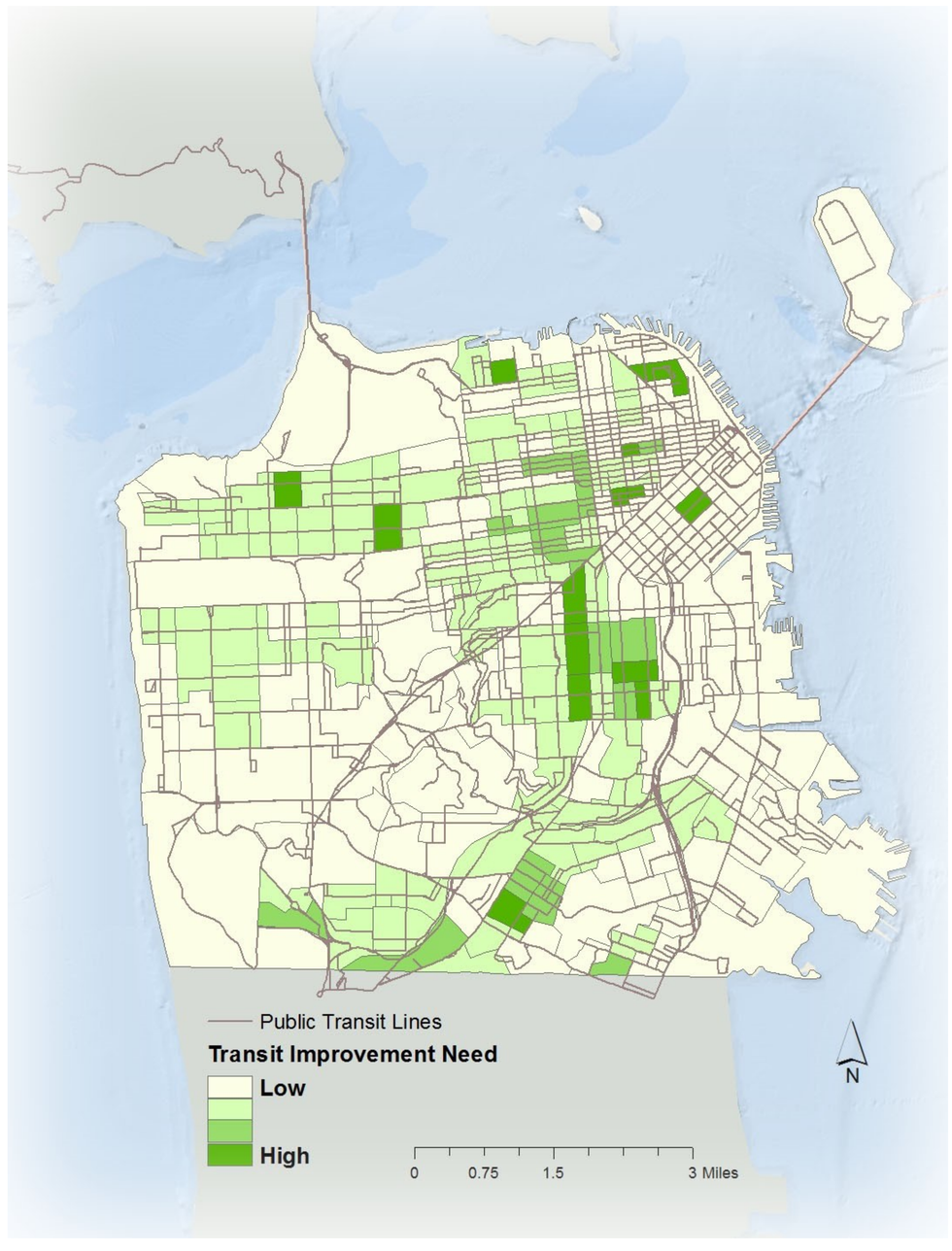
Examining San Francisco's Public Transportation Accessibility and Needs

Tufts University

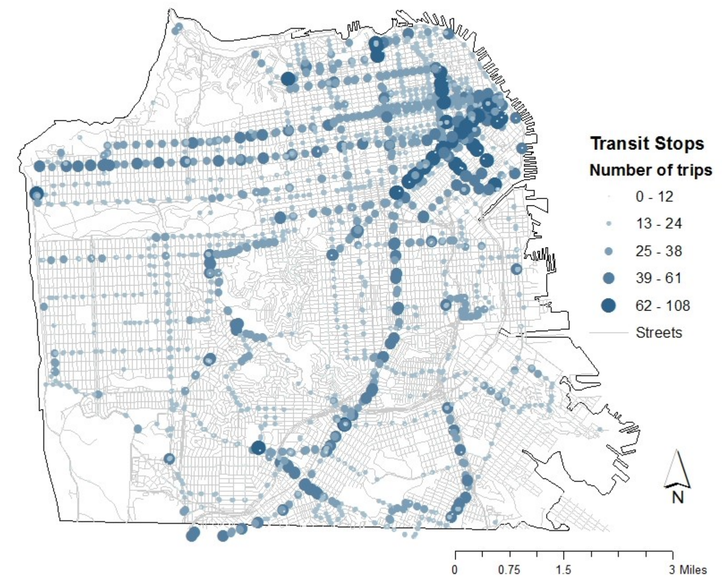
Introduction

As the second densest major city in the US, San Francisco has a need for a good public transportation system to ease traffic congestion and make the city more accessible for low-income and disabled residents. San Francisco Municipal Transportation Agency (SFMTA) operates the Muni system, which includes buses, metro trains, and cable cars. SFMTA is constantly making improvements to the transit system, which have benefits such as decreased traffic congestion, increased safety, and increased air quality. One example is the making road lanes into bus-only lanes marked with red paint, a project that started in 2014.

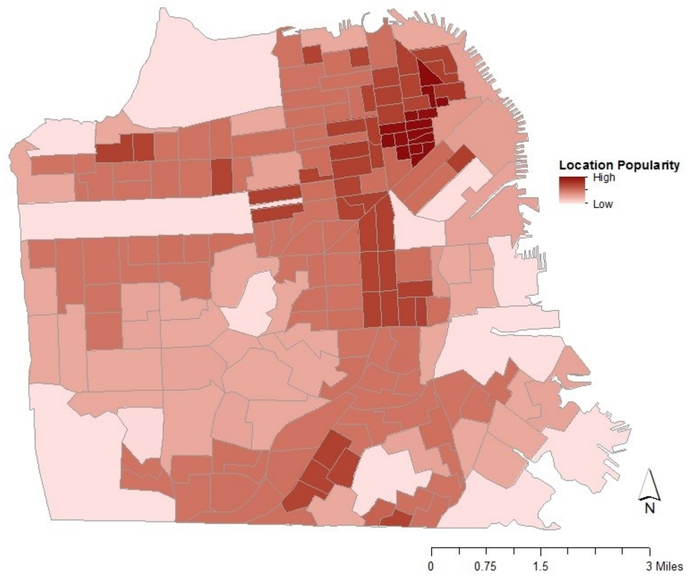
When deciding where to make these improvements, it's important to consider that not all areas of the city require the same level of service. Most of San Francisco's residents and offices are concentrated on the eastern half of the city. Analyses can be performed by categorizing the city's land as residence, work, or service to determine which areas have the highest density of people traveling to and from that area (Boelter & Branch, 1960). These areas should be most accessible by public transportation. Other analyses have measured accessibility of a public transportation system by considering both the path it travels as well as how frequently the line runs (Farber & Fu, 2017). Areas with disparity between need and current accessibility are likely the areas that should be improved.



Public Transportation Accessibility from 8am-9am



Location Popularity



Methodology

To determine location popularity, 4 factors were used: population density, office space density, educational/cultural space use, and retail space use. Population density was calculated by dividing the total population in a census tract by its area (ft^2). Office space density was found by dividing the total square footage of office buildings by the area of the census tract(ft^2). Educational/cultural space and retail use were both calculated by dividing the total uses according to business points from Dun & Bradstreet by area (ft^2). Four maps showing the mean density or use of each tract are below. Four raster maps were created for each of the criteria, and each of the four raster maps were reclassified into scores from 1 to 5, 1 being low density/use and 5 being high density/use. A weighted average was taken to get location popularity for each census tract.

Population density	50%
Office space density	30%
Education and cultural space use	15%
Retail space use	5%

In order to find public transportation accessibility, General Transit Feed Specification (GTFS) data from SFMTA was used. An R script was used to count the number of trips that depart from each stop between 8:00am and 9:00am. A public transportation accessibility score was found for each census tract by summing the value at each stop and normalizing it by the area of the census tract.

After the location popularity scores and public transportation accessibility scores were found for each tract, z-scores were calculated. In order to show where there are relative disparities between location popularity and public transportation access, the following was found and displayed in the final map.

$$\textit{Transit improvement need} = z_{\textit{popularity}} - z_{\textit{accessibility}}$$

Results

The analysis shows that the areas with the highest need for improvement are spread out throughout the city. The areas with the highest location popularity are do not have high transit needs, meaning they are being served relatively well by public transportation. There are a few downfalls to the method used. For example, the three census tracts in the Mission District (near the center) were rated high for transit improvement need. However, those three tracts are between two transit lines, so while there may not be many stops within the tracts, public transportation is still accessible. Another downfall of the method used is that the number of stops is not always indicative of accessibility because having a higher number of stops can sometimes slow down the trip. However, this analysis gives a good a starting point for deciding where to look at improvements. There are areas with high need for improvement that have transit lines running through them, which could be places to start—changes to the schedule or addition of bus-only lines are a few potential solutions.

Projection: NAD 1983 StatePlane California III FIPS 0403 Feet

Sources: US Census, SFMTA, SFgov

References:

Boelter, L. M. K., & Branch, M. C. (1960). Urban planning, trans portation, and systems analysis. *Proceedings of the National Academy of Sciences*, *46*(6), 824-831.

Farber, S., & Fu, L. (2017). Dynamic public transit accessibility using travel time cubes: Comparing the effects of infrastructure (dis) investments over time. *Computers, Environment and Urban Systems*, *62*, 30-40

Muni Bus [Digital image]. (2012, March 26). Retrieved December 6, 2017, from https://c1.staticflickr.com/9/8375/8596007911_32c14c6ee8_b.jpg

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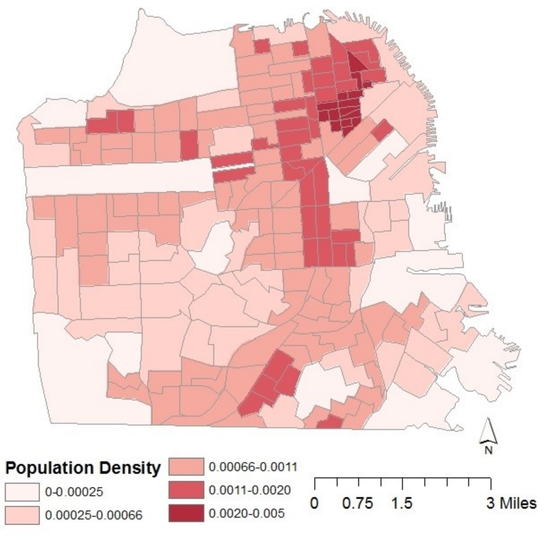
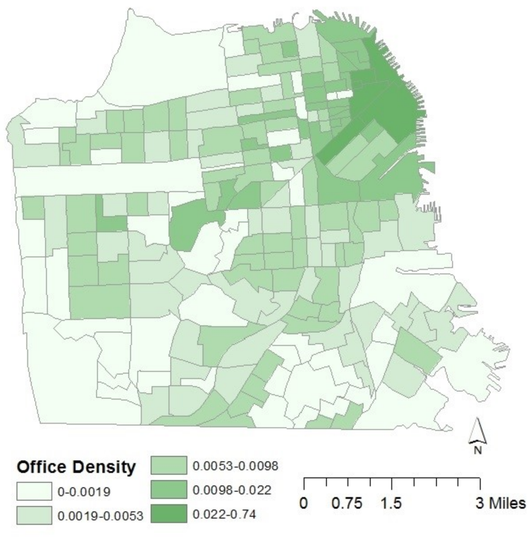
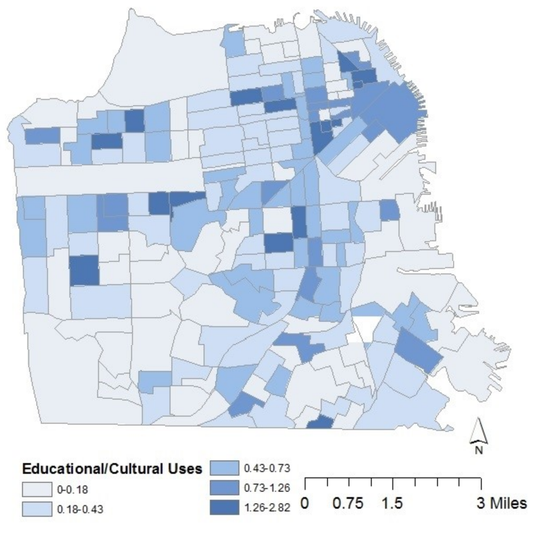
People per ft^2



Office square footage per ft^2



Educational/Cultural use points per ft^2



Retail use points per ft^2