SOCI 40217 Research Question
Assessing Transit Equity via Commuting Times

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1 Introduction & Background

In my research paper, I plan to investigate issues regarding equity and transit in Chicago through understanding the differences in commute times. Not only are long commute times associated with poor health outcomes [4], but they also can reveal issues regarding public transit access and planning. While we would expect areas with less transit access to have longer commute times, if there exists areas in which there are many transit stops but residents still experience long commute times, then public transit planning to get people where they need to go. During the course of this project, I seek to answer the following questions: Does current transit access address commute patterns for all Chicagoans equally? Specifically, does transit accessibility affect low-income and non-white communities differently with respect to commute times?

Previous research regarding commute times and commute distances fail to address spatial correlation issues [2] or utilize multilevel modeling instead of spatial regression[1]. While one paper does include spatial econometric models to understand commute times and modes of transit through job accessibility [3], I plan to extend this research through incorporating specific transit station data spatial regression and analyzing more recent data from the City of Chicago.

2 Data Description

To conduct this analysis, I will download data from the City of Chicago Data Portal and the Census Bureau's American Community Survey 5-year estimates (ACS). Because the smallest geographic region available from the ACS is block group, the data will be aggregated at the block-group level. There are 46,300 block groups in Chicago as defined by the 2010 census, which will serve as the data points in this research.

The City of Chicago Data Portal will provide information regarding the transit stops (bus and subway/L stations) and the shape files for the block groups. The ACS will provide demographic data for the census tract, including but not limited to race/ethnicity, income, number of vehicles owned, commute times, commute modes. Please see below for demographic information to be used from the ACS as variables in my analysis. As the transit data that is available for this analysis was updated in 2019, I will use the ACS data for the time period of 2013-2018 as 2019 data will not be publicly available until later this year.

3 Model Specification

3.1 Outcome variable

Because the ACS commute times data is binned, e.g. under 5 minutes, between 5 and 9 minutes, for interpretibility, I will convert this data into the dependent variable of percentage share of the block group's population with above median commute time. Median commute time will be determined by aggregating across all data to get the city-wide median commute bin. Any individuals with commute time greater than the upperbound of this bin will be considered a high travel time commuter. The outcome variable will then be the percentage of people in this block group that are high travel time commuters.

3.2 Independent Variables

I plan to incorporate the following independent variables into my analysis:

- Percentage car-light households: a car light household is defined as having fewer vehicles than residents in a household, e.g. two people live an apartment and share 1 car.
- Density of block group: number of residents per square mile.
- Percentage of working age residents.
- Percentage of residents below poverty line.
- Percentage of employed residents.
- Percentage of Hispanic residents.
- Percentage of black residents.
- Number of public transit stops (bus or train stops) within half mile from the centroid of the census block: the half mile distance from the centroid will be used because it is in keeping with previous literature, which is roughly based on locations under a 15 minute walk.
- Percentage of residents that use personal vehicles to commute to work: this will include those that carpool and those that drive individually.
- Percentage of residents that use public transit to commute to work: this will include both bus and L riders.
- Interaction term between number of transit stops and percentage of residents that use public transit.

3.3 Model

While I need to run LM Error and LM Lag tests to understand whether a spatial lag or spatial error model would better suit the data, there is motivation for both due to the following reasons:

1. Spatial Lag Model: Because traffic patterns in one block group can significantly influence traffic and therefore commute time in another group, there is justification for investigating a spatial lag model. For example, wider streets in one block group could lead to lower commute times in surrounding block groups for both car and bus commuters. Additionally, because many public transit commuters change transit lines throughout their commutes (e.g. to commute to River North from Hyde Park, someone may ride the 15 bus to the red L line), the transit lines within an adjacent block group will affect the commute times of a given block group.

2. Spatial Error Model: By nature, public transit is continuous in that a transit line will cross multiple, adjacent block groups. Therefore, block groups near each other are more likely to share transit lines than block groups located far away from one another. This similarity in transit lines may influence the outcome variable of commute time and therefore, the error term in a regular OLS regression model would be correlated. Chicago's spoke-and-wheel transit model could also amplify this correlation.

References

[1] Boer Cui, Geneviève Boisjoly, Ahmed El-Geneidy, and David Levinson. Accessibility and the journey to work through the lens of equity. *Journal of Transport Geography*, 74:269–277, 2019.

[2] Lingqian Hu. Racial/ethnic differences in job accessibility effects: Explaining employment and commutes in the los angeles region. *Transportation Research Part D: Transport and Environment*, 76:56–71, 2019.

[3] Mizuki Kawabata and Qing Shen. Commuting inequality between cars and public transit: The case of the san francisco bay area, 1990-2000. *Urban Studies*, 44(9):1759–1780, 2007.

[4] Annette Schaefer. Commuting Takes Its Toll. `https://www.scientificamerican.com/article/commuting-takes-its-toll/`, 2019. Accessed: 2020-04-26.