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Analysis of Public Transport Comprehensive Evaluation Model based on Intelligent Transportation

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Abstract

Ten different bus stops in Wuhu City are selected as the research object to build a fuzzy comprehensive evaluation model. Through the investigation of ordinary people, government staff, bus company staff and other different people, different survey results are obtained. Five factor sets are selected to determine the comment set, including the distance from the mall, the distance from the school, the distance from the hospital, the distance from the entertainment place and the traffic jam, Evaluate and adjust the convenience of ten stations in Wuhu. The results are obtained by MATLAB. Big data plays an important role in transportation. This paper will also give suggestions on big data in intelligent transportation to promote the normal and efficient operation of urban transportation.

Keywords

Fuzzy Comprehensive Evaluation; Intelligent Transportation; Big Data; Matlab.

1. Introduction

In recent years, with the rapid development of economy and society, traffic monitoring equipment for expressways and national and provincial trunk roads has been built on a large scale. Various video monitoring terminals and information collection equipment are spread all over cities and roads, providing strong scientific and technological guarantee for public security traffic management departments to carry out road traffic management, and promoting the process of police informatization and digitization of public security traffic management, it has effectively improved the ability of road traffic control and the law enforcement level of public security police. [1] The traditional transportation management mode has been difficult to adapt to the development of modern industry and does not meet the modern transportation demand, especially the problem of traffic congestion is becoming more and more serious. [2] The difficulties in resource sharing, connection and business synergy seriously limit the sustainable development of transportation, resulting in weak basic information sharing capacity and lack of comprehensive applications. The problem of information service quality is becoming more and more serious. Big data technology can improve the above problems. [3] This paper makes a comprehensive evaluation on the establishment of existing bus stops in Wuhu, constructs a fuzzy comprehensive evaluation model, improves the existing bus stops, and gives big data suggestions on intelligent transportation.

2. Data Source and System Construction

2.1 Data Sources

The data of this paper comes from the results of actual investigation. In order to facilitate the research of the problem, the following assumptions are put forward:

(1) All data sources are true and reliable, and there are no false reports;

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(2) The results of the survey exclude personal subjective emotions and are true and reliable.

2.2 Construction of Index System

Combined with the existing research, ten stations with large flow of people in Wuhu, such as Times Square, New campus of a Normal University, Department Store, Olympic Park, Anhui University of engineering, Binjiang Park, Country Garden, Beicheng primary school, Bajiao ecological park and Baima temple, are selected for the survey. Select different factor sets and determine different comment sets to make a reasonable evaluation of the convenience of the ten sites.The site table is as follows Table 1:

Table 1. Site table

Serial Number	Symbol	Definition
1	M_1	Times Square
2	M_2	New campus of An Normal University
3	M_3	Department Store
4	M_4	Olympic Park
5	M_5	Anhui University of engineering
6	M_6	Binjiang Park
7	M_7	Country Garden
8	M_8	Beicheng primary school
9	M_9	Bajiao ecological park
10	M_{10}	Baima Temple

3. Analysis of Fuzzy Comprehensive Evaluation Model

3.1 The Steps of Fuzzy Comprehensive Evaluation are as Follows

(1) Determine the factor set. The effective use of each site needs to be comprehensively evaluated from many aspects, such as the distance from the site to the mall, to the school, to the hospital and so on. All these factors constitute the set of evaluation index system, that is, the factor set, which is recorded as:

$$\mathrm{U} = \{\mathrm{u}_1, \mathrm{u}_2, \cdots, \mathrm{u}_\mathrm{n}\}$$

(2) Determine the comment set. Due to the different evaluation values of each index, different grades are often formed. For example, the distance from the site to the shopping mall is good, good, medium, poor, very poor, etc. The set composed of various decisions is called the comment set, which is recorded as:

$$\mathrm{V} = \{\mathrm{v}_1, \mathrm{v}_2, \cdots, \mathrm{v}_\mathrm{n}\}$$

(3) Determine the weight of each factor. Generally, each factor in the factor set plays a different role in the comprehensive evaluation. The result of the comprehensive evaluation is not only related to the evaluation of each factor, but also depends on the role of each factor in the comprehensive evaluation to a great extent. Therefore, it is necessary to determine the weight distribution between factors. It is a fuzzy vector above, which is recorded as:

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$$A = [a_1, a_2, \cdots, a_n]$$

In: the weight of the i th factor and meet =1.

(4) Determine the fuzzy comprehensive judgment matrix. For indicators, the membership degree of each comment is a fuzzy subset of. The evaluation of the index is recorded as:

$$R_i = [r_{i1}, r_{i2}, \cdots, r_{im}]$$

The fuzzy comprehensive judgment matrix of each index is:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix}$$

It is a fuzzy relation matrix ranging from U to V.

(5) Comprehensive evaluation.If there is a fuzzy relation R= (r ij) n m, then a fuzzy transformation can be obtained using R:

$$T_R: F(U) \to F(V)$$

From this transformation, the comprehensive evaluation results can be obtained:

$$B = A \cdot R$$

The comprehensive evaluation can be regarded as a fuzzy vector on V, recorded as:

$$B = [b_1, b_2, \cdots, b_m]$$

3.2 Empirical Analysis

3.2.1 First, Score Times Square

(1) Take factor set

U = {Distance from the mall U_1, Distance from the school U_2, Distance from the hospital U_3,Distance from the entertainment venues U_4, Traffic jams U_5}.

(2) Take comment set

V ={Excellent V_1, Fine V_2, Just like V_3, Inferior V_4, Dissimilarity V_5}.

Determine the weight of each factor:

$$A = [0.2\ 0.3\ 0.1\ 0.15\ 0.25]$$

Determine the fuzzy comprehensive judgment matrix and evaluate each factor.

1).U_1 Score by the masses:

$$R_1 = [0.40\ 0.35\ 0.15\ 0.10\ 0]$$

On the type said, 40% of the people participating in the score think the distance from the shopping mall performance is excellent, 35% of the masses think the distance from the shopping mall

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performance is good, 15% of the masses think the distance from the shopping mall performance is general, 10% of the masses think the distance from the shopping mall performance is poor, no people think the distance from the shopping mall performance is poor.

2).U_2, U_3 Score by leaders of municipal departments:

$$R_2 = [0.2\ 0.32\ 0.26\ 0.18\ 0.04]$$
$$R_3 = [0.210.33\ 0.19\ 0.23\ 0.04]$$

3).U_4, U_5 Score by the leader of the bus-affiliated company:

$$R_4 = [0.33\ 0.27\ 0.25\ 0.15\ 0]$$
$$R_5 = [0.26\ 0.43\ 0.31\ 0\ 0]$$

The row i constitutes the evaluation matrix:

$$\mathrm{R} = \begin{bmatrix} 0.40 & 0.35 & 0.15 & 0.10 & 0.00 \\ 0.20 & 0.32 & 0.26 & 0.18 & 0.04 \\ 0.21 & 0.33 & 0.19 & 0.23 & 0.04 \\ 0.33 & 0.27 & 0.25 & 0.15 & 0.00 \\ 0.26 & 0.43 & 0.31 & 0.00 & 0.00 \end{bmatrix}$$

It is a fuzzy relation matrix from factor set to comment set.

4). Fuzzy comprehensive evaluation. Perform matrix synthesis operation:

$$\mathrm{B} = \mathrm{A} \cdot \mathrm{R} = [0.2\ 0.3\ 0.1\ 0.15\ 0.25] \cdot \begin{bmatrix} 0.40 & 0.35 & 0.15 & 0.10 & 0.00 \\ 0.20 & 0.32 & 0.26 & 0.18 & 0.04 \\ 0.21 & 0.33 & 0.19 & 0.23 & 0.04 \\ 0.33 & 0.27 & 0.25 & 0.15 & 0.00 \\ 0.26 & 0.43 & 0.31 & 0.00 & 0.00 \end{bmatrix}$$
$$= [0.2755\ 0.3470\ 0.2420\ 0.1195\ 0.0160]$$

5). If the comment with the largest value is taken as the comprehensive evaluation result, the evaluation result is "good".

3.2.2 The Same Survey and Evaluation Were Conducted for the Other Nine Regions, with the Weight a Shown in the Table 2 Below

Table 2. Weight table of each factor

	U_1	U_2	U_3	U_4	U_5
M_2	0.14	0.23	0.12	0.42	0.09
M_3	0.23	0.15	0.11	0.25	0.26
M_4	0.21	0.32	0.16	0.13	0.18
M_5	0.18	0.22	0.15	0.25	0.20
M_6	0.22	0.28	0.10	0.32	0.08
M_7	0.30	0.20	0.18	0.12	0.20
M_8	0.26	0.24	0.22	0.18	0.10
M_9	0.19	0.31	0.16	0.22	0.10
M_{10}	0.16	0.25	0.19	0.22	0.18

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The fuzzy relation matrix R of the other nine regions is shown in the following Table 3:

Table 3. Fuzzy Matrix R

		V_1	V_2	V_3	V_4	V_5
M_2	R_1	0.2	0.4	0.1	0.15	0.15
	R_2	0.15	0.35	0.3	0.1	0.1
	R_3	0.25	0.35	0.25	0.15	0
	R_4	0.30	0.40	0.20	0.1	0
	R_5	0.4	0.25	0.15	0.2	0
M_3	R_1	0.3	0.3	0.2	0.2	0
	R_2	0.2	0.5	0.2	0.1	0
	R_3	0.25	0.35	0.2	0.1	0.1
	R_4	0.35	0.3	0.25	0.05	0.05
	R_5	0.4	0.2	0.2	0.1	0.1
M_4	R_1	0.3	0.3	0.2	0.2	0
	R_2	0.4	0.3	0.15	0.1	0.05
	R_3	0.3	0.25	0.15	0.2	0.1
	R_4	0.2	0.2	0.2	0.2	0.2
	R_5	0.35	0.15	0.25	0.15	0.1
M_5	R_1	0.25	0.35	0.15	0.15	0.1
	R_2	0.4	0.35	0.2	0.05	0
	R_3	0.3	0.2	0.2	0.2	0.1
	R_4	0.4	0.3	0.3	0	0
	R_5	0.3	0.3	0.2	0.1	0.1
M_6	R_1	0.5	0.3	0.2	0	0
	R_2	0.3	0.4	0.2	0.1	0
	R_3	0.3	0.3	0.3	0.1	0
	R_4	0.4	0.2	0.2	0.1	0.1
	R_5	0.3	0.2	0.3	0.1	0.1
M_7	R_1	0.3	0.25	0.25	0.1	0.1
	R_2	0.3	0.4	0.25	0.05	0
	R_3	0.2	0.3	0.4	0.1	0
	R_4	0.3	0.3	0.2	0.1	0.1
	R_5	0.2	0.2	0.3	0.1	0.2
M_8	R_1	0.5	0.2	0.3	0	0
	R_2	0.15	0.25	0.25	0.15	0.2
	R_3	0.2	0.3	0.2	0.2	0.1
	R_4	0.3	0.2	0.4	0.1	0

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	R_5	0.3	0.3	0.2	0	0.2
M_9	R_1	0.2	0.3	0.1	0.3	0.1
	R_2	0.2	0.3	0.1	0.2	0.2
	R_3	0.3	0.3	0.2	0.1	0.1
	R_4	0.4	0	0.1	0.4	0.1
	R_5	0.3	0.2	0.2	0.3	0
M_{10}	R_1	0.2	0.3	0.2	0.2	0.1
	R_2	0.4	0.4	0.1	0.1	0
	R_3	0.4	0.2	0.3	0.1	0
	R_4	0.3	0.3	0.2	0.1	0.1
	R_5	0.3	0.4	0.2	0.1	0

4. Conclusion

Through the fuzzy comprehensive evaluation of the above ten regions, the evaluation results of the ten regions can be obtained as shown in the table below. The convenience of the new campus of ANN Normal University, Bajiao ecological park and Baima temple is poor, and the other stations are good or excellent. The government and bus companies can improve these three stations to ease the flow of people and maximize their convenience. The final evaluation results are shown in the Table 4 below:

Table 4. Final score table

	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9	M_{10}
Score	0.3470	0.2155	0.1950	0.2260	0.2020	0.2300	0.2210	0.2440	0.2230	0.2080
Grade	Fine	Dissimilarity	Dissimilarity	Fine	Excellent	Fine	Fine	Excellent	Excellent	Dissimilarity

5. Suggestions on the Application of Big Data in Intelligent Transportation

Smart transportation construction aims to build a transportation service system with smarter infrastructure, finer urban traffic management and more convenient public travel. The main construction contents include comprehensive transportation management service platform and multiple smart transportation applications. [4] Applying big data to the field of intelligent transportation can not only effectively adjust and improve the current situation of intelligent transportation services, scientifically solve traffic congestion and other problems, but also further promote China's intelligent transportation to achieve the goal of sustainable development. [5].

5.1 Ease Traffic Congestion

With the development of economy, there are more and more private cars, especially in the rush hour, which is prone to traffic jams. The big data platform can reasonably plan the route for car owners according to the real-time situation of the road, provide convenience for traffic police to guide the traffic, and effectively alleviate the traffic jam in the city.

5.2 Mitigation of Potential Hazards

Use big data to simulate possible traffic accident scenarios and other illegal pursuit scenarios, and effectively dispatch traffic police to maintain traffic order and evacuate people. The second is to simulate the routes of rescue vehicles such as ambulances and fire engines, and use big data technology to find a road that saves the most time and is the least congested during attendance.

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5.3 Effectively Dispatch Buses and Other Public Transport

The big data platform can reasonably schedule bus operations according to the daily passenger flow, the passenger capacity of buses in various places and the degree of road congestion, and maximize the passenger capacity of buses by using big data information. Through the application of big data technology, the bus stops can be monitored in real time and dynamically. People can also query the bus operation through relevant application software, understand the vehicle information at the first time, effectively avoid the emergence of boarding difficulties and blind waiting, and the allocation of relevant traffic resources is more reasonable. [6].

5.4 Implementation of Road Safety Supervision

Under the analysis of big data, the roads and bridges passed by vehicles are monitored in time, and the relevant information of roads when vehicles are driving is collected in an all-round way. [7] In case of accidents or road collapse, the background can get feedback at the first time and rescue in time, and also provide effective travel routes for other car owners to ensure road safety.

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