

The spatial distribution of bus stations and optimization strategy in the main urban area of Lanzhou

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Keywords: bus station; spatial distribution; optimization strategy; Lanzhou city

Abstract: Based on the POI data and bus route data of bus stations in the main urban area of Lanzhou to study the spatial layout of bus stations macro distribution and internal connections. The results show that: In the spatial pattern of the bus station cluster in the main urban area of Lanzhou city, there is a spatial structure of “one main center and two sub-centers”. From the perspective of internal relations, the degree center value of most of the 694 bus stations in the main urban area of Lanzhou is greater than the intermediate center value, with the mean values of 370.607874 and 132.401578 respectively. This indicates that most of the bus stations in the main urban area of Lanzhou have good direct access ability, but the interconnections between them are poor. By combining the overall urban planning of Lanzhou, further optimize the spatial layout of bus stations in the main urban area of Lanzhou.

1. Introduction

With the acceleration of urbanization, cities are endowed with unprecedented economic, political and technological rights, and inevitably pushed to the center of the world stage, playing a leading role. At the same time, cities are also facing challenges such as environmental pollution, traffic congestion, energy shortage, housing shortage, unemployment and disease. Green travel lifestyle is more and more adopted by the public, bus as one of the main ways of green travel, bus station and bus line is an essential basis. Bus station plays an obvious role in attracting and organizing passenger flow. The layout of bus station directly affects the proportion of passenger bus trips. At the same time, the choice of bus route and its service capacity have a great impact on the travel of urban residents, the income of bus operators and the urban traffic conditions^[1]. Rapid economic growth has stimulated the rapid growth of traffic demand, and the total number of residents' trips has been greatly increased. As a result, there is a contradiction between the increasing traffic demand and the slow growth of traffic supply, resulting in the traffic problem. The concept of “bus priority” originated in France, and was soon promoted in western developed countries^[2-5]. And bus stations mainly focuses on service area research^[6-8], evaluation layout^[9-11], layout optimization^[12-13] and impact analysis^[14-15]. In recent years, with the development of social network theory, more and more scholars begin to use social network analysis method to study the problems of various neighborhoods. Therefore, this paper takes the main urban area of Lanzhou city as the research object, takes the POI data of bus stations as the basis, and adopts GIS spatial method to quantitatively analyze the layout status of bus stations in the main urban area of Lanzhou city from the macroscopic distribution and internal connections of bus stations, so as to fill the vacancy of relevant research on bus stations in Lanzhou city.

2. Data acquisition and research methods

2.1 Data acquisition

The data used by the research institute are divided into two major categories : (1) POI data of bus stations, which are obtained by GeoSharp in September 2018. After cleaning and sorting, the data include 694 bus station location data in the main urban area of Lanzhou. The bus line data comes from

the route data published by the official homepage of lanzhou bus group.(2) basic map data are derived from 1:400,000 prefecture-level administrative map of the national basic geographic information center. Based on this vector, the map of main urban area of lanzhou is obtained.

2.2 Research methods

DBSCAN (Density-based Spatial Clustering of Applications with Noise) Spatial Clustering algorithm is a kind of Spatial Clustering algorithm Based on Density, can be directly understood as a Clustering method Based on Density of Noise, it will have enough Density of the area is divided into cluster (cluster), and has the Noise in the Spatial database of discover clusters of arbitrary shape, it connected the cluster is defined as the Density of the maximum set point of Lanzhou city in the clustering of bus stations in 2018, to explore the spatial distribution features, and then using social network analysis of bus stops centrality research, this article will bus network as a kind of social network structure, bus lines in the site as the nodes in the network structure, site and between the lines as a network structure in the attachment, respectively using centrality and intermediary centrality analysis of characteristics of bus network structure.

3. Results analysis

3.1 Spatial pattern of bus station cluster in the main urban area of lanzhou

DBSCAN spatial clustering algorithm was implemented by Python programming on the basis of Arc GIS software, and the cluster of bus stations in main urban area of lanzhou city was identified. Before DBSCAN clustering, the parameter determination method provided by relevant scholars is used to determine the epsilon and epsilon radius value of the neighborhood and the minimum cluster value of MinPts is 4. Then, cluster analysis is conducted according to the spatial coordinate position of bus stops in the main urban area.[25] Within the scope of the study, 32 clusters (clusters) and 184 abnormal points were identified out of the 694 bus stations in the main urban areas in 2018, that is, they did not belong to any cluster. The number of bus stations included in each cluster was taken as the scale index of the cluster, and some large clusters were listed in the form of Table (Table 1). According to the results of spatial clustering, cluster points of bus stations in the main urban area identified by DBSCAN clustering algorithm present a spatial structure of “one main and two pairs (centers)”.

Table 1 cluster of bus stations in main urban areas of lanzhou

A sequence	The cluster	The scale	place
0	A cluster	216	chengguan
1	Two clusters	55	Qilihe district
2	17 clusters	45	West solid area
3	Clusters of 27	15	Gong's house bay
4	Four clusters	14	The original bus south station
5	Cluster.	12	The western market
6	Cluster.	10	Two hot
7	The cluster of twenty-five	10	LAN jiao tong university

Most of the “one main center” is located in chengguan district, a few in qilihe district, and its cluster size is much larger than all other clusters. Chengguan part are mainly distributed in the silver road, south binhe road, east east road, the wild goose beach surrounded by east road and red road area, including three layers: one is the chengguan can cross - JingNing intersection as the core business, mainly in sales cross as spindle of jiuquan road, qingyang road west on the cross old street and zhongshan road, zhang ye road and JingNing north road, south road and qingyang road intersection JingNing streets, always is the main commercial street, lanzhou is also a cultural entertainment zones; Second, it is a circle with dongfanghong square -- tianshui crossing as the core. This area is an important place for lanzhou to hold sports events, cultural activities and major political, economic

and commercial activities. It has gathered a large number of customers in e-commerce, business and tourism. Third, yantan road - yannan road is the core of the circle, this area is lanzhou furniture industry and high-tech research and development services and headquarters base. Qilihe part are mainly distributed in west lake park and shenyang road, west lake park, so-called "lanzhou is one of the ancient eight sights", is a comprehensive recreation park with local traditional style, the Yellow River in lanzhou city style line of main shaft, its distribution along the many tourist attractions, attracted to the general public to visit the rest, while around shenyang road with many schools and factories.

A "two vice center" is located in qilihe district, mainly distributed in the south binhe road, road and XiJin dunhuang west road intersection area, the main centre is located in lanzhou 4, it is made up of two cluster around, to the left of the cluster are mainly distributed in guanghua, wuwei road and road intersection in the spheres of dunhuang, the right of the clusters are mainly distributed in the melon state road, south binhe road, and in the spheres of qilihe north street intersection, the main centre is west station, cross - bus group as the core of spheres of this area is in downtown lanzhou city commercial finance, convention and exhibition, cultural and sports center, the municipal administration office center; The other sub-center is located in xigu district. It is mainly distributed in the intersection area of east welfare road, west welfare road, west park road, east park road and park road.

In addition, some of the larger five clusters are divided by region, with two distributed in qilihe district, one in chengguan district, one in anning district and one in xigu district. One of the two clusters in qilihe district is located in the circle where jianguyan road, langongping road and south ring road meet. The other is located in the circle where wushan road, gongjiaping west road and gonghu road meet. This area is a cluster of education and medical care, including primary and secondary schools, colleges, lanzhou university of technology and the third people's hospital, the second grade a hospital. The cluster of chengguan district is mainly located in the circle of jiyuguan north road, jiyuguan south road and jiyuguan west road. This area is bounded by jiyuguan west road. The cluster of anning district is mainly located in the circle where anning west road, jianning east road and xuefu road meet. The cluster in xigu district is mainly located in the circle where kangle road, heshui south road and xigu west road meet. This area is not only a primary school gathering area, but also an important place for business activities, including guofang department store, hongan international plaza and western household city.

3.2 Centrality analysis of bus stations in main urban areas of lanzhou

Based on the social network analysis method, 694 bus stations are taken as network nodes and routes between stations as network relations to construct the weighted undirected matrix of bus stations in the main urban area of lanzhou city with 694×694 . Then, the matrix is imported into Ucinet software for processing and operation of social network analysis.

Degree Centrality is the most direct measure depicting node Centrality in network analysis. In an undirected graph, Degree Centrality measures the Degree to which a node in a network is connected with all other nodes. If a point is directly connected with many points, then we say that the point has a high Degree Centrality. The degree centrality of bus stations in the main urban areas of lanzhou city is quite different. The mean value and standard deviation of network degree center of bus stations are 370.6079 and 156.6203 respectively. The xiguan cross station located in chengguan district, the degree center is as high as 619, in addition to its many and close contact with each station in the city, but also more contact with other urban areas, and located in qilihe district 515 hospital station, bearing factory station and city three hospital station, degree center is only 26, the difference between the two is 23.8 times more. The top ten stations in degree center are xiguan cross station in chengguan (619), xihu park station in qilihe district (615), lanzhou west station (609), bus group station (599), qilihe bridge station (598), lanzhou west passenger station (585), dongli outlets square station (577) and xiuchuan xincun station (576). It can be seen that qilihe district has a high degree of contact with other three urban areas, which may also be related to the location of qilihe district. It is connected with chengguan in the east, xigu in the west, and anning in the north across the river.

Betweenness Centrality, or Betweenness Centrality, describes the control ability of a node. Betweenness refers to the degree to which a node mediates between other nodes in the network. The mean value and standard deviation of network intermediary centers of bus stations in the main urban area of Lanzhou were 132.4016 and 223.4217 respectively. Among them, Xiguan cross station, located in Chengguan district, has an intermediary center as high as 2249.327, which is an important transfer station in the main urban area of Lanzhou. Mediation center of the top five sites and degree of center, is located in the city of Xiguan cross (2249.327), located in Qilihe district of the West Lake Park (1941.826), Lanzhou West Railway Station (1756.011), (1325.403), Qilihe Bridge Station Bus Group (1302.266), starting from the sixth with the change of the individual, in turn, is located in Qilihe OudeNa Binhe Road Station (1092.15), Ma Beach Village North Station (1092.15), the East Stand Outlet Square Station (908.324) and Show Sichuan Saemaul Undong Stand (908.324).

The comparison between the two centers shows that the five stations of Xiguan cross station, West Lake Park station, Lanzhou West Station, Bus Group station and Qilihe Bridge station not only have high degree center, but also have high intermediary center, which indicates that there are not only many direct lines, but also many connections with other lines. On the whole, the degree center value of most of the 694 bus stations in the main urban area of Lanzhou city is higher than the intermediate center value, and their mean values are 370.607874 and 132.401578 respectively. Lanzhou city bus stops in the bulk of direct ability is good, but related with site is poor, this also is associated with the terrain of Lanzhou, typical of a Sichuan “two mountains valley type characteristics of zonal distribution, make the city layout in narrow valley terrace, the terrain features also decided to basic outline in the spatial distribution of the bus lines.

4. Discussion

The bus station cluster in the main urban area of Lanzhou city presents a structure of “one main center and several sub-centers” in the spatial pattern. In addition, through DBSCAN spatial clustering method, 32 clusters (clusters) were identified out of the 694 medical institutions in the main urban areas in 2018 within the scope of the study, showing an overall distribution pattern of “more in the east and less in the west”. Firstly, as one of the main urban areas, Anning district has not formed an obvious cluster. In the future planning of urban bus station spatial layout, it is necessary to continue to strengthen the bus station layout of Anning district and further optimize the spatial layout of bus stations in the main urban area of Lanzhou. Second, 694 bus stops in the vast majority of degrees were greater than the value of the mediation center, the center value, the mean value of 370.607874 and 132.401578 respectively, shows the vast majority of bus stops in direct ability is good, but less related with site, this is associated with Lanzhou urban area landform features, typical of “one river two mountains” valley type characteristics of zonal distribution, urban layout on long and narrow river two triple terrace, the background factors determine basic outline in the spatial distribution of the bus lines. Finally, after the opening of the rail transit line 1, the city's bus line website layout will be fully optimized, and the urban public transportation system featuring rail transit as the backbone, urban bus as the network, slow traffic as the auxiliary, and water bus will be built. . At the same time, it will further increase the elimination of old bus vehicles, speed up the launch of new energy buses with large capacity, high comfort and security, and continuously improve the travel experience of citizens.

Acknowledgement

This work was supported by the Strategic Priority Research Program of the Chinese Academy of Sciences (A) (XDA20040400), the National Natural Science Foundation of China (41701173, 40771054), the Ministry of Education Humanities and Social Sciences Research Youth Foundation (17YJCZH268), the Key Research and Development Project of Gansu Province (18YF1TA052), the General Project of the “Belt and Road” Research in Gansu Province (LDBR2018-017) and the Key Project of the Gansu Provincial Government Decision Advisory Committee in 2019..

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