

## **Understanding the route choice behavior of metro passengers: A case study of Shanghai**

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### **Abstract**

With the rapid and large-scale construction of metro system, the complex network has been formed, providing convenience for users. However, this expansion also leads to an increase in the uncertainty of users' route choice behavior, which poses challenges in accurately predicting human travel demands and effective operation management for metro system. Hence, it is crucial to understand the nature of route choice behavior to ensure the efficient operation of metro system. This study aims to provide valuable insights into the decision-making processes of metro passengers. First, various attributes that influence passengers' route choice decisions are identified, including travel time and its reliability, number of transfers, transfer time, crowding, seat availability, route familiarity and travel context variables (e.g. purpose, pressure). A choice experiment is designed to collect data, this experiment systematically varies eight 4-level attributes and eight 2-level attributes, an orthogonal fractional factorial design was used to lessen task complexity, with 64 situations generated and blocked into 8 subsets using software SAS, which means each respondent was requested to complete a random subset consisting of 8 situations. An online survey was performed in June 2023 in Shanghai. 218 valid questionnaires (1,774 observations) were collected after data cleaning. Discrete choice models like Multinomial Logit (MNL) and Mixed Logit (ML) models are employed to capture the perception of various variables for passengers, with MNL, parameters are constant, while with ML, parameters are random, the heterogeneity among respondents can be captured. Results show that metro passengers value not only travel time but also its reliability when choosing routes, and they prefer routes they are familiar with. Regarding travel context, passengers care more about urgency instead of the purpose of their travel that is about to occur. Besides, the interaction effect between travel time and time pressure is uncovered, implying that passengers are more sensitive about travel time when traveling is urgent. Meanwhile, other variables like transfer, crowding, and seat availability are statistically significant as expected. This illustrates metro passengers would trade off various factors when making route choice decisions. Latent class choice model (LCCM) is additionally applied to capture the potential heterogeneity of different individuals. The passengers are categorized into two latent classes based on the indicator BIC (Bayesian Information Criterion) index. The first class respondents—who make up 64.68% of the samples—present a strong inclination towards prioritizing travel time, emphasizing efficiency when choosing routes, while the remaining second class respondents present a preference for comfort. Moreover, respondents with high income are less likely to choose the comfort option, whereas respondents with more than 10 years of driving experience are more likely to do so. The implications of this study could be used for the design strategies and future planning of metro systems as well as the development of innovative solutions to enhance the overall commuting experience for passengers.