Taxi Estimated Price Model: Exploration of Innovative Billing Strategies and Fraud Prevention Mechanisms

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Abstract: This paper aims to explore an innovative taxi estimated pricing model to address the issues of opacity and meter fraud in traditional pricing methods, thereby improving service quality and passenger satisfaction in the taxi industry.By introducing AutoNavi Maps' route planning technology and server-based billing rules, a new billing process was designed. Its advantages and challenges in terms of price transparency, fraud prevention, and operational efficiency improvement were analyzed.The estimated pricing model can reduce price disputes, prevent meter fraud, and enhance operational efficiency.However, it also faces challenges in technical, operational, and regulatory aspects. This paper proposes corresponding optimization suggestions and implementation paths, including technological upgrades, operational improvements, and policy support, to promote the application of the estimated pricing model in the taxi industry. In the future, with technological advancements and improved industry management, this model is expected to become a key direction for the digital transformation of the taxi industry, enhancing overall service levels and competitiveness.

Keywords: Taxi;Estimated Price;Billing Model;Fraud Prevention

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1. Introduction

As a vital component of urban public transportation, taxis have long played an indispensable role in daily travel. However, with accelerated urbanization and diversified travel demands, the traditional taxi industry faces numerous challenges. Among these, taximeter fraud has persisted as a chronic issue plaguing both passengers and industry regulators. Unscrupulous drivers utilize illicit devices[1] (colloquially termed "small motors") to manipulate odometers or duration readings, inflating fares and undermining passenger rights and industry integrity. Additionally,the opacity of conventional fare systems frequently triggers disputes between passengers and drivers, destabilizing sector development. In this context, establishing a fairer, more transparent, and fraud-resistant billing model is urgently needed.

2. Materials and Methods

2.1. Integration of Gaode Map Route Planning

Gaode Map, as a leading electronic map service provider in China, possesses a powerful route planning function. By integrating a vast amount of geographical information data and real-time traffic data, it can provide users with precise route planning solutions. As shown in Figure 1, in the working process of the taxi estimated fare mode, the route planning function of Gaode Map plays a crucial role. When passengers get in the car and input their destinations, the system will call upon Gaode Map's API interface. Based on the starting and ending locations and combined with real-time traffic information, it will quickly generate an optimal driving route.

This route not only considers the shortest distance but also takes into account traffic congestion situations to ensure the rationality of the travel time. Through Gaode Map's route planning, drivers can understand the approximate path and travel time of the trip in advance, providing accurate basic data for subsequent fare estimation. At the same time, Gaode Map's real-time traffic update function can also provide traffic alerts to drivers during the trip, helping them avoid congested sections and further improving the travel efficiency.

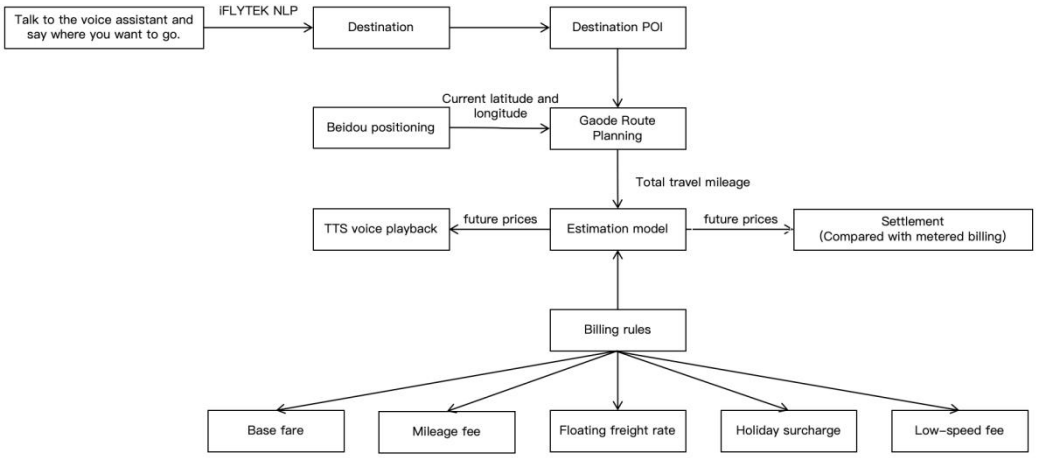

Figure 1. The Workflow of the Estimated Price Model

2.2 Construction of Server-Based Billing Rules

The billing rules of the server are the core component of the estimated pricing model. The rationality of their design directly affects the accuracy and fairness of the estimated pricing. The formulation of the billing rules takes into account multiple factors[2], including the starting fee, the surcharge for exceeding the transportation distance, the mileage fee, the night surcharge, the floating fare, the low-speed fee, the holiday surcharge, etc. The starting fee is priced differently in different time periods and regions; the surcharge for exceeding the transportation distance is mainly used to subsidize long-distance trips; the mileage fee is determined based on the length of the route planned by Gaode Map; the night surcharge is mainly to compensate for the increase in operating costs during the night (23:00 to 5:00 the next day), for example, in Shanghai taxis, the starting fee and mileage fee will increase by 1 yuan during the night; the floating fare adopts the "base fare ± floating range" model, with floating ranges divided into +5%, 0, and -5% grades; the low-speed fee takes into account the possible congestion during the trip, and estimates the average speed of each congested section of the trip through analyzing historical traffic data and real-time traffic information; the holiday surcharge refers to an additional charge of 10 yuan per trip during the Spring Festival holiday, National Day holiday, and May Day holiday. The server-based billing system will quickly calculate the estimated cost from the starting point to the destination and display it to the passengers before the trip begins. This server-based billing method can effectively avoid the possibility of cheating by traditional meters. When drivers use "small motor" to cheat, the actual generated cost will be higher than the estimated cost by the server, but in the final settlement, the system will choose the estimated price as the final fare.

2.3 Passenger Experience Workflow

After getting on the vehicle, passengers can input their destination on the in-vehicle terminal or use the voice recognition function for voice input. After inputting, the system will automatically call out the Gaode Map for route planning, and generate an estimated price and estimated mileage according to the billing rules of the server. Then, it will display these on the in-vehicle terminal, and also notify passengers through voice announcements, so that passengers

can clearly know the cost range before the journey begins. After the journey is over, the system will automatically obtain the actual metered pricing result and compare it with the estimated price. If the actual metered pricing is lower than the estimated price, it will be taken as the standard; if the estimated price is lower than the actual metered pricing, the estimated price will be taken as the standard. Passengers only need to pay the lower fee. This mechanism can not only protect the passengers' interests but also increase the frequency of passengers using taxis.

3. Result

3.1 Price Transparency

The traditional taxi pricing method mainly relies on the real-time billing of the meter. Before the journey begins, passengers often cannot accurately know the amount they need to pay. This lack of transparency can easily cause passengers to worry and lose trust in the price. The estimated pricing model, by showing the estimated price before the journey starts, enables passengers to understand the cost range in advance, thereby reducing disputes caused by unclear prices. Passengers can clearly know approximately how much they need to pay before getting in the car, which not only improves passengers' satisfaction but also enhances their trust in the taxi industry. Moreover, this transparent billing method also helps to regulate drivers' charging behavior and reduce the occurrence of arbitrary charging.

3.2 Cheating prevention mechanism

One of the core advantages of the estimated pricing model lies in its powerful anti-cheating mechanism. Traditional meter cheating mainly involves installing cheating devices on the meter to falsely increase mileage or time. However, in the estimated pricing model, the billing process is entirely completed by the server system based on preset rules, unaffected by the actual readings of the meter. The system will generate an estimated price according to the billing rules, the route planned by Gaode Map, and real-time traffic information, and compare it with the actual metered billing at the end of the trip. The lower of the two prices will be used as the final charging basis. This comparison mechanism ensures that even if the driver uses cheating devices, they cannot benefit from it, effectively preventing the occurrence of meter cheating. At the same time, this model also provides passengers with dual protection. Even if a dishonest driver uses cheating devices, passengers only need to pay a lower fee, maximizing the protection of their economic interests.

3.3 Improvement in operational efficiency

The estimated pricing model not only has significant advantages in terms of price transparency and fraud prevention, but also effectively improves the operational efficiency of taxis. Firstly, through the route planning function of Gaode Map, drivers can know the optimal driving route in advance, avoiding taking detours or encountering severe congestion due to unfamiliar road conditions, thereby saving time and energy consumption. Secondly, this model reduces the communication cost between drivers and passengers regarding the price before the trip begins. Under the traditional pricing method, drivers and passengers sometimes have disputes over the price, while the estimated pricing model, by showing the estimated price in advance, enables passengers to accept the price before getting in the car, reducing unnecessary communication and disputes, and improving operational efficiency.

4. Existing Problems and Challenges

4.1 Technical Challenges

Despite the numerous advantages of the estimated price model in design, several technical challenges arise during practical implementation. Firstly, although Gaode Map's route planning generally provides accurate route information, inaccuracies may occur under special circumstances such as road construction or sudden traffic accidents. These deviations could lead to discrepancies between the estimated price and actual travel conditions, compromising billing accuracy. Secondly, the stability of the server-based billing system is critical. The system must seamlessly integrate with onboard terminal devices, Gaode Map APIs, and other related systems to ensure real-time and accurate data transmission. System failures or poor vehicle network connectivity may result in billing errors or failure to retrieve estimated price data, negatively impacting user experience and operational efficiency for drivers.

4.2 Operational Challenges

At the operational level, the estimated price model faces additional hurdles. On one hand, some drivers exhibit resistance to the new billing model. Familiarity with traditional taximeters contrasts with the requirement for drivers to input destinations before trips under the estimated price model. Issues such as slow typing speeds or non-standard Mandarin pronunciation may increase workload and frustration for older drivers. Moreover, drivers may fear reduced income if estimated prices are perceived as too low. On the other hand, passenger skepticism poses another challenge. While estimated prices are generated using scientific billing rules and Gaode Map routing algorithms, their preliminary nature necessitates supplementary validation through big data analysis to ensure price reasonableness.

4.3 Regulatory Challenges

At the regulatory level, the estimated fare is subject to the influence of Gaode Map's estimation service interface, necessitating stringent oversight of its algorithms, particularly to ensure alignment with annual fare adjustment packages and real-time synchronization of holiday surcharge policies (e.g., additional fees during major holidays). Furthermore, proactive advocacy and guidance are essential to ensure drivers strictly adhere to the established pricing strategies during operational execution.

5. Conclusions

This study proposes an innovative taxi estimated price billing model, aiming to address the opacity and taximeter fraud prevalent in traditional fare calculation methods by integrating Gaode Map's route planning technology and server-based billing rules. The paper elaborates on the principles and design of the estimated price model, analyzing its advantages in enhancing price transparency, preventing fraud, and improving operational efficiency. It also highlights the technical and operational challenges encountered during implementation.

6. Future expectations

In the future, with continuous technological advancements and gradual improvements in industry regulation, the estimated price model is expected to gain broader adoption in the taxi sector. The integration of artificial intelligence and big data technologies could further refine fare prediction accuracy and optimize billing rules. Industry regulators should strengthen oversight of taxi fare practices to promote standardization and institutionalization of the estimated price model. Moreover, this innovative billing paradigm offers fresh insights for the digital transformation of the taxi industry, potentially elevating service quality and competitiveness. Future research could explore the adaptability of the estimated price model across diverse urban contexts and operational environments, as well as strategies to facilitate its large-scale implementation through policy incentives and technological refinements.

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