Project Title: The Spatial Effect of Socio-Economic Demographics on Transit Ridership: a Case Study in New York

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Demand for vehicle and public transportation systems continues to increase in and around major urban centers. This increase is especially pronounced during the morning and evening commutes and is further complicated by the complex spatial interactions that influence the variation in system demand. In an effort to help agencies better understand this variability and develop better demand forecasts this research investigated the underlying factors impacting public transportation ridership regardless of transit mode, then uses this insight to estimate specific models to help forecast changes in subway ridership. The spatial database for the case study consisted of social, economic, and land use characteristics for all 2166 census tracts in New York City, NY's five boroughs. The data were used to estimate spatial econometric models for the percentage of commuters using public transportation at the census-tract level and the change in subway ridership between 2011 and 2016 at the subway station-level.

Analysis of the commuters indicate that census tracts with a higher average commute time, greater employed population, higher per capita income and lower median household income were found to have a higher percentage of commuters using public transportation. Additionally, this percentage increased if neighboring census tracts had a greater commercial space area or fewer buildings. Lastly, the percentage increased in a tract if it increased in neighboring tracts and vice-versa. The may be reflecting social norms or stigma related to public transportation versus personal vehicle ownership.

Results of the change in subway ridership between 2011 and 2016 indicate that subway stations that serve more train lines or are in areas comprised of census tracts with a greater number of tax units (residential, commercial, etc.) or lower mean household incomes experienced a greater increase in ridership. Furthermore, subway stations located in areas surrounded by census tracts with more commercial property or higher median family income are also expected to have a greater increase in ridership. Lastly, ridership at a given station decreases due to an increase in ridership at neighboring stations. This may indicate that a change in ridership at a station is due, in part, to riders in a region changing which station they use instead of riders shifting from alternative modes of transportation.

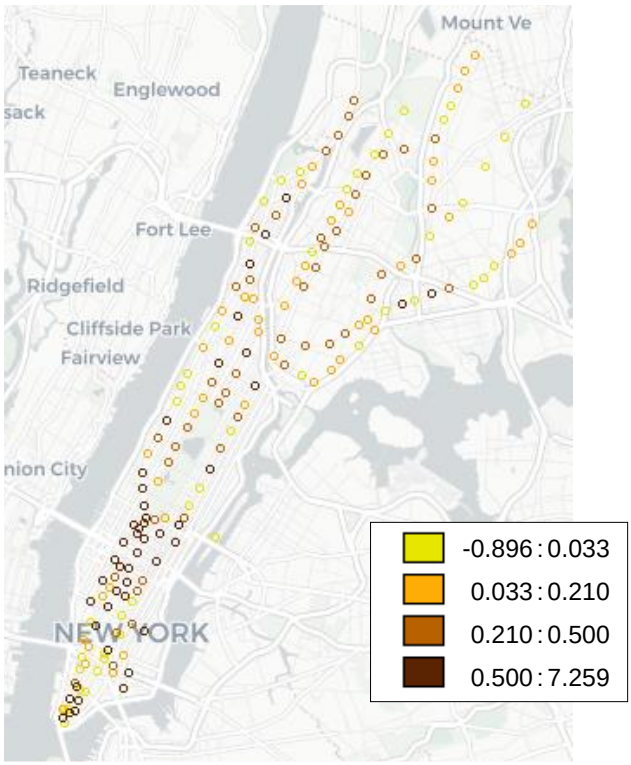

Figure 1. Change in Subway Ridership between 2011-2016 (in millions)

The spatial models were found to have a higher overall model fit compared to their non-spatial counterparts. Moreover, spatial dependence was found to be statistically significant in both models. Failure to account for spatial dependence in estimating public transportation use at the census tract or station level could lead to biased, inefficient or inconsistent parameter estimates. The completed research can help public agencies better address resource allocation by identifying locations for network expansion or locations that are over or underperforming in terms of expected ridership.

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