Mobility change in NYC with MTA turnstile data

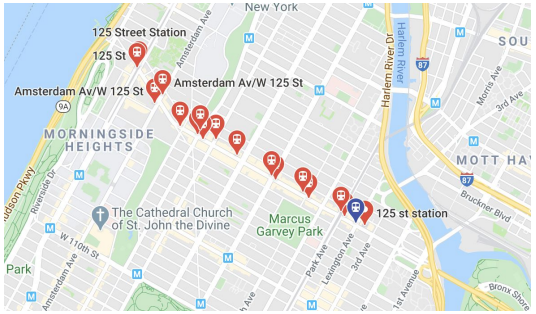
Problems & Approaches

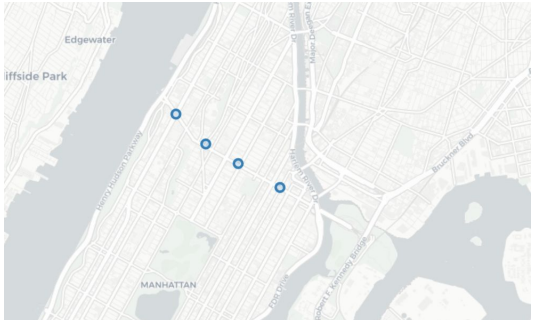
- How does mobility change over time? How does stat-at-home policies affect the trends?
  - compare with last year and previous month
- Does mobility change show different patterns in different areas?
  - look at aggregations of the data over zip codes or neighborhoods
  - the flow to and from work
  - see if patterns change in key bridges and tunnels
- How does subway ridership correlate to other matrices such as confirmed cases?
- How do people feel about the mobility change because of Covid-19?

Data Cleaning

MTA Turnstile Data http://web.mta.info/developers/turnstile.html

- Accumulative counters
  - Negative counters
  - Resets
  - Jumping counters, …
- Stations
  - Matching station and location data
  - Station definition: station name + lines



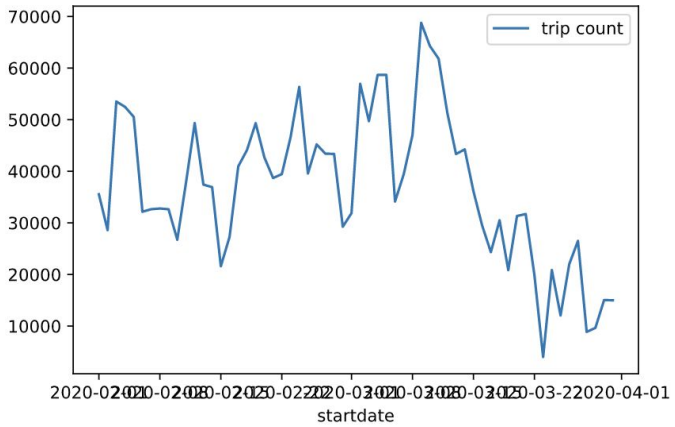


Other traffic datasets

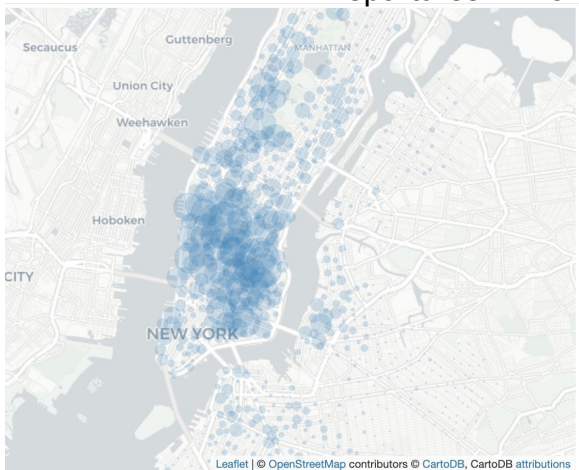
CitiBike Trip History in February and March

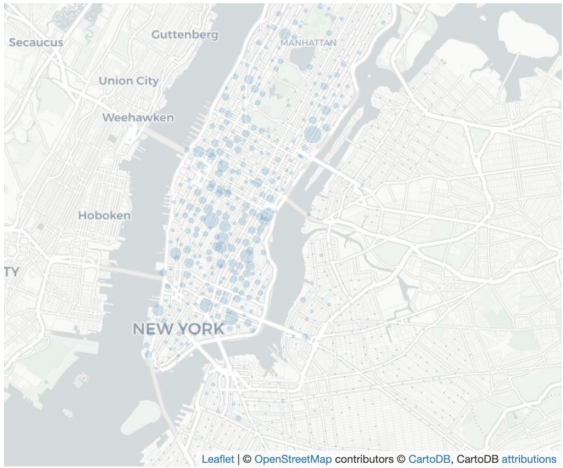
https://www.citibikenyc.com/system-data

- Number of trip has dropped
- Hard to define normal pattern



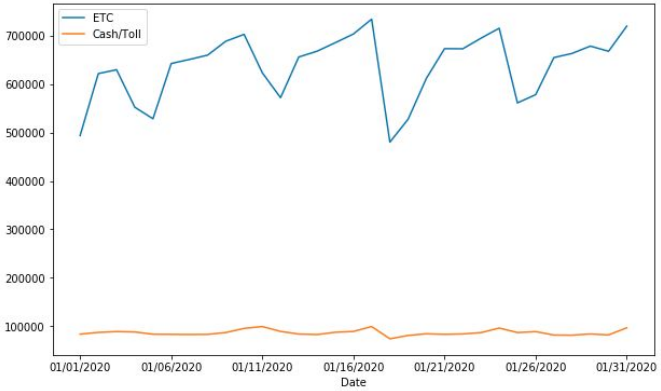
Departures in March 1 and. March 25

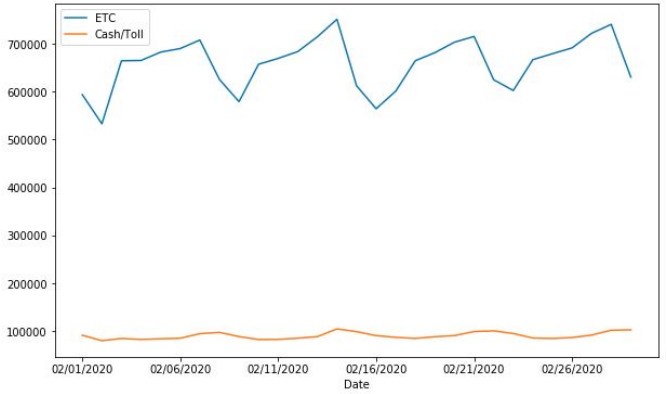


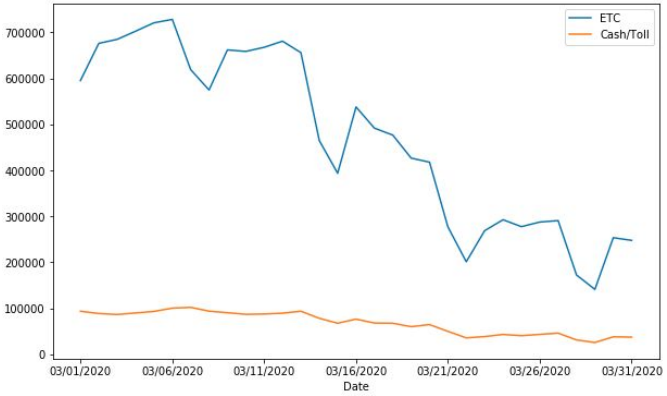


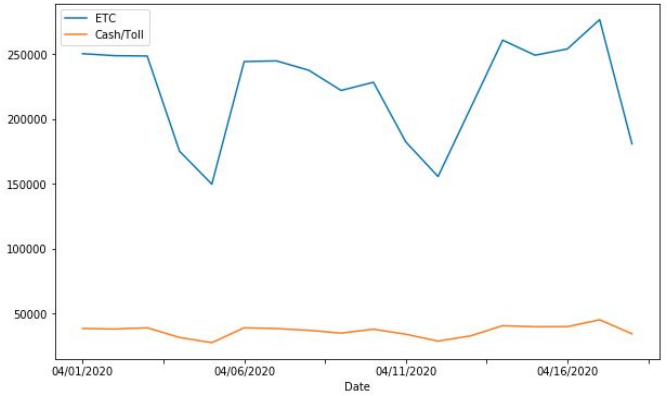
Bridges and Tunnels Traffic

- Compare NYC bridges and tunnels Traffic between Jan 2020 to Apr 2020
- Around mid-March the traffic starts to plummet which is consistent with covid outbreak
- Maintains at a low level in Apr









Subway Tweets Analysis

- Positive and neutral tweets are the majority
- #Aline, #Fline, etc are popular hashtags
- Incident reports tends to have more retweets
- No pattern to people's emotions over time

Turnstile data Analysis

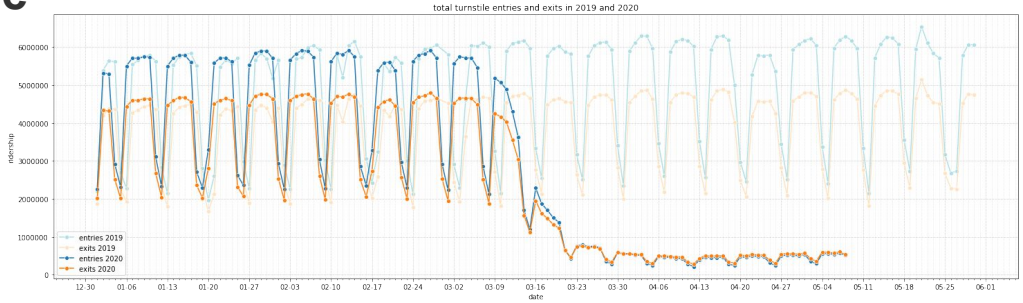
1. Overall ridership change over time
2. Ridership change by station and location
3. Ridership change by time-slot
4. Ridership by spatial distribution

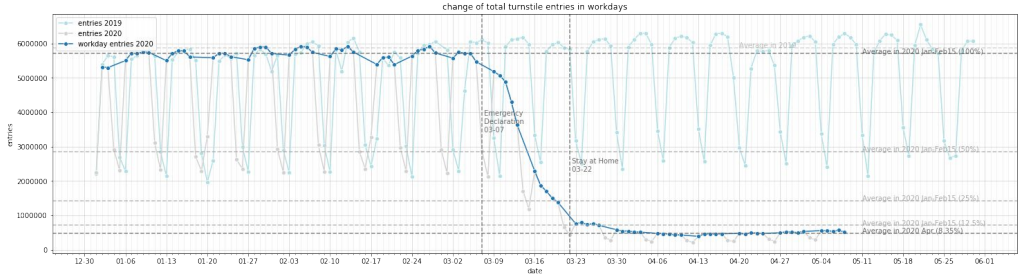
1. Overall ridership change over time

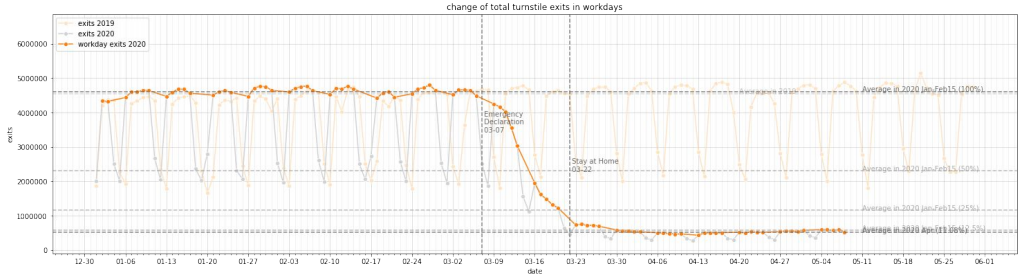
Normal days

- Entries always higher than exits
- Workday much higher than weekends and holiday

Can take 2020 Jan-Feb15 as normal pattern





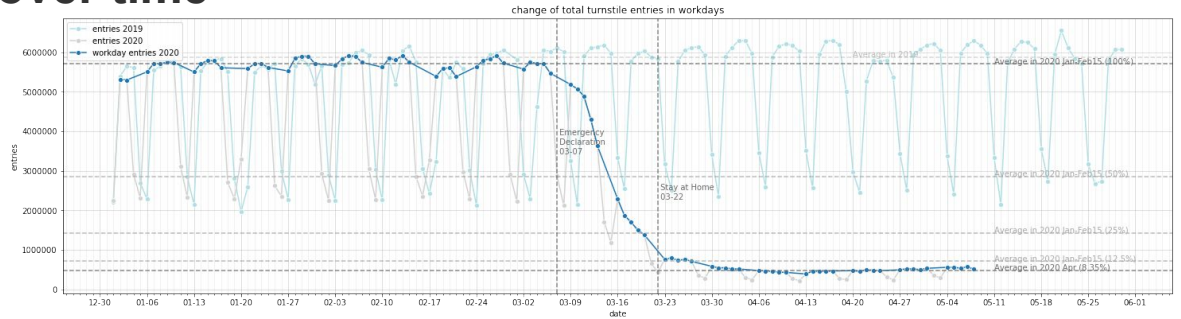


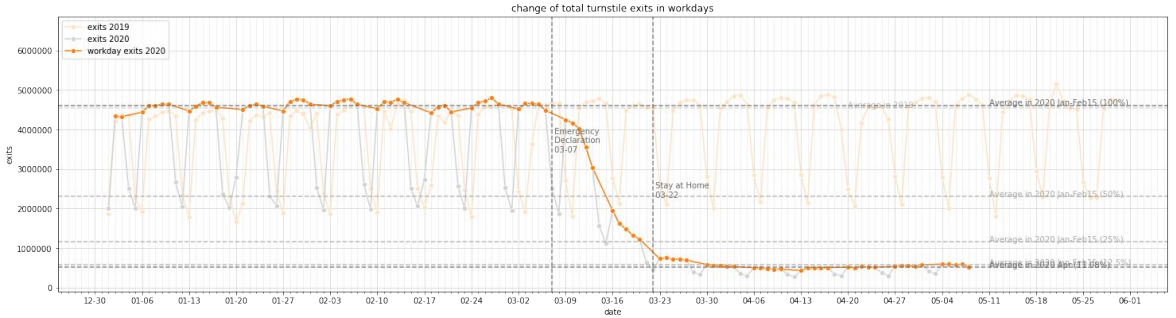
1. Overall ridership change over time

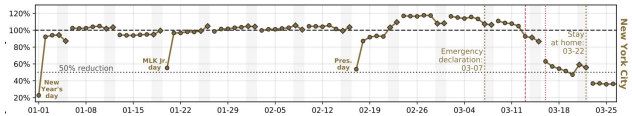
Quantify the change

- Entries dropped to 8.35%
- Exits dropped to 11.8%

Compare with other metrics







percent of daily commute
Brennan Klein et al.
[Assessing changes in commuting and individual mobility in major metropolitan areas in the United States during the COVID-19 outbreak]

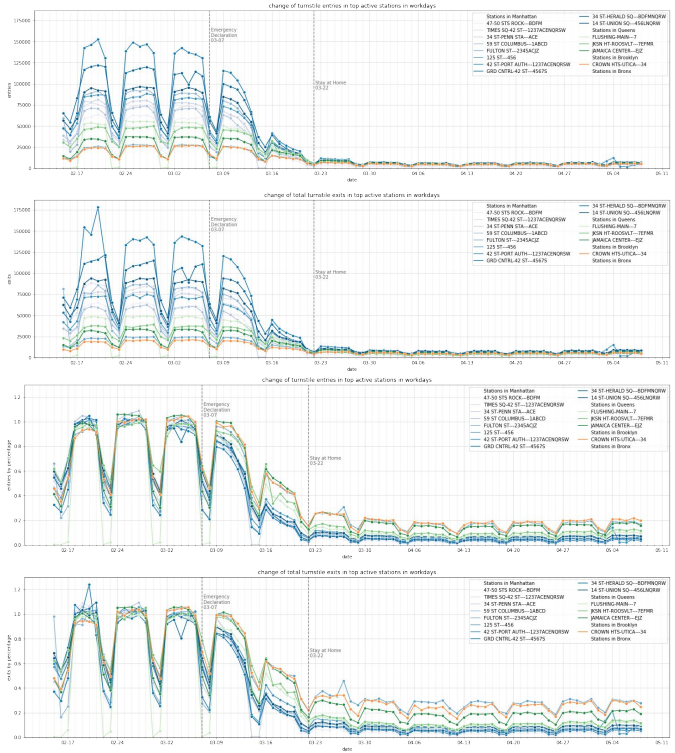
2. Ridership change by station and location

New top 10 stations in April 2020

- JAMAICA CENTER(EJZ) Queens
- CROWN HTS-UTICA(34) Brooklyn
- JKSN HT-ROOSVLT(7EFMR) Queens
- 125 ST(456) Manhattan
- FLUSING_MAIN(7) Queen

By percentage of change, Manhattan stations dropped the most, but..

- Regular ridership in Manhattan stations are way higher
- Top April station in Manhattan (14 ST-UNION SQ)
- Outlier: 125 ST (456) dropped to about 30%



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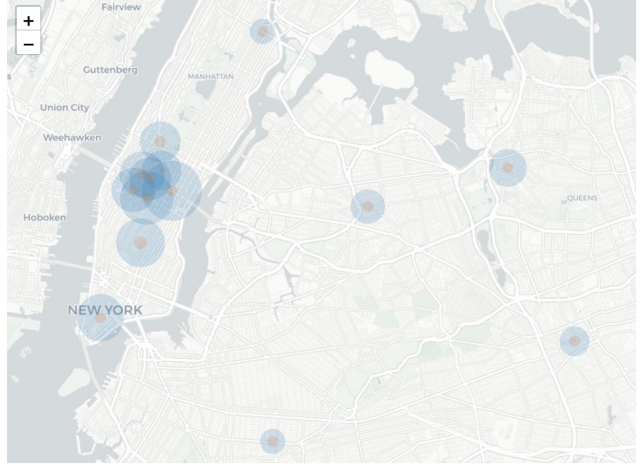
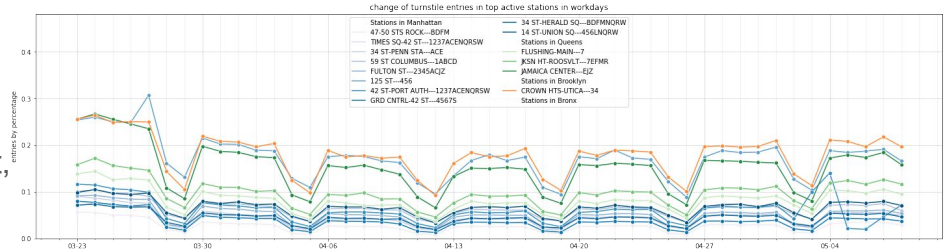
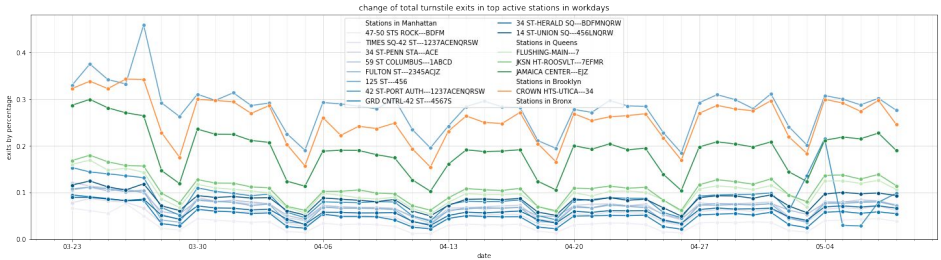






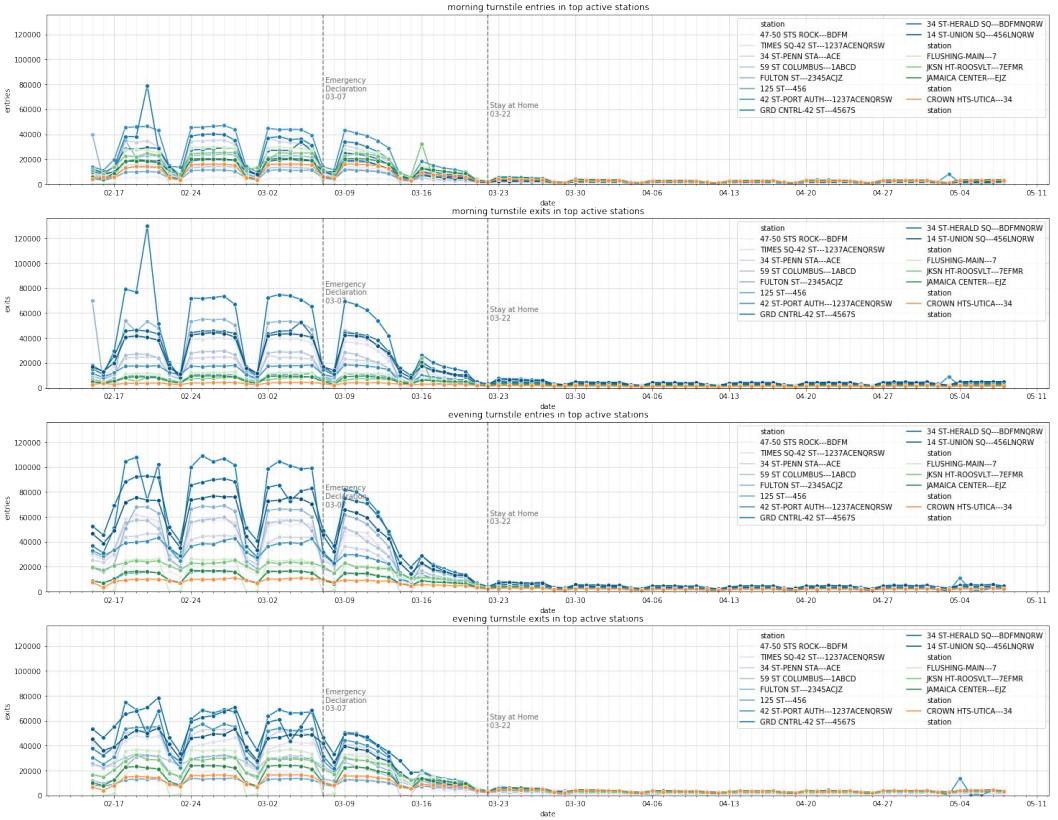
3. Ridership change by time-slot

4 hour time interval

- Morning: before 12 p.m.
- Evening: after 12 p.m.

The flow of commuters

- From elsewhere to big stations in Manhattan.
- After the outbreak, Manhattan stations are still the top target.
- But number of commuters in Manhattan may dropped the most.



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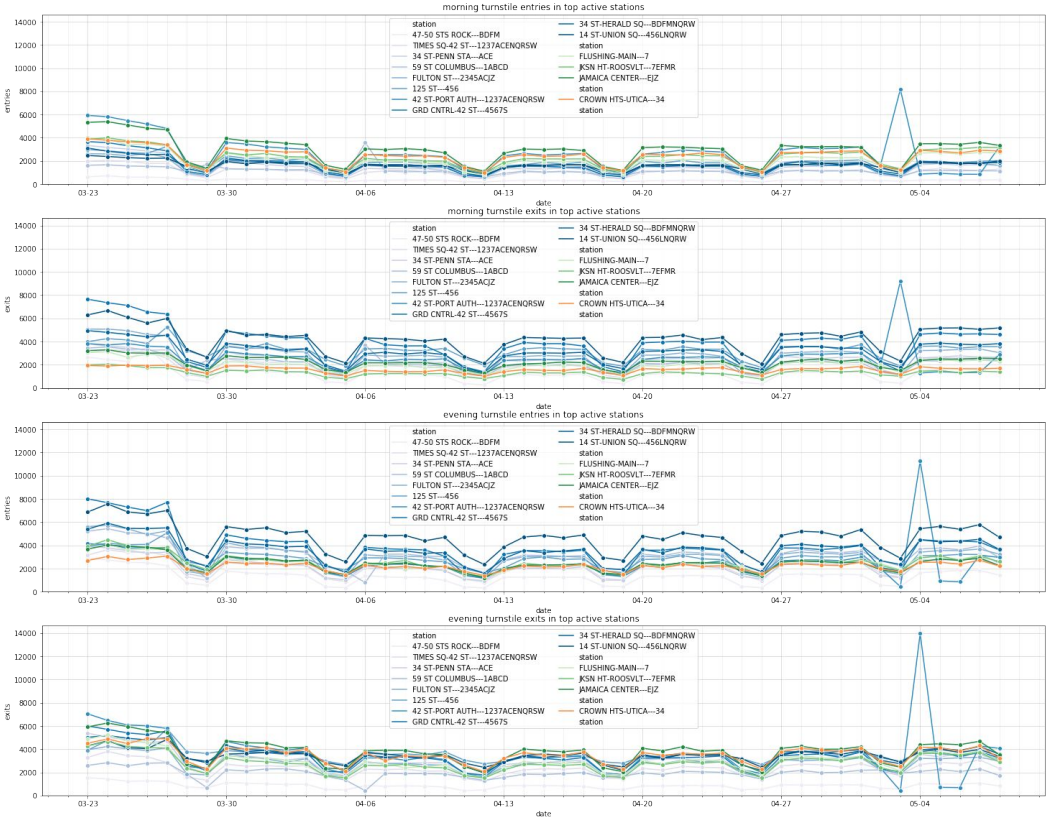
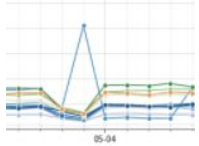


Brief discussion on previous sections



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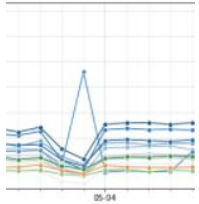
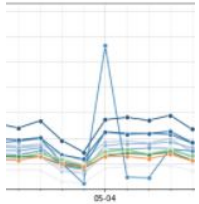
3. Ridership change by time-slot



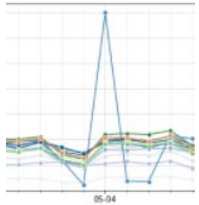
Pros:

- Better data cleaning, comparable with other quantified studies
- Flow to and from work



Limitations:

- Data quality: How to explain outliers?
- Limitation of turnstile dataset
- Static plots: Use more interactive demonstration in the future?



4. Ridership by Spatial Distribution - Methodology

Spatial Aggregation: Quadtree Spatial Index

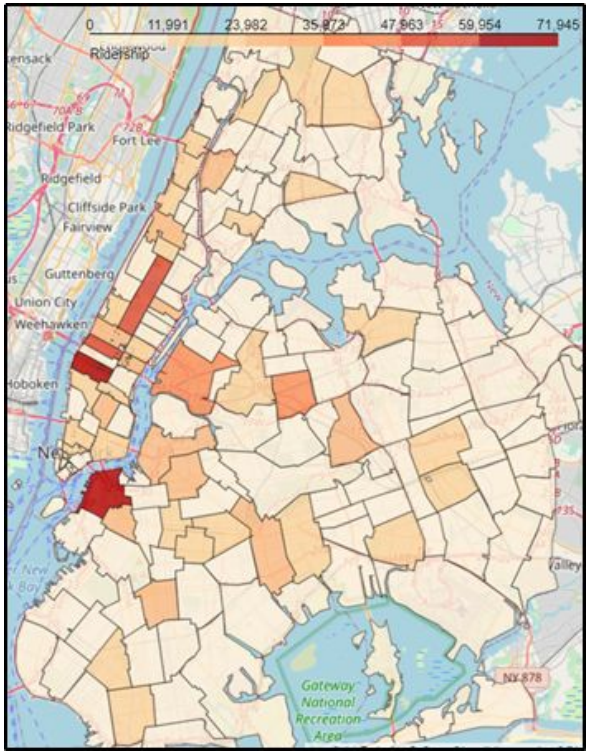
To generate the distribution of ridership based on zip codes, apply spatial index to accelerate aggregation

Quadtree

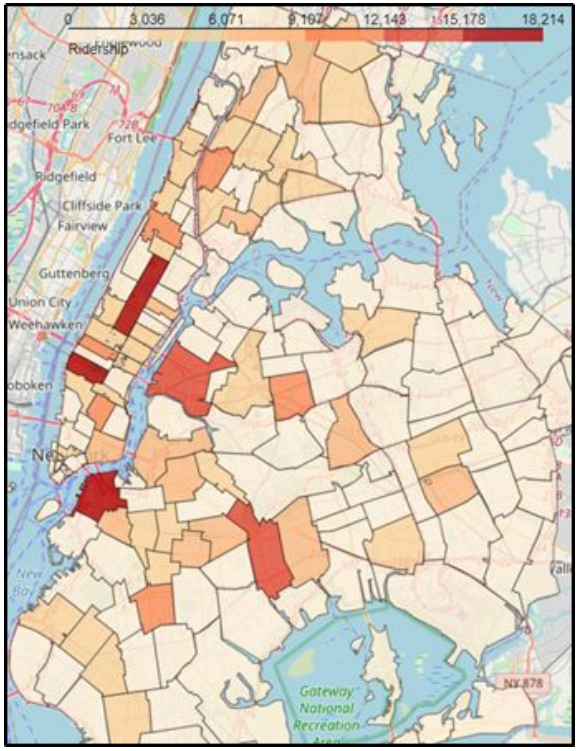
- Represents 2D planes
- Each internal node has 4 children
- Each children represents a quadrant of sub-plane
- Iterate through an array row-by-row
- If all 4 sub-regions exhibit desired property, merge into single node

4. Ridership by Spatial Distribution - Overview

02 / 19 Ridership Map



03 / 18 Ridership Map



04 / 22 Ridership Map

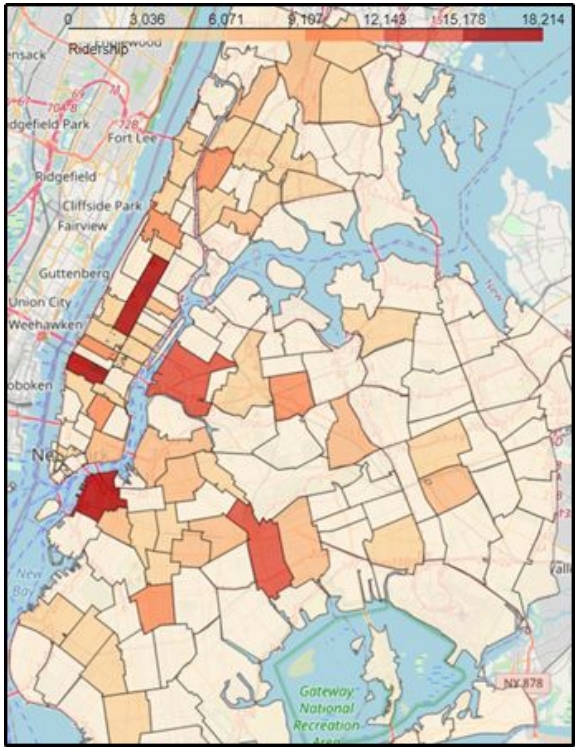
4. Ridership by Spatial Distribution - Founds

Similar Features

- Depend on the layout of subway lines
- Highest ridership in midtown Manhattan
- Higher ridership in regions surrounding Manhattan

Trends during epidemics

- Huge decrease of ridership, especially in Manhattan
- Ridership in different regions become more recognizable
- Increased proportion of ridership in inland regions



04 / 22 Ridership Map

4. Ridership by Spatial Distribution - Possible Influential Factors

Possible Factors

- Population
- Positive Rate
- Regional Income

Conducting Correlation Matrix

Positive ON

- Populations in Each Region

Slightly Negative ON

- Positive rate
- Regional Income
- Positive Cases Per Thousand People