The Effects of Weather on Passenger Flow of Urban Rail Transit

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Abstract

Predicting passenger flow on urban rail transit is important for the planning, design and decision-making of rail transit. Weather is an important factor that affects the passenger flow of rail transit by changing the travel mode choice of urban residents. This study aims to explore the influence of weather on urban rail transit ridership, taking four cities in China as examples, Beijing, Shanghai, Guangzhou and Chengdu. To determine the weather effect on daily ridership rate, the three models were proposed with different combinations of the factors of temperature and weather type, using linear regression method. The large quantities of data were applied to validate the developed models. The results show that in Guangzhou, the daily ridership rate of rail transit increases with increasing temperature. In Chengdu, the ridership rate increases in rainy days compared to sunny days. While, in Beijing and Shanghai, the ridership rate increases in light rainfall and heavy rainfall (except moderate rainfall) compared to sunny days. The research findings are important to understand the impact of weather on passenger flow of urban rail transit. The findings can provide effective strategies to rail transit operators to deal with the fluctuation in daily passenger flow.

Keywords: Urban Rail Transit; Weather Effect; Passenger Flow; Estimation Model.

1. Introduction

The passenger flow estimation of urban rail transit is commonly used as the basis for the planning, design, and daily operations of rail transit. Weather can influence people's travel mode choice, and then have an impact on passenger flow of rail transit. But, weather factors are not usually presented in the existing models for estimating rail transit ridership, which results in an insufficient or excessive estimation in the design stage, and unexpected large fluctuations in operation stage. With the rapid development of urban rail transit, one challenge is to figure out the impacts of weather factors on passenger flow of rail transit. The relevant research mainly includes three aspects: data pre-processing of passenger flow [1, 2], quantitative analysis of impact factors [3-7] and the development of estimation models [8, 9].

Several studies have established the effects of rain and snow on public transit ridership. Inclement weather has an impact on people's travel modes and travel routes, and further affects on passenger flow in public transport [10, 11]. Changnon [12] found that summer rain days have a reduced number of passengers using public bus compared to summer sunny days. Cravo et al. [13] found that rain and snow have negative impacts on passenger flow of bus and subway.