binzhou tourism.

4 Conclusions

(1) The nearest distance index R of tourist attractions graded AAA and above in Binzhou City is 1.35, greater than 1, showing that these tourist attractions are evenly distributed. However, there is a big difference between different counties and districts in the distribution of tourist attractions graded AAA and above in Binzhou City. The nearest distance index R of the tourist attractions in High-tech Industrial Development Zone, Yangxin County, Huimin County and Zouping City is less than 1, that is, the spatial aggregation of the tourist attractions is strong.

(2) The β index and γ index of tourist attractions graded AAA and above in Binzhou City are 1.36 and 0.47 respectively, revealing that the tourism traffic connectivity of Binzhou City has not yet reached the ideal state and needs to be improved further.

(3) The average accessibility A_i of tourist attractions graded AAA and above in Binzhou City is 45.26 km, and the accessibility index of 13 tourist attractions graded AAA and above in Binzhou City is higher than the city's average, and they are mainly concentrated in the north of Binzhou City.

(4) The compactness index C of tourist attractions graded AAA and above in Binzhou City is 0.74, showing that the compactness degree of tourist attractions graded AAA and above in Binzhou City is high, which provides a certain foundation for the setting of regional tourism traffic network and the layout of the spatial structure in Binzhou City.

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