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# Understanding the Impact of the Nightlife Industry on Urban Mobility in NYC and Charting COVID-19 Related Disruption

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Sponsor: VibeLab

CUSP Mentor: Kim Mahler

July 23 2020

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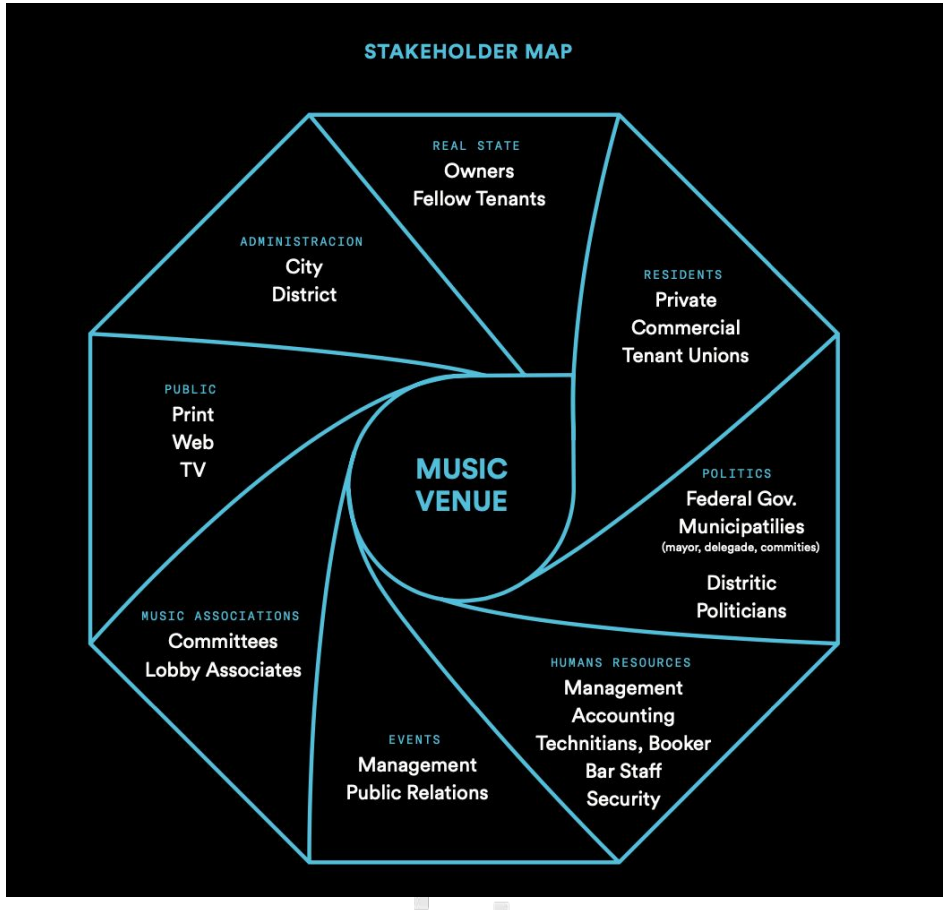
# Creative Footprint





Source: Creative Footprint,
"Measuring Live Music Space in NYC" (2018)

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# Why is this project important?

## NYC's Music Industry accounts for:

**57,000** Jobs

**$4.7B** in Wages

**$21B** in Economic Output

Source: Mayor's Office of Media & Entertainment, "Music in New York City" (2017)

# Research Questions

- **Where does NYC's nightlife occur?**
  - **Is it centralized or diffuse?**
  - **Are there specific (or surprising) clusters?**

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# Research Questions

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- **How do people access nightlife in NYC?**
  - **Are there any discernible predictors of difference in mode choice?**

# Research Questions

- Where does NYC's nightlife occur?
  - Is it centralized or diffuse?
  - Are there specific (or surprising) clusters?
- How do people access nightlife in NYC?
  - Are there any discernible predictors of difference in mode choice?
- **What changes do we see in citywide/boro-wide nighttime transportation ridership due to COVID-19?**

# Responding to COVID-19

**We built a baseline model of winter day and nighttime transportation with data from 2019, expecting to see significant variation given the arrival of the COVID-19 pandemic and related disruptions.**

## Establish a **Baseline**:

"Normal" transit conditions (same period in 2019)

Capture all night time transportation data

Source: nycgo.com

## **Transition** Period:

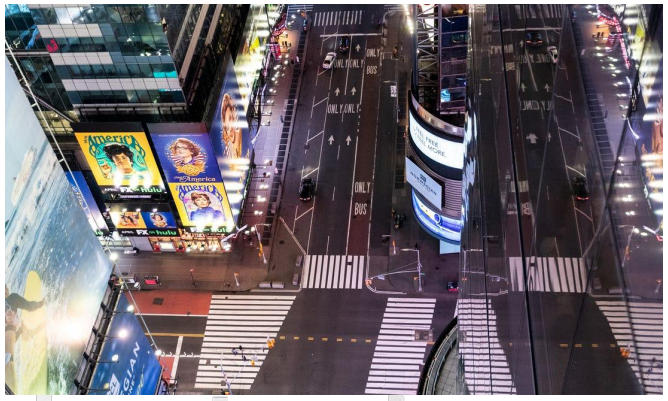
**Pre-**COVID closures, number of cases surging but businesses still open

- Did venue clusters see a decline in traffic before they were ordered shut?
- Was impact greater than in other areas?

## Current **Snapshot**:

**Post-**COVID outbreaks (2020)

Changes in mobility and activity once nightlife businesses/venues were closed



Source: Business Insider

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# Data

- **Venue Data:**

  Creative Footprint (494 venues) + Google Maps (3,601 venues)

- **Transportation Data:**

  TLC (For-hired vehicles) + MTA + Citibike

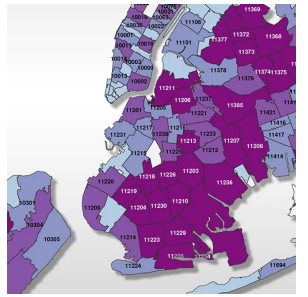
- **Demographics:**

  Land Scan: day and night population

- **Built Environment Features:** PLUTO (NYC DCP)

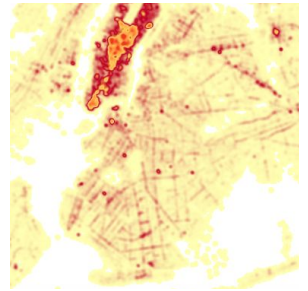
- **Weather:** Weather Underground

Zip Codes



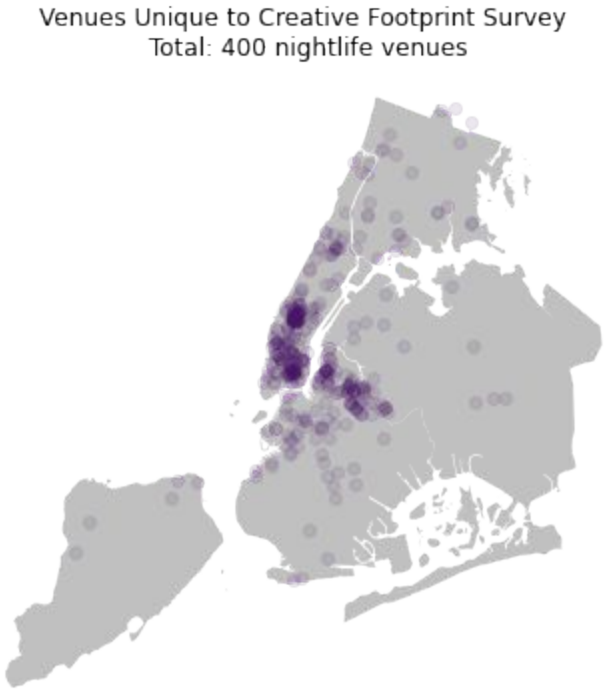
Taxi Zones

Census Blocks



Nightlife Venues

# Venue Data (Creative Footprint survey)



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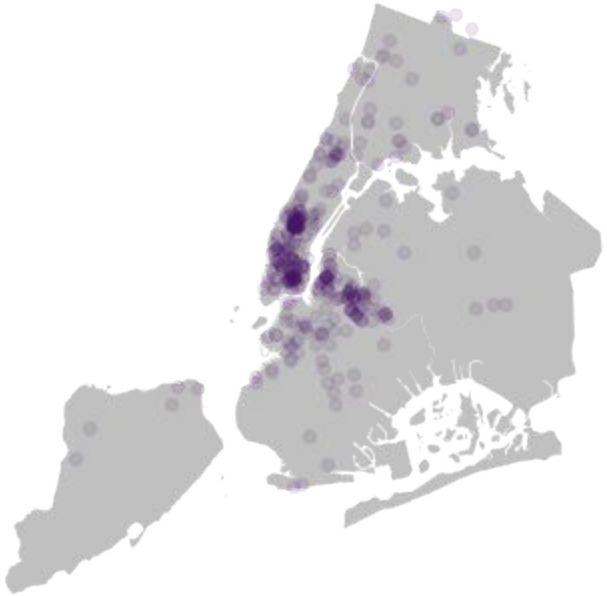
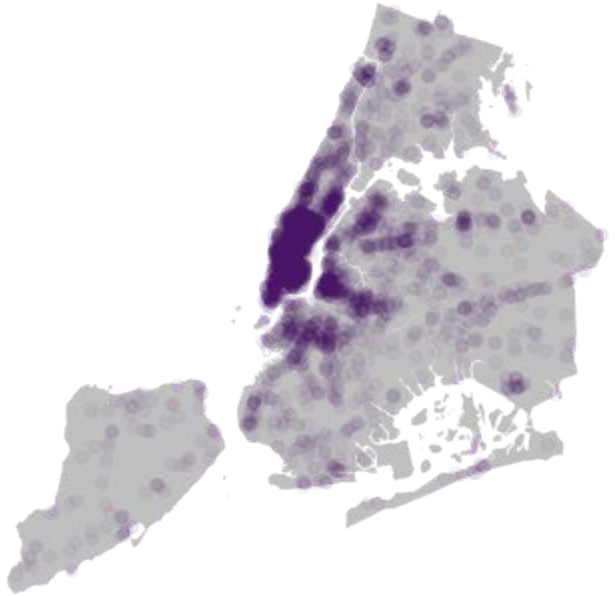
# Venue Data (supplementing with Google)

Venues Unique to Creative Footprint Survey
Total: 400 nightlife venues



Google Maps Nightlife Venues
Total: 3601 bars and clubs



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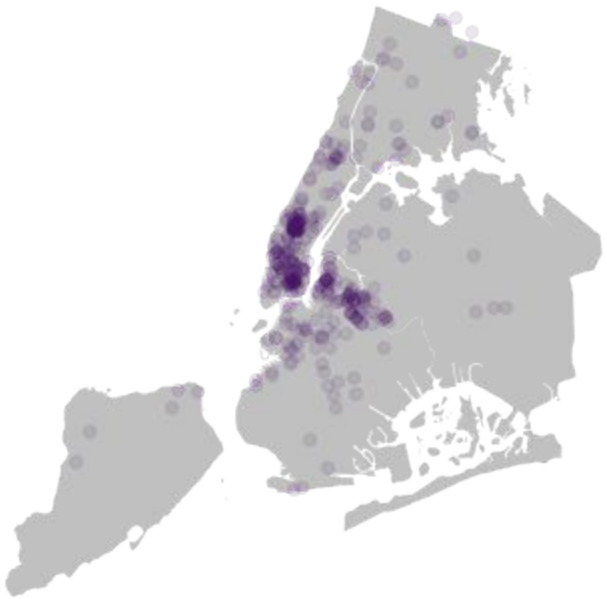
# Aggregated Venue Data

Venues Unique to Creative Footprint Survey
Total: 400 nightlife venues



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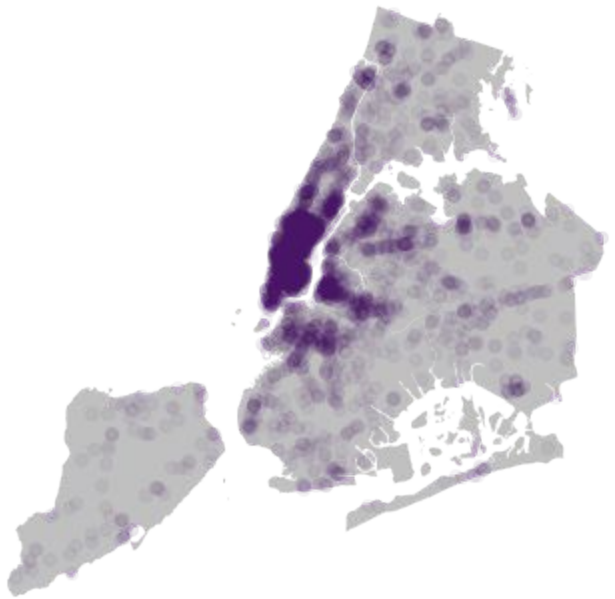
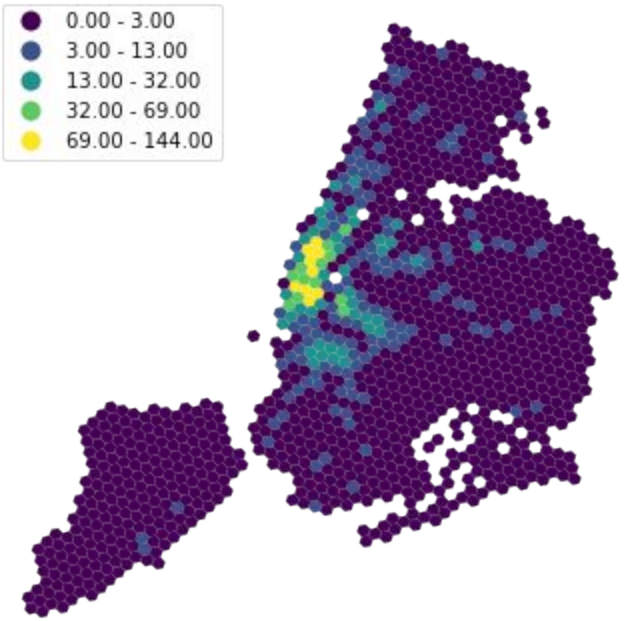


Venues aggregated to hexbin scheme
Total hexes: 1199



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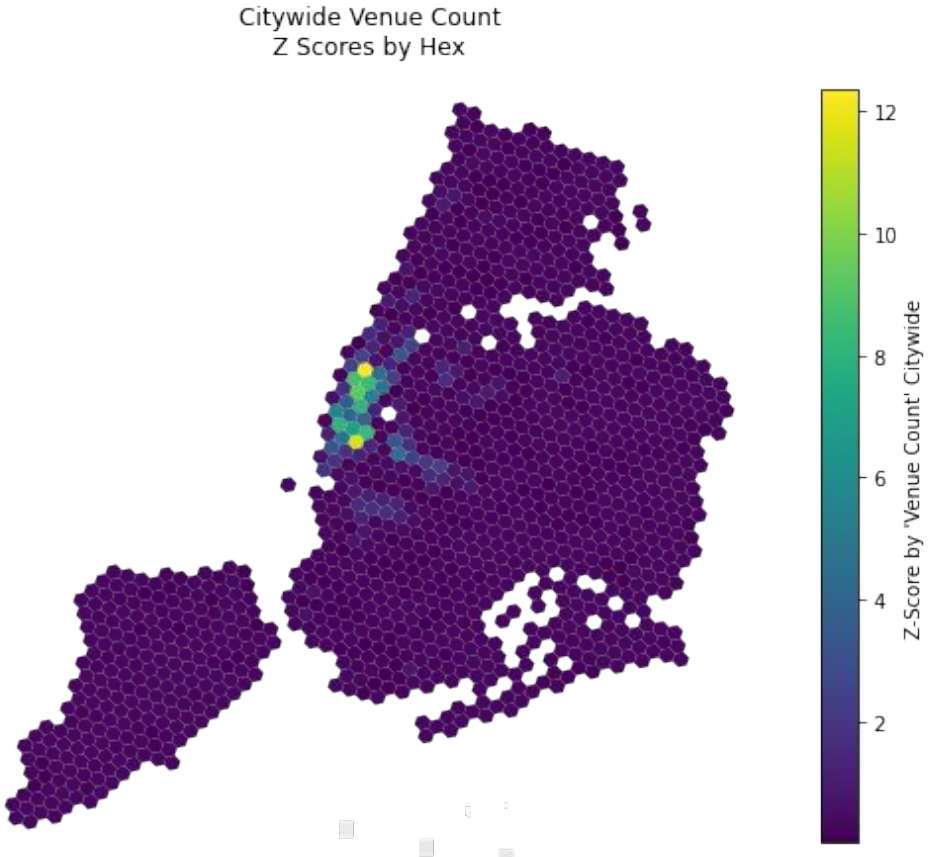
# Detecting Venue Clusters: The Wrong Way




**μ = 3 venues**
**σ = 11 venues**

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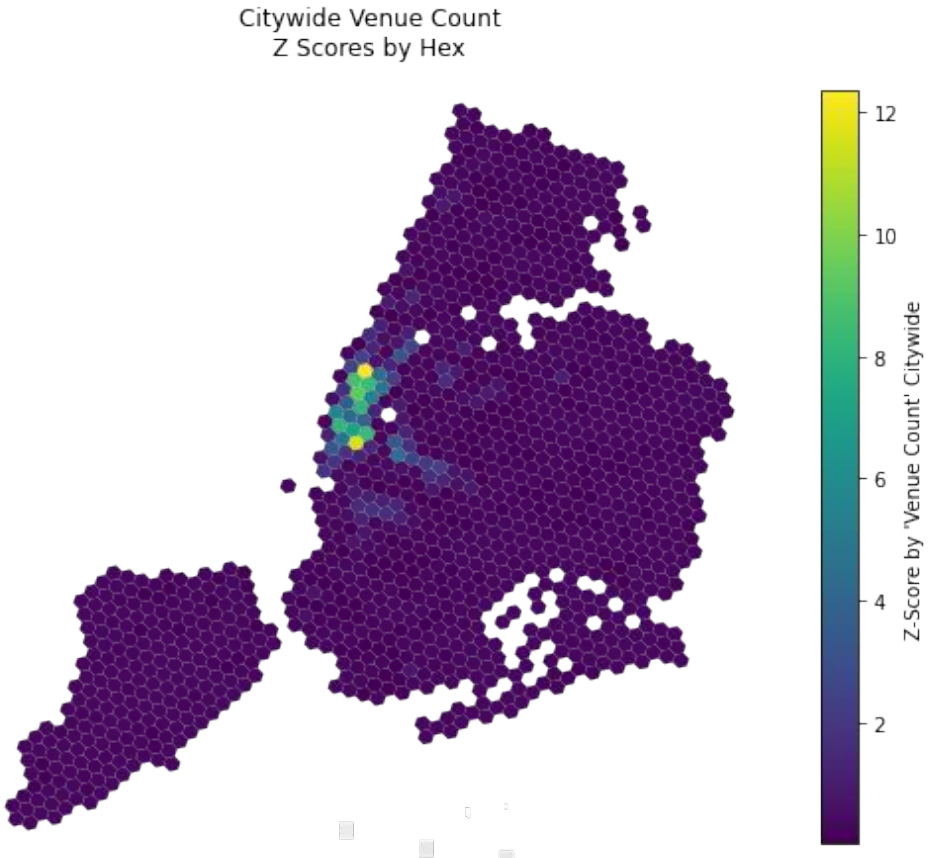


μ = 3 venues
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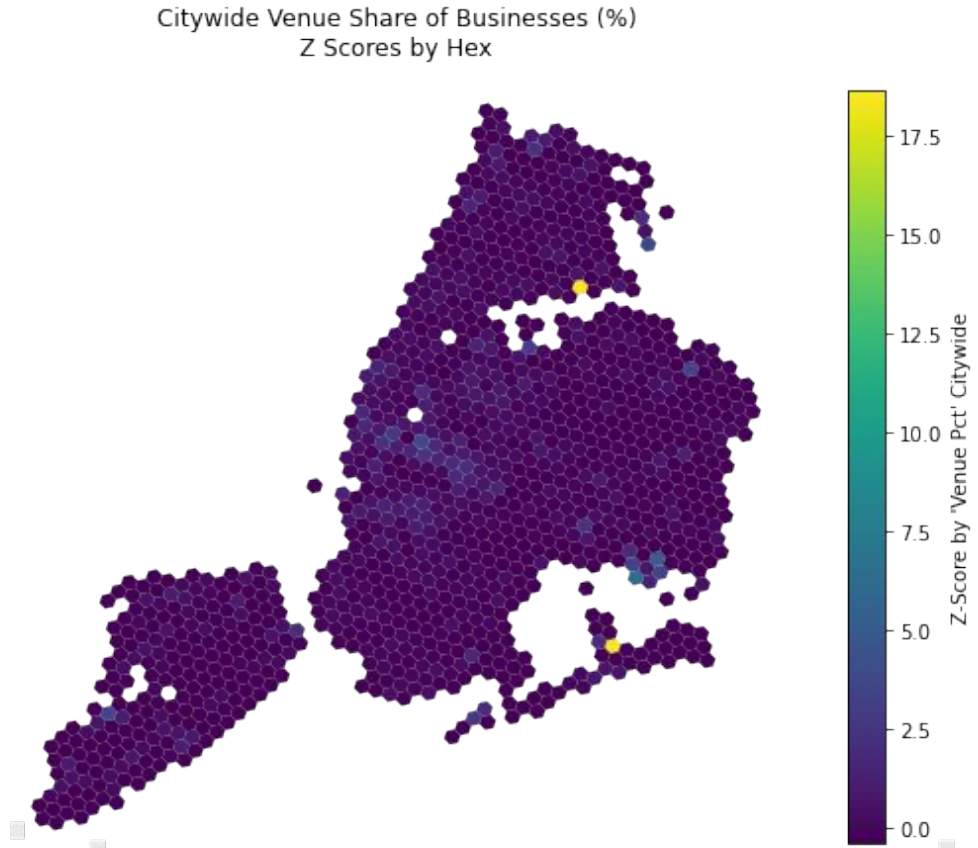


μ = 0.66% venue share
σ = 1.76% venue share

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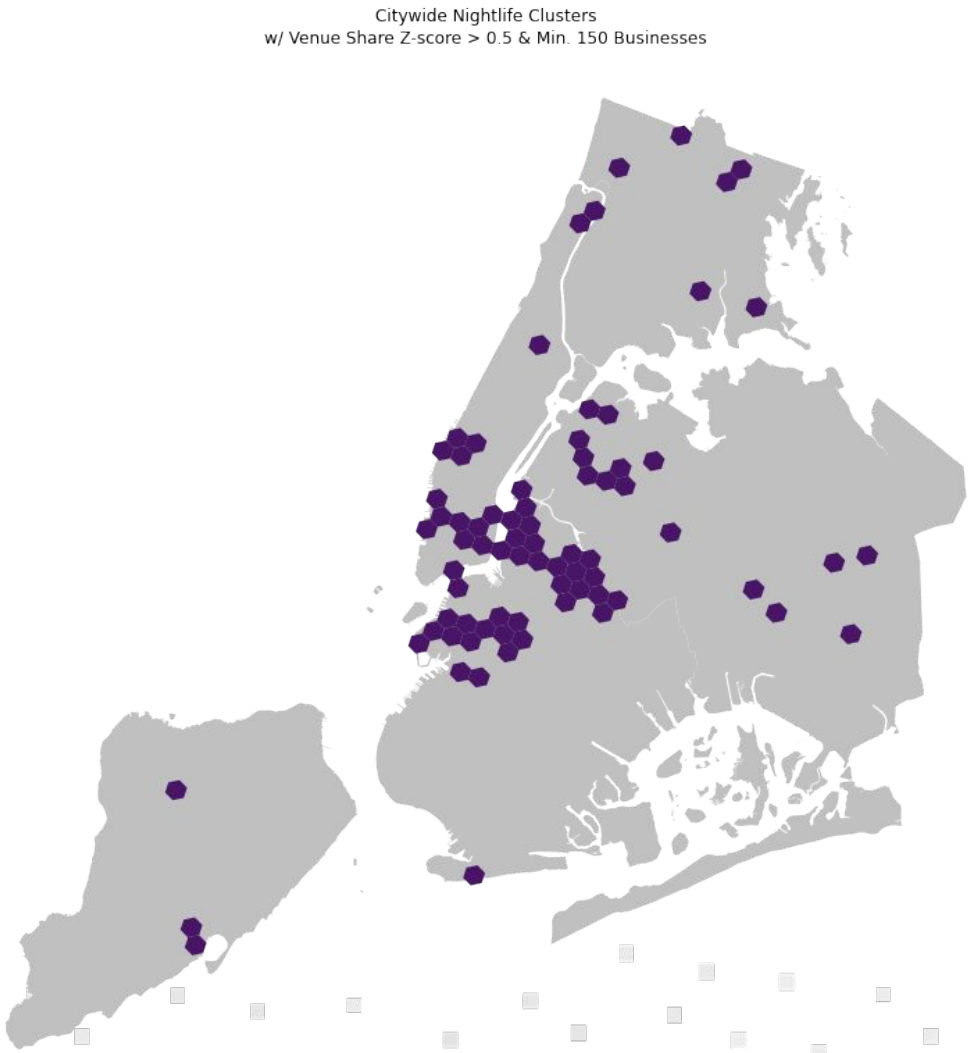

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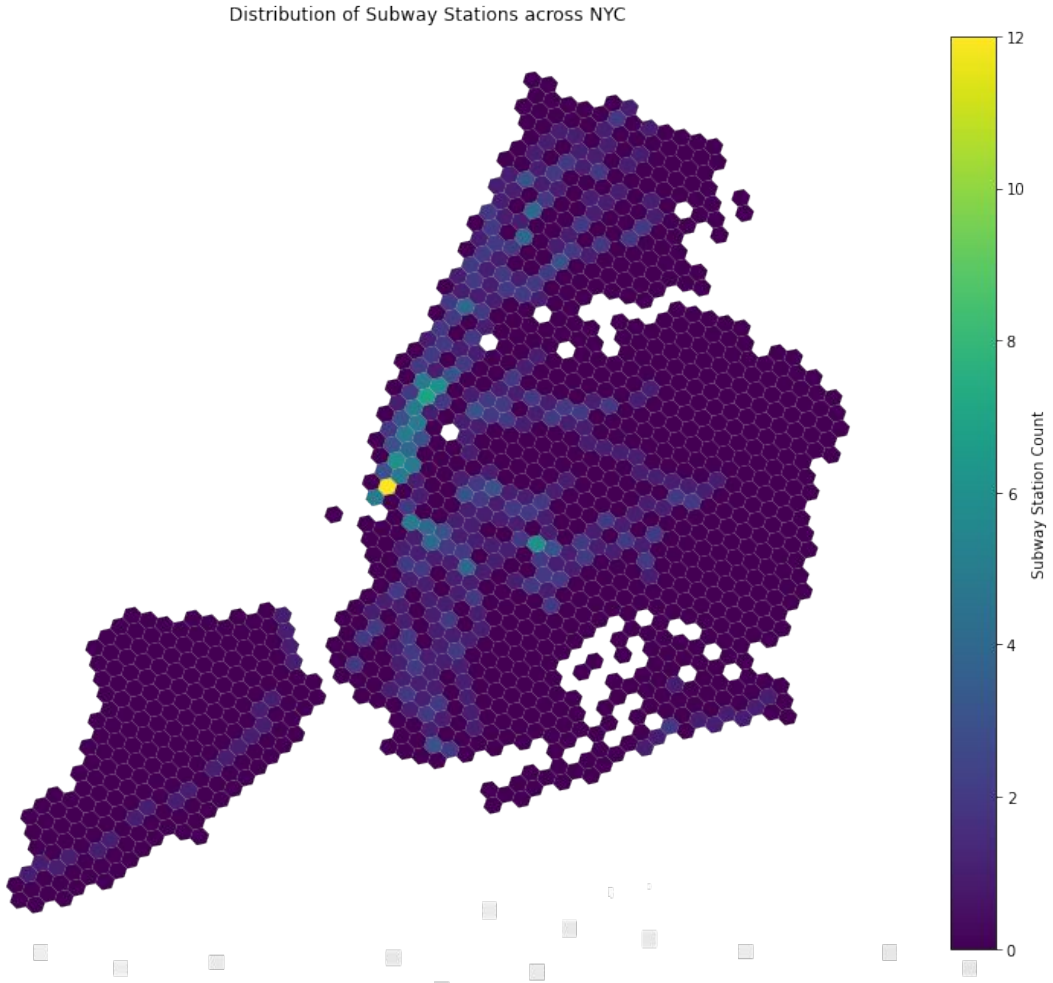
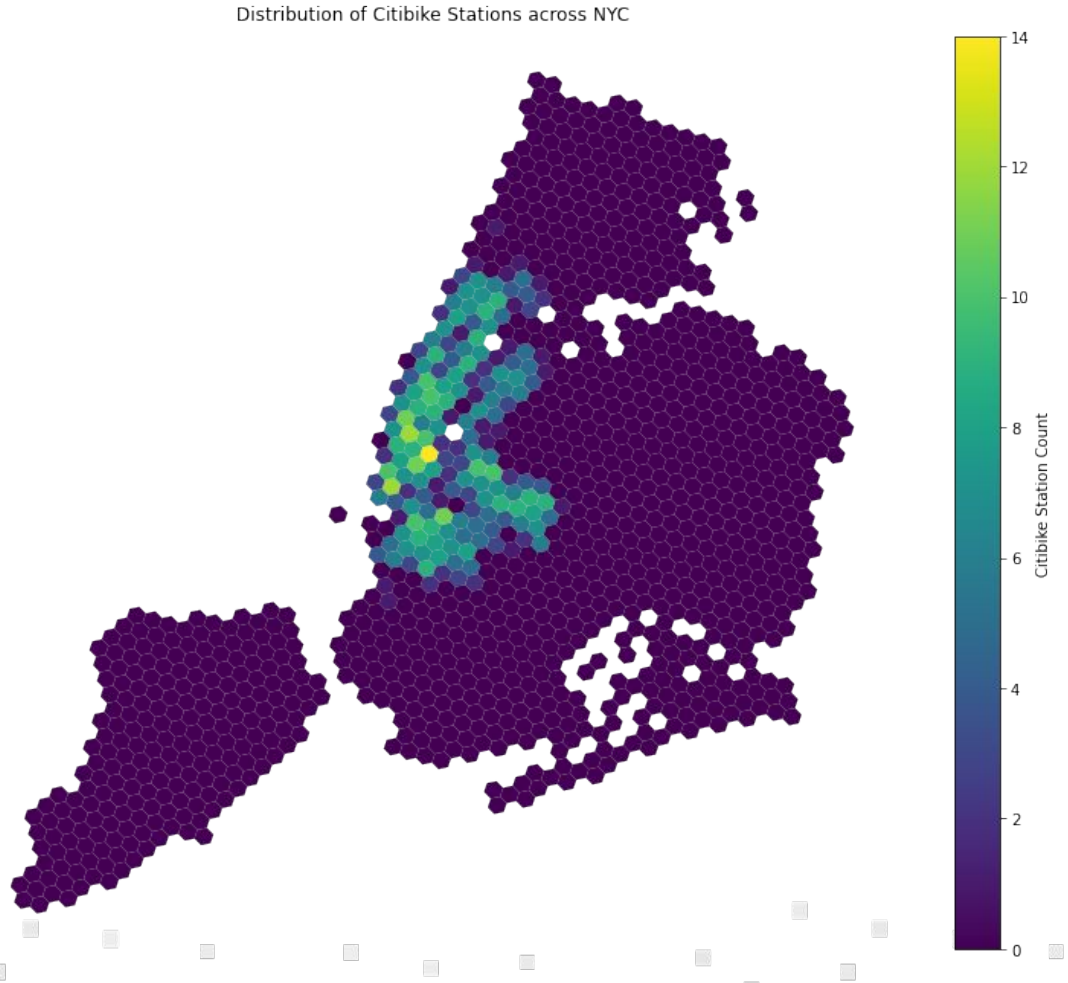
# Transportation Data (Public Transit)



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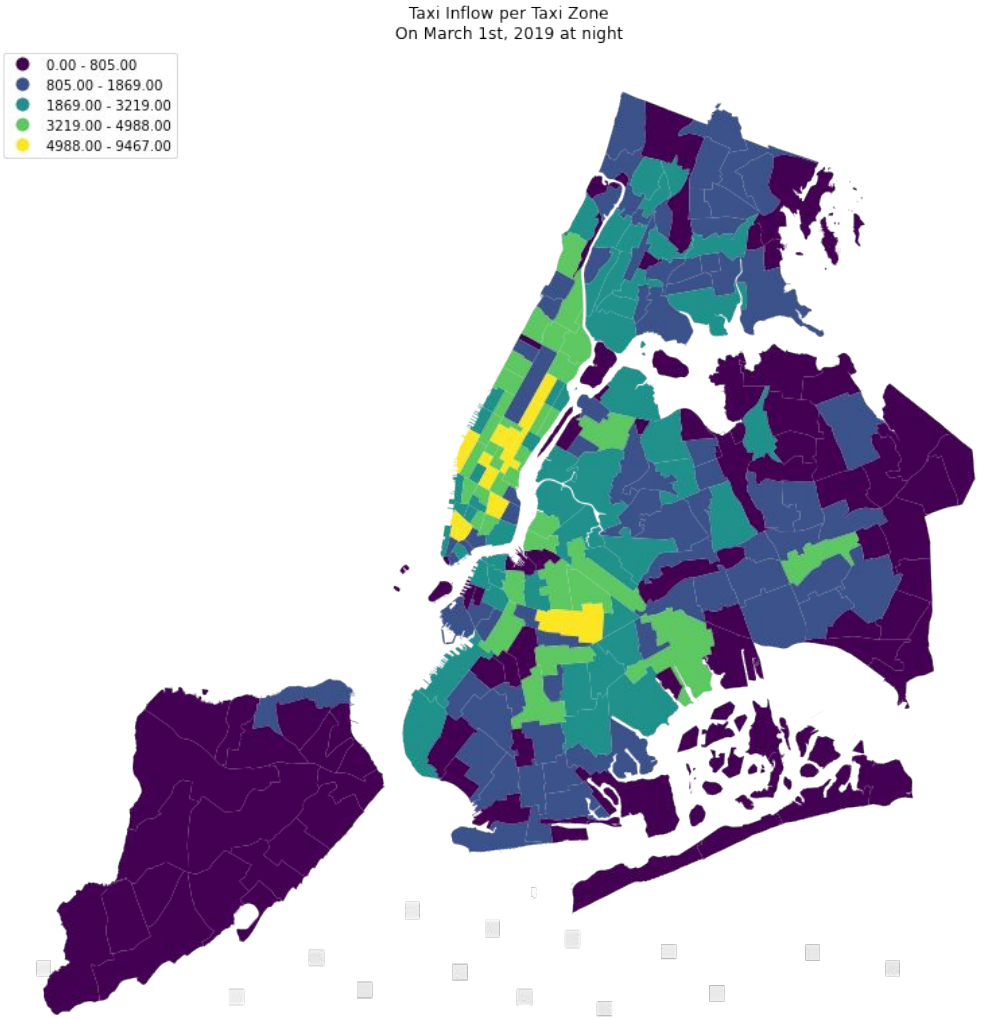
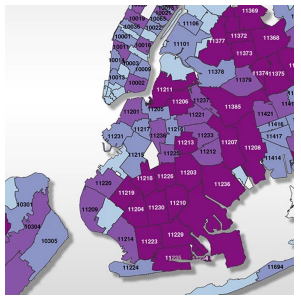
# Transportation Data (For-Hire Vehicles)




Zip Codes



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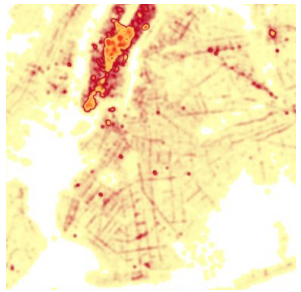

Nightlife Venues

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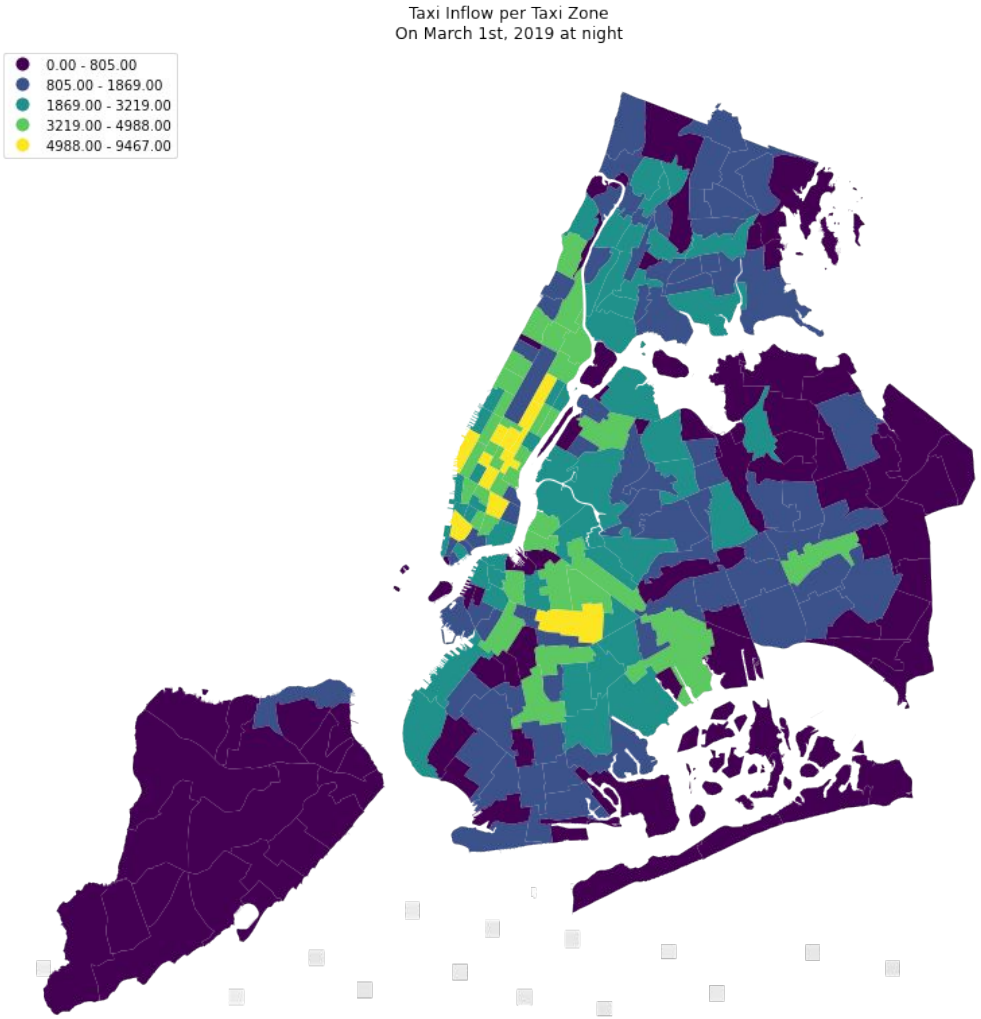
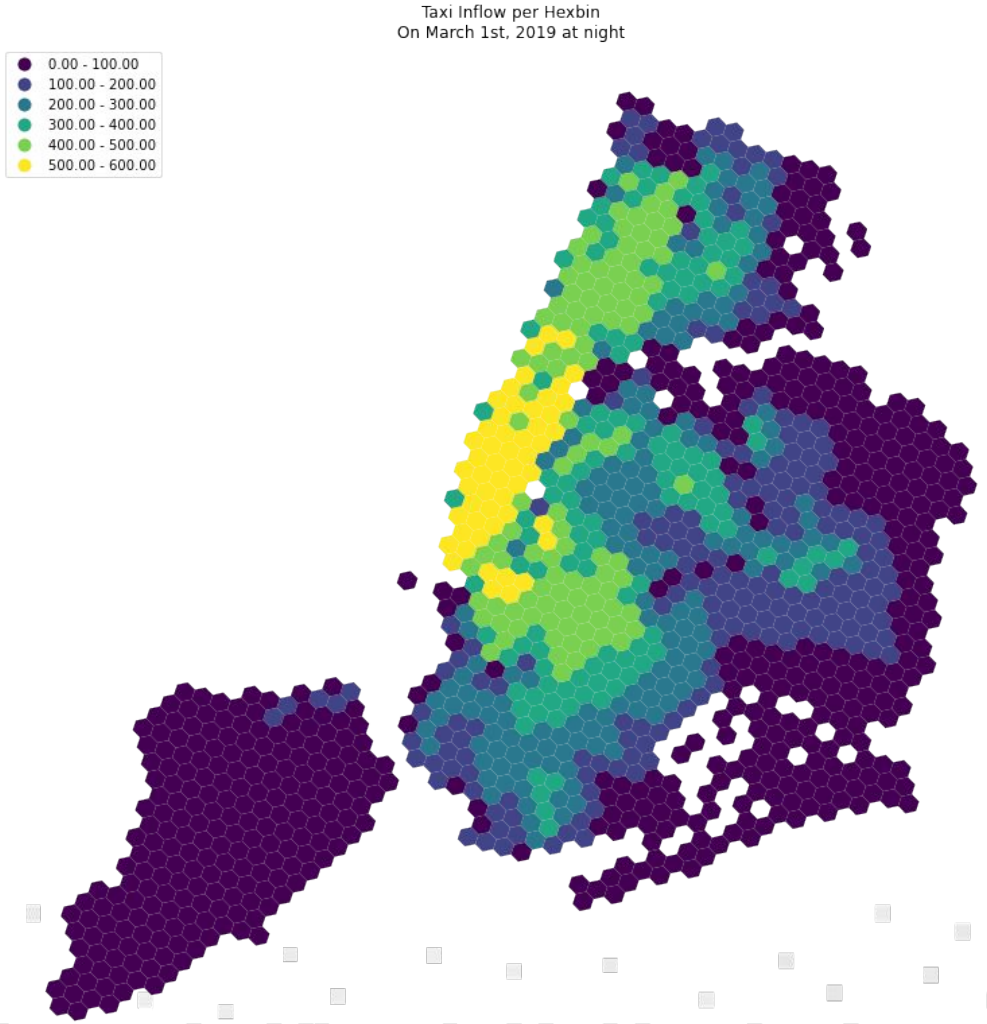
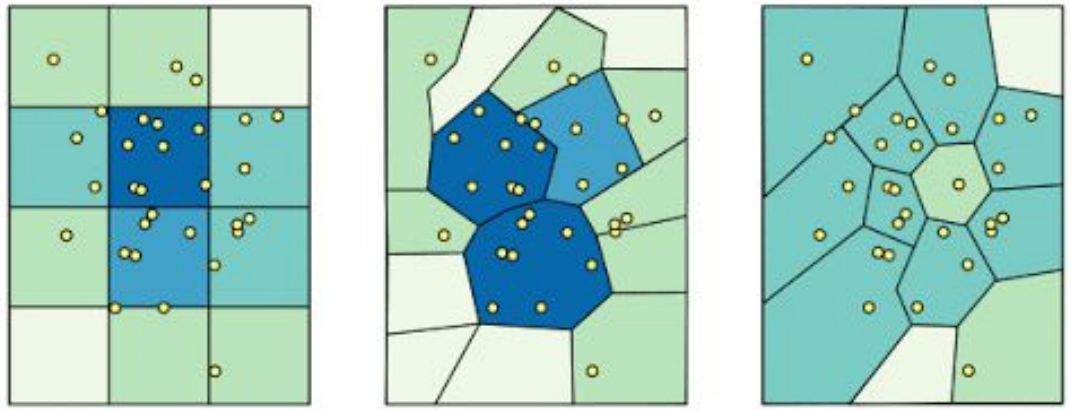
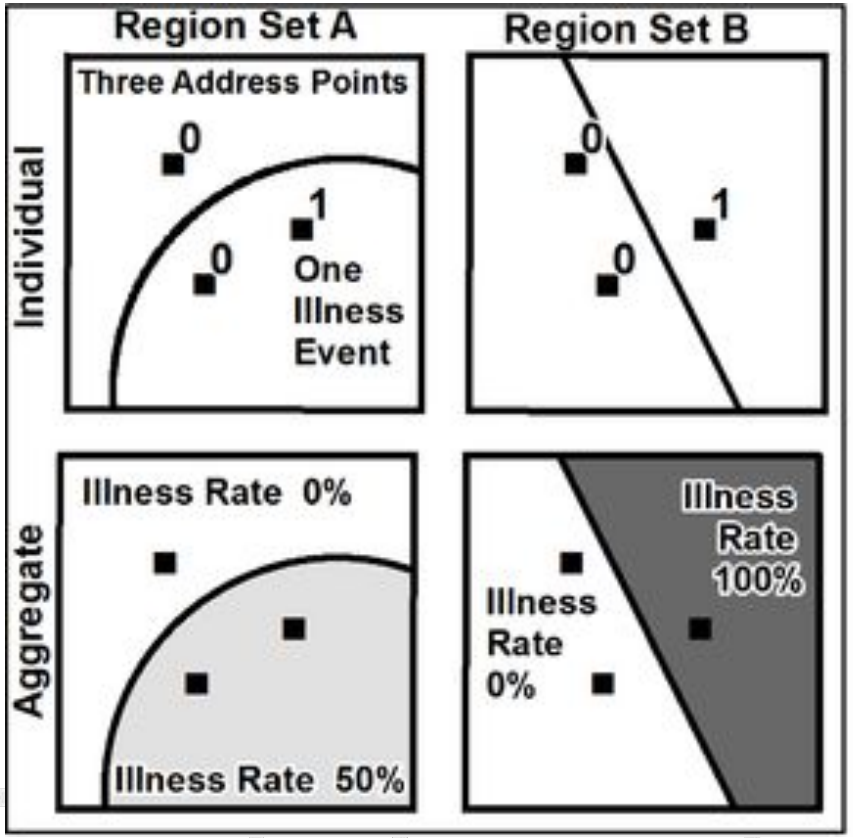
# Transportation Data (For-Hire Vehicles) Areal Interpolation



# The Modifiable Areal Unit Problem (MAUP)





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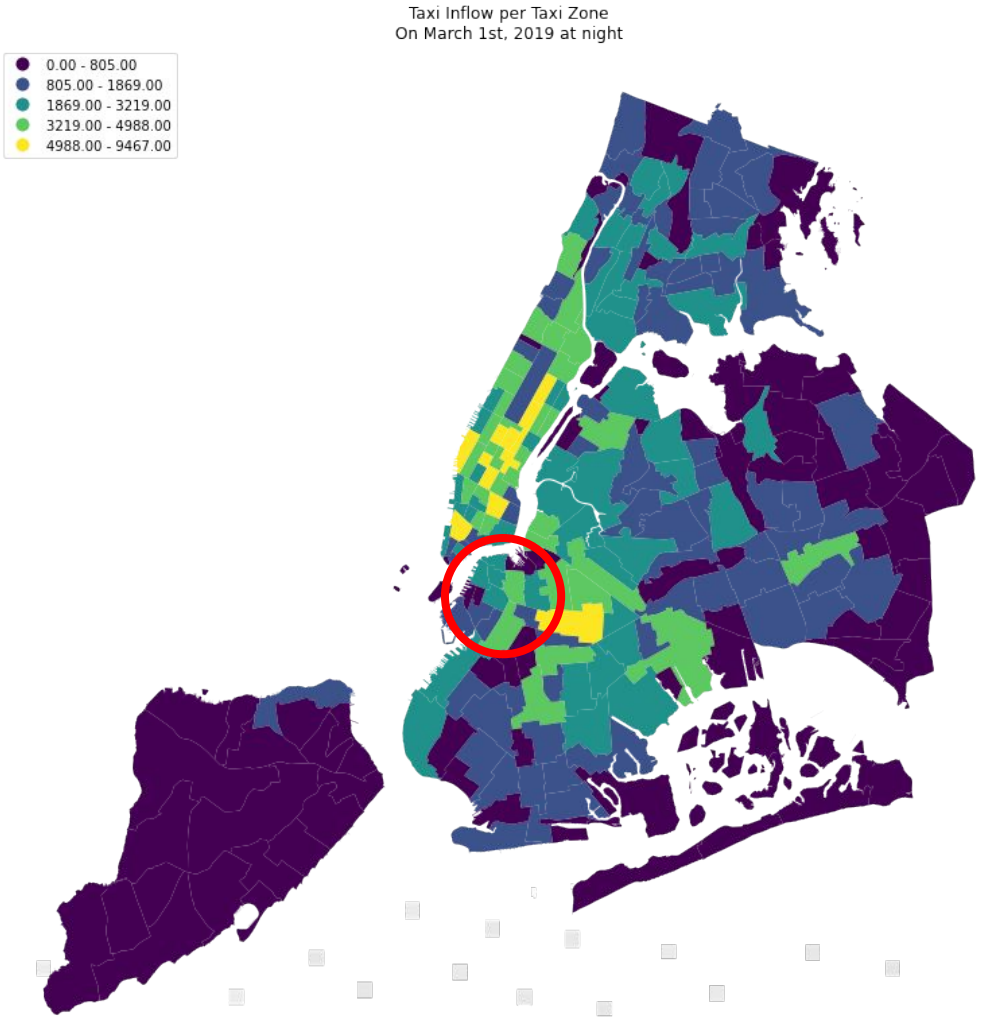


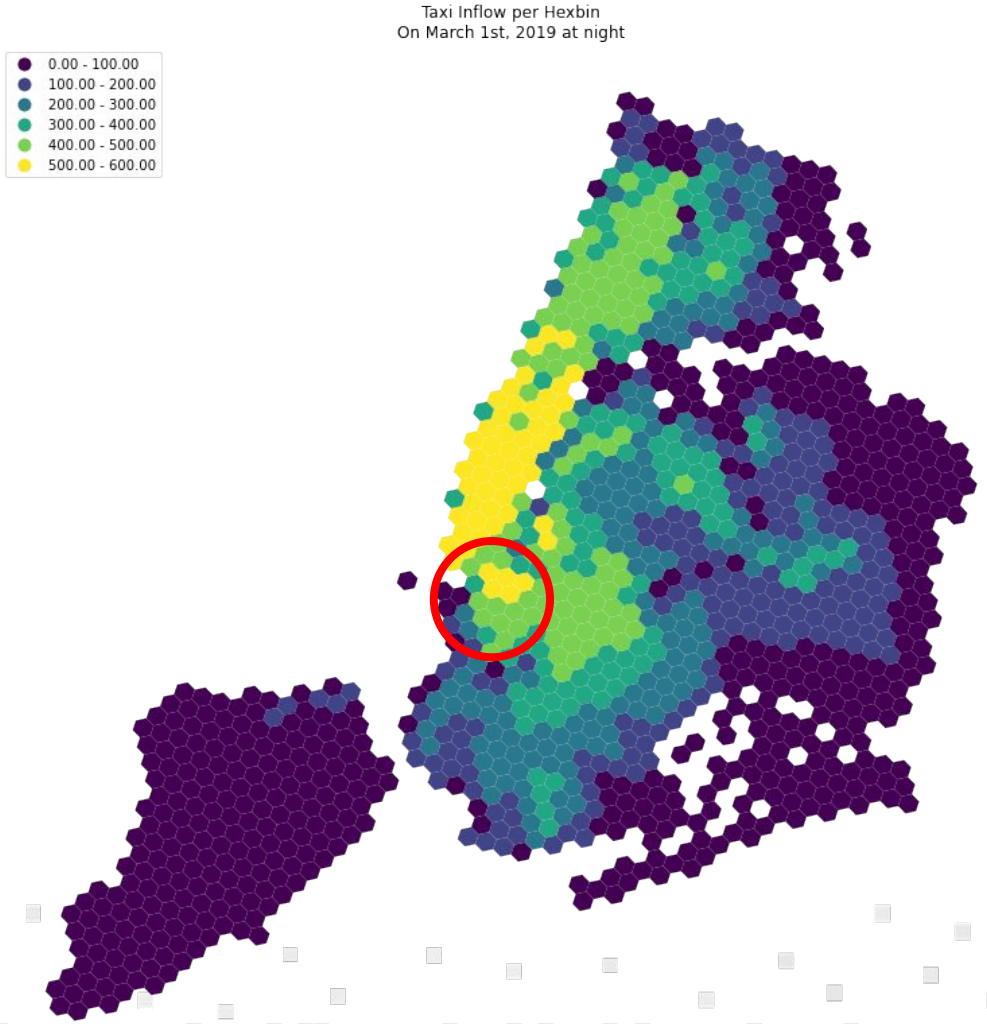

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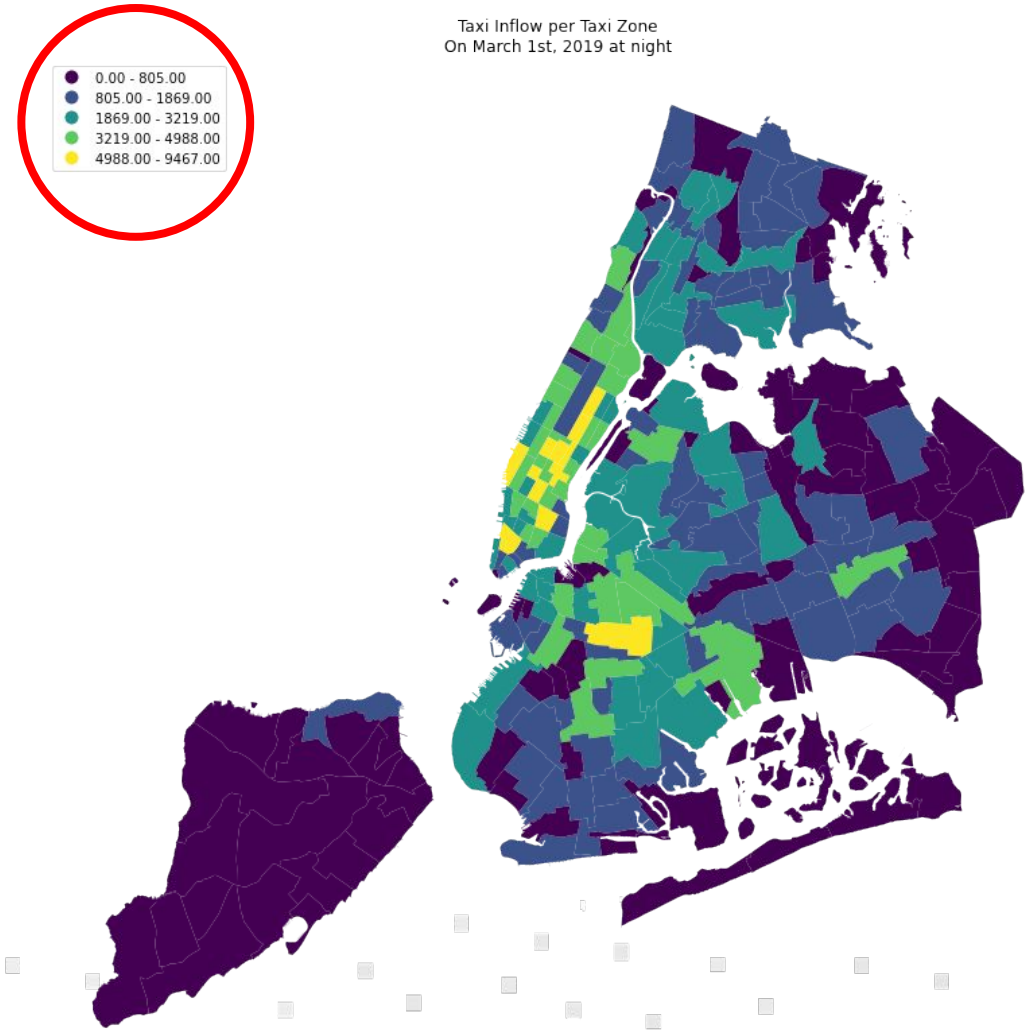


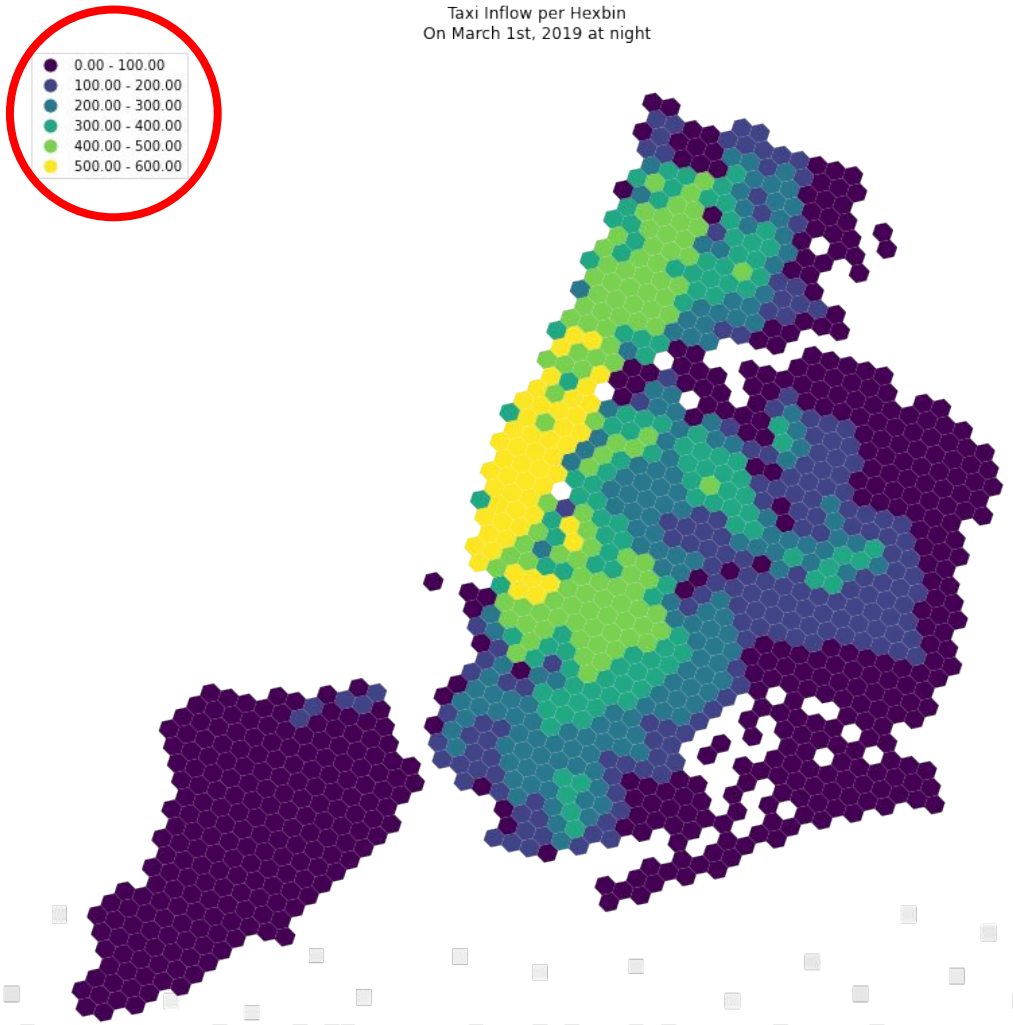

# Method - Data Engineering

## Big Data

The sheer size of trip records

## Streaming

Process data row by row; no monopolizing RAM

## Final Dataset Preparation

Aggregating to **daily day and night** data intervals ranging from **Jan. 1 - Apr. 30** for the **years 2019 and 2020**

| Hex ID | Day/ Month/ Year | Night? | FHV/ Citibike/ MTA Inflow/ Outflow | Night/ Day Population | Venue/ Business Count | Res/ Comm Area | Temperature/ Rainfall | Covid? | Boro Code | Nos. of Citibike/ MTA stations |
|---|---|---|---|---|---|---|---|---|---|---|
| str | timestamp | bool | int | int | int | float | float | bool | int | int |

Available via Github and available for public use and research (https://github.com/nlicalzi/cuspcapstone).

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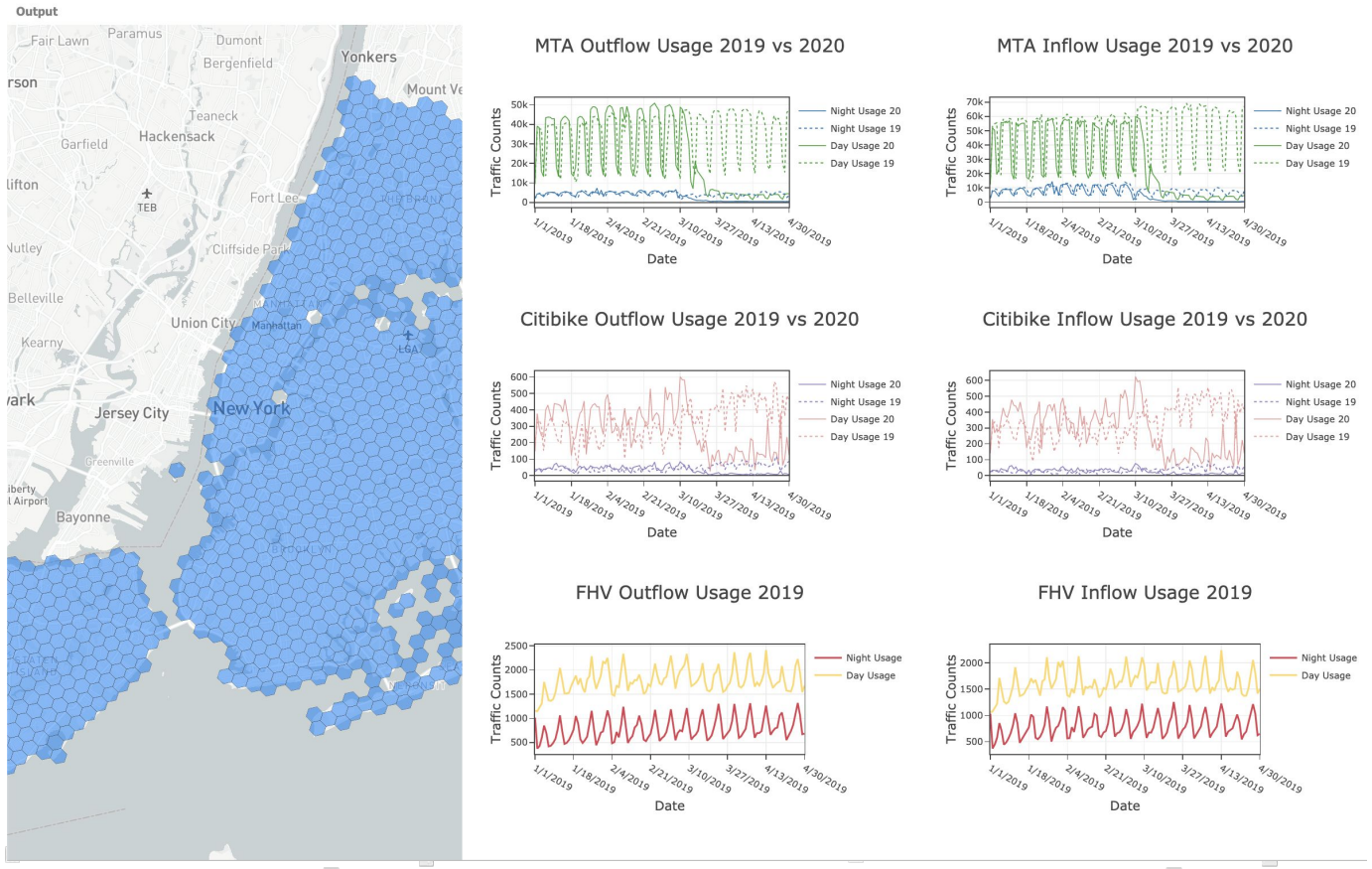
# Method - Data Visualization

## Data Visualization Interface

- D3.js and the MapboxGL Javascript API
- Monitor daily or nightly changes of different mobility usage in hexagons
- Time series analysis
- Comparison to baseline model



# Method - Regression Analysis

$$DailyInflow_i = \beta_0 + \beta_1 DayoftheWeek_i + \beta_2 AveTemp_i + \beta_3 Precipitation_i + \beta_4 NightDummy + \varepsilon_i$$

$$VenueCounts_i = \beta_0 + \beta_1 BuseinssCount_i + \beta_2 TMTAInflows_i + \beta_3 CitiBikeInflow_i + \beta_4 FHVInflows_i + \beta_5 Stationcounts_i + \beta_6 boroDummy + \varepsilon_i$$

$$NightDailyInflow_i = \beta_0 + \beta_1 StationCount_i + \beta_2 BusinessCount_i + \beta_3 LotsArea_i + \beta_4 ResidentialArea_i + \beta_5 OfficeArea_i + \beta_6 RetailArea_i + \beta_7 NightPopulation_i + \beta_8 BoroughDummy + \varepsilon_i$$

**Transportation:** MTA, Citibike, Fhv(Yellow Cab, Ubers etc.), Station counts(MTA & Citi)

**Year :** 2019 and 2020 (Covid-19)

**Environment built Features:** Business Counts,Residential, Commercial, Retail Area

**Demographic feature:** Population data

**Weather:** Temperature, Precipitation

**Time-related:** Day of the Week, day or night

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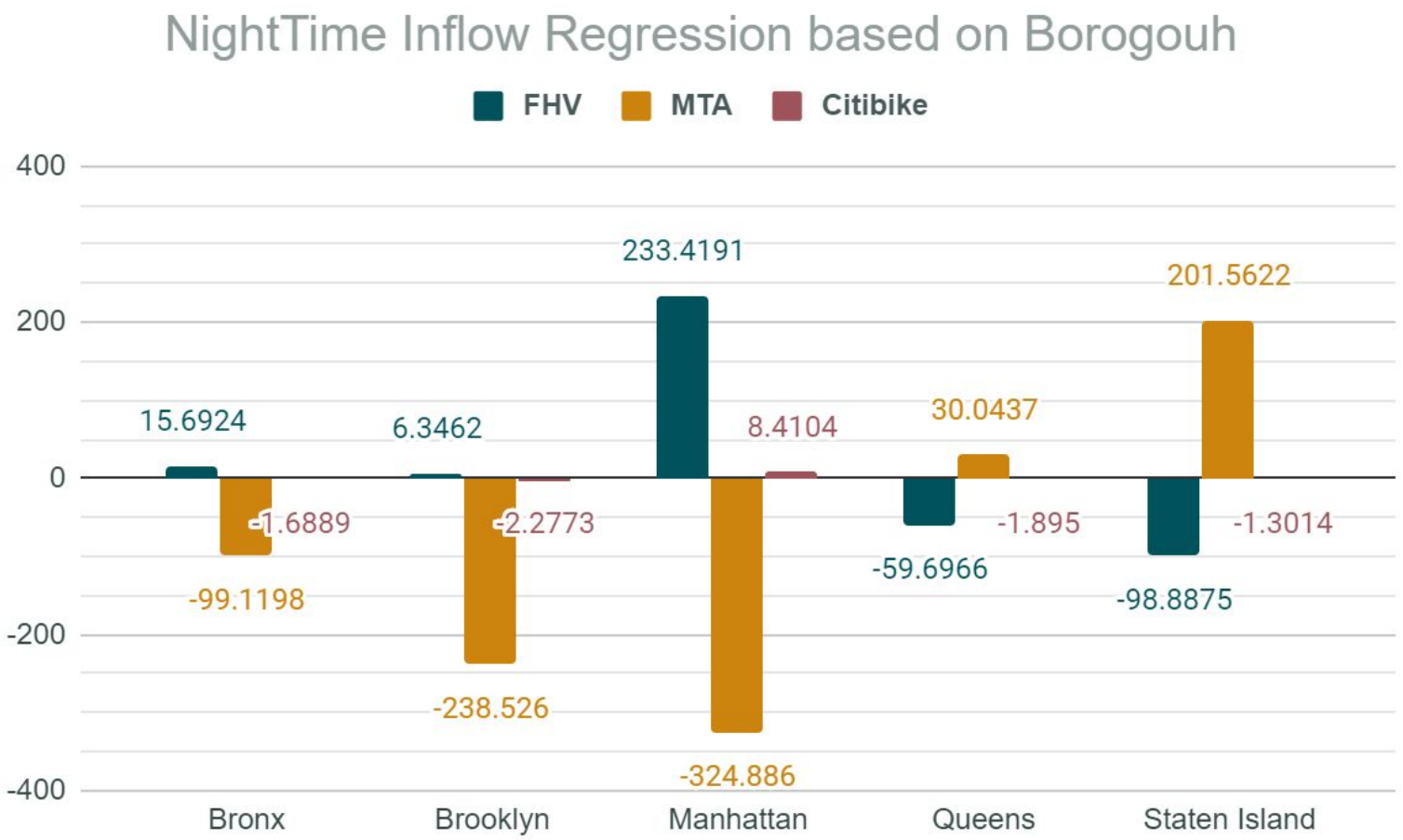
# Result

**How do people access nightlife in NYC and are there any predictors of difference in mode choice?**




Unit approximately ⅛ Central Park.

Nightlife transportation preference

- Staten Island - MTA Preferred
- Manhattan - Taxi Preferred

Citi Bike Influence

- Manhattan - More dock locations

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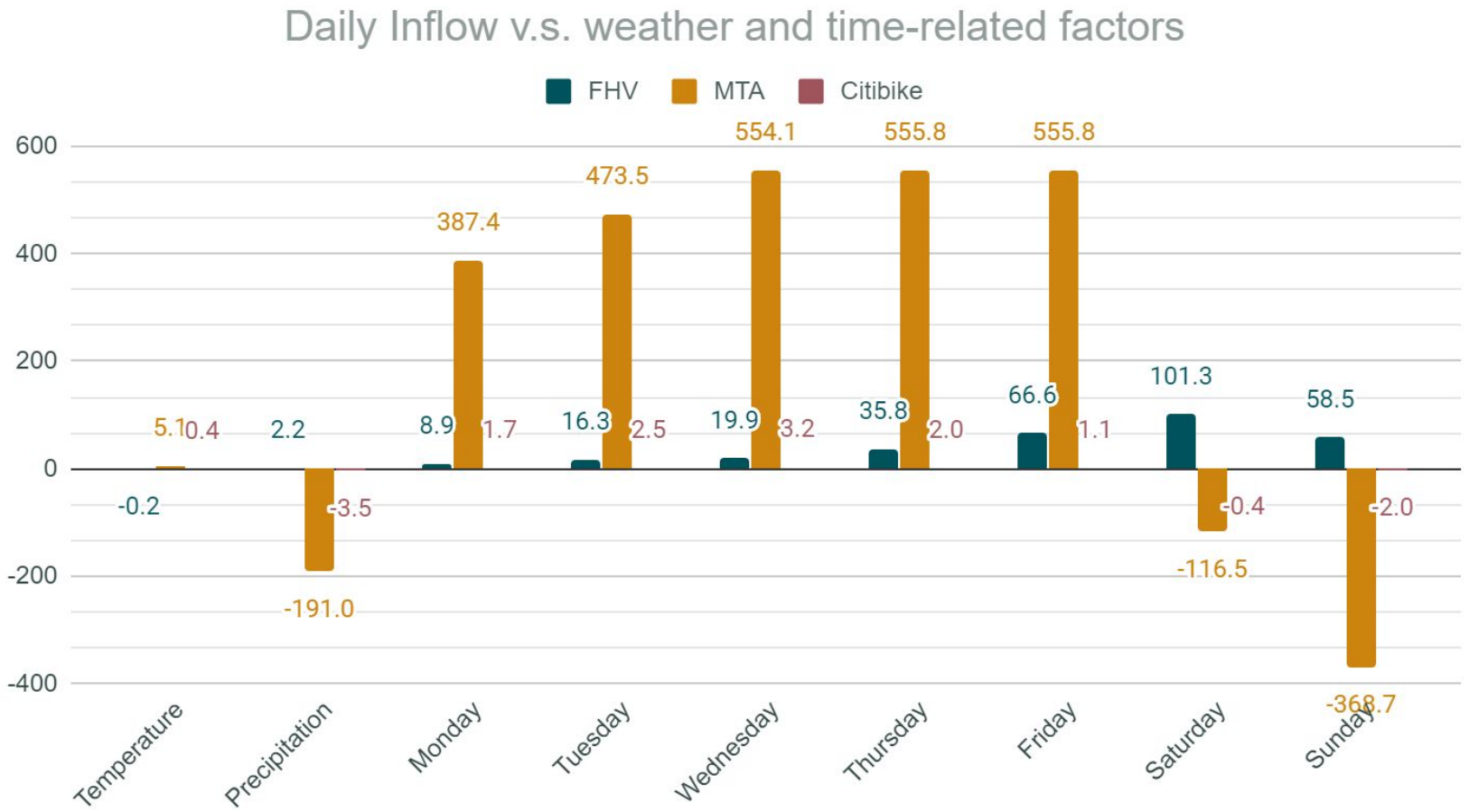
# Result

**What is the relationship between transport mode choice and weather, weekday and weekend and day or night?**




Area size: approximately ⅛ Central Park

- Weekend

  Taxi > Citi Bike > MTA

- Weekday

  MTA > Taxi > Citi Bike

- Rainy Day solution

  Taxi ↑

  MTA and Citi Bike ↓

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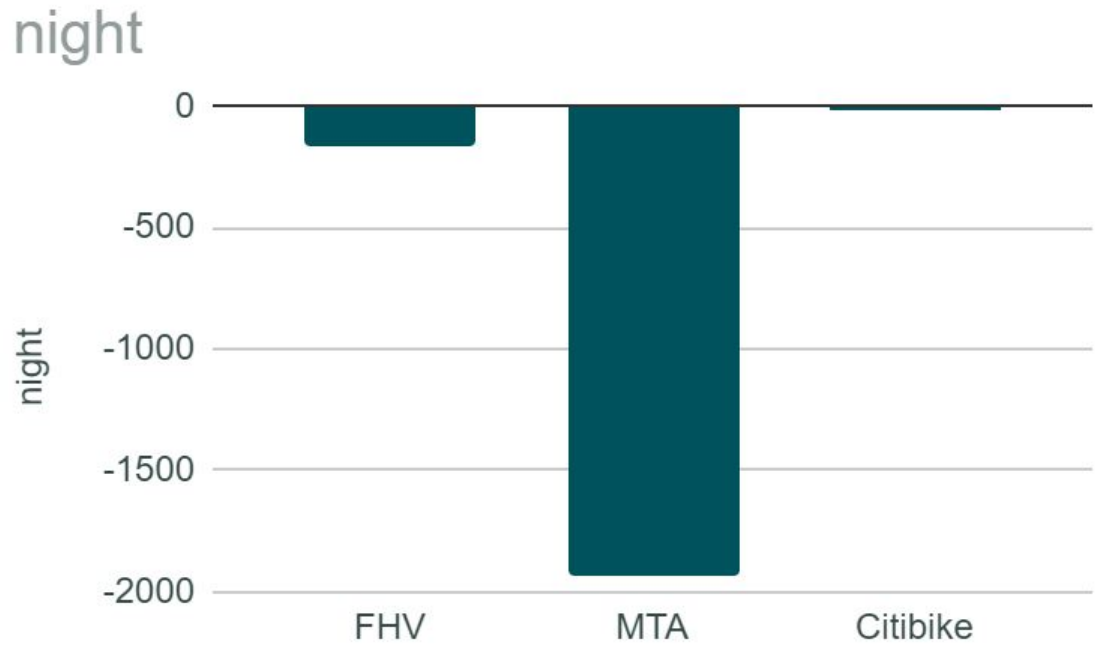


Area size: approximately ⅕ Central Park

**All Decrease at Night**

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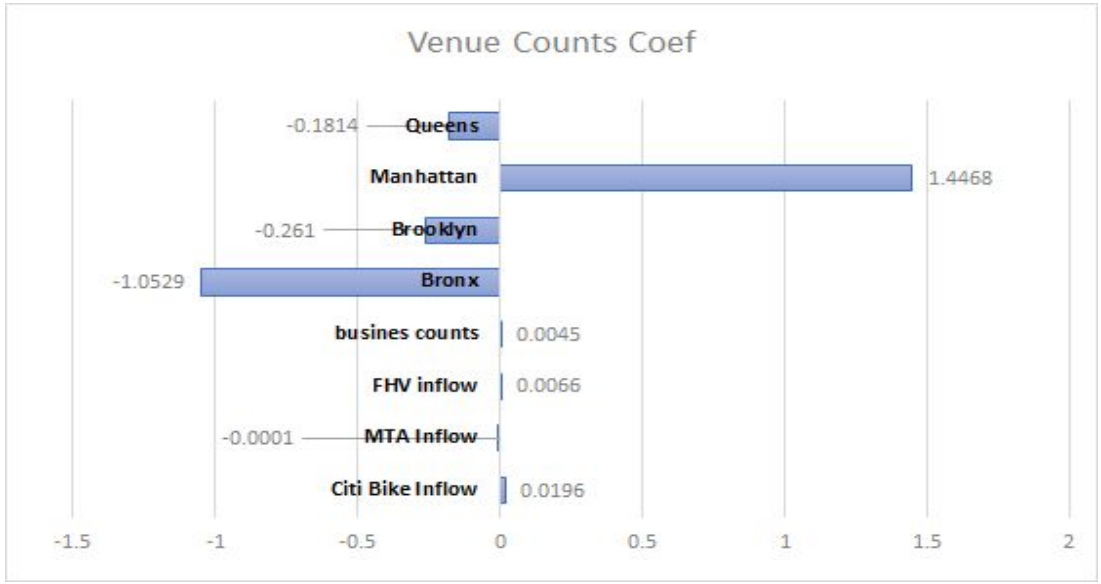
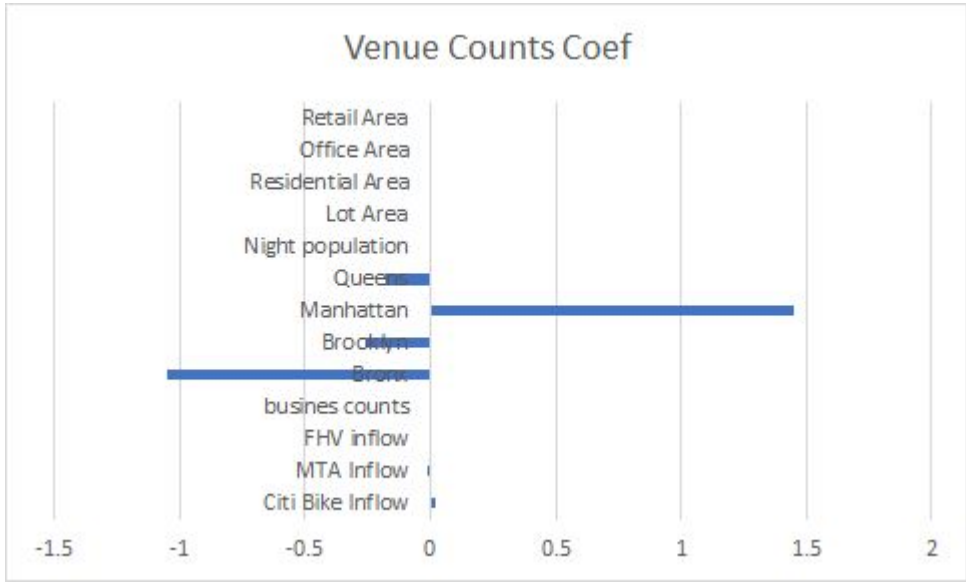
# Result

## How does the nightlife venue grows?




- **Manhattan has the highest venue counts**
- **Citibike has a higher positive coefficient on venue counts.**
  - **traffic congestion at night time**
- **Different land use has less impact on venue counts**
- **Venue locations have strong relationships with boroughs**
- **Little relationship with populations**

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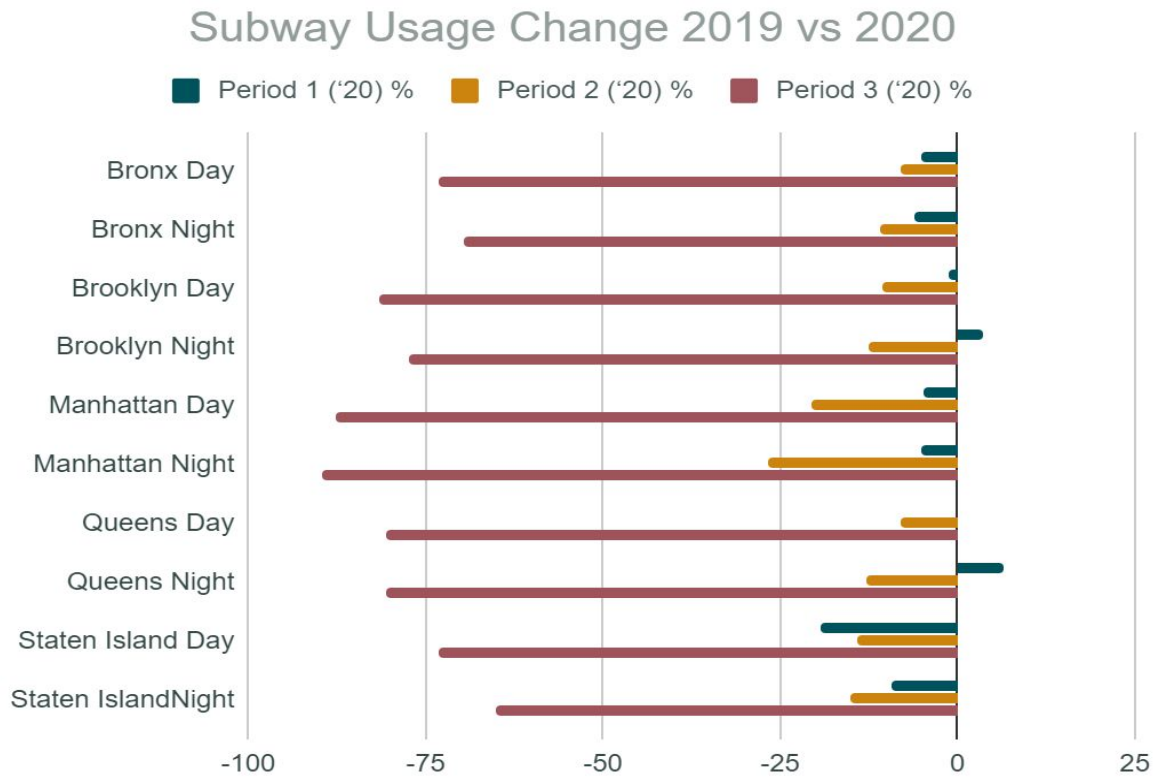
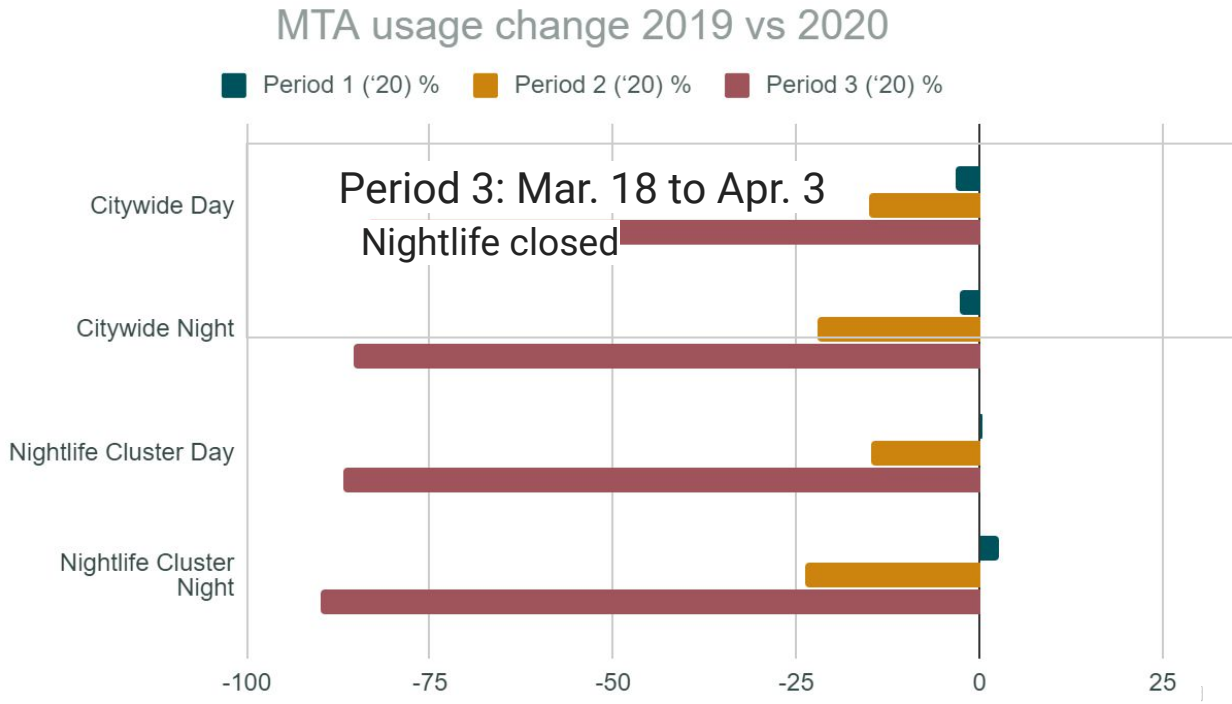
# Result

**What is the citywide and borough-wide decrease in transportation utilization due to Covid-19?**

Period 1 Feb.12 to 28
Normal Condition → Period 2 Mar.1 to 17
Aware of Covid-19 Outbreak → Period 3 Mar.18 to Apr.3
Nightlife Closed



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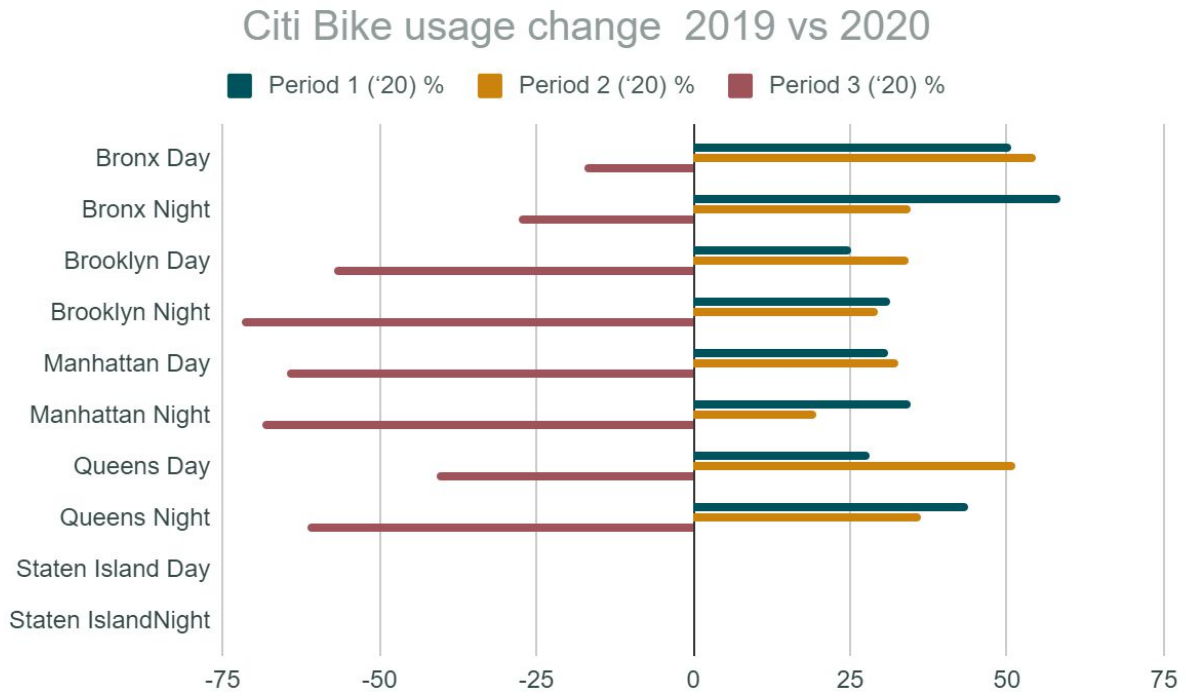


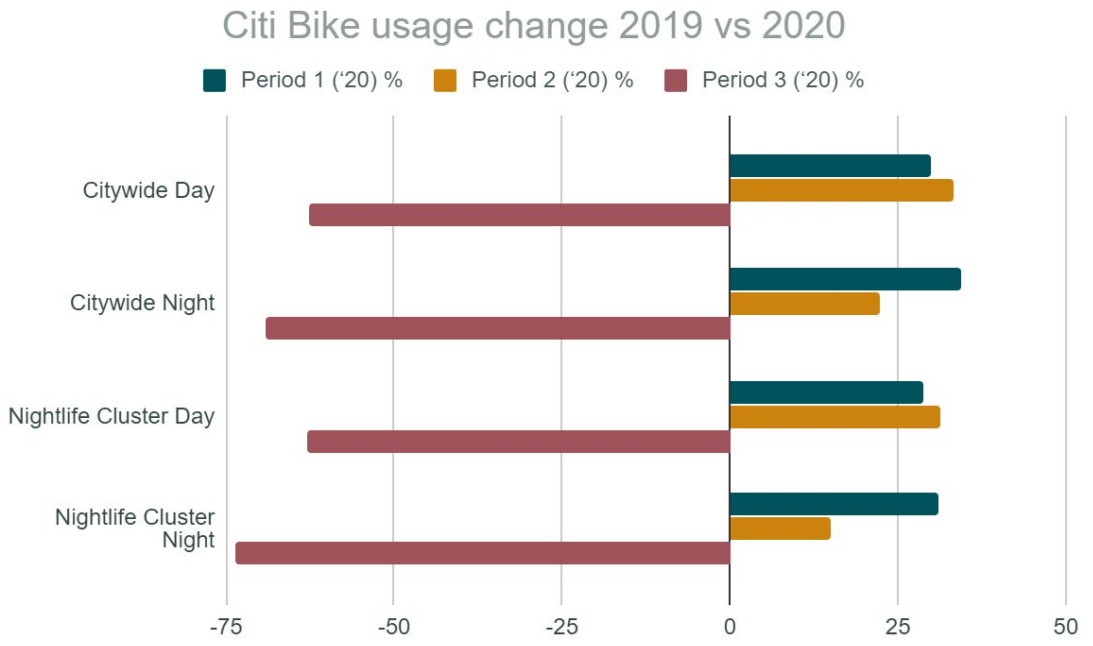

# Conclusion & Future work

We have outlined a process for identifying nightlife hotspots, combine and analyze disparate datasets to attempt to explain ridership phenomena.

Potential extensions of our work might include:

1. using measures of local/global spatial autocorrelation to identify clusters of nightlife activity
2. the use of Ridge/LASSO regressions to neutralize any collinearity in our datasets
3. placing a greater emphasis on last mile transit options

The COVID-19 pandemic has had devastating effects on the City as a whole, but particularly on the nightlife sector, and we hope that the research and processes contained in this project may be of use to interested parties.

NYU Center for Urban Science + Progress

VibeLab

**Thank you!**

**Q&A Session**