Do Elevators in Subways Promote an Increase in ADA and Senior Pass Use?

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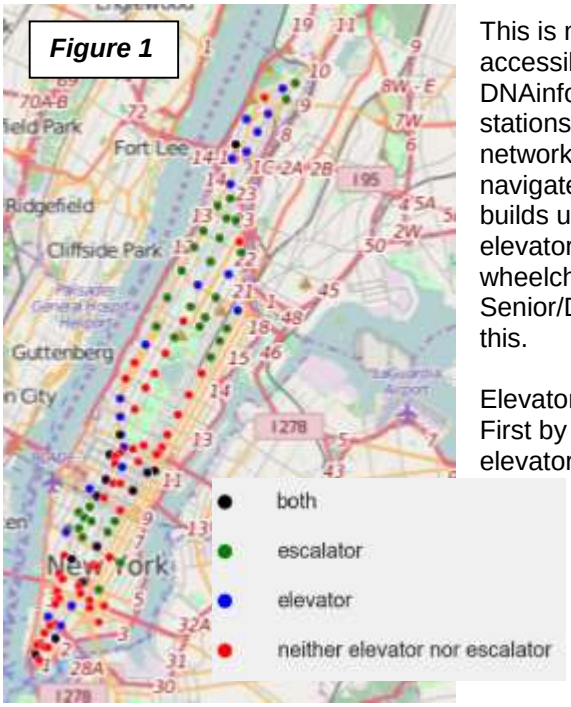
Abstract

The New York City (NYC) subway system offers elevators for approximately 26% of its stations city-wide. This research effort investigated elevator usage by using the Senior/Disabled and American with Disabilities (Senior/ADA) fare types as proxies for use. Efforts sought to determine if there was a difference in use between stations with and without elevators. In addition, the presence of transit connections and amenities such as parks, libraries, and hospitals were evaluated to see if they had a significant impact on use. Results did not show any significant differences or with amenities.

Introduction

The NYC Subway is a valuable transportation asset and carries approximately 8.8 million passengers daily. However, it is built largely for access by foot as there are only elevators in approximately 26% stations. This severely limits the benefits for a sub-set of the population. This project investigates usage by fare swipes between the American with Disabilities Act (ADA) and Senior/Disabled fare types at stations that offer elevators as opposed to stations that don't offer elevators.



This is not the first time someone has looked at subway accessibility. In June of this year, a map was posted on DNAinfo, one of the many blogs about NYC, showing only the stations with wheelchair accessibility for the entire subway network. Another place that discusses accessibility and how to navigate the subway is wheelchairtraveling.com. This study builds upon the two efforts by investigating not just where the elevators are located but if those stations have a higher wheelchair use rate than stations without elevators. The Senior/Disabled and ADA fare types will be used as a proxy for this.

Elevators as an accessibility measure is evaluated in two ways. First by comparing the proportion of use at stations with elevators against stations that do not have elevators. Then determining if amenities such as libraries and parks have influence on usage. Results did not show a significant difference. A map of station types is shown in figure 1.

Data

Data was collected from two main sources, the Metropolitan Transportation Authority (MTA) and Google maps. All compiled datasets are available in the GitHub repository listed above.

Datasets from MTA, all are available on their website:

- Station locations – all subway stations for NYC were collected, only Manhattan was used; this included escalator data
- Elevator locations – separate file from station locations; used reference guide
- Fare data (developer key needed) – compiled a stratified sample using the second week of data for December 2013 through November 2014 in order to represent an entire year's worth of useage

Data from Google Maps was collected by creating a one half-mile (.5 mile) buffer from the station location (calculating by using .5 mile on the street network may yield different results):

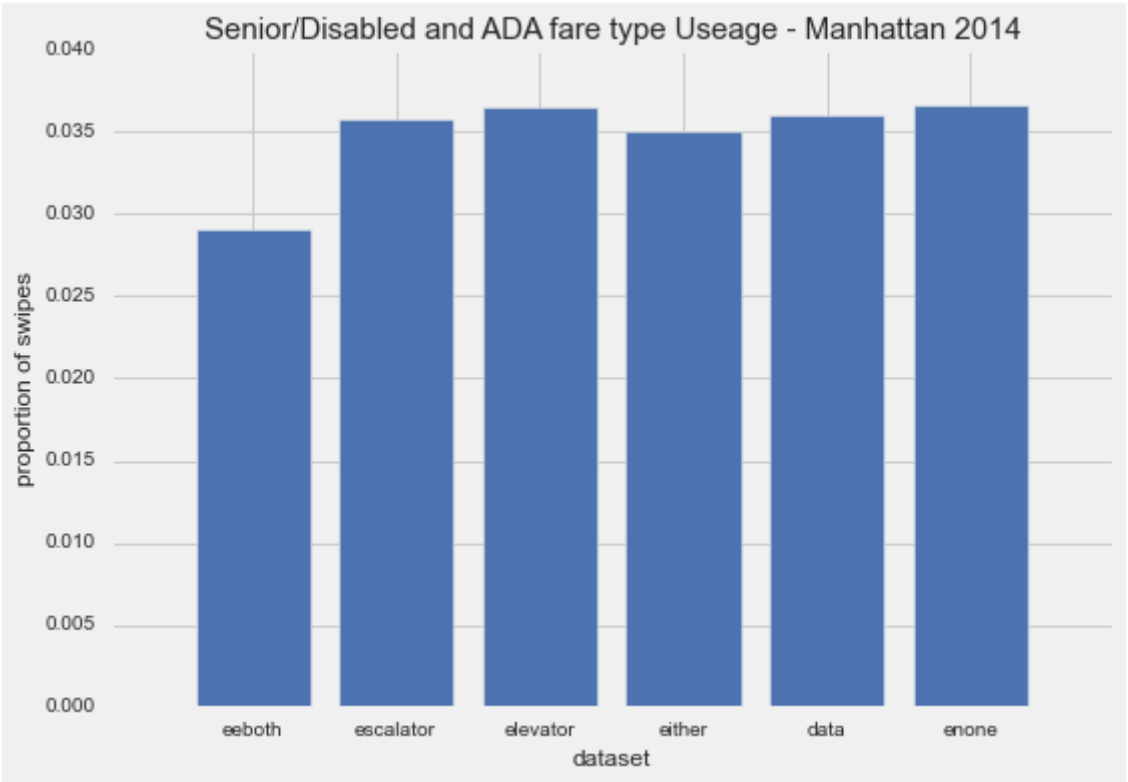
- Libraries – branches of the NYC Public Library
- Hospitals – major hospitals such as Cedar Saini
- Parks – all greenspaces were counted as "1" so playgrounds, community parks, and Central Park all had the same weight

Datasets were combined in csv files. The most difficult process was combining fare data with station locations because there was not a common field to map. Fare data had station names that used "+", "&", "and" which made it difficult to combine with locations (no unique identifier in datasets). Datasets were mapped by hand in the csv files.

Methodology

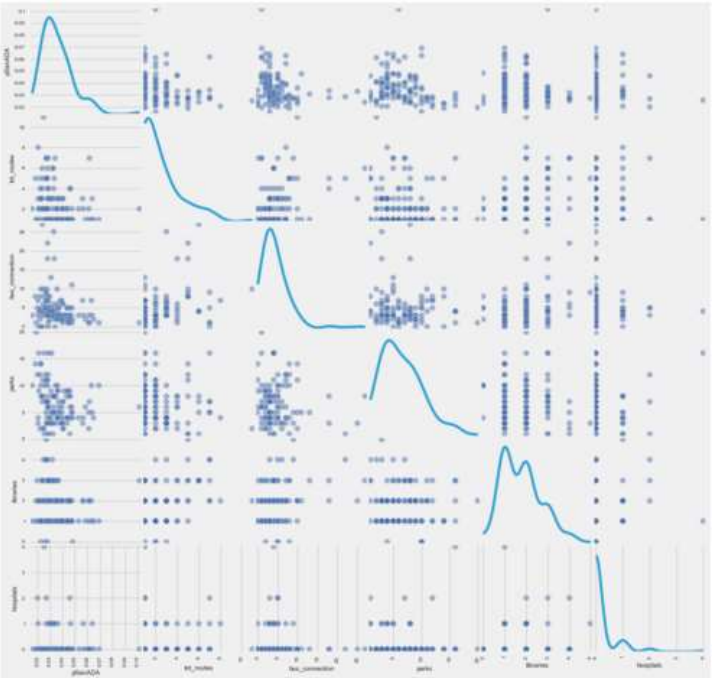
Python and corresponding packages numpy, pandas, statsmodels, and others were used to evaluate the data. After basic descriptive stats, a plot of the proportion of Senior/ADA fare swipes was created to provide a visual representation as shown in figure 2.

Figure 2



It is surprising to see such little variation in results, especially between the 'enone' dataset (stations without an elevator or an escalator) and the stations with elevators which appear about the same. To confirm if a difference existed, a spearman correlation test was performed and confirmed that no, there was not a difference in distribution between the two datasets. Scatter matrices were produced to further investigate the data and it appears that a relationship exists between proportion of Senior/ADA fare swipes and transit connections and parks as seen in figure 3.

Figure 3 - Proportion of Senior/ADA fare swipes is the left-hand column, transit connections and parks are columns 2 through 4.



Further relationships and predictive analysis was performed through a series of regression analyses. The proportion of Senior/ADA fare swipes was used as a dependent variable and transit connections, parks, libraries, and hospitals were the regressors. The first regression used the full dataset and all the regressors.

The regression did not offer much significance, r-squared was under 0.2 and several variables had a p-value over 0.1. As such, a second model was run with only the significant variables but it did not yield results with increased significance.

The regression process was re-run with all the datasets. Most models produced results similar to the first, low r-squared vales and high p-values for the coefficients. Another disconcerting result was that most confidence intervals were very small and included the intercept. This means that the effect could be positive or negative so significance could not be validated.

Conclusions

Findings did not show any significance. Correlations did not produce a significant p-value and therefore a difference in distributions could not be rejected. Regression analysis did not show transit connections or amenities within .5 mile from a station with an elevator or escalator produce (or predict) an increase of station use. This is contrary to the initial thought that stations with elevators would have a higher proportion of Senior/ADA fare swipes.

Because of the lack of significance, there may be some latent variable that was not included in the model. Possible variables include age of station (or pre-ADA passing versus older stations) or a wide variety in station types (some stations are in more residential areas, some have magnitudes of use 10 or more times others).

Future work

Future work could include grouping by stations that have similar characteristics, general use rate, neighborhood demographics, and the like. Comparisons to bus usage could also be made to determine which system is more accessible.

Bibliography

MTA Accessibility info (elevator listings in Manhattan)
http://www.nyc.gov/html/mopd/downloads/pdf/accessibility_guide.pdf

MTA Fare Usage (developer key may be needed)
http://web.mta.info/developers/fare.html

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Code

https://github.com/MFilippelli/PUI2015_EC