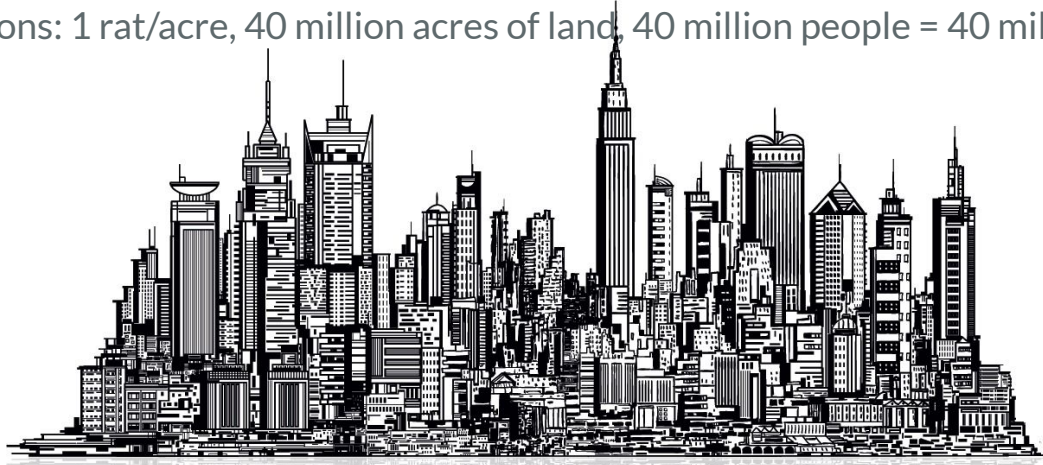


# **Rats!**

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Roger Lefort  
Hansen Xu**

# NYC Rat Infestation! More rats than people?

- Originated from W.R. Boelter's 1909 book 'The Rat Problem'
  - Assumptions: 1 rat/acre, 40 million acres of land, 40 million people = 40 million rats



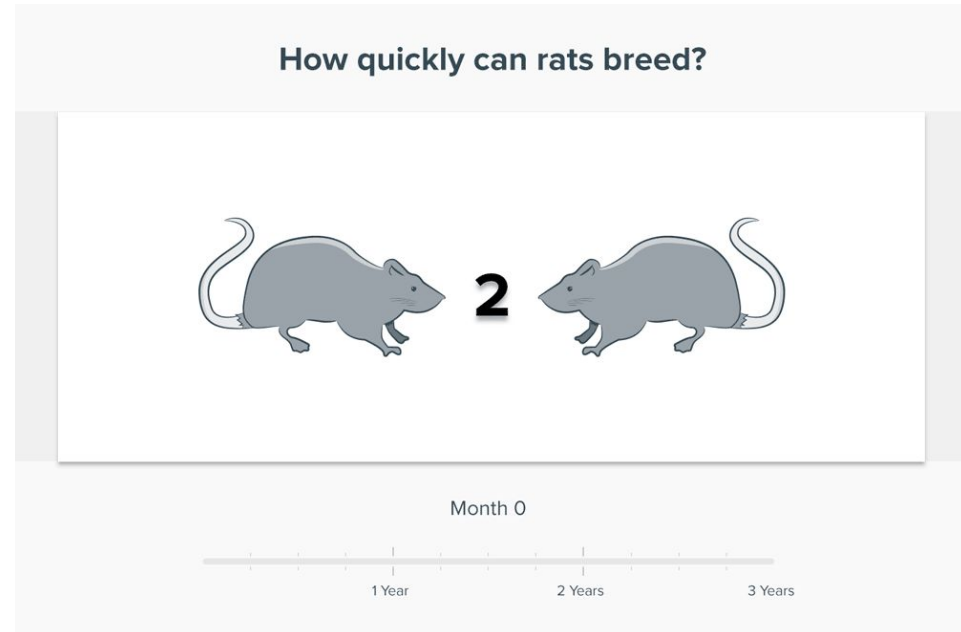
NYC rat population: ~2,000,000\*

\*Auerbach, Jonathan, [Does New York City really have as many rats as people?](#) (2014)

# Ratpocalypse: Could climate change lead to rat population explosion?

## Rat breeding:

- Gestation period: ~24 days
- Fertile at ~ 6-8 weeks of age
- Litter size: ~ 4-8 pups
- Optimal breeding temperature: 65-75 F



# Hypothesis

- **Climate change affects rat population**
- Questions:
  - Is there a correlation between climate and rat sightings?
    - a. Temperature
    - b. Humidity
    - c. Pressure
    - d. Precipitation
  - Is there a seasonal difference in rat sightings?
  - Where are sightings more likely to occur? Public or private spaces?

# Materials and Methods

- Data sources:
  - Rat sightings: NYC Open Data
  - NYC weather: NOAA
  - Shape files: NYC Open Data
- Packages:
  - Pandas
  - Modin
  - Numpy
  - Matplotlib
  - Seaborn
  - Geopandas
  - Datetime

# Initial data exploration and cleanup

Unique Sightings

Date of sighting - String Object

Zip code  
- Missing (433)  
- Incorrectly formatted (1)

## Rat Data

	Unique Key	Created Date	Closed Date	Agency	Agency Name	Complaint Type	Descriptor	Location Type	Incident Zip	Incident Address	...	Vehicle Type	Taxi Company Borough	Taxi Pick Up Location	Bridge Highway Name	Bridge Highway Direction	Road Ramp	Bridge Highway Segment	Latitude	Longitude	Location
0	36258648	05/23/2017 12:00:00 AM	06/01/2017 12:00:00 AM	DOHMH	Department of Health and Mental Hygiene	Rodent	Rat Sighting	3+ Family Apt. Building	11385.0	1737 WILLOUGHBY AVENUE	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	40.708279	-73.918762	(40.70827884615599, -73.9187618147548)
1	36258650	05/23/2017 12:00:00 AM	07/06/2017 12:00:00 AM	DOHMH	Department of Health and Mental Hygiene	Rodent	Rat Sighting	Construction Site	11238.0	820 WASHINGTON AVENUE	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	40.673394	-73.962926	(40.673393560937974, -73.9629260422388)
2	32989859	03/25/2016 12:00:00 AM	04/05/2016 12:24:24 PM	DOHMH	Department of Health and Mental Hygiene	Rodent	Rat Sighting	Vacant Lot	10473.0	319 WHITE PLAINS ROAD	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	40.812046	-73.855925	(40.81204563877927, -73.85592527378644)
3	33287723	05/05/2016 12:00:00 AM	05/10/2016 12:00:00 AM	DOHMH	Department of Health and Mental Hygiene	Rodent	Rat Sighting	1-2 Family Dwelling	10308.0	96 CRANFORD STREET	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	40.551770	-74.139026	(40.55177043984348, -74.1390262249373)
4	35161193	01/03/2017 12:00:00 AM	01/27/2017 12:00:00 AM	DOHMH	Department of Health and Mental Hygiene	Rodent	Rat Sighting	Other (Explain Below)	11217.0	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	40.679734	-73.974312	(40.67973435074979, -73.97431183772623)

131004 rows and 38 columns

From 01/01/2010 02:15:27 PM to 12/31/2018 12:00:00 AM

Dwelling type

Index(['Unique Key', 'Created Date', 'Closed Date', 'Agency', 'Agency Name', 'Complaint Type', 'Descriptor', 'Location Type', 'Incident Zip', 'Incident Address', 'Street Name', 'Cross Street 1', 'Cross Street 2', 'Intersection Street 1', 'Intersection Street 2', 'Address Type', 'City', 'Landmark', 'Facility Type', 'Status', 'Due Date', 'Resolution Action Updated Date', 'Community Board', 'Borough', 'X Coordinate (State Plane)', 'Y Coordinate (State Plane)', 'Park Facility Name', 'Park Borough', 'Vehicle Type', 'Taxi Company Borough', 'Taxi Pick Up Location', 'Bridge Highway Name', 'Bridge Highway Direction', 'Road Ramp', 'Bridge Highway Segment', 'Latitude', 'Longitude', 'Location'], dtype='object')

# Initial data exploration and cleanup

## Weather Data

Date of sighting - Datetime object

	STATION	NAME	LATITUDE	LONGITUDE	ELEVATION	DATE	PRCP	TAVG	TMAX	TMIN	...	WT11	WT13	WT14	WT15	WT16	WT17	WT18	WT19	WT21	WT22
0	USW00094789	JFK INTERNATIONAL AIRPORT, NY US	40.6386	-73.7622	3.4	2010-01-01	0.04	NaN	41.0	32.0	...	NaN	1.0	NaN	NaN	1.0	NaN	1.0	NaN	NaN	NaN
1	USW00094789	JFK INTERNATIONAL AIRPORT, NY US	40.6386	-73.7622	3.4	2010-01-02	0.00	NaN	33.0	17.0	...	NaN	NaN	NaN	NaN	1.0	NaN	1.0	NaN	NaN	NaN
2	USW00094789	JFK INTERNATIONAL AIRPORT, NY US	40.6386	-73.7622	3.4	2010-01-03	0.00	NaN	24.0	18.0	...	NaN	NaN	NaN	NaN	1.0	NaN	1.0	NaN	NaN	NaN
3	USW00094789	JFK INTERNATIONAL AIRPORT, NY US	40.6386	-73.7622	3.4	2010-01-04	0.00	NaN	32.0	20.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	USW00094789	JFK INTERNATIONAL AIRPORT, NY US	40.6386	-73.7622	3.4	2010-01-05	0.00	NaN	32.0	21.0	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

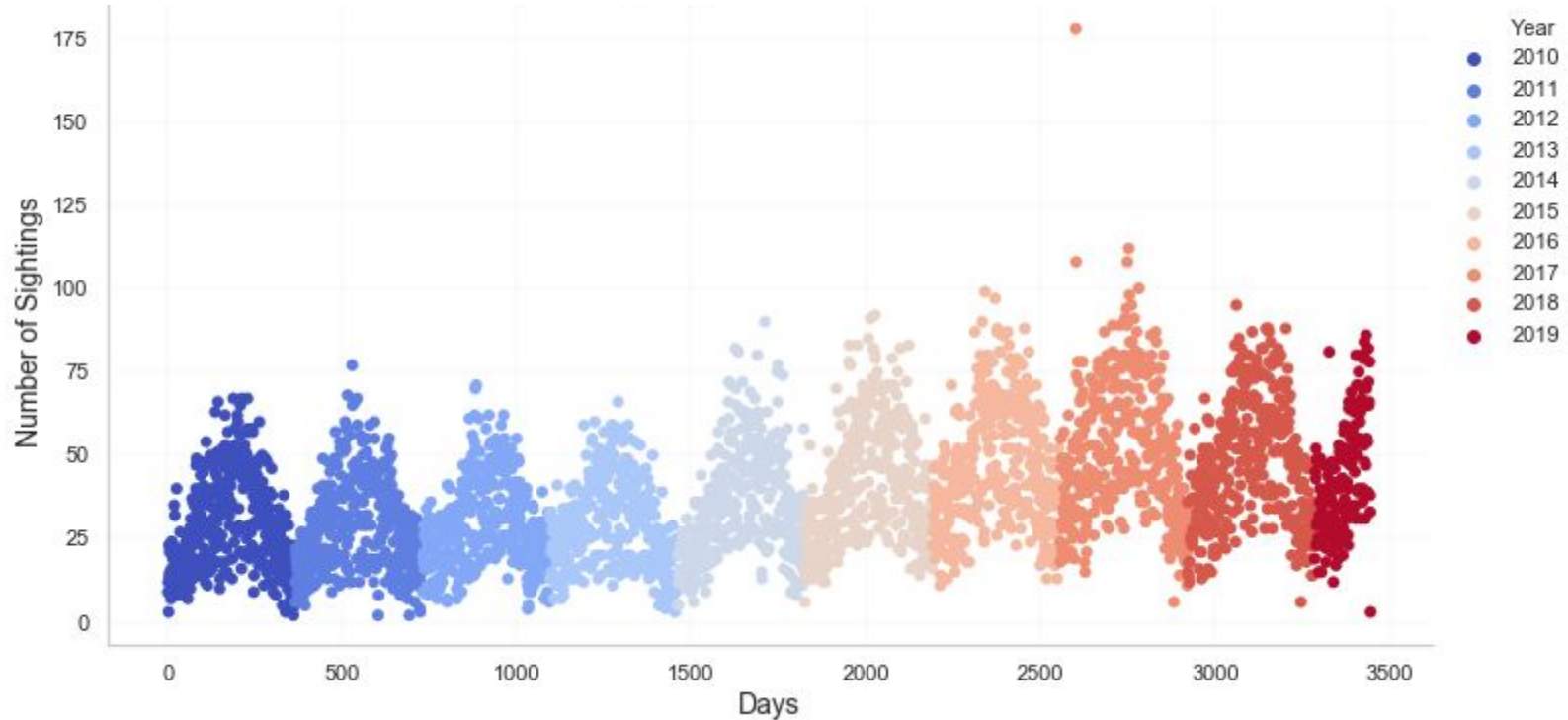
3447 rows and 29 columns

From 2010-01-01 to 2019-06-09

Climate parameters

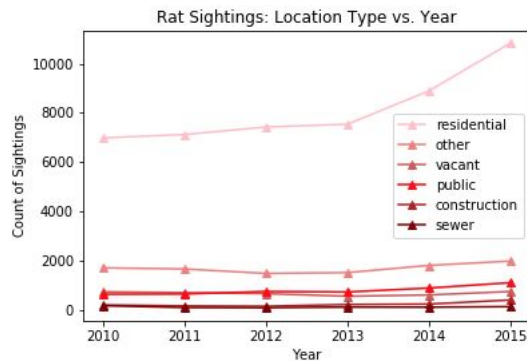
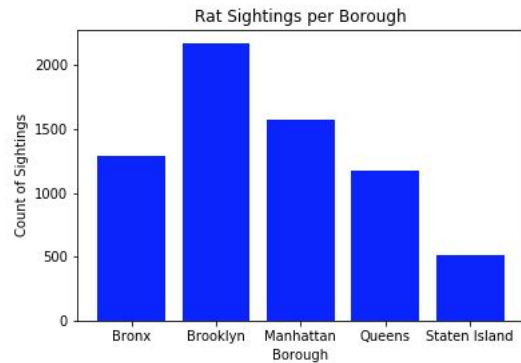
```
Index(['STATION', 'NAME', 'LATITUDE', 'LONGITUDE', 'ELEVATION', 'DATE', 'PRCP', 'TAVG', 'TMAX', 'TMIN', 'WT01', 'WT02', 'WT03', 'WT04', 'WT05', 'WT06', 'WT07', 'WT08', 'WT09', 'WT11', 'WT13', 'WT14', 'WT15', 'WT16', 'WT17', 'WT18', 'WT19', 'WT21', 'WT22'],  
      dtype='object')
```

# Data Analysis: Does the rat population increase over time?

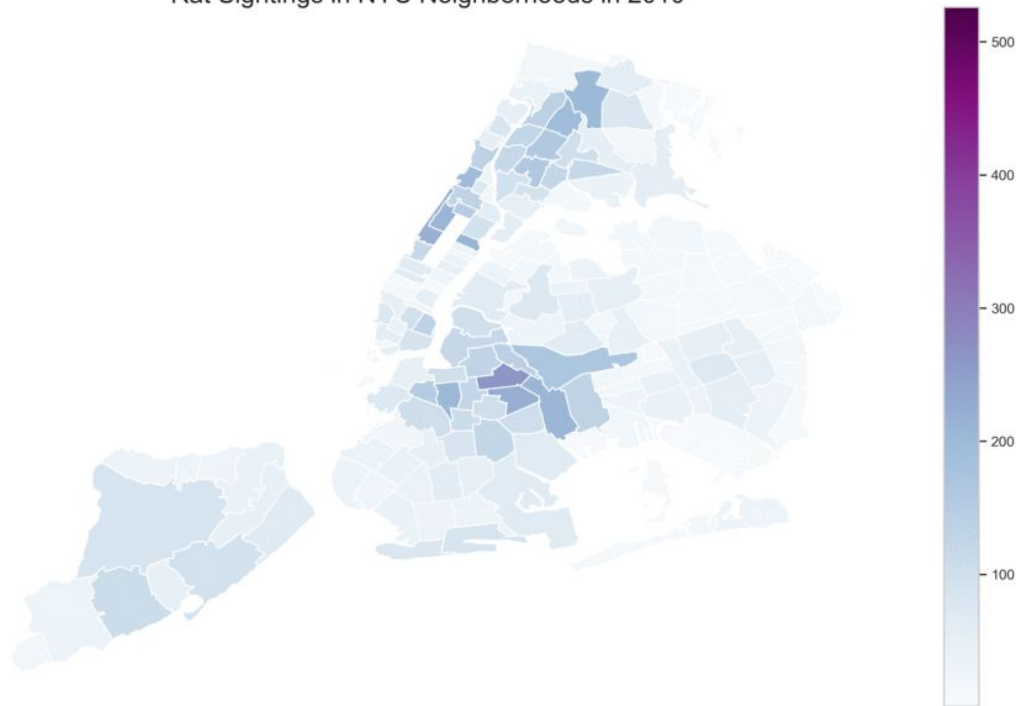




# Where are the rats?



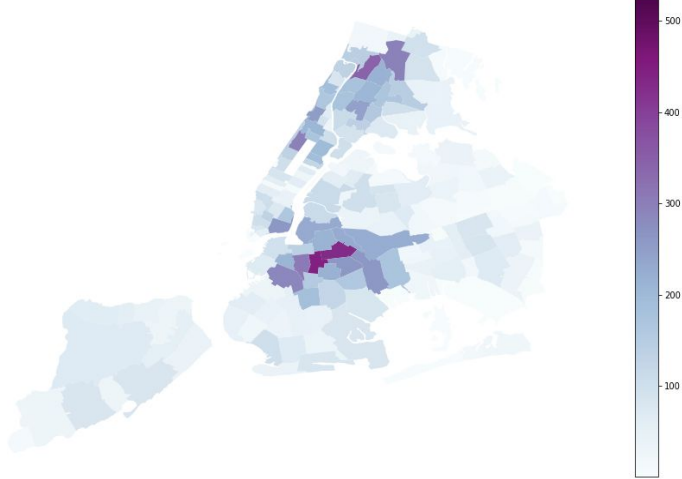
Rat Sightings in NYC Neighborhoods in 2010



A New York City Rat Invasion - Over 100,000 Reported Sightings Since 2010

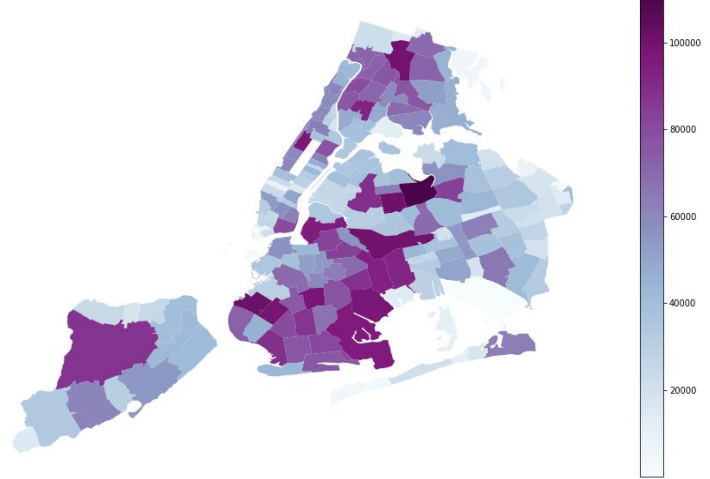
# Are rats where people are?

Rat Sightings in NYC Neighborhoods in 2015



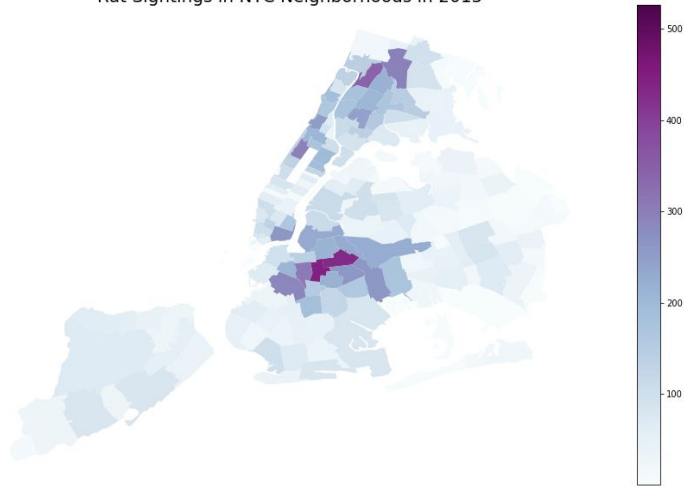
A New York City Rat Invasion - Over 100,000 Reported Sightings Since 2010

Population Distribution in NYC in 2015



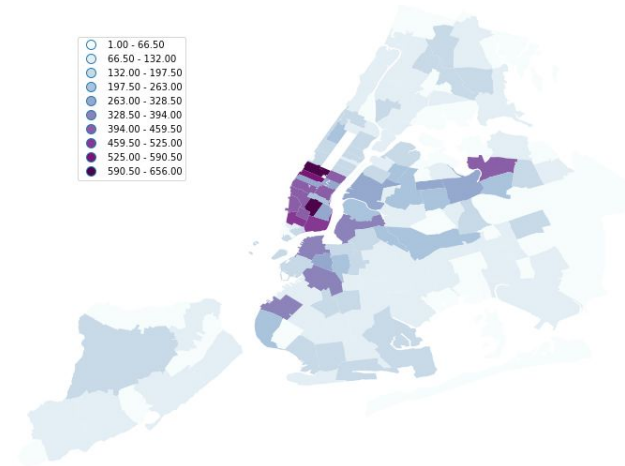
# Are rats where restaurants are?

Rat Sightings in NYC Neighborhoods in 2015



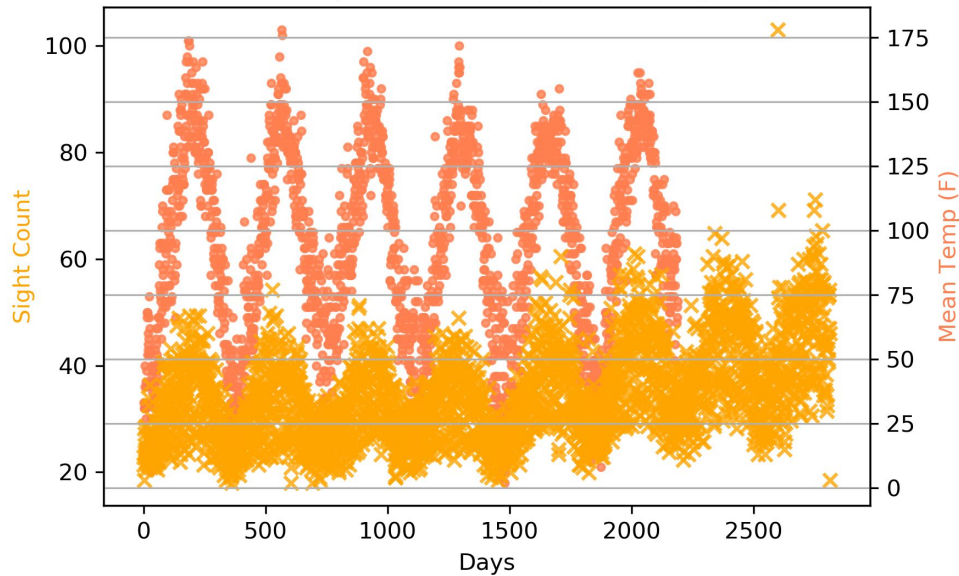
A New York City Rat Invasion - Over 100,000 Reported Sightings Since 2010

Restaurant Distribution in NYC

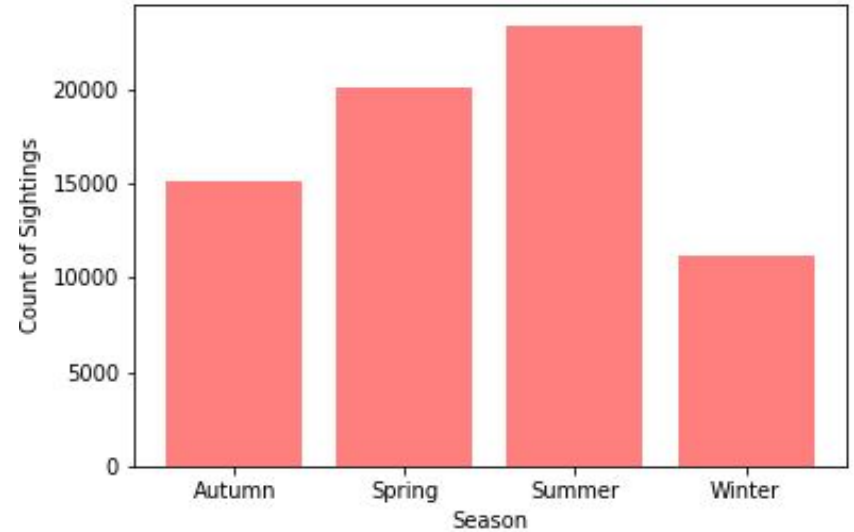


# Do rat sightings change with the seasons?

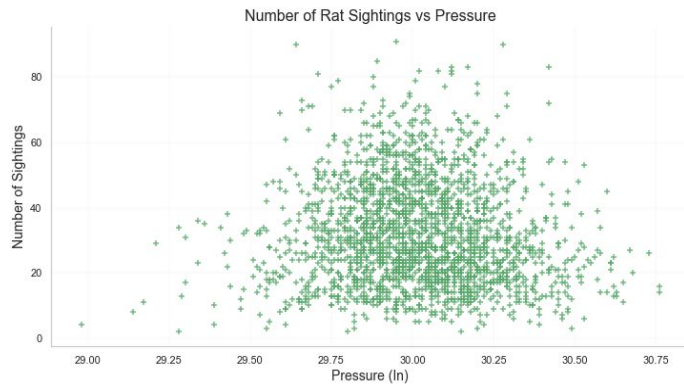
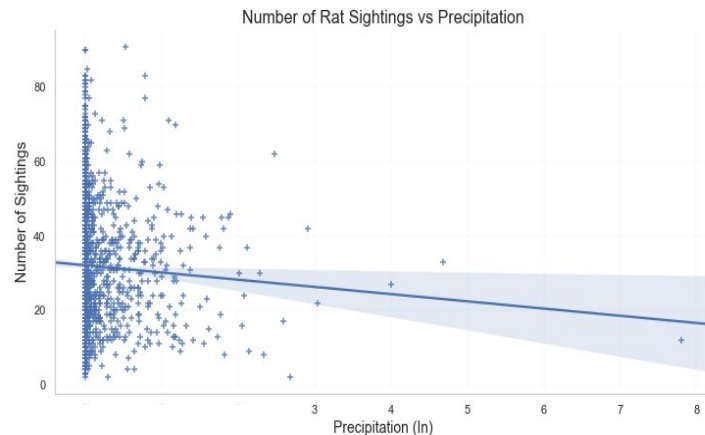
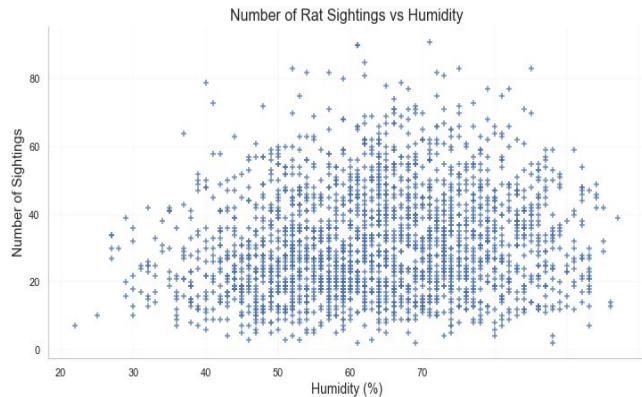
Mean Temperature Per Days vs Rat Sighting



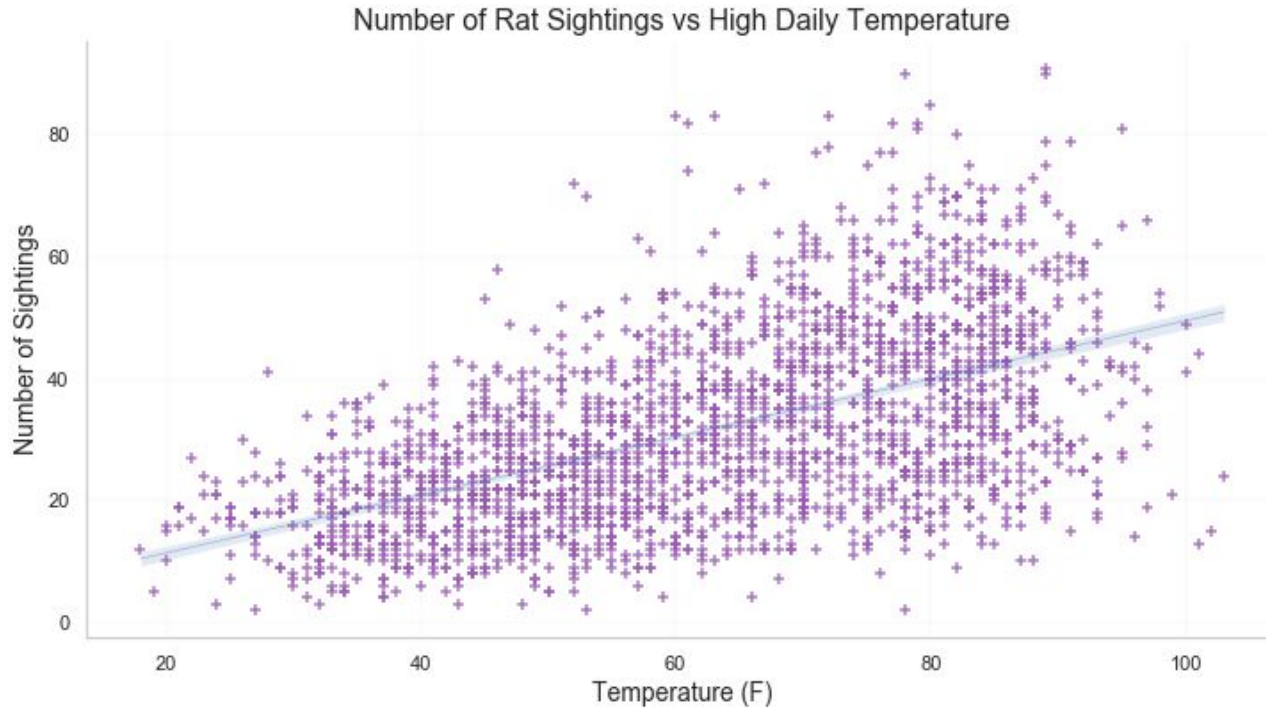
Rat Sightings per Season



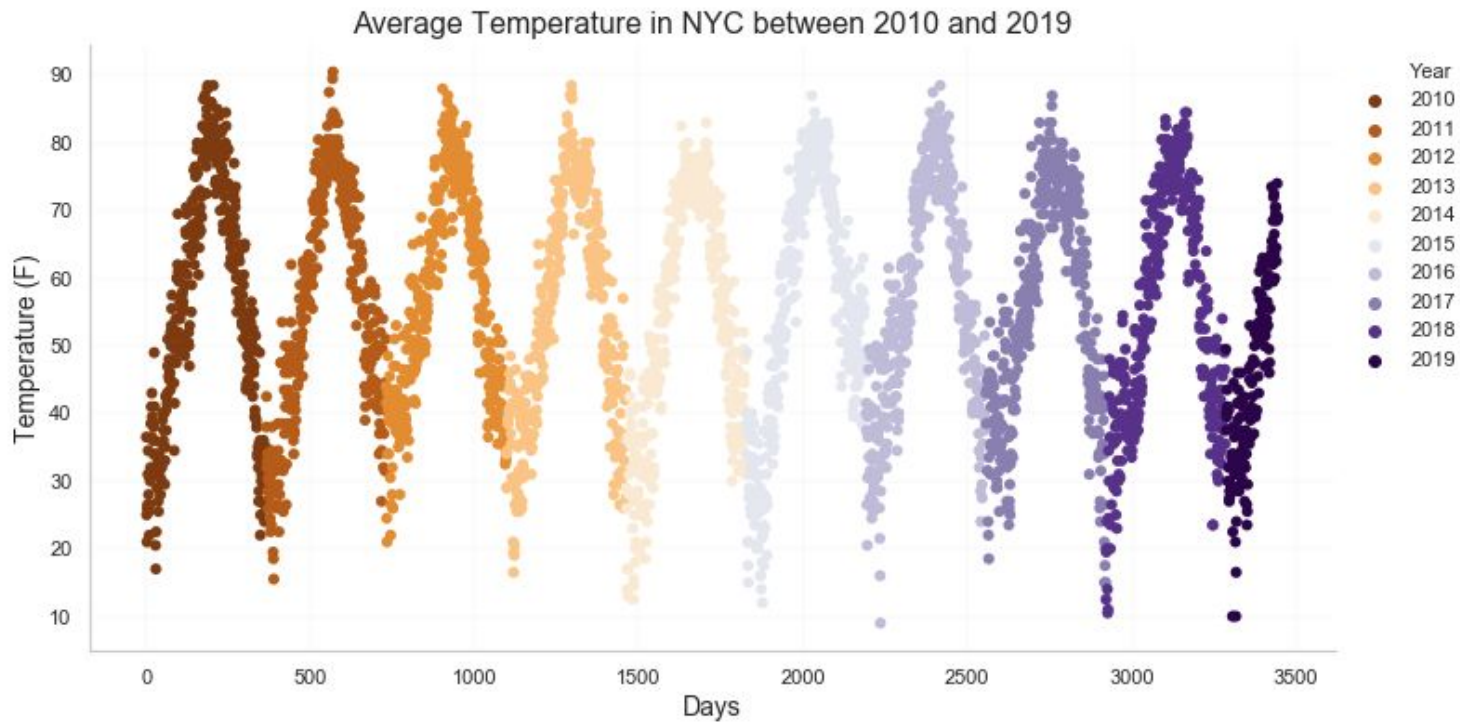
# Humidity, Precipitation and Pressure?



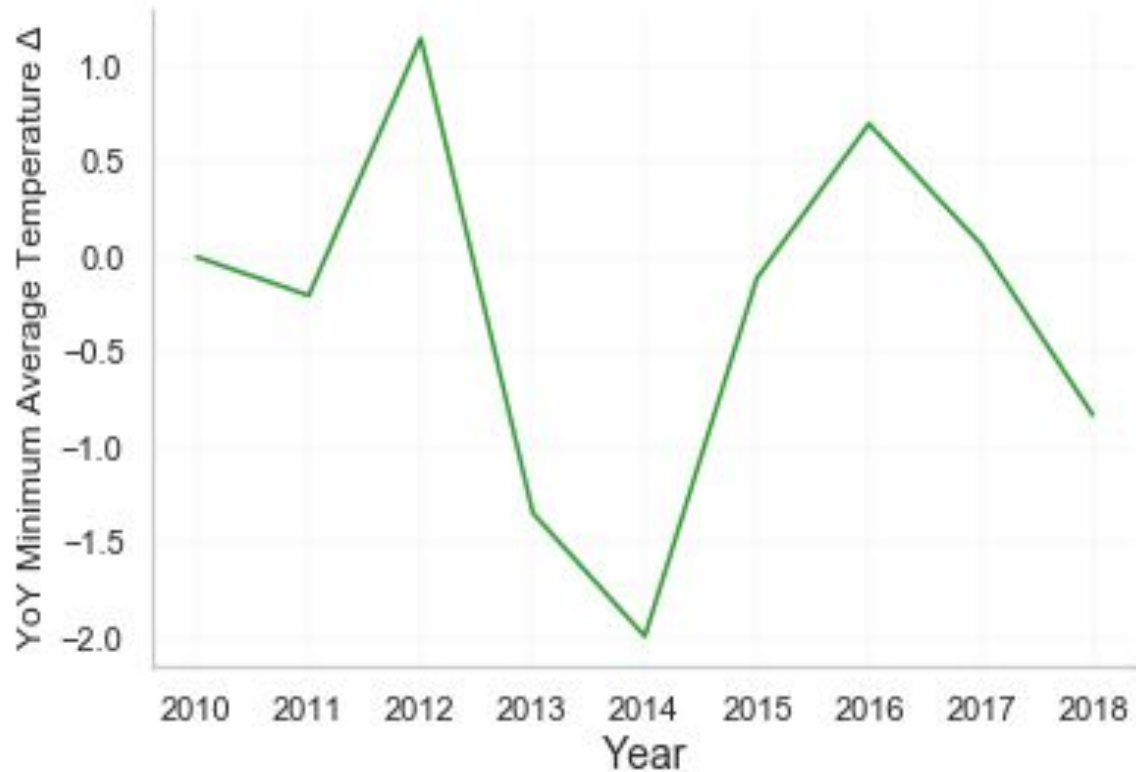
# Rat sightings increase with temperature



# Is NYC getting hotter?

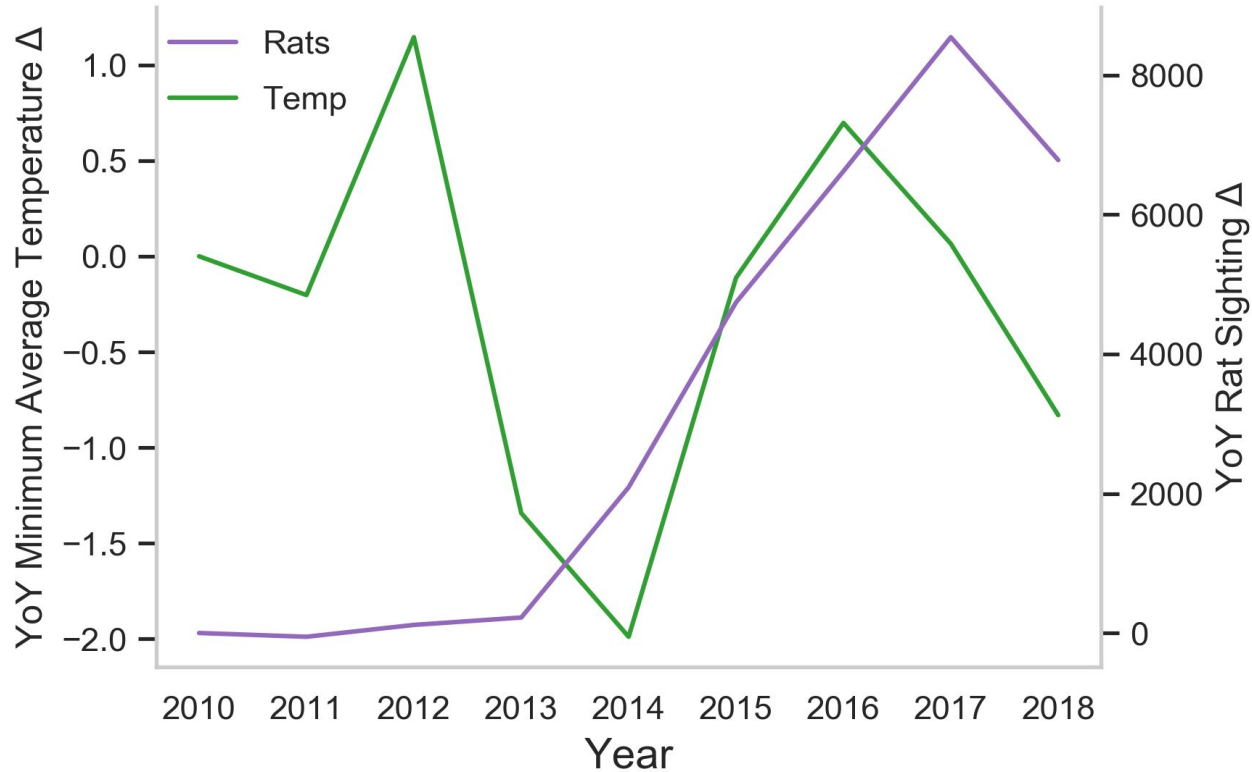


# Are winters getting milder?





# Inconclusive results



# Conclusion

- Increase in rat population over time
- Residential areas
  - Brooklyn (specifically Bushwick and Bed-Stuy)
- Population
  - No correlation
- Weather
  - Seasonal pattern
  - Other weather patterns
- Temperature

# Caveats

- Assumptions
  - Increase in sightings = increase in populations
  - Population is not being disturbed by outside factors
- Additional questions
  - Look further into population and restaurants
  - Other cities/towns
  - Urban vs. Rural
  - Socioeconomic level



Questions?