

There's a Rat Problem in Brooklyn! (Project 1)

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10/16/2020

Introduction

Rat sightings in New York City are associated with sociodemographics, housing characteristics, and proximity to open public space. Between January 1, 2010 and March 24, 2014, a total of 43,542 rat sightings were reported to the Department of Health and Mental Hygiene from all five New York city's boroughs. Rats can compromise public health. They can also be reservoirs for significant human bacterial pathogens thus tracking their whereabouts can prevent zoonotic outbreaks and instill a safe environment. New York City has one of the largest rat populations than any city in the US. This data describes the associations between reported rat sightings collected from the NYC DOHMH and specific features of the social and physical landscape of NYC. The aim of the data is to represent those specific features that are associated with a higher rate of rat sightings in order to determine if those specific locations of environments in the city present an opportunity for the prevention of human-rat encounters in the city of New York.

Initial Data Cleaning

```
rats_raw <- read_csv("Rat_Sightings.csv", na = c("", "NA", "N/A"))
rats_clean <- rats_raw %>%
  rename(created_date = 'Created Date',
         location_type = 'Location Type',
         borough = Borough) %>%
  mutate(created_date = mdy_hms(created_date)) %>%
  mutate(sighting_year = year(created_date),
         sighting_month = month(created_date),
         sighting_day = day(created_date),
         sighting_weekday = wday(created_date)) %>%
  filter(borough != "Unspecified")
```

Data Summarzation 1

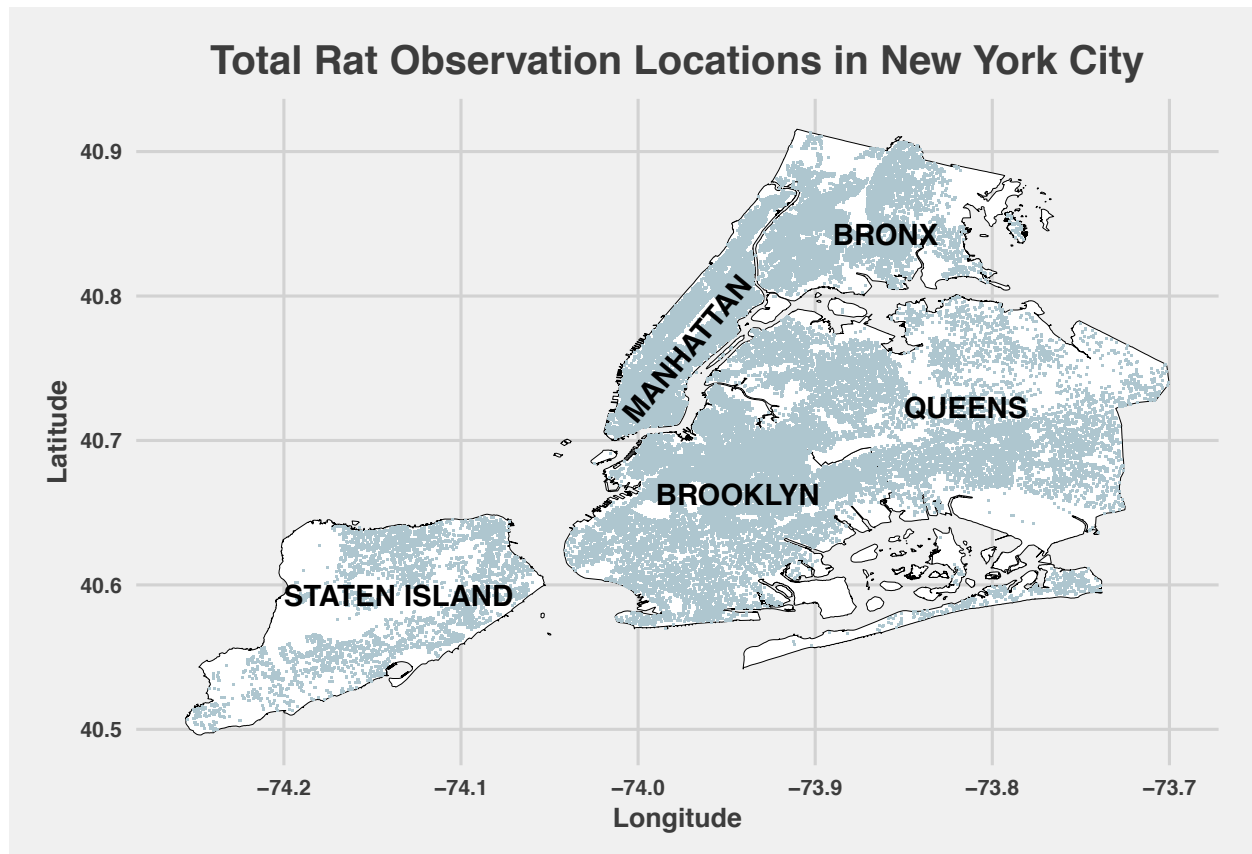
```
p <- rats_clean %>%
  count(Latitude, Longitude)
p1 = p[-1,]
p2 <- na.omit(p1)
p2_data <- data.frame(p2)
names(p2_data)[names(p2_data)=="Longitude"]<-"x"
names(p2_data)[names(p2_data)=="Latitude"]<-"y"

print(p2_data[1:10,]) #Partial summarizatoin for brevity
```

```
##           y           x  n
## 1  40.49950 -74.23979  1
## 2  40.49953 -74.23980  2
## 3  40.49967 -74.23791  3
## 4  40.49972 -74.23892  1
## 5  40.49981 -74.23767  1
## 6  40.49981 -74.23895  2
## 7  40.49984 -74.23992  1
## 8  40.50000 -74.23730  2
## 9  40.50037 -74.24484  1
## 10 40.50043 -74.24110 11
```

Plot 1-Visualizing Rat Sightings in New York

```
nymap = readOGR(
  dsn="Borough Boundaries-3/geo_export_c72d48c0-d4c5-47b6-88d2-09e4c3285f26.shp")
nymap_tidy <- tidy(nymap)
ggplot(nymap_tidy, aes(x = long, y = lat, group = group)) +
  geom_polygon(color = "black", size = 0.1, fill = "white") +
  geom_point(data=p2_data, aes(x=x, y=y), color="#AEC6CF", inherit.aes = FALSE,
    pch='.') +
  annotate(geom = 'text', label = "STATEN ISLAND", x = -74.20, y = 40.6,
    hjust = 0, vjust = 1, fontface=2) +
  annotate(geom = 'text', label = "BROOKLYN", x = -73.99, y = 40.67,
    hjust = 0, vjust = 1, fontface=2) +
  annotate(geom = 'text', label = "QUEENS", x = -73.85, y = 40.73,
    hjust = 0, vjust = 1, fontface=2) +
  annotate(geom = 'text', label = "BRONX", x = -73.89, y = 40.85,
    hjust = 0, vjust = 1, fontface=2) +
  annotate(geom = 'text', label = "MANHATTAN", x = -74.01, y = 40.72,
    hjust = 0, vjust = 1, fontface=2, angle=50) +
  theme_fivethirtyeight() +
  theme(axis.title = element_text()) +
  ggtitle("Total Rat Observation Locations in New York City") +
  xlab("Longitude") +
  ylab("Latitude") +
  theme(plot.title = element_text(hjust = 0.5)) +
  theme(text=element_text(face="bold", size=10))
```



What This Tells Us

The 43,542 rat sightings reported to the NYC Department of Health and Mental Hygiene are plotted in light blue across all census tracts along with public spaces and subway lines. The city of Brooklyn is an area of high concentration of rat sightings. Brooklyn is the most over-populated borough in the city of New York. Rats are ecologically driven to warmth, comfort and food of all types. Combine their ecology to the physical atmosphere of New York, makes the city a haul for rat infestation. Some features of New York landscape that may facilitate human-rat interaction are proximity to public space; public spaces in NYC can accumulate debris quickly which may create a nest for rats. Second, neighborhoods with a high proportion of vacant housing units can also be a congregation for rats.

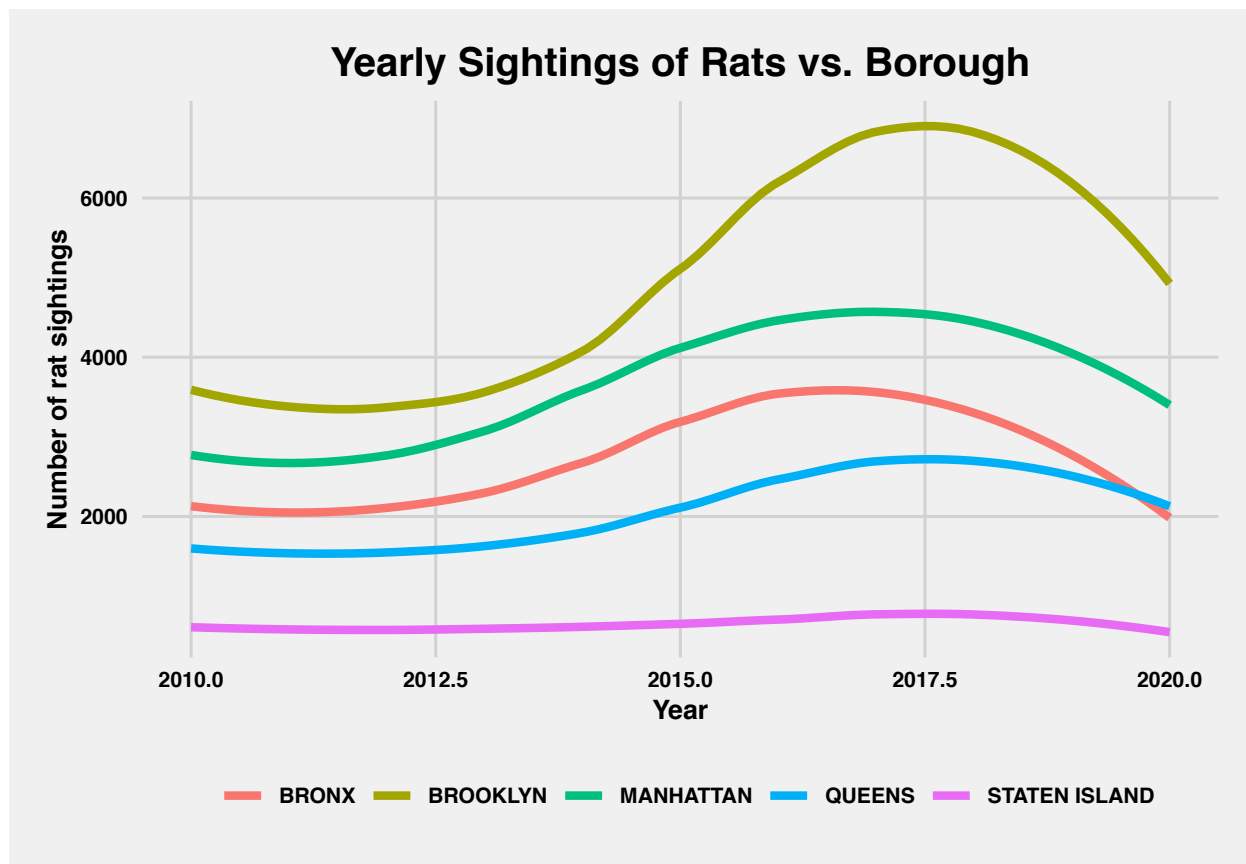
Data Summarization 2

```
t <- rats_clean %>%  
  count(sighting_year, 'Park Borough')  
print(t)
```

```
## # A tibble: 55 x 3  
##   sighting_year 'Park Borough'      n  
##   <int> <chr> <int>  
## 1      2010 BRONX      2067  
## 2      2010 BROOKLYN    3399  
## 3      2010 MANHATTAN   2867  
## 4      2010 QUEENS     1569  
## 5      2010 STATEN ISLAND 632  
## 6      2011 BRONX      2174  
## 7      2011 BROOKLYN    3671  
## 8      2011 MANHATTAN   2461  
## 9      2011 QUEENS     1600  
## 10     2011 STATEN ISLAND 548  
## # ... with 45 more rows
```

Plot 2-Tracking Rat Sightings Per Year

```
t %>%  
  ggplot(aes(x=sighting_year, y=n, color = 'Park Borough')) +  
  geom_smooth(size=1.5, se=FALSE) +  
  theme_fivethirtyeight() +  
  theme(axis.title = element_text()) +  
  theme(legend.title=element_blank()) +  
  ggtitle("Yearly Sightings of Rats vs. Borough") +  
  theme(plot.title = element_text(hjust = 0.5, face = "bold")) +  
  xlab("Year") +  
  ylab("Number of rat sightings") +  
  theme(text=element_text(color="#000000", face="bold", size=10))
```



What This Tells Us

Brooklyn has been the borough with the most rat sightings since at least 2010. The number of rat sightings took a turn in 2013, which started to increase significantly. The data seems to indicate that rat populations either increased or rats are entering spaces where there is more human-rat interaction. Understanding the rat ecology may help to address the problem. Rats adapt to human food outlets and reproduce at high rates. If enough food is present a single rat can reproduce up to 12 pups in a litter.

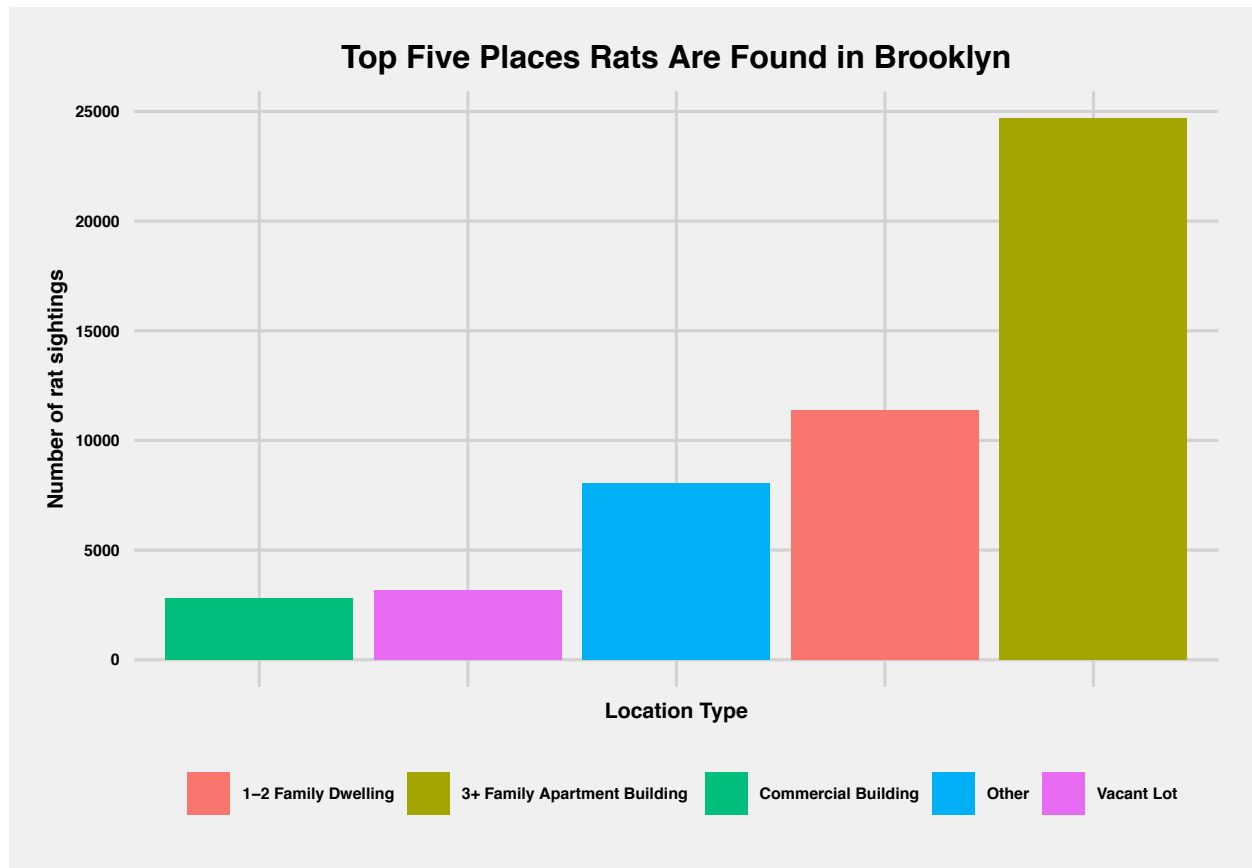
Data Summarization 3

```
z= rats_clean %>%
  count(location_type, 'Park Borough')
z2 <- z[c(2, 7, 14, 16, 21, 26, 31, 35, 38, 40, 45, 51, 55, 58, 63,
        68, 74, 77, 82, 87, 92, 97, 101, 103, 108, 112, 117, 122,
        127, 130, 133, 138, 143, 147,
        153, 156, 161),]
newrow <- c("3+ Family Apartment Building ", "BROOKLYN", 24684)
newrow2 <- c("Other", "BROOKLYN", 8045)
newrow3 <- c("Vacant Lot", "BROOKLYN", 3170)
z3 <- rbind(z2, newrow, newrow2, newrow3)
z4 <- z3[c(38, 39, 40, 12, 1),]
z5 <- transform(z4, n= as.numeric(n))
print(z5)
```

```
##              location_type Park.Borough      n
## 1 3+ Family Apartment Building      BROOKLYN 24684
## 2              Other      BROOKLYN    8045
## 3          Vacant Lot      BROOKLYN    3170
## 4      Commercial Building      BROOKLYN    2782
## 5      1-2 Family Dwelling      BROOKLYN  11396
```

Plot 3-Where People in Brooklyn Are Seeing Rats

```
z5 %>%
  ggplot(aes(fct_reorder(location_type, n), y=n, fill=location_type, label="Location Type"))+
  geom_bar(stat="identity")+
  ylab("Number of rat sightings")+
  xlab("Location Type")+
  theme_fivethirtyeight()+
  theme(axis.title = element_text())+
  guides(fill=guide_legend(title=NULL))+
  ggtitle("Top Five Places Rats Are Found in Brooklyn")+
  theme(plot.title = element_text(hjust = 0.5, face = "bold"))+
  theme(text=element_text(color="#000000", face="bold", size=8))+
  theme(axis.text.x=element_blank())
```



What This Tells Us

Most rat sightings were reported in 3 + family apartment buildings. Once they make way into a building, they are likely to stay in the first floor or basement. Closer proximity to subway lines and public spaces was found to be associated with higher concentration of rat areas. Urban city locations can contribute to the rat infestation. The likelihood of poor sanitation, dripping pipes, and debris can be expected to be higher in urban cities therefore producing a concentration of rat sightings.

Policy Implication

According to my graph, we can find out that Brooklyn has the most sightings of rats. Also, rats are reported most frequently in 3+ family apartment buildings. Garbage in houses, shops, subways and restaurants contribute to the livelihood of city rats. Therefore, there should be targeted subsidies to encourage residents of Brooklyn to buy rat traps and other rodent killing products. Also, in order to reduce the amount of food waste, state governments should impose a fine on residents of Brooklyn for excessive food waste. Households with 3 or more people are likely to throw out more garbage than single-person households. When I saw more rats sighting in buildings with three or more people households than buildings with two people households, this may be a result of more garbage being discharged from three or more people households. Therefore, it could be effective to set the amount of waste for each household and pay fines for exceeding the standard, so that people living in Brooklyn will gradually reduce the amount of garbage they dispose.