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Research on Taxi Driver Decision Analysis Based on BP Neural Network

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ABSTRACT. *With the improvement of people's living standards, taxi drivers how to choose the return plan and balance the benefits of long and short distance taxi drivers appear. In order to find out the relevant factors that affect the decision-making of taxi drivers, this paper determines the main influencing factors by consulting the relevant survey information, and establishes the decision-making model of taxi drivers based on BP neural network. First of all, this paper analyzes the factors that affect the decision-making of taxi drivers and the relevant mechanism, and selects the indicators that may affect the decision-making of taxi drivers, namely, the number of flights (more flights, more passengers), "car storage pool" vehicle number, weather, time period, season and flight mileage. On the basis of considering the change rule of the number of airport passengers and the income of taxi drivers, the decision-making model of taxi drivers based on BP neural network is established, and the selection strategy of taxi drivers is determined. The accuracy is 99%, and the driver's decision-making effect is very good.*

KEYWORDS: *BP neural network, Decision-making, Taxi, Revenue*

1. Introduction

Many big cities in the world suffer from traffic congestion every day. In 2018, Forbes conducted a traffic congestion survey on 403 cities from 56 countries[1]. Mumbai, India, is the world's most congested city, with drivers often spending more than 65% of their driving time to reach their destinations, according to the report. Bogota, Colombia, Lima and Peru are the second and third largest cities with congestion rates of 63% and 58%, respectively. At home, Chongqing, Zhuhai, Guangzhou and Beijing are the most crowded cities in China. The reasons for the serious traffic congestion are various. The number of vehicles has increased significantly year by year, with an increase rate of 12%[2]. Secondly, the road design causes traffic congestion, and the third is driver behavior.

Do taxi drivers who send passengers to the airport choose to go to the arrival area to wait in line for passengers to return to the city, or do they choose to go back to the city directly to pull passengers? The number of flights arriving in a certain period of time and the number of vehicles already in the "car storage pool" are

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certain information that can be observed by the driver. Usually, the decision-making of drivers is related to their personal experience judgment, such as the number of arriving flights and the number of possible passengers in a certain season and a certain period of time. In practice, there are many uncertain factors that affect the decision-making of taxi drivers, which have different relations and effects. This paper analyzes the influencing mechanism of factors related to taxi driver's decision-making, comprehensively considers the changing law of airport passenger number and the income of taxi driver, establishes the decision-making model of taxi driver's choice, and gives the driver's choice strategy.

2. Decision Model of Taxi Driver Based on BP Neural Network

We regard the decision-making of taxi drivers as a classification, and the best scheme will be selected by the drivers. That is to say, under the influence of various indicators, we compare the schemes and choose the best scheme according to the results. By reading the relevant literature, we extract several key factors that will affect the choice of drivers to stay, namely, the number of flights (more flights, more passengers), “car storage pool” vehicle number, weather, time period, season and flight mileage. Based on this, BP neural network is used to build the evaluation model.

2.1 Model Preparation

First of all, by referring to relevant data, we take out 20 possible situations (represented by six indicators) and get 20 samples. Then, according to the principle of random number, the samples are expanded to 500, of which 450 are training sets and 50 are test sets. Secondly, the index analysis shows that the number of passengers is positively correlated with the driver's income, the number of taxis in the “car storage pool” is negatively correlated with the driver's income, and the other variables are all 1 or - 1.

2.2 Establish Bp Neural Network Model

① Determine the number of layers and the number of neurons in each layer

According to experience, three layers are generally used. In the determination of the number of nodes in the hidden layer, the number of nodes is too small for the network to learn well, so the number of training needs to be increased. If there are too many nodes, the training time will be longer, and the network is easy to over fit. Therefore, it is determined by the following formula:

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$$l < n-1 \tag{1}$$

$$l < \sqrt{(m+n)+a} \tag{2}$$

$$l=\log_2 n \tag{3}$$

② Initializes the ownership value in the network and randomly assigns values in (-1,1). At the same time, the activation functions of hidden layer and output layer are determined. Because the number of network layers is small, sigmoid function is selected.

(2) Training network

Randomly select an input sample. First, the input and output of the hidden layer of the current sample are calculated, and the output of the hidden layer is:

$$ho_k = f(hi_k) \quad (h=1,2,...,p) \tag{4}$$

Calculate the output of the current sample output layer as:

$$yo_o = f(yi_o) \quad (o=1,2,...,q) \tag{5}$$

Calculate the partial derivative of the error function to the parameters between the output layer and the hidden layer and the partial derivative of the error function to the parameters between the hidden layer and the input layer, and finally calculate the global error:

$$E = \frac{1}{2m}\sum_{k=1}^{m}\sum_{o=1}^{q}(yo_o - d)^2 \tag{6}$$

2.3 Solution of the Model

The number of nodes in the middle hidden layer is 10. Then the training function is determined as trainparam, and the final training results are as follows:

```
    0.9652    1.0258    0.9752   -0.0251    0.0882    1.0694
    0.0348   -0.0258    0.0248    1.0251    0.9118   -0.0694


ans =

    '识别率是 100.000%'
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Fig.1 Decision Results of Taxi Drivers Based on Bp Neural Network

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The results show that the output of the network is output. Through the analysis of the structure of the output matrix, we can see that the output of the network can be regarded as two. We record them as 1 and 2, which respectively represent the two choices of the taxi driver. For example: (1) when a certain behavior of output is 10, it indicates that the situation should choose 1. (2) When one of the output's behaviors is 01, it means that 2 should be selected in this case. In the simulation test of network net after training, the test data is testinput; here, y returns the prediction value of test input after network training, for example: (1) when a certain behavior of Y is 1.0220 -0.0020 -0.0091, representing the output result C1 = 1.0220, the output result C2 = -0.0220; (2) when a certain behavior of Y is -0.0108 0.9884 -0.0216, representing output result C1 = -0.0108, output result C2 = 1.0108.

Only one 1 and two zeros in the output result are ideal results. In the simulation, the classification output is often unable to achieve such results, but we can judge according to which value corresponding to which result is close to 1. For example, the simulation result (1) indicates that the situation is likely to belong to the category of selection 1, and the simulation result (2) indicates that the situation is likely to belong to the category of selection 1 Select a class of 2. In 10000 iterations, the accuracy of model classification converges to 99%, and the classification effect is good.

3. Conclusion

Based on the analysis and study of the relevant factors that affect the decision-making of taxi drivers and their incentives, the decision-making model of taxi drivers is established and the selection strategy of taxi drivers is determined on the basis of considering the change law of the number of airport passengers and the income of taxi drivers. The BP neural network used in this paper takes time from input to output in its mapping function. Under the proof of mathematical derivation, it is found that all nonlinear continuous functions can be approximated by three-layer neural network with arbitrary precision. This makes BP neural network very practical in solving some internal mechanism complex problems. When training, BP neural network can automatically distinguish and extract the rules between input and output data, and memorize the learning content in the weight of the network adaptively, which has the ability of highly adaptive and self-learning.

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