ORF467 Final Project
Group 3: Transit Trips
New York Region -- NY, NJ, CT

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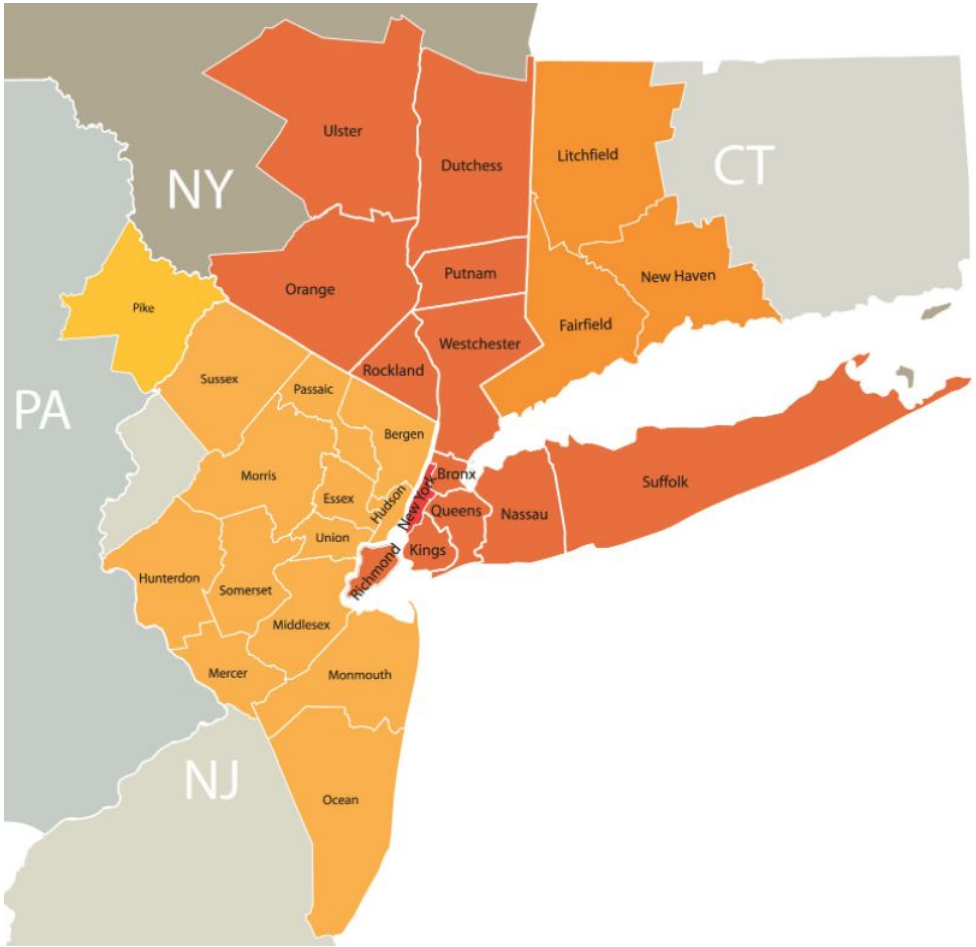
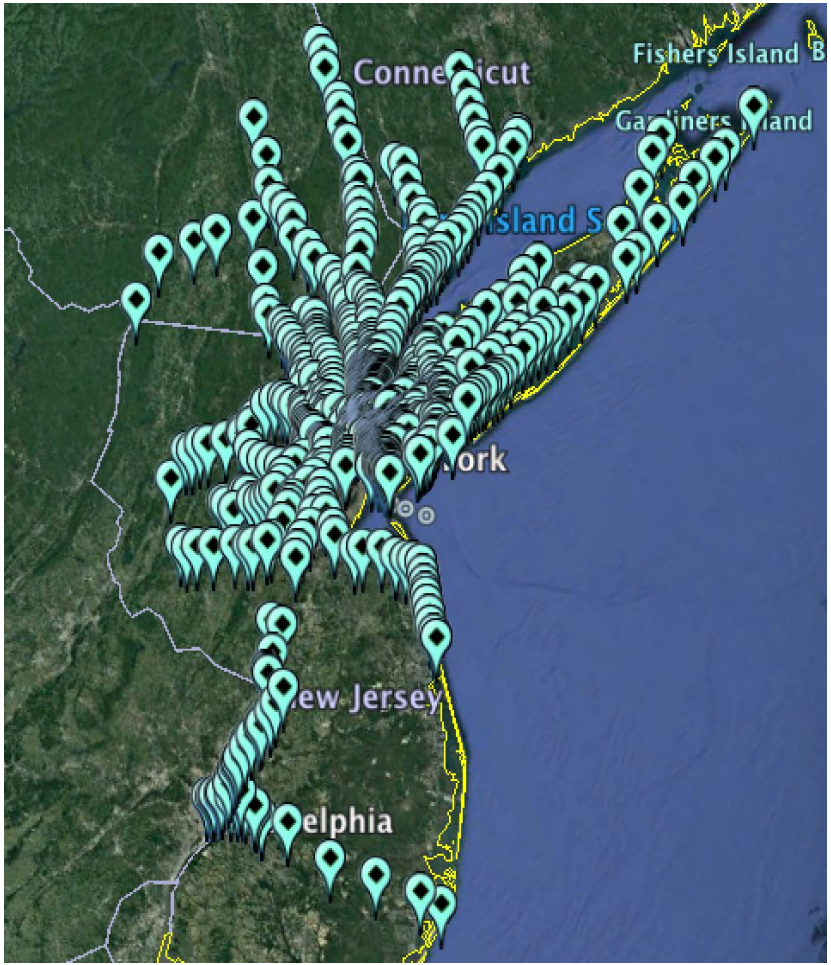
1/13/17

The New York City Metropolitan Area

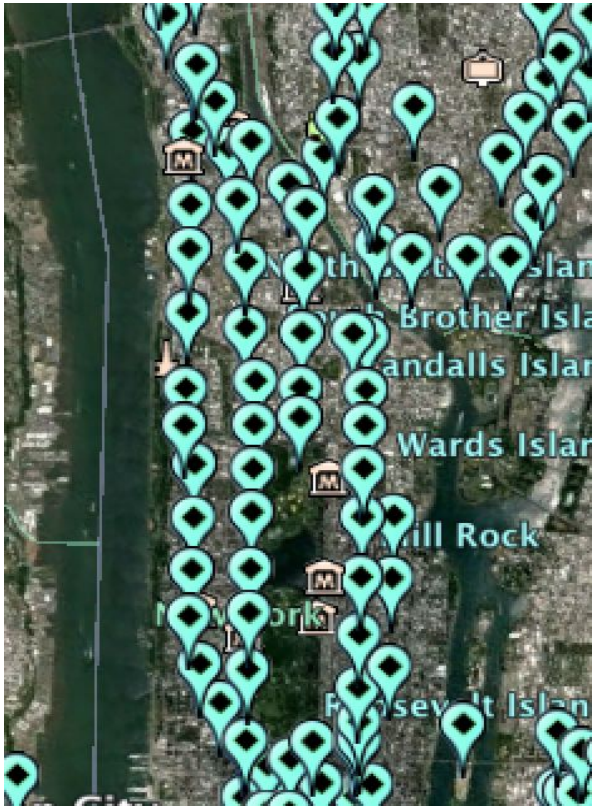
- “Combined Statistical Areas (CSA) group together adjacent core-based statistical areas with a high degree of economic interconnection.”
- The *New York-Newark, NY-NJ-CT-PA Combined Statistical Area* had an estimated population of 23.7 million as of 2014.
- About 1/15 Americans reside in this region, which includes 7 additional counties in New York, New Jersey, and Connecticut.
- About 1/3 of mass transit riders in the United States and 2/3 of the nation's rail riders live in the New York City metropolitan area.
- 13 counties, 80 trip files

Sources: http://www.ny.gov/agencies/metropolitan-transportation-authority
https://en.wikipedia.org/wiki/Transportation_in_New_York_City


NY
CT
PA
NJ
Ulster
Dutchess
Litchfield
Orange
Putnam
New Haven
Pike
Westchester
Fairfield
Rockland
Sussex
Passaic
Bergen
Morris
Essex
Hudson
New York
Bronx
Queens
Nassau
Suffolk
Union
Kings
Richmond
Hunterdon
Somerset
Middlesex
Mercer
Monmouth
Ocean


Connecticut
Fishers Island B
Gardiners Island
Island S
ork
ew Jersey
elphia

Close Up View of New York City Subway



8 Primary “Zones” and 4 Rail Systems

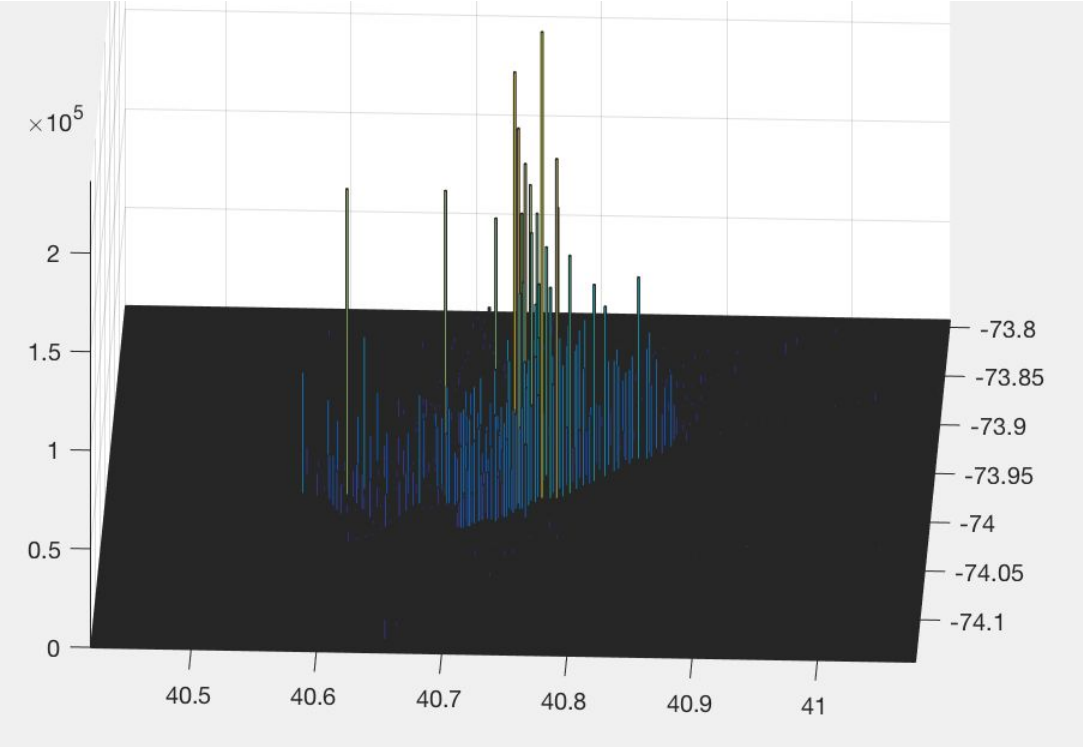
1. Manhattan (36061)
2. Bronx (36005)
3. Brooklyn (36047)
4. Queens (36081)
5. Staten Island (36085)
6. New York State commuters
    a. Westchester (36119)
    b. Rockland (36087)
    c. Nassau (36059)
7. New Jersey commuters
    d. Hudson (34017)
    e. Bergen (34003)
    f. Passaic (34031)
8. Connecticut commuters
    g. Fairfield (09001)
    h. New Haven (09009)

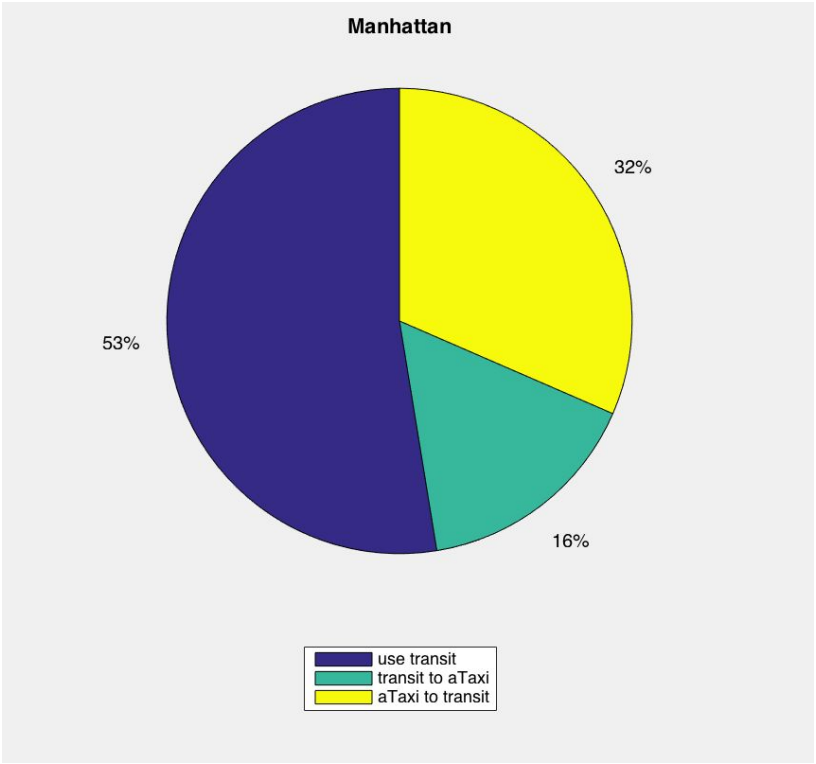
1. NYC Subway
2. Metro-North
3. NJTransit
4. LIRR

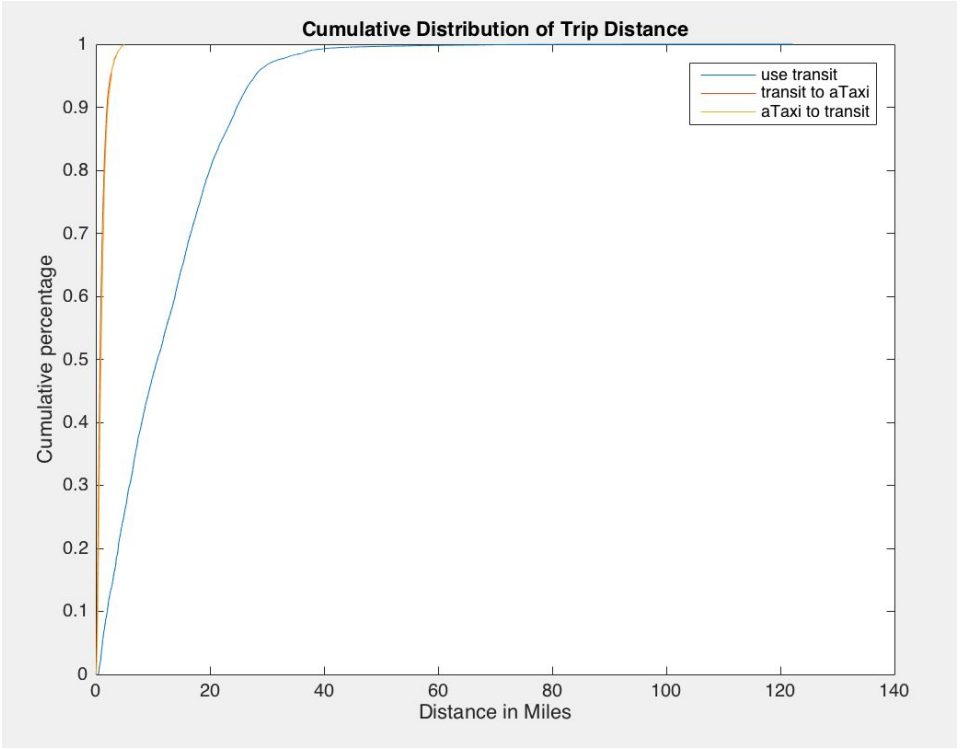
Methodology

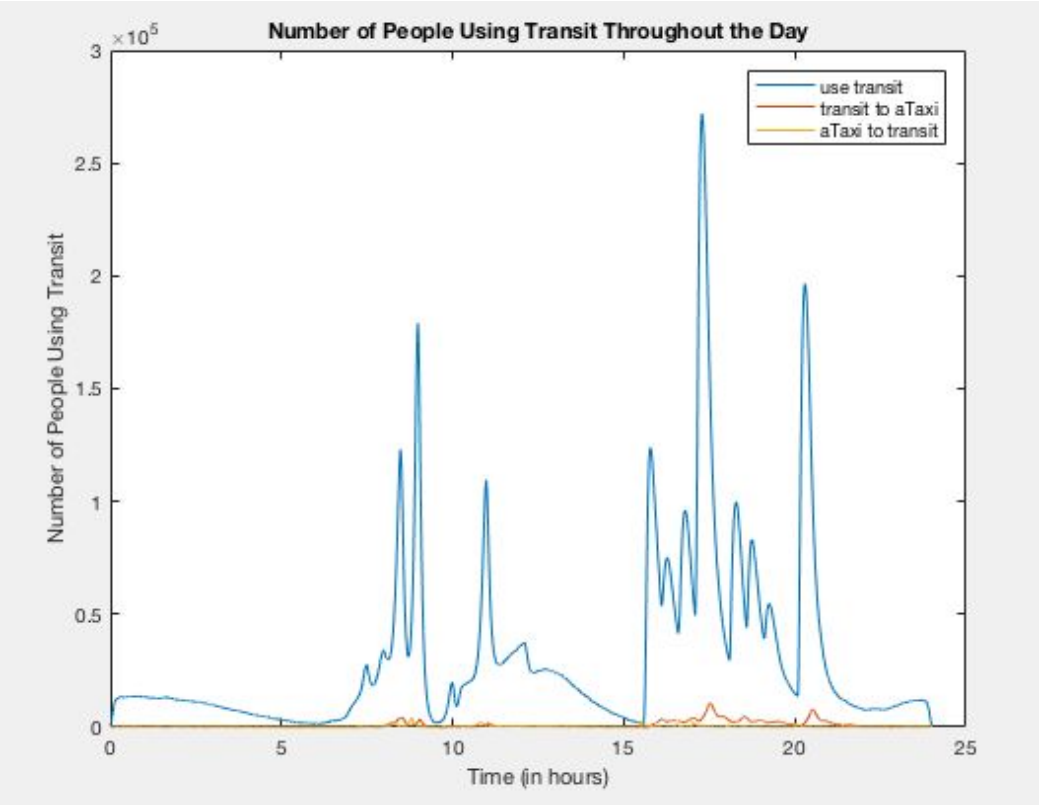
- List all major rail systems: NYC Subway, Metro-North, NJTransit, and LIRR
  - Find lat-lon of each train station on each line
- Find all trips (other than ShortTrips and LongTrips) that start or end within a 5 minute walk of a fixed transit station and determine if they are candidates to be served by the transit system.
  - Trip Distance between 5 miles and 100 miles
  - Max Circuity < 1.3
- Mode-Split on trip type, time of day
  - Walk ➔ Transit ➔ Walk
  - Walk ➔ Transit ➔ aTaxi
  - aTaxi ➔ Transit ➔ Walk
- Visualization (3D histogram, walk/aTaxi ➔ train station plot)
- HUGE thanks to Evan, Liz, Jamie, Jarret, and Alex for letting us run our files on their code

Zone 1: Manhattan

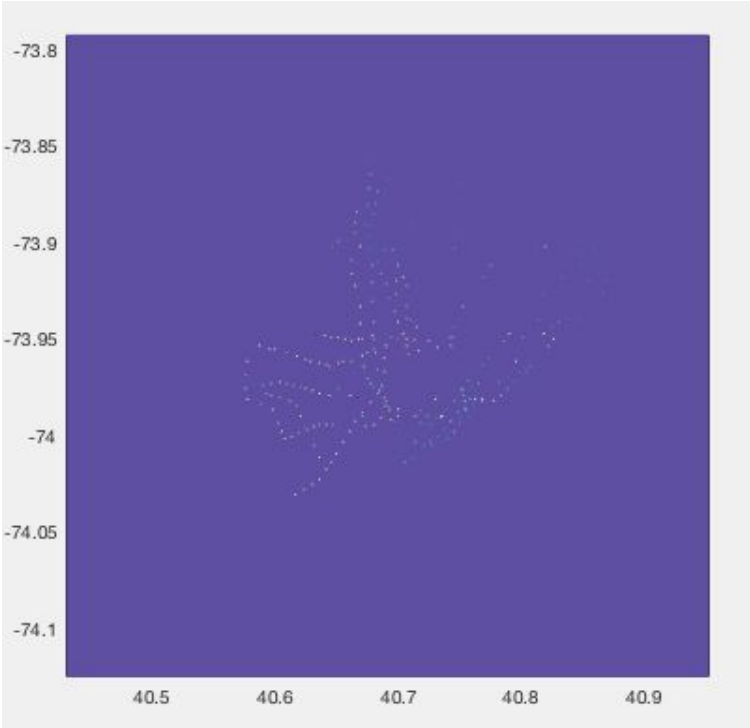


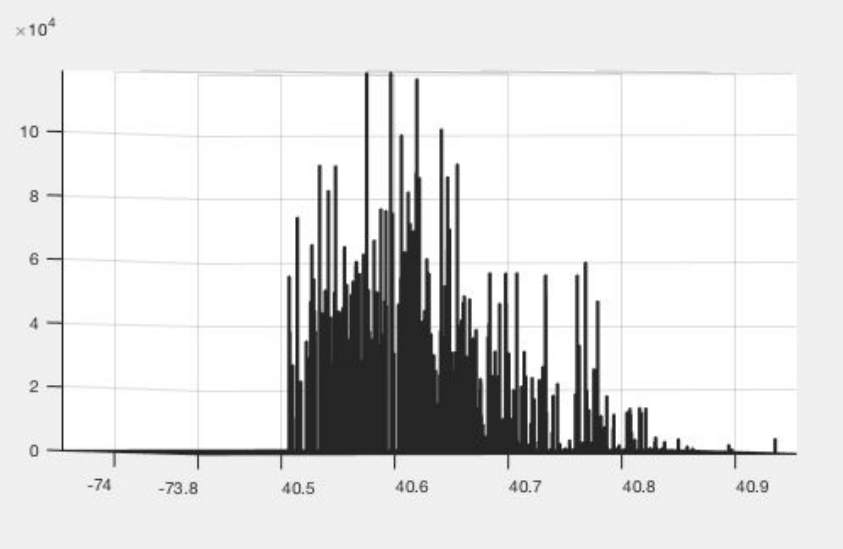

Manhattan
32%
53%
16%
use transit
transit to aTaxi
aTaxi to transit

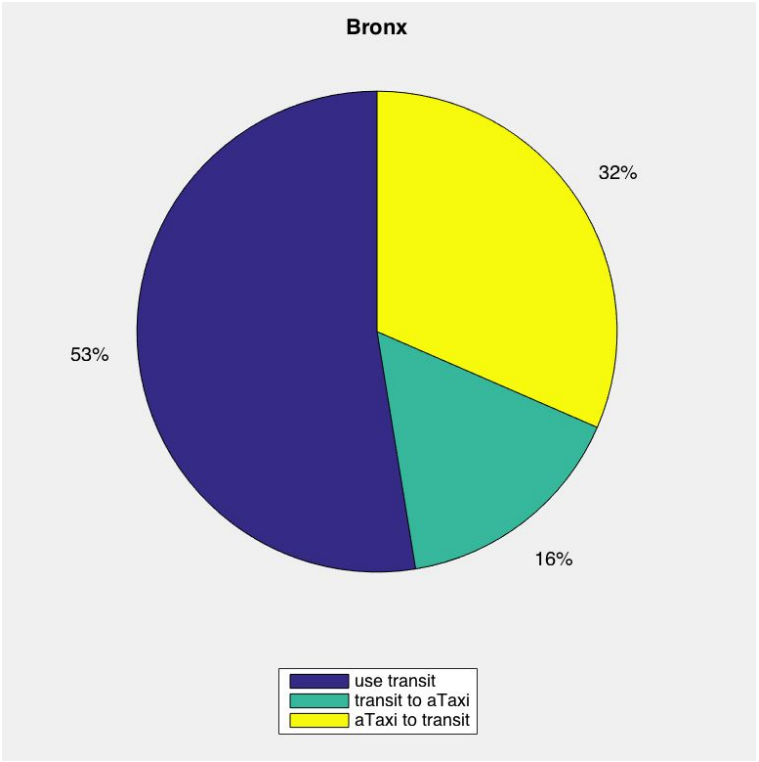

Cumulative Distribution of Trip Distance
use transit
transit to aTaxi
aTaxi to transit
Cumulative percentage
Distance in Miles
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140

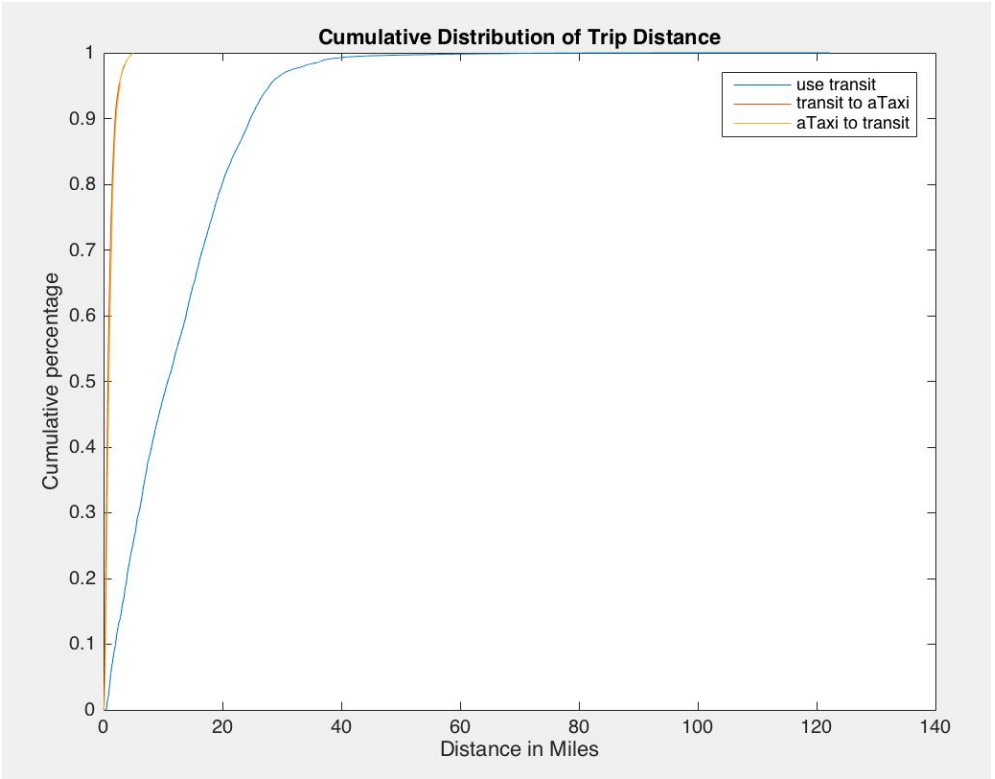

Number of People Using Transit Throughout the Day
×10^5
3
2.5
2
1.5
1
0.5
0
Number of People Using Transit
0
5
10
15
20
25
Time (in hours)
use transit
transit to aTaxi
aTaxi to transit

Zone 2: Bronx

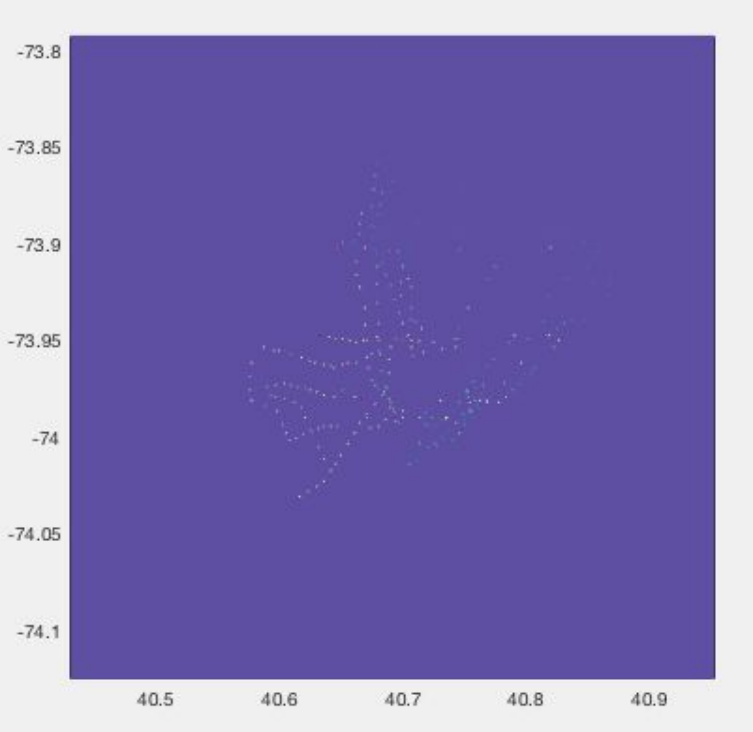

-73.8
-73.85
-73.9
-73.95
-74
-74.05
-74.1
40.5
40.6
40.7
40.8
40.9

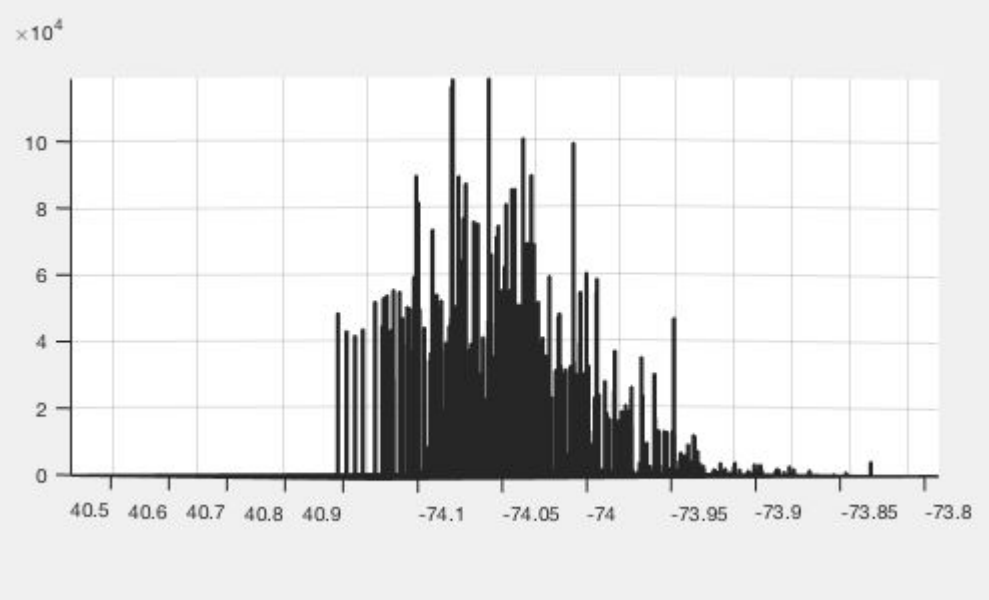

×10^4
10
8
6
4
2
0
-74
-73.8
40.5
40.6
40.7
40.8
40.9

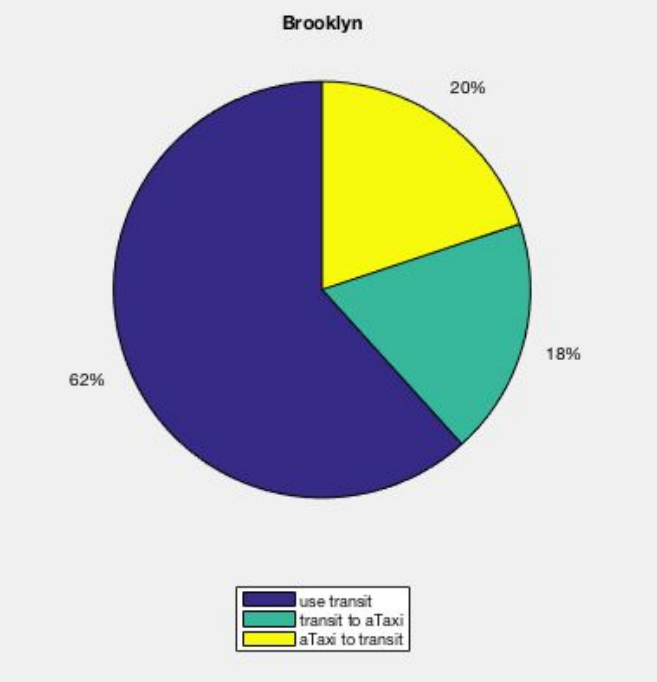

Bronx
32%
53%
16%
use transit
transit to aTaxi
aTaxi to transit

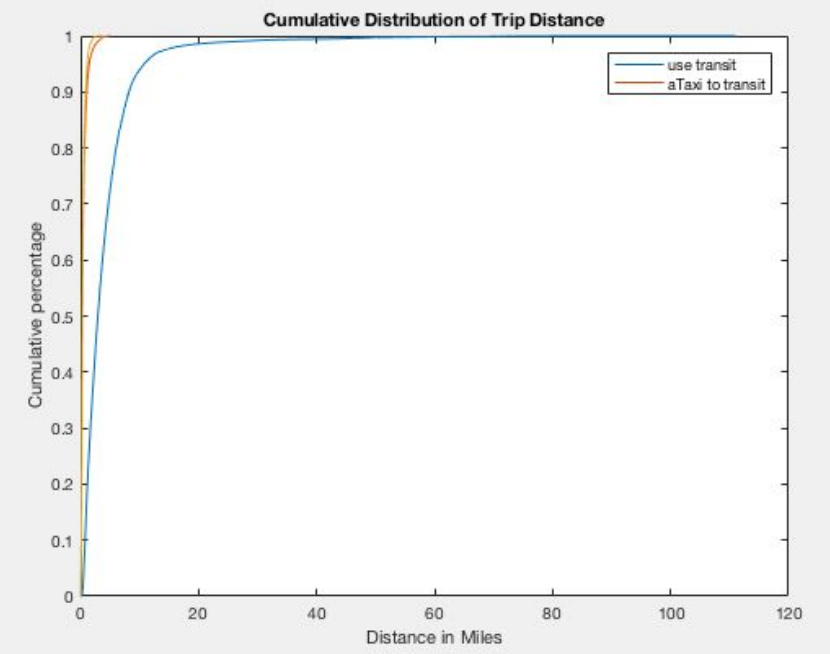

Cumulative Distribution of Trip Distance
use transit
transit to aTaxi
aTaxi to transit
Cumulative percentage
Distance in Miles
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140

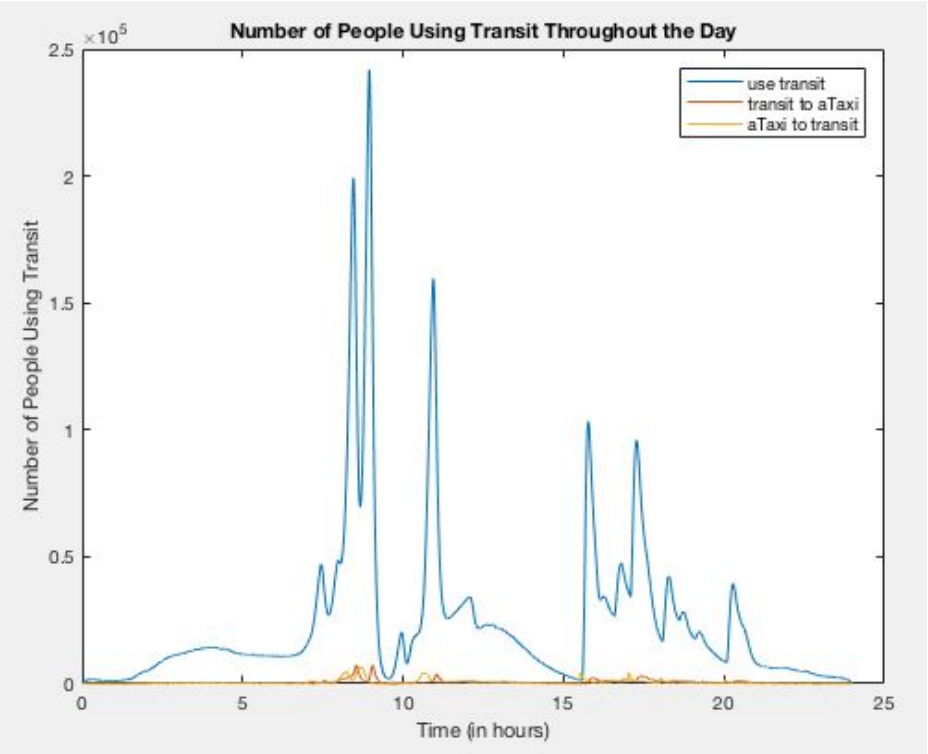
Zone 3: Brooklyn



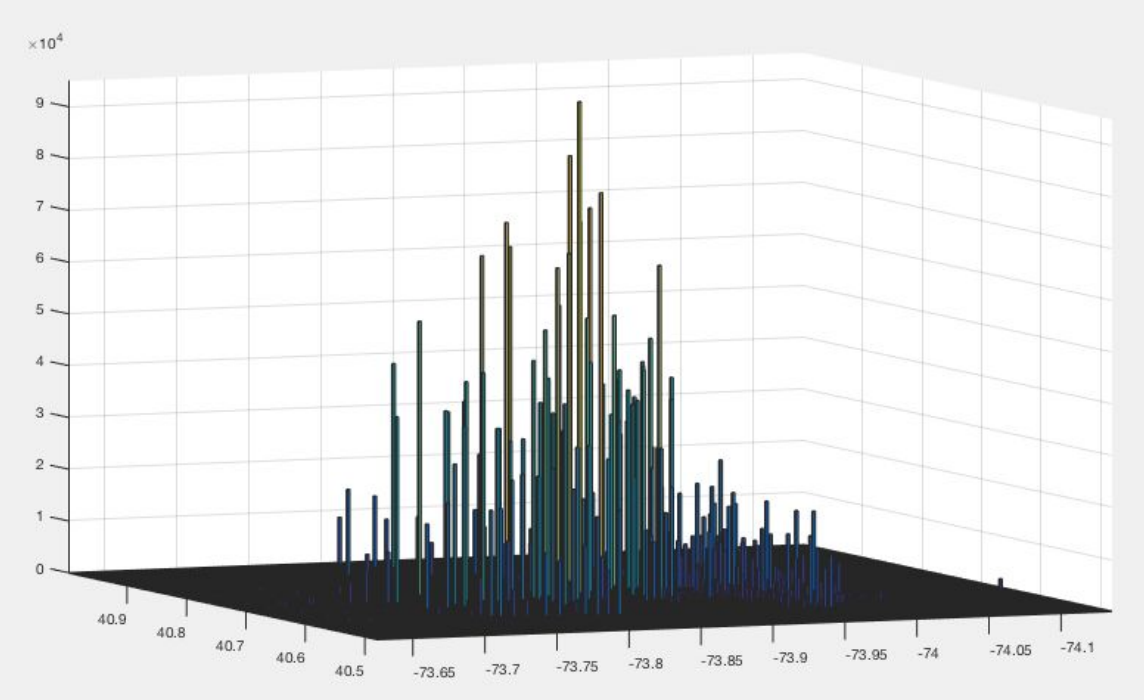



Brooklyn
20%
18%
62%
use transit
transit to aTaxi
aTaxi to transit

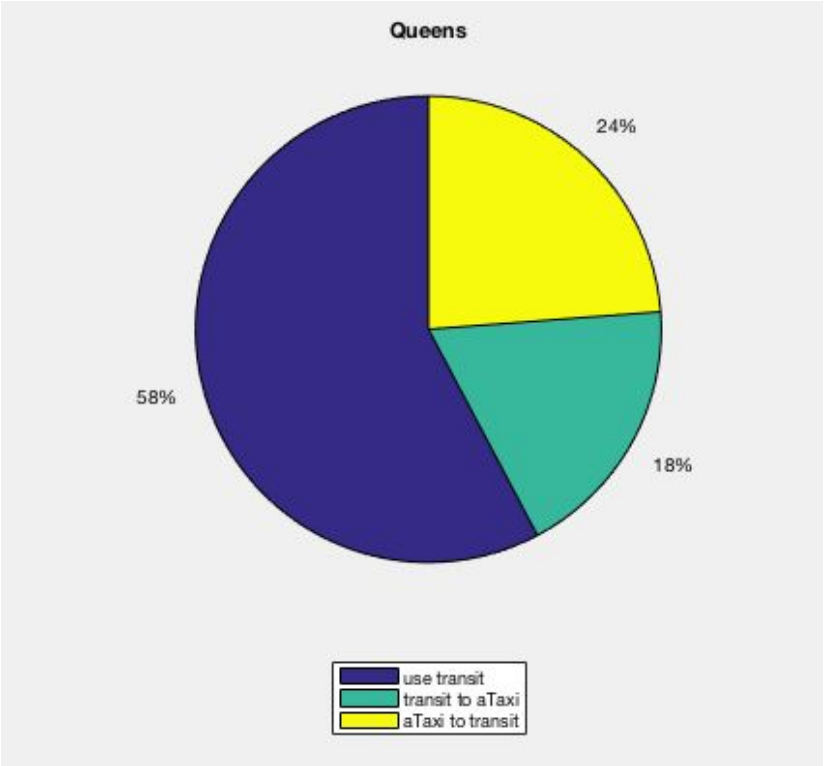

Cumulative Distribution of Trip Distance
use transit
aTaxi to transit
Cumulative percentage
Distance in Miles
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120

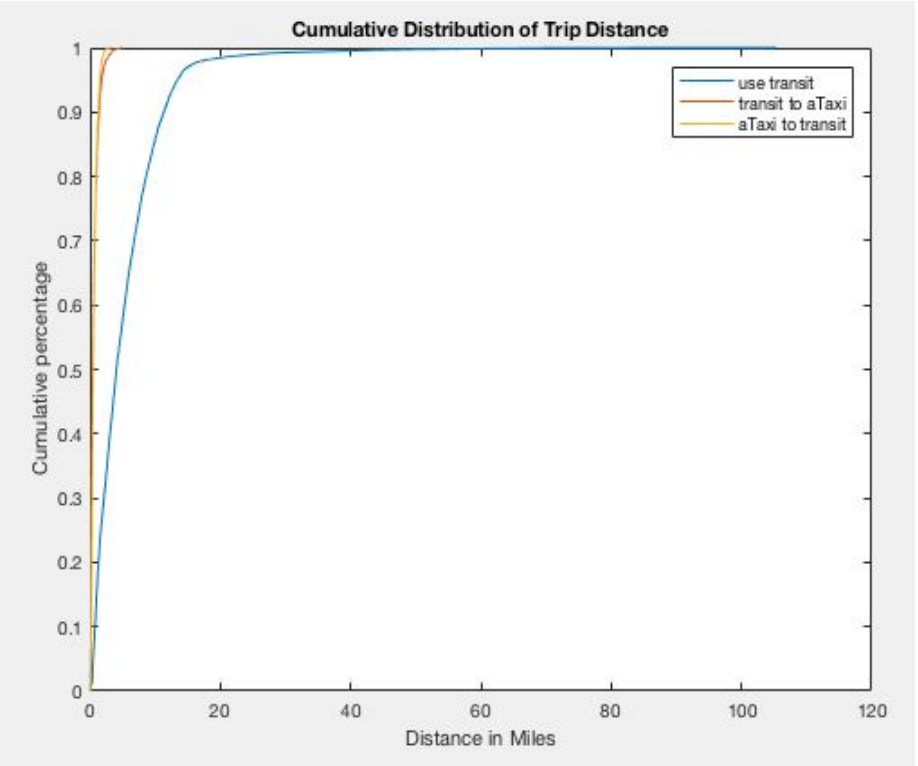

Number of People Using Transit Throughout the Day
×10^5
2.5
2
1.5
1
0.5
0
Number of People Using Transit
0
5
10
15
20
25
Time (in hours)
use transit
transit to aTaxi
aTaxi to transit

Zone 4: Queens

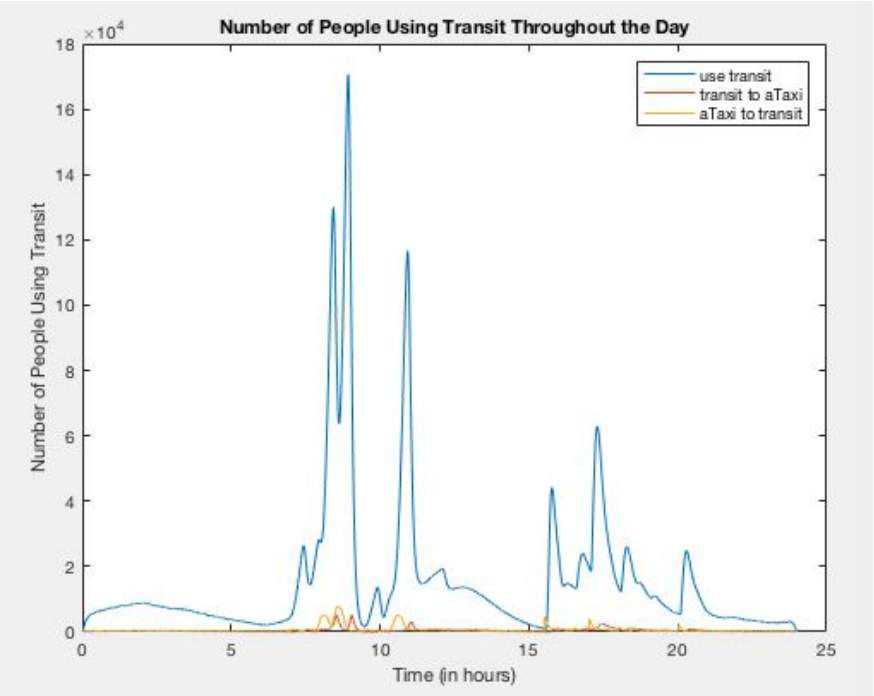


Zone 4: Queens

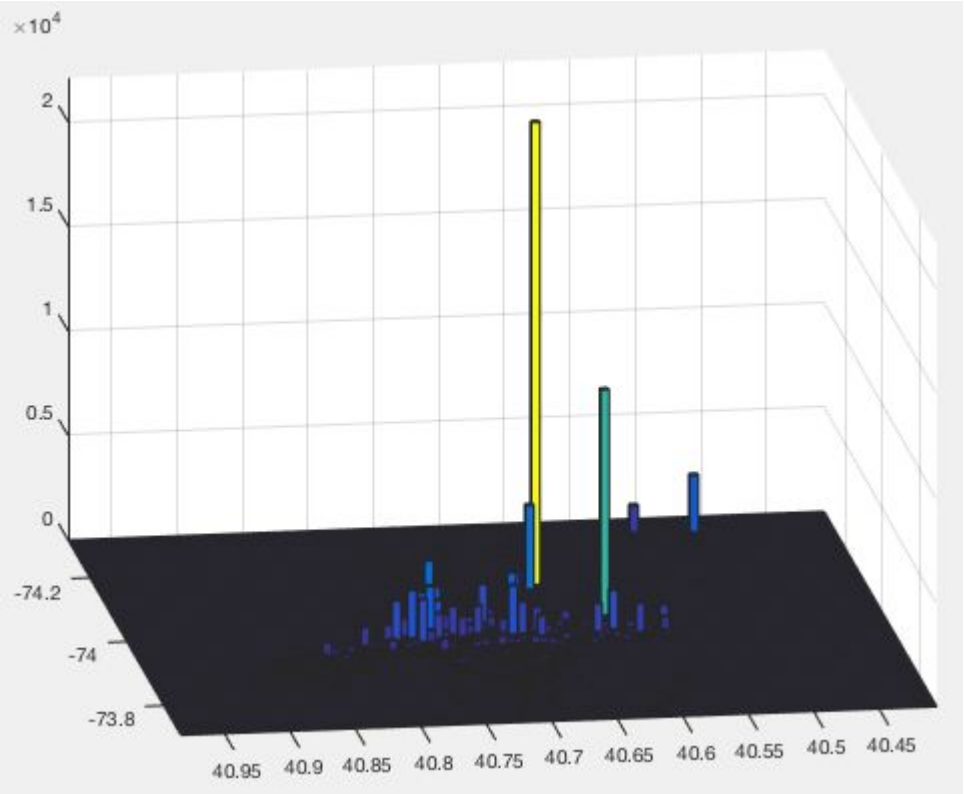




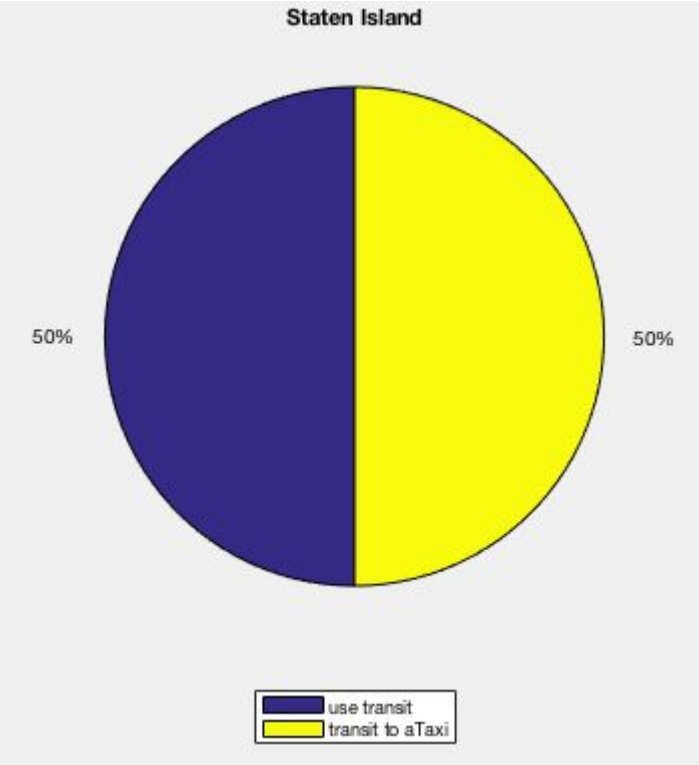
Zone 4: Queens

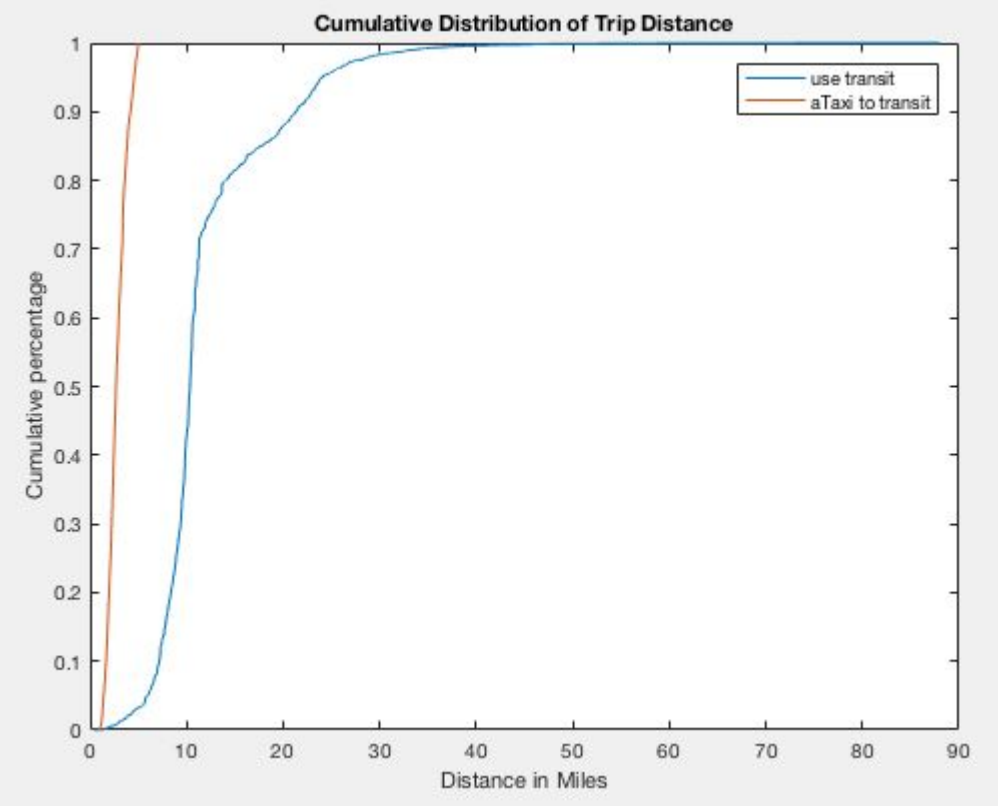


Zone 5: Staten Island

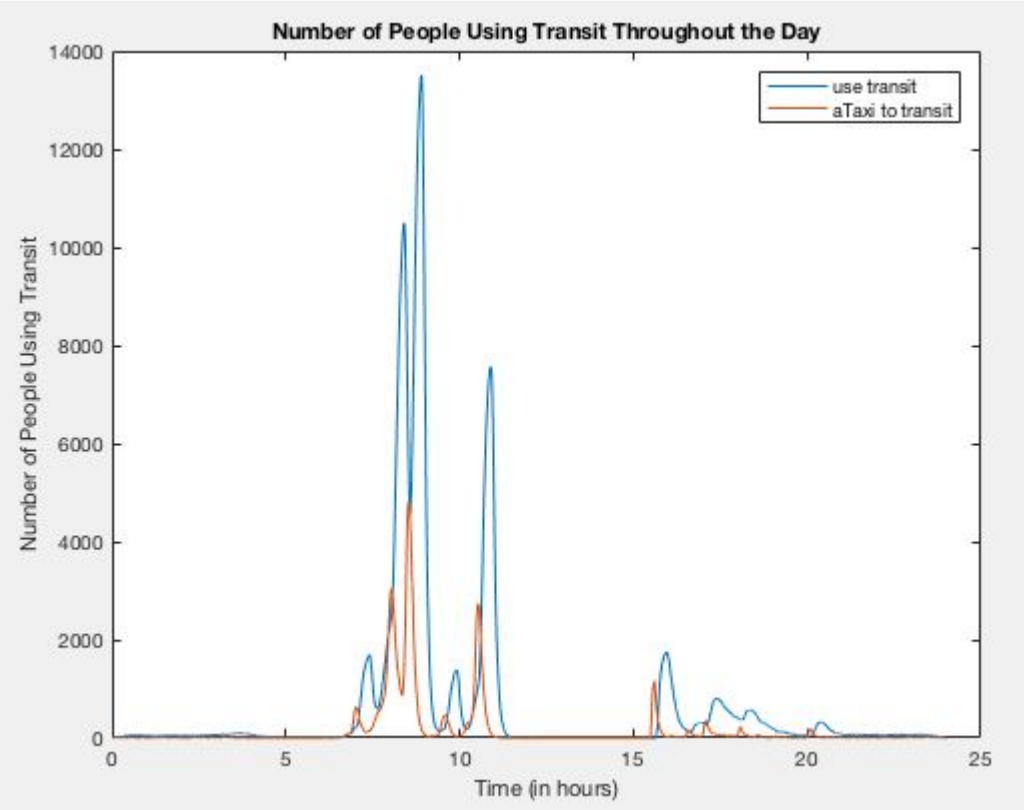


Zone 5: Staten Island

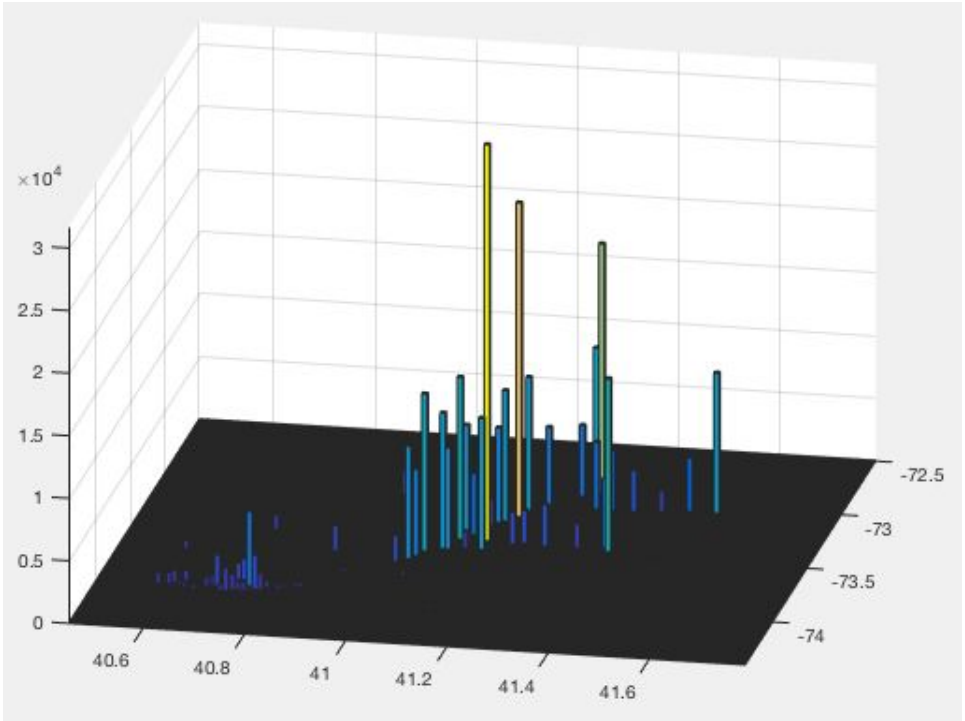


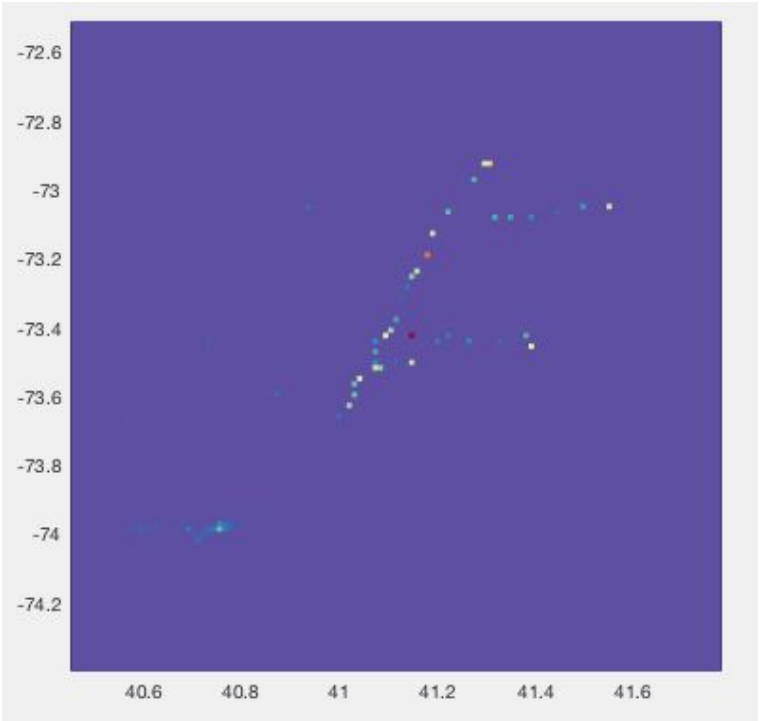


Zone 5: Staten Island

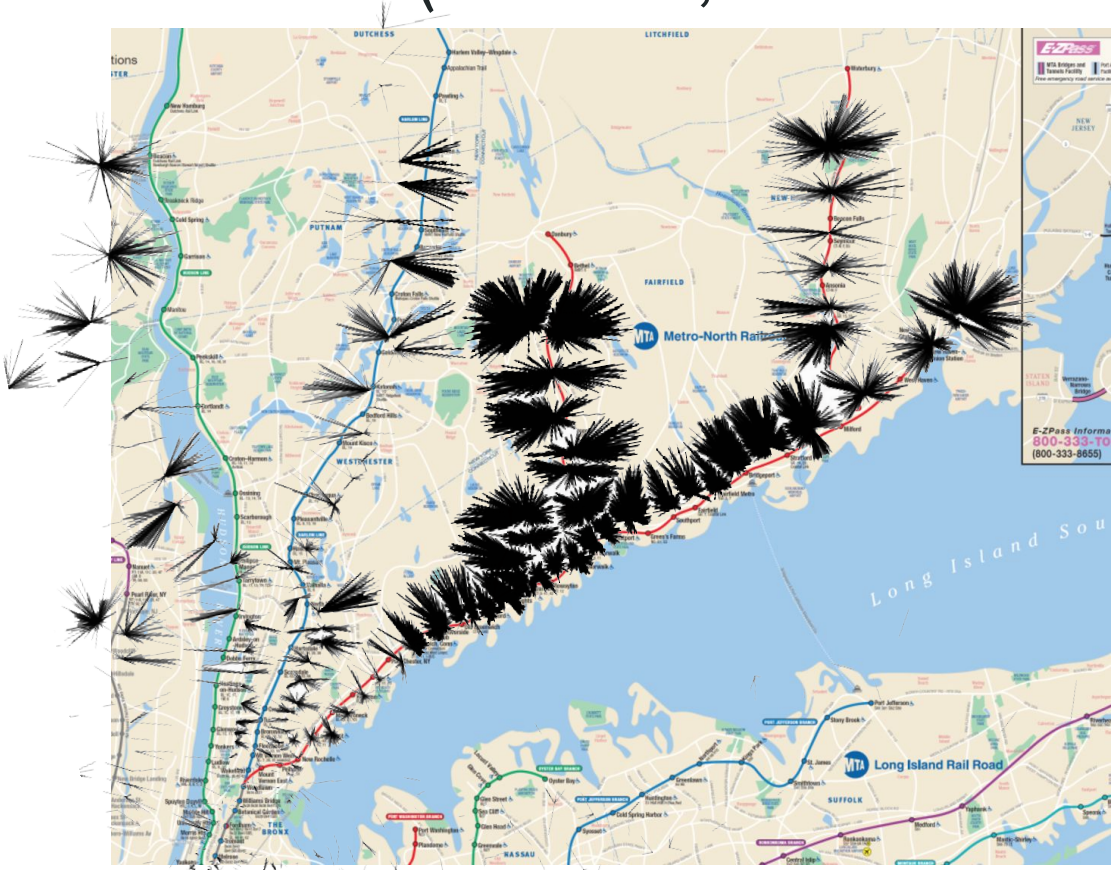


Zone 6: Connecticut (Fairfield, New Haven)

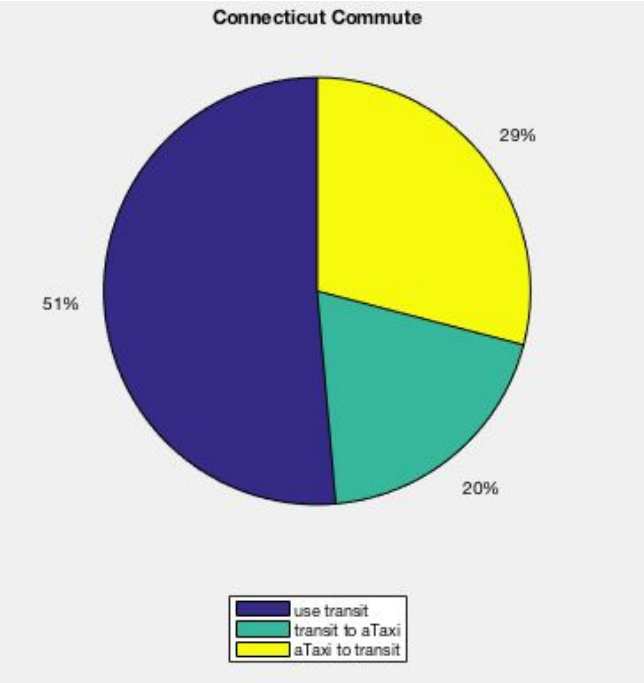


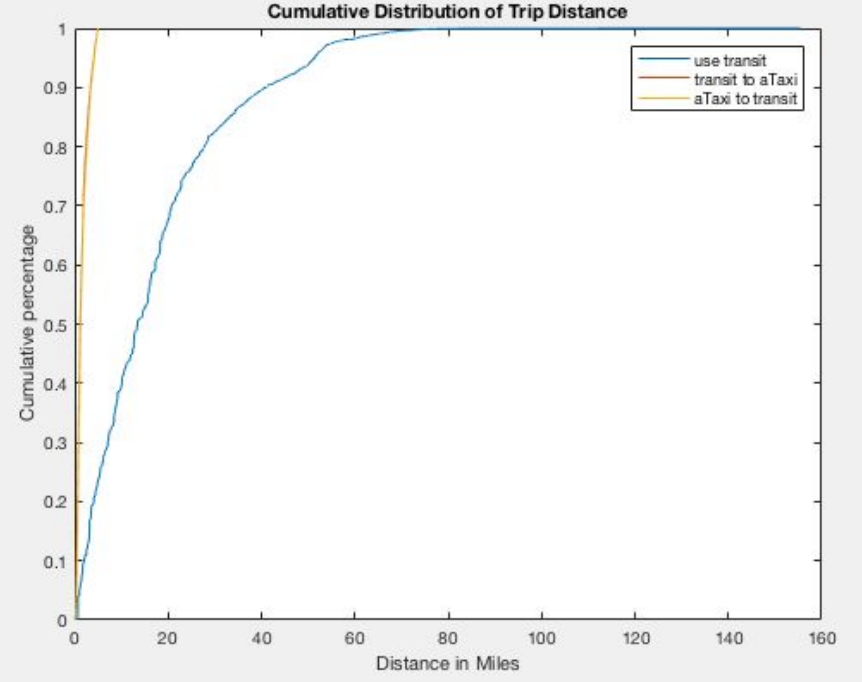


Zone 6: Connecticut (Fairfield, New Haven)

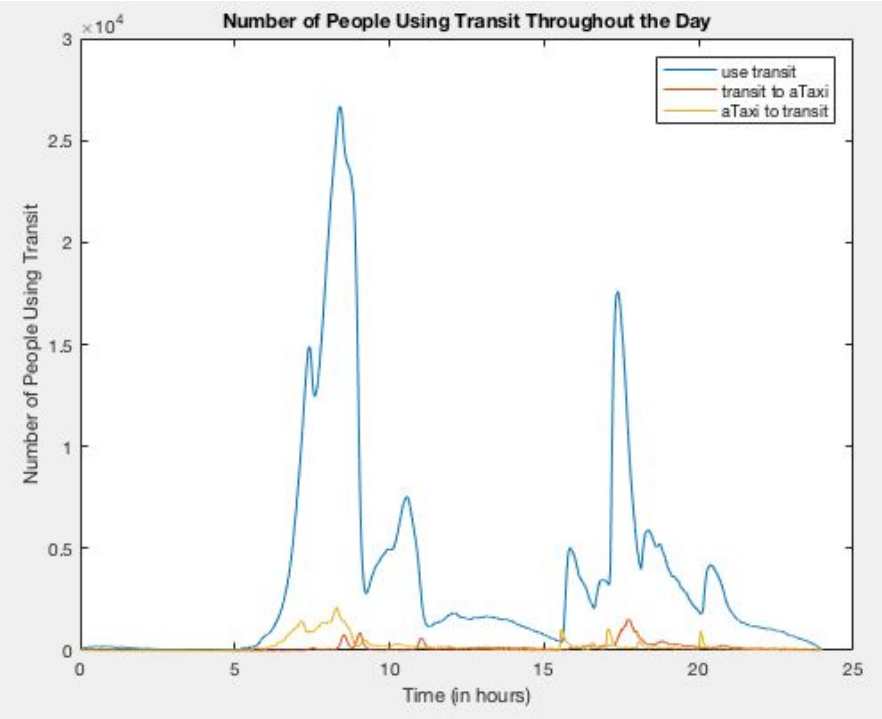


Zone 6: Connecticut (Fairfield, New Haven)

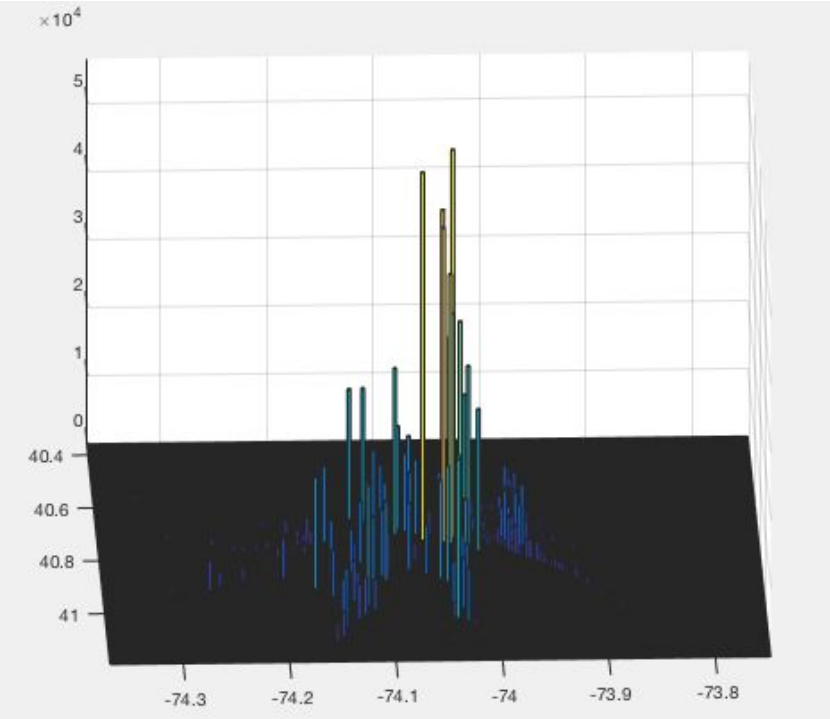


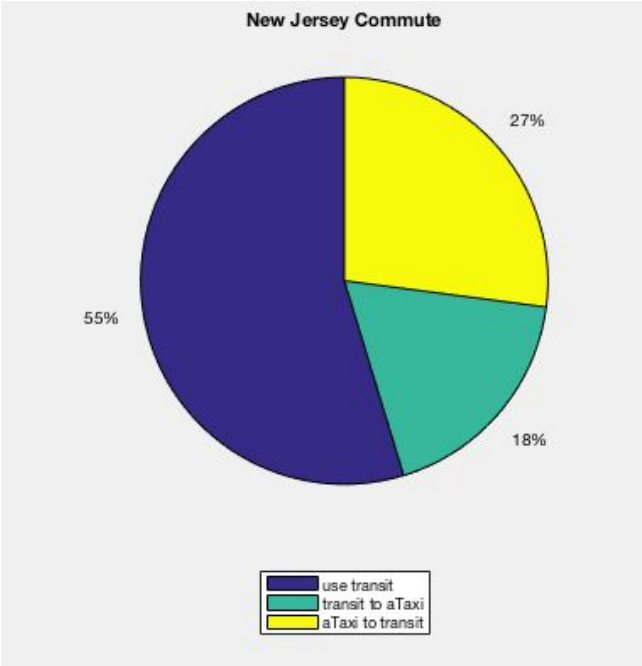


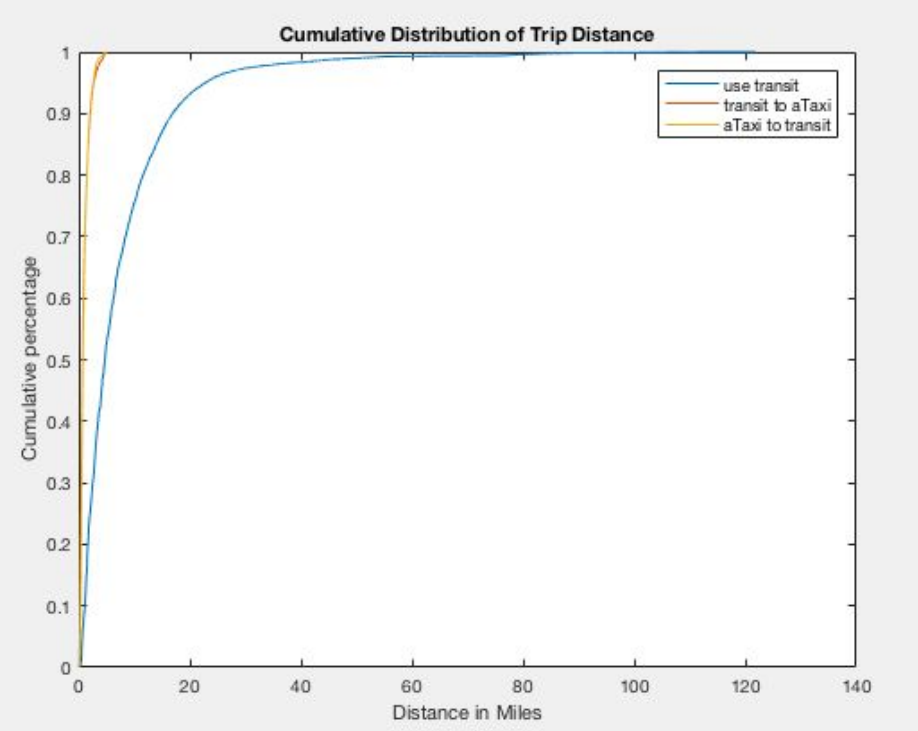
Zone 6: Connecticut (Fairfield, New Haven)

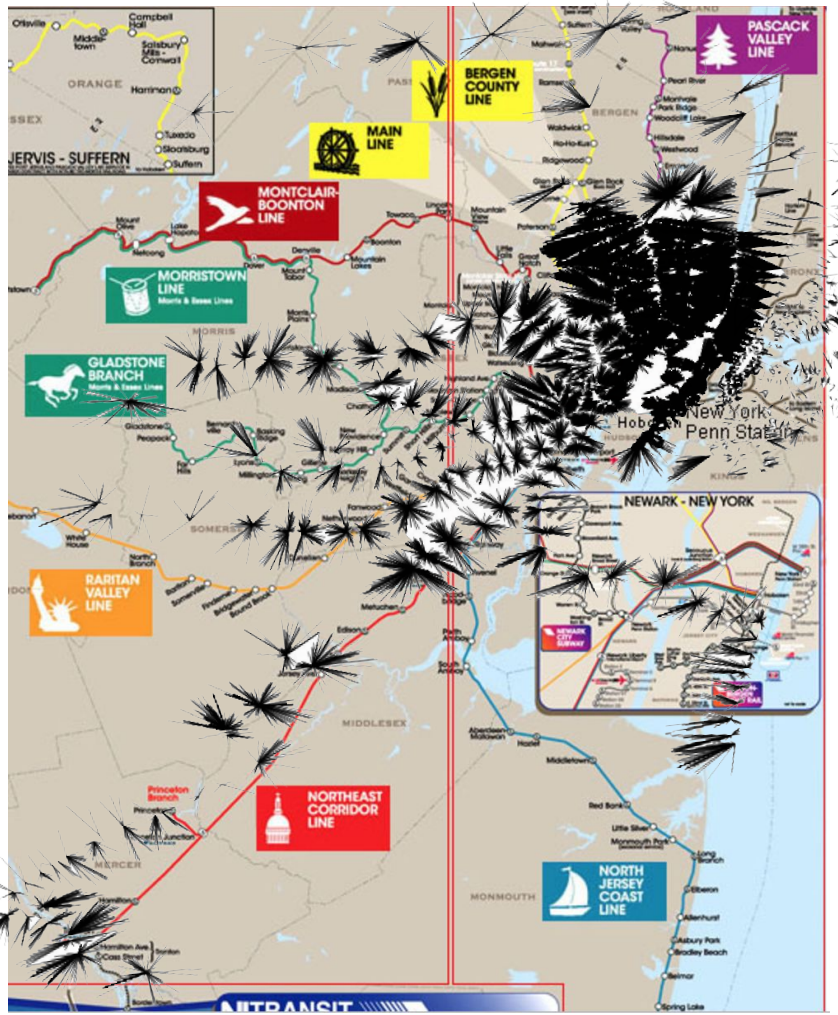


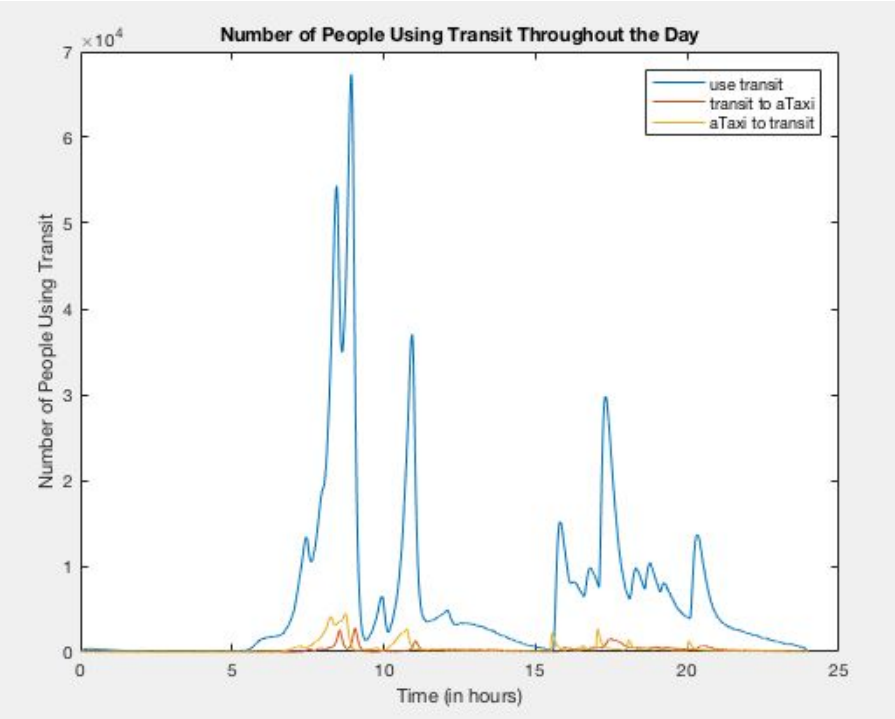
Zone 7: New Jersey (Hudson, Bergen, Passaic)



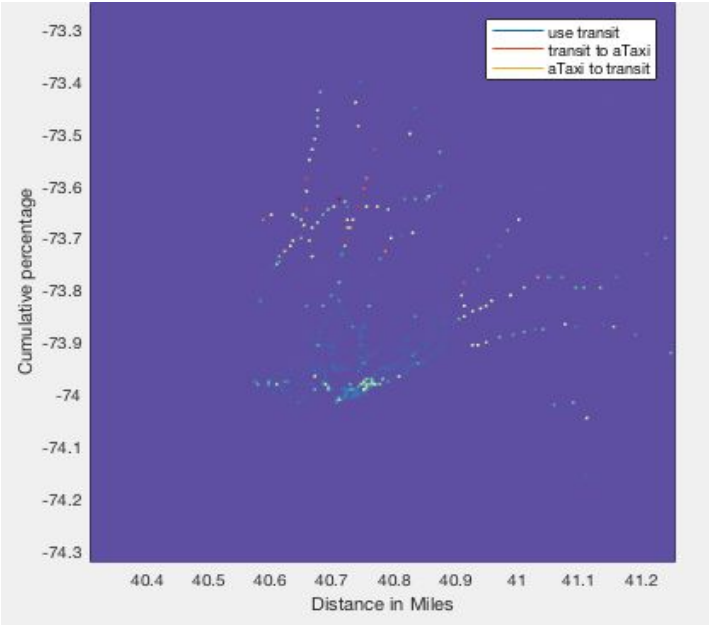

New Jersey Commute
27%
55%
18%
use transit
transit to aTaxi
aTaxi to transit

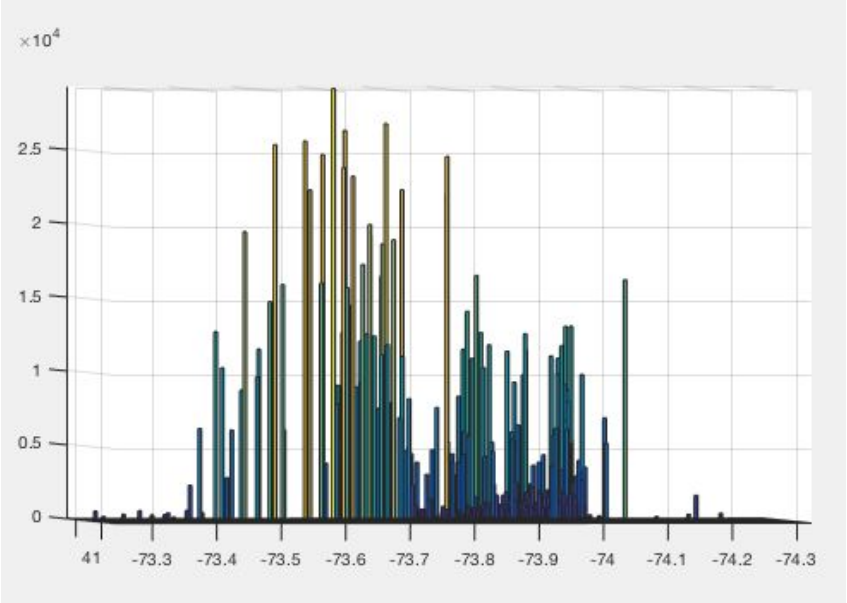

Cumulative Distribution of Trip Distance
use transit
transit to aTaxi
aTaxi to transit
Cumulative percentage
Distance in Miles
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140

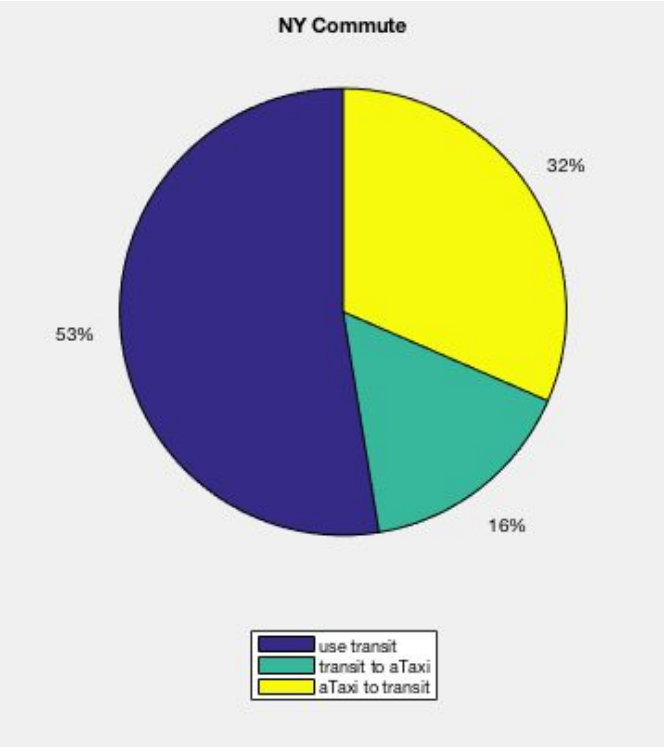

PASCACK VALLEY LINE
BERGEN COUNTY LINE
MAIN LINE
MONTCLAIR-BOONTON LINE
MORRISTOWN LINE
GLADSTONE BRANCH
RARITAN VALLEY LINE
NORTHEAST CORRIDOR LINE
NORTH JERSEY COAST LINE
NEWARK - NEW YORK
JERVIS - SUFFERN
New York Penn Station
ORANGE
BERGEN
MORRIS
SOMERSET
MIDDLESEX
MERCER
MONMOUTH

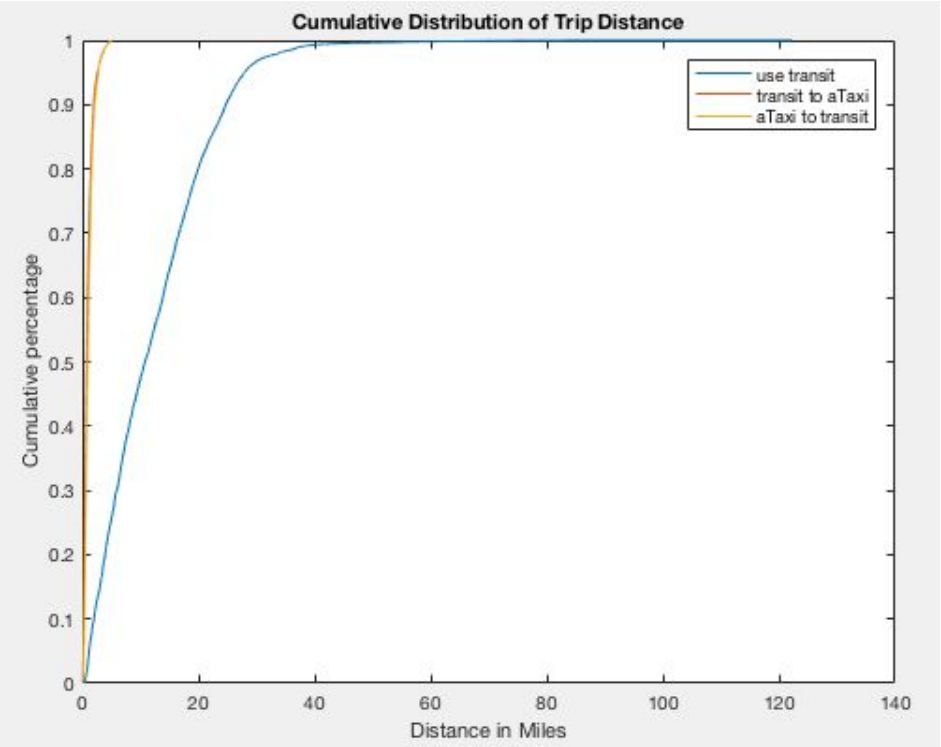

Number of People Using Transit Throughout the Day
×10^4
7
6
5
4
3
2
1
0
Number of People Using Transit
0
5
10
15
20
25
Time (in hours)
use transit
transit to aTaxi
aTaxi to transit

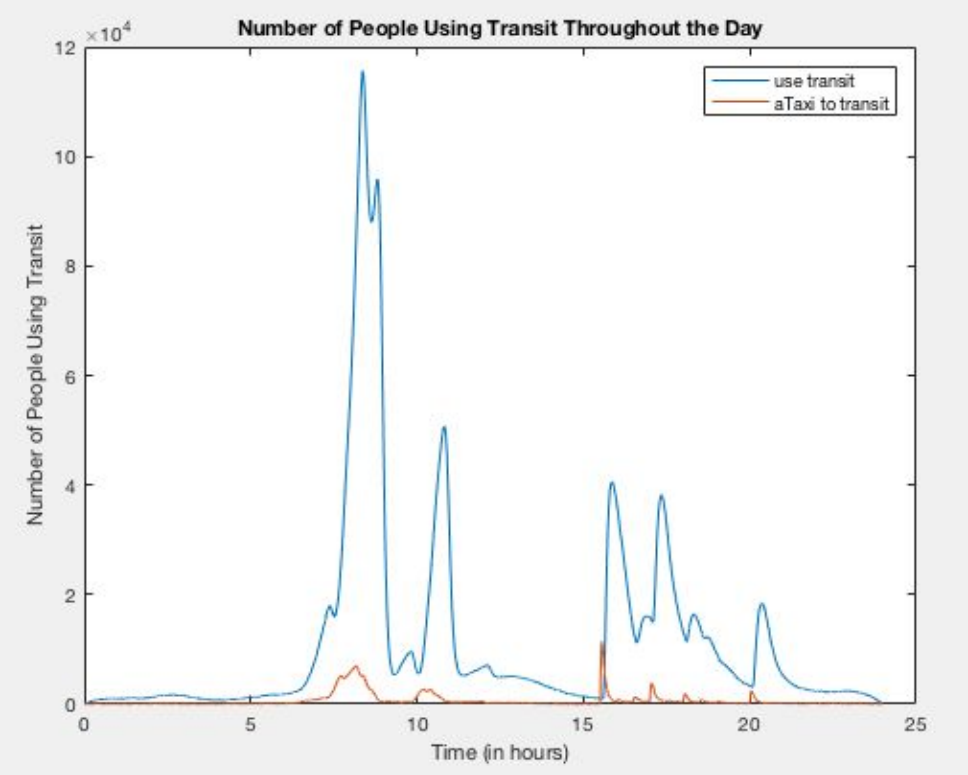
Zone 8: NY State (Westchester, Rockland, Nassau)






NY Commute
32%
53%
16%
use transit
transit to aTaxi
aTaxi to transit


Cumulative Distribution of Trip Distance
use transit
transit to aTaxi
aTaxi to transit
Cumulative percentage
Distance in Miles
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140


Number of People Using Transit Throughout the Day
×10^4
12
10
8
6
4
2
0
Number of People Using Transit
0
5
10
15
20
25
Time (in hours)
use transit
aTaxi to transit

Challenges and Lessons Learned

- Runtime
  - MATLAB not feasible, bottlenecked by process of finding nearest station
  - Use KDTree in Java or other language with less overhead
- Pixelation method needs to be adjusted for Manhattan
  - Proximity of stations and trip destination/origins presents challenge for analysis
  - We analyzed each station using exact GPS coordinates
  - Future studies of ride-sharing in Manhattan should use smaller pixels
- Use of ndhist.m to produce 3D histograms for visualization
  - https://www.mathworks.com/matlabcentral/fileexchange/45325-efficient-2d-histogram--no-toolboxes-needed

Conclusions

- NYC boroughs besides Staten Island have similar time of day graphs (9AM, 5:30PM, 8PM and multiple smaller peaks during the day); Commuting areas have similar time of day graphs (peak at 8:30AM & 5:30PM)
-

	95% of Distance	transit only	aTaxi Pickup	aTaxi Dropoff	Train Trips In and Out of area/All Trips Originating in Area
Manhattan	30	53	32	16	66.70%
Bronx	30	53	32	16	80.30%
Brooklyn	15	62	20	18	45.40%
Queens	15	58	24	18	61.00%
Staten Island	25	50	50	0	3.30%
NY State	30	53	16	32	NA
CT State	50	51	20	29	NA
NJ State	25	55	18	27	NA