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Research on Airport Taxi Problem Based on Poisson Distribution Flow

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Abstract: To analyze the problem of airport taxi, we should not only improve the driver's income from the perspective of taxi drivers, but also reduce the passenger lag flow from the perspective of airport. Drivers have to make decisions based on the number of passengers at the airport and the number of taxis waiting in line to pick up passengers. In this paper, Poisson distribution is used to estimate the airport passenger flow and the number of taxis at each time, and the critical time for drivers to wait is obtained. To set up an appropriate boarding point, it is necessary to comprehensively consider the effects of safety and efficiency. In this paper, three kinds of advance schemes are considered from many angles, the advantages and disadvantages of each scheme are analyzed and compared, and the relatively better scheme is selected according to the quadratic polynomial function relationship between passenger flow and pedestrian flow density. The efficiency of the better scheme is obtained, and the total number of taxis successfully waiting in T time is obtained.

1. Introduction

The airport is one of the most important transportation hubs in a city. Air transportation is safe, comfortable and convenient. Now more and more people choose to travel by air[1]. Airplanes need wide, flat places to take off and make noise, so most urban airports are built in the suburbs. Passengers cannot get to and from the airport from the city without means of transportation. Many people choose to travel between the airport and the city by taxi. Taxi drivers pick up and drop off passengers between the city and the airport every day[2]. If a taxi driver delivers a passenger to the airport, the driver has two options.

In the first option, drivers drop off passengers at the airport and wait in a”car storage pool”until they pick up passengers returning to the city and then pull them back into the city. The second option, the driver will send passengers to the airport, directly empty car back to the city, to the city to meet and see off passengers. Drivers can judge the number of passengers based on personal experience, and can also accurately observe the number of taxis waiting in line to receive passengers [3].

2. Automobile Model Analysis

Drivers have only two choices when seeing off passengers at the airport. The first option is to enter the"car storage pool"and wait for passengers returning from the airport to the city. The second option is to return to the city directly from the airport to pick up passengers and pull people in the city. Without considering season, weather, and spend time in an airport passenger(that is, the passengers off the plane can be directly taxi ride)factors such as condition, assuming that one day the airport passenger traffic as the different and periodic changes in the time period, as w(t), the airport passenger throughput quantity is constant, set to w, a day to the airport taxi quantity is constant, set to Q, and each time period into the airport waiting for taxi quantity is change, is set to Q(t). Our group used the Poisson distribution flow function to make fitting statistics on the number of passengers arriving at the airport and the number of taxis entering the airport in each time period, and calculated the following results:

W(t), (t=0, 1, 2, 3. 23), which Pt is the probability of airport passenger traffic per hour.

$$W = \sum_{t=0}^{23} w(t) \tag{1}$$

$$P_t = P(w(t)) = \sum_{t=23}^{\infty} \frac{\lambda^t}{23!} e^{-\lambda^t} \tag{2}$$

3. Model Simplification and Establishment

Assume that the average ridership in a day is:

$$\Phi = \frac{\sum_{t=0}^{23} \mathrm{w(t)}}{\mathrm{t}} \tag{3}$$

Similarly, after the normalization of the number of taxis queuing for passengers at the airport, the new variable data is as follows: $q'(t) = \frac{(q(t) - \Phi)}{\sigma} = \lambda$

Assuming that $q'(t) > w'(t)$, At this time, the number of taxis queuing for passengers is greater than the passenger flow in the airport at this time, the driver will directly empty back to the city. The driver at the airport waiting, there is a limit to the length of the driver based on experience judgement, he is willing to wait for the time forΔt, if at this time $q'(t+\Delta \mathrm{t}) > w'(t+\Delta \mathrm{t})$. The driver will not wait for thisΔt time, but empty straight back to the urban passenger. Set the distance between the airport and the city as L, and the average driving speed of the taxi driver is constant;set as V, then the time it takes the driver to return to the city is T=L/V. Cost per unit time spent.

After the driver takes the passenger to the airport, according to the empirical judgment, upon arrival at the airport $q'(t) \leqslant w'(t)$. Without considering the driver back to the factors such as the driver can directly to the passengers would be willing to wait for, waiting forΔt time internal energy to draw the passengers, and there will be no income loss, return to downtown in the airport passenger passenger revenue for D. After theΔt the waiting time, every many wait for t0 time, will lose epsilon(RMB). Suppose the limiting condition that the driver is willing to wait is that after waiting for T time, he just picks up the passenger and returns to the urban area, and there is no passenger revenue and no loss at this time(that is, after waiting for T time, the passenger revenue=the fuel cost of empty return to the urban area).

4. Conclusions

To sum up, under this model, we can get that when passengers arrive at the airport in the early morning, they will choose to go back to the city directly, while from 6:00 to 22:00 in the evening, drivers will choose to wait in line successively. In this model, because we choose the hour time, it is difficult for us to accurately calculate the data between each time period, so there is a large deviation in the data obtained.

The established model takes into account the main factors affecting whether the driver waits or not, and the model is reasonable and of high practical significance. There are many numerical calculations about Poisson distribution flow in the model, we use professional software to calculate and evaluate, the numerical results are accurate, the credibility is high, the human factor is reduced to the lowest, and it is closely related to the actual situation. according to the actual situation encountered by taxi drivers, the problem is analyzed and solved, so that the established model has a high degree of practicality and generalization.

References

[1] Ren Guoyou, Wang Wentao, Liu Xu(2019). Characteristics of pedestrian flow in Terminal T3 of Capital Airport under boarding and departure scenarios[J]. Security, vol. 40, no. 08, pp. 11-16.

[2] Liu Ruiyuan, Zhang Zhixia(2008). Hypothesis test of binomial distribution and Poisson distribution discrimination[J]. Journal of Qinghai University(Natural Science Edition), no. 01, pp. 44-47.

[3] LIN Silui(2018). Research on Forecasting Technology of Airport Taxi Transport Demand[D]. University of Electronic Science and Technology of China.