Evaluation of Bus Line Network Based on Network Model

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Abstract. According to the relationship between site and site, station and line, line and line, this paper builds the model of bus station network, bus transfer network model, and bus line network, which is a kind of public transit network, which collects all the bus lines and bus stop. The network of each network is calculated from the collected data, and the average probability distribution of each network node is calculated. The average shortest path distance of each network is calculated by MATLAB using Dijkstra algorithm. Finally, each network is calculated. And the network characteristics of the three networks are analyzed to evaluate the rationality of the urban public transport network.

1. Introduction

People's living standards improved significantly, more and more families to buy cars, urban traffic pressure is increasing. People's governments at all levels to take the necessary measures to limit motor vehicles to reduce motor vehicle travel, in order to limit the impact of travel restrictions on the public, you need to improve the level of urban public transport services. While the evaluation of the existing urban public transport network will make the basis for the further optimization of the bus lines.

2. Definition of parameters

2.1 Network diagram representation

A concrete network can be abstracted as a graph G = (V, E) consisting of point set V and edge set E. Each edge in E corresponds to a pair of points in V. (Vi, vj), (Vj, Vi) represents the same side, then the network is undirected network, otherwise it is directed network. The number of nodes is denoted by M = V, and the number of edges is denoted as N = E. If each network has its own weight, the network is a weighted network.

2.2 Degree and degree of distribution

The degree of a node is the number of edges connected to the other nodes. The degree of degrees in the directed network can be divided into outbound and inbound nodes. The outbound degree is the number of edges pointing from the node to the other nodes. The degree of the node is the number of edges pointing from other nodes to the node. Generally speaking, the greater the degree of a node, it means that the greater the role of this node in the network. The average of all nodal degrees is the average.

2.3 Average shortest path distance

The shortest path distance between two nodes i and j in the network G is defined as the number of edges connecting the shortest path of the two nodes. For an undirected network, the mean shortest path distance is defined as the average of the shortest distance between the pairs of nodes in the network: Where the average shortest path distance can measure the dispersion of the network nodes

2.4 Clustering coefficient

Suppose a node i in the network G has ki edges connected with other nodes, and this node is called the neighbor of node i. Obviously, this node may have up to ki (ki-1) / 2 edges. The ratio between the number of edges Ei and the number of possible edges ki (ki-1) / 2 between nodes is defined as the clustering coefficient of node i. The average of the clustering coefficients of all the nodes in the network is the network Of the clustering coefficient, with Ci

3. The establishment of Urban Public Transport Network Model

3.1 The Representation Method of Urban Public Transport Network in Computer

The network of a city is composed of nodes and edges as well as other networks. The structure of the network can be represented by matrices in Matlab. It is assumed that the public transport network N is an unweighted and undirected network. Then the public network N is represented by the matrix M, and M (i, j) is defined as an element of the i-th row and j-th column of the M matrix. If there is an edge connection between the i-th node and the j-th node, M (i, j) = 1, and 0 otherwise.

2.2 The urban public transport parameters of the logical algorithm

A. Data table of bus network station line

We collected information about the city bus lines, including bus lines, stations, and site serial numbers. The establishment of road network information table.

B. Establish the adjacency matrix and calculate the network characteristics of the logic algorithm

Step 1: Obtain the adjacency matrix

To ordinary bus station network, for example, two bus stations i, j as long as the corresponding bus line name is the same and the corresponding bus station line no sequence number difference of 1 or -1, the two sites i, j is connected, adjacency matrix The element M (i, j) = 1, otherwise M (i, j) = 0.

Step 2: Calculate the degree of the node

Each row and column in an adjacency matrix represents the connection between the node and the other nodes. It is obvious that the sum of the row and column element values representing the node is the degree of the node.

Step 3: Calculate the shortest path distance

Using Floyd algorithm, in which the basic idea of Floyd algorithm is:

1) Define a matrix D to record the information of the inserted point. D (i, j) denotes the point from node i to node j, and initializes D (i, j) = j.

2) M (i, j) = min (M (i, j), M (i, j) + M (k, j)) by inserting each vertex into the graph and comparing the distance from the original interpolated distance. , And if the value of M (i, j) becomes small, D (i, j) = k.

3) In D, the shortest path distance information is included, and the shortest path distance is calculated based on this information.

Step 4: Node clustering coefficient

1) Compute the clustering coefficient of point i, first remove all nodes that are not connected to point i.

2) Determine the number of nodes connected to point i

3) Determine the number of edges consisting of all nodes connected to point i

4) According to the definition can be calculated node clustering coefficient.

4. The Solution of Public Transport Network Model

The network structure is represented by matrices in Matlab. It is assumed that the public transport network N is an unweighted and undirected network. Then the public network N is represented by the matrix M, and M (i, j) is defined as an element of the i-th row and j-th column of the M matrix. If there is an edge connection between the i-th node and the j-th node, M (i, j) = 1, and 0 otherwise.

In the bus network, the two stations can not be used between other stations connected with a bus line, then the two bus stations are connected in the adjacency matrix with 1, said 0 otherwise. At this point, by finishing the city bus station information table, through the construction of the bus station network M1

In the bus transfer network, the same bus line between the various sites are fully connected, in the adjacent matrix with 1 said otherwise expressed by 0, built by MATLAB bus transfer network M2.

In the bus line network, if the two bus lines have the same docking station, then connect an edge between the corresponding two nodes, adjacent matrix is still 1, Network M3.

By using the Floyd algorithm, the shortest path distance, the average shortest path distance and the clustering coefficient are calculated by using the Floyd algorithm to solve the degree of each network according to the definition of degree.

(1) Analysis of the network characteristics of urban public transit stations

A. The Distribution of Degree and Degree of a Node

The transit station network model is moderately indicating how many stations are connected to a station.

B. The shortest path distance and the average shortest path distance

The shortest path in a transit station network means that at least a few edges are traversed from one station to another, and the average shortest path distance is the average of the shortest path distances. The Floyd algorithm is used to get the most path matrix according to the network adjacency matrix of urban public transit network.

C. Clustering coefficient

The clustering coefficient in the urban transit network indicates the density of bus lines between sites connected to this site. The average clustering coefficient reflects the line density of the entire transit network. The average clustering coefficient of the whole network is larger, indicating that the city's public security site density is larger.

(2) Analysis of urban public transport network characteristics

A. Degree and degree distribution of a node

The degree of city bus transfer network nodes indicates the number of stations that do not need to transfer to other lines in the middle of the station, and the sites with large values are the hub stations in the bus network.

B. The shortest path distance and the average shortest path distance

The shortest path matrix is calculated according to the actual adjacency matrix of the urban public transport network, and the shortest path distance distribution of the urban transfer network is obtained. The shortest route distance between nodes in a transit network model indicates the number of transfers needed from one station to another plus one. The average number of transfers in a city is the average shortest path distance minus one, the minimum number of transfers between stations.

C. Clustering coefficient

The coefficient of urban public transport network clustering indicates that there is a possibility of having a direct route between adjacent stations. The larger the clustering coefficient of a station is, the better the transfer between the station and the adjacent station is.

(3) The characteristics of urban line network model

A. Degree and degree distribution of a node

The transit station network model is moderately indicating how many stations are connected to a station.

B. The shortest path distance and the average shortest path distance

The shortest path distance between nodes represents the least number of edges between any two lines. The shortest path distance is calculated from the average distance between the two routes. That is, the shortest distance travels from one line to another. The average number of times a line is to be transferred is the average shortest distance minus one.

C. Clustering coefficient

In the urban bus network, the clustering coefficient represents the possibility of connection between adjacent lines. The average clustering coefficient is calculated and the size indicates the possibility of the connection between adjacent lines.

5. Summary

For the evaluation model of the bus line, the network model analysis method can be used to evaluate the rationality of the bus lines in the city. Can reflect the poor transfer, the average site distance and other issues. In considering the problem of bus lines without considering traffic congestion factors, the specific practical human factors, in this regard, our model needs to be re-improved

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