Exploring the relationship between mode selection and usage frequency in multi-day mode choice patterns for commute trips

Ganesh Ambi Ramakrishnan[1,*], Karthik K. Srinivasan[1], Shobhit Saxena[2], Abdul Rawoof Pinjari[3], Chandra R. Bhat[2] and Ram Pendyala[4]

[1]Department of Civil Engineering, Indian Institute of Technology Madras, Chennai 600 036, India
[2]Department of Civil, Architectural and Environmental Engineering, The University of Texas at Austin, Texas 78712, USA
[3]Centre for Infrastructure, Sustainable Transportation and Urban Planning, Indian Institute of Science, Bengaluru 560 012, India
[4]School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe, Arizona 85287, USA

The present study introduces a comprehensive multiple discrete-continuous extreme value (MDCEV) framework to study multi-day mode choice decisions among workers in Chennai, India. Unlike the popular cross-sectional models, this framework accounts for both mode selection and mode usage dimensions simultaneously. Specifically, individuals are assumed to select a portfolio of modes with varied frequencies to meet their diverse activity and travel requirements. The mode shares and frequencies vary considerably between primary (regular) and secondary (alternative) modes. Primary modes have a high mode use frequency (85–94%) but comprise only 38% sustainable mode share. In contrast, secondary modes have a larger sustainable mode share (59%) but a lower frequency (12–18%). The proposed MDCEV model is superior to existing models in predicting primary mode frequency by 42–50% and secondary mode frequency by 22–29%. The improvement in the discrete component is also substantial, ranging from 55% to 56% in terms of mode adoption, 30–31% for primary mode shares, and about 66–67% for secondary mode shares. The MDCEV results show a complex and non-linear relationship between the mode usage intensity and the mode selection dimensions. Specifically, the multiple-discrete nature of mode choice and the multiple peaks in mode use frequency are represented. Additionally, the set of influential factors varies across dimensions of mode selection and mode use frequency. Non-commute activities and micro-access to transit influence both the likelihood of adopting a mode and its subsequent usage frequency, whereas features such as first- and last-mile connectivity primarily affect how often the mode is used once it has been chosen. Furthermore, sensitivity to the 'translation parameters' satiation effects differs substantially across modes, unlike in prior literature. Additionally, the model results indicate potential complementarity and substitution effects in the usage frequency across modes. Neglecting these complex relationships can lead to a poor model fit and biased coefficients. The models and results have significant practical implications. By utilising richer multi-day data and models, planners can differentiate the roles of key factors in mode adoption or consideration, primary and secondary mode choice, and mode usage frequency dimensions. Illustrative policy analysis reveals that various policy levers can be employed to encourage intensities of primary and secondary mode usage. For instance, improving train service network coverage affects the frequency of primary mode, whereas direct bus services can enhance the frequency of secondary mode usage.

Keywords: Alternative-specific gamma profile, MDCEV model, multi-day mode choice, multivariate mode frequency, unimodal and multimodal segments, primary and secondary sustainable mode choice

TRAVEL mode choice is an important facet of travel behaviour with significant implications for urban traffic congestion, energy consumption, and environmental impact. Existing literature on mode choice has focused predominantly on cross-sectional data. This approach elicits aggregated mode choice information in the form of 'usual' or 'most often used' mode of travel without reference to the number of days or alternative modes used. The cross-sectional choice models focus on mode choice decisions on a single trip or a trip chain and do not recognise the possibility that a user might use various modes over longer periods (e.g., a month), and hence neglect information on less frequently used modes.

It is not uncommon, especially in developing countries, to observe multimodal behaviour in multi-day datasets, wherein different modes are used by an individual over different days[1]. However, this multi-day mode choice process is relatively underexplored[1]. Multi-day datasets provide a wealth of mode choice information that is not observable in cross-sectional data. These include: (i) the travel modes chosen by an individual at least once in a given period (i.e.,

*For correspondence. (e-mail: ambi.ganesh@gmail.com)