Project: The Latent Classes in Joint Residence-Workplace Location Choice, and Travel Behavior Study
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Project Purpose

Residential and workplace location choices have been studied extensively in travel demand modeling and urban planning literature. This is understandable given that these medium-to-long term location choices have a significant impact on day-to-day short term activity-travel decisions. I conventional choice (e.g. MNL) models, the utilities of different alternatives are specified as a function of different observed variables that can affect the choice being modeled. The parameters in the utility specification are estimated using survey data such as household travel surveys. However, several important factors including attitudes and preferences are typically not observed in the survey data. For instance, it is reasonable to assume that there are certain households/people who have greener life styles or tech-savvy attitudes from the rest of the population. People in these 'neo' households are likely to have different residential and work location preferences compared to those in 'conventional' households. But, these attitudinal variables are not available in most revealed preference datasets. So, standard choice models cannot control for these factors. In such scenarios, latent class models that can probabilistically classify households into latent classes (e.g., neo and conventional) are particularly useful. It is important to note that these groups or classes are not observed in the real world (and hence the name 'latent'). The goal of the research is to determine the effect of household characteristics on travel behavior and joint residence-workplace location choices using the latent class approach. Location choices and travel behavior are the reflection of prevalent preferences of individual household. Latent class models are appropriate for this analysis because of the facts that discrete lifestyle preferences exist, they are not directly observed from the data, unquantifiable and that households with different lifestyles will exhibit different location choice (for residence and workplace) and travel behavior. Latent class models allow us to cluster households with similar characteristics which are able to better explain the travel behavior along with joint residence-workplace location choices. The latent class approach helps to determine suitable number of household groups, identify characteristics that lead to segmentation and estimate prevalence of those groups. Several key observed variables including household socio-demographics (e.g., household composition, income, auto ownership), employment details of workers (e.g., occupation industry, part-time versus full-time status, work flexibility), and travel behavioral preferences (usual commute mode, average trip rates, frequency of non-motorized mode usage) will be tested in the latent class membership model component.

Analytical Approach

This project developed a latent class model that explicitly accounts for probabilistic nature of choice sets by using a two-stage modeling framework that assumes people first pick a neighborhood and then look for specific locations within the chosen neighborhood. The expected utility from the second stage zonal choice model component was used as an explanatory variable in the utility specification of neighborhood choice model to link the two models. The model was used to analyze residential and work location decisions in Nashville, Tennessee. The model results indicate significant heterogeneity in the consideration probability of different neighborhood alternatives both in the residential and work location choices. Also, the latent class neighborhood models were found to outperform standard MNL models that assume all decision makers consider the complete universal choice set in their decision making. The model applicability was demonstrated by calculating elasticity effects and identifying demographic groups with considerably different residential and work location preferences.

Initial Findings

The data for this study is derived from the 2012 household travel survey data conducted in Nashville metropolitan area. In addition to geo-coded location information, the data include detailed socio-economic and demographic data and activity travel diary data of all respondents. The travel skims and network related variables were gathered form the Nashville Travel Demand Model (TDM). Instead of using the

standard definition of spatial unit of location choices (census tract or TAZ), this paper employs neighborhood categories based on household and employment density to characterize location choices. This helps make the definition of choice alternatives clear and manageable and more effectively captures the notion that people are looking for a built environment (land use density) that suits their mobility and lifestyle preferences. In other words, people are not choosing between TAZ A or B directly, but rather between a unit that offers a built environment of certain attributes versus another unit that offers a different built environment. Residence and workplace locations are categorized into four possible alternatives or neighborhoods based on a combination of population and employment density (population and employment in the half mile radius). After extensive data cleaning, the final estimation sample includes 4,344 households and 3,992 employed individuals without any missing information on all explanatory variables used in this study. The distribution of individuals in the four residential neighborhood alternatives was - 8.90% rural, 29.74% suburban, 60.36% urban, and 1.00% CBD. The distribution of individuals with respect to work neighborhood was 2.96% rural, 17.41% suburban, 65.88% urban, and 13.75% CBD. In the final sample, the share of respondents who live in CBD was quite low. So, the estimation of latent choice set model where people considered CBD alternative probabilistically is difficult with such small sample size. So, respondents are assumed to either consider or do not consider both the CBD and URBAN alternatives as a bundle but not separately. So, the set of feasible choice sets is reduced to the six possibilities: {CBD, URBAN, SUBURBAN, RURAL}, {CBD, URBAN, SUBURBAN}, {CBD, URBAN}, {SUBURBAN, RURAL}, {SUBURBAN}, {RURAL}. For the same reasons, the SUBURBAN and RURAL alternatives are considered as bundle in the latent choice set component of the work neighborhood choice model. Latent choice modeling has served as a valuable modeling method for identifying population segments with significant behavioral heterogeneity, probabilistic choice sets, decision rule heterogeneity, and alternate dependency pathways among inter-dependent choices. However, studies that used latent choice methods in the context of location choices are relatively rare. This is primarily because of large choice sets in zonal-level destination choice models that make it unwieldy for estimating latent class models.

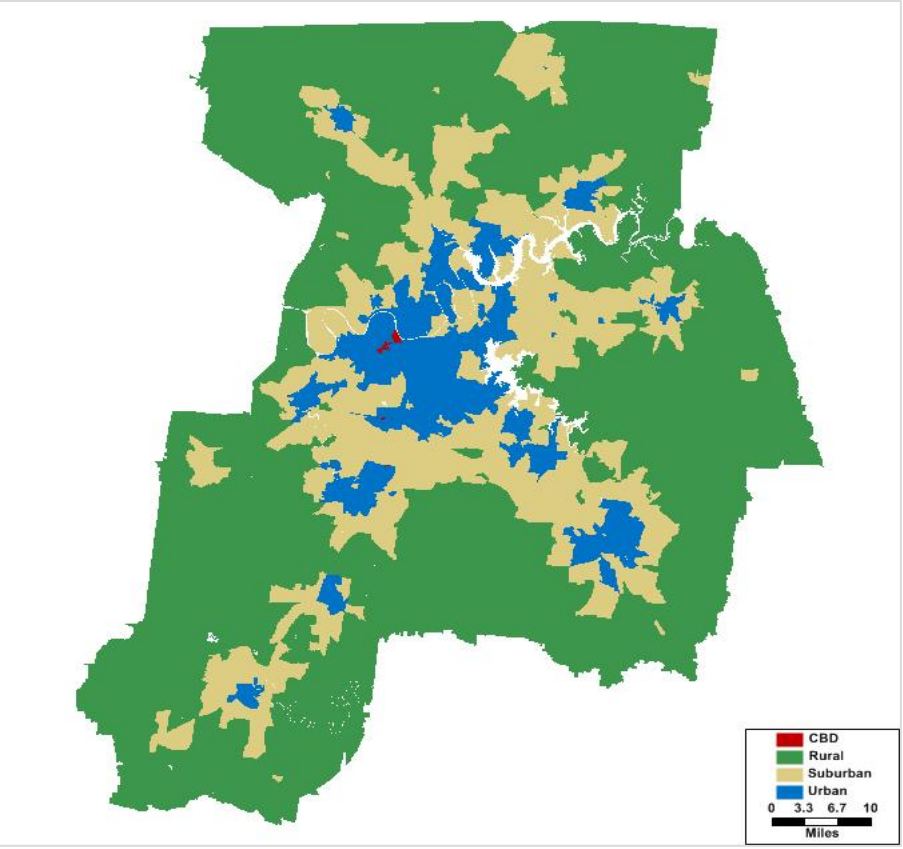

Figure 1. Neighborhood Based on Residential & Employment Density.

Project Result Dissemination

Paleti, R., Mishra, S., Haque, K., Sarker, A., Golias, M., and Chen, C. C. (2017). Latent class analysis of residential and work location choices. Paper submitted for presentation at the 96th Annual Meeting of Transportation Research Board, Washington DC, and publication in Transportation Research Record.