

Data Visualization Final Report

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Abstract — The NYC311 service aims to help the citizens of New York City resolve non-emergency issues. In this report we aim to help identify patterns and reasons for the high number of requests with the purpose of continually enhancing the NYC resident's quality of life. In our Dashboard we made visualizations that investigated several requests made in New York. These included Illegal parking, Noise, Homelessness and Construction Work. These issues were addressed by identifying the reasons for their occurrence and some solutions were provided.

I. INTRODUCTION

The NYC311 service plays a vital role in addressing community concerns across New York City, providing an efficient platform for citizens to report non-emergency issues. In our previous project, we analyzed a subset of NYC311 data from September 2016, comprising 39 variables and over 185,000 service requests. Through rigorous cleaning and preprocessing, Redundant variables were identified with 11 columns removed for having over 60% missing data and 9 more for containing duplicate information. Date-related variables, initially in character format, were reformatted to POSIXct for compatibility with analyses, and new metrics such as IssueDuration and IssueBalance were created. A column to differentiate resolved (IsResolved) and unresolved complaints was also added. Complaint categories were standardized into 10 types (e.g., Noise Complaints, Building & Housing Issues) to improve visualization clarity. Rows missing both Incident Address and geolocation data were excluded. Post-cleaning, the dataset contained 181,372 observations and 22 variables, including numerical, date, and categorical types, providing a streamlined foundation for further analysis.

In Exploratory Data Analysis, (EDA) several plots were created to identify patterns in the data and detect irregularities. The analysis revealed that Brooklyn consistently had the highest number of complaints, while Staten Island had the fewest. This suggested a possible correlation between population density and the volume of complaints. Additionally, complaints followed a

clear weekly pattern, with a higher number of complaints during weekdays, especially in the morning and early afternoon. A significant spike in complaints was observed on Saturday nights, indicating that residents may have more concerns during weekends.

The categorization of complaints across different boroughs showed distinct regional patterns. In the Bronx, Brooklyn, and Manhattan, many complaints were related to noise, while in Queens and Staten Island, traffic and street issues were more prevalent. Notably, Brooklyn, despite having a high volume of noise complaints, also had a substantial number of complaints related to traffic and streets, which suggests a more diverse range of concerns in this borough compared to others.

II. DASHBOARD

The project aims to provide insights that can inform the mayor with policy recommendations to improve municipal services and community satisfaction. Therefore, we started by analyzing what were the main themes of complaints of each borough in the month of September 2016.

The primary requests were "Noise - Residential," "Illegal Parking," "Blocked Driveway," "Noise - Street/Sidewalk," "Unsanitary Condition," and "Homeless Person Assistance," with "Noise - Residential" being the most reported complaint type overall. To better investigate these significant requests a Dashboard was developed containing several visualizations that were necessary in revealing their underlying information. The Dashboard consisted of three windows which helped guide us in our research. The side-panel had two sliding prompts. The first was a minimum complaint threshold, this would enable us to create a minimum count in requests for it to be seen in the visualizations, enabling better structured and less cluttered visualizations. The second sliding prompt consisted of the Date region allowing us to focus the data on a specific time frame in the dataset. The rest of the side

panel contained checkboxes that were centered around the day of the week (Monday- Sunday), the selected Boroughs and the Complaint Types that were addressed throughout the report. The main panel had 3 windows: The first one contained 2 plots and one map. A bar plot that displayed the number of complaints per Borough; and a time series line plot that consisted of the number of requests but throughout the month. Each line had a different color depending on the complaint type highlighted. The map mainly showcased the locations of each issue but could also display the locations of the Parking Lots and Garages that are mentioned in part B (“Illegal Parking”). The second window had a heat map that presented the Number of complaints per day of the week and the hour of the day. It also had a Map, again showing the location of the complaint types. The final window had a main tab that displayed a graph with nodes and edges that would show the relationship of the requests by their Zip Code, each Zip code was also color coordinated depending on the Borough it resided in.

A. Noise (Residential and StreetSidewalk)

Residential Noise was the most reported complaint type of all, with 20394 complaints in total. Street noise was also significant with 7685 complaints in total; therefore, we decided to further investigate these types of complaints.

When analyzing the “Noise - Street/Sidewalk” complaint type, we noticed that there was a direct correlation between the number of complaints in this category and the population density. First ranks Manhattan, followed by Brooklyn, the Bronx, Queens, and Staten Island both in population density and street noise complaints, suggesting that higher population density is linked to higher noise levels on the streets.

However, the same pattern was not observed for Residential Noise complaints. While Manhattan has the highest population density, with approximately 72,033 people per square mile, it ranked only fourth in the frequency of complaints compared to other boroughs. This suggests that Residential Noise issues are more prevalent in other areas. Although Queens is the fourth most densely populated borough, it ranked second in the number of Residential Noise complaints. Brooklyn, the second most populous borough in NYC, had the highest number of complaints in this category. This indicates that Queens experiences a disproportionate impact from Residential Noise complaints. (Figure 1)

Therefore, we wanted to investigate the time of day and the days of the week when these complaints were reported in the borough of Queens. We noticed that most complaints were reported on Saturday nights/Sunday mornings, but there was also a considerable number of complaints on Friday nights/Saturday mornings and Sunday nights/Monday

mornings (Figure 2), which makes sense, since the reason for most complaints was due to “Loud Music/Partying”.

Most of the other boroughs showed the same pattern, implying that there is a need for more police presence during these hours, especially in Queens.

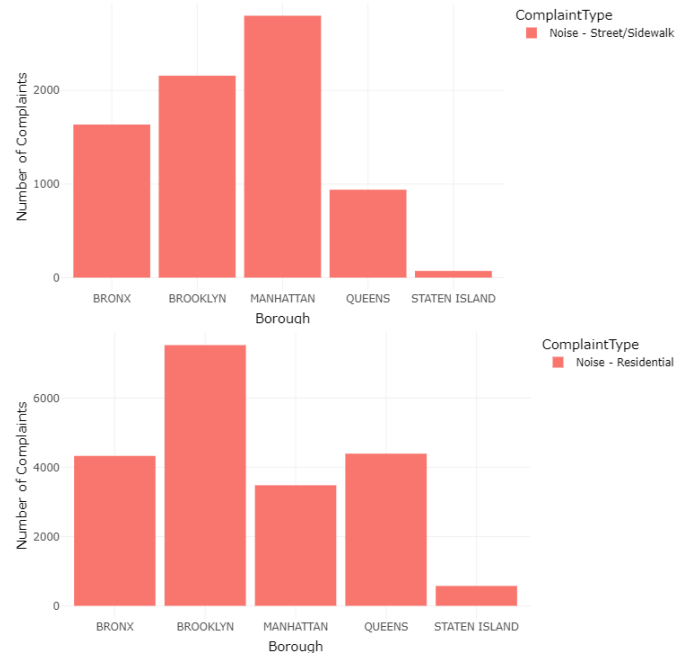


Fig. 1 Amount of Noise – Residential and Street/Sidewalk complaints per borough

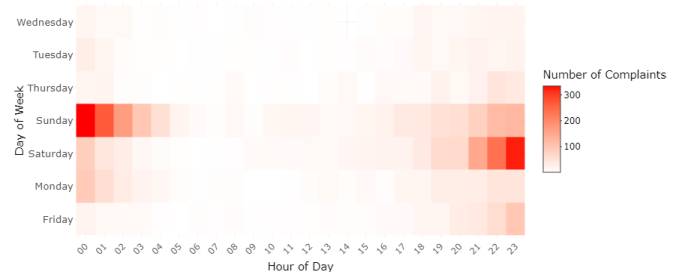


Fig. 2 Complaints Distribution by hour and day of week in Queens

B. Illegal Parking

To address the illegal parking issue, we first checked how parking was generally affected in the month of September in 2016. Looking at the Bar chart in fig.4 we can see that most illegal parking was done in the Boroughs of Brooklyn and Queens. At first glance, it is not surprising both Boroughs have a higher number of illegal parking requests than their counterparts, due to their larger population. But deeper research can lead us to some new information that gives us a clearer indication of one cause why illegal parking in these Boroughs was so prevalent.

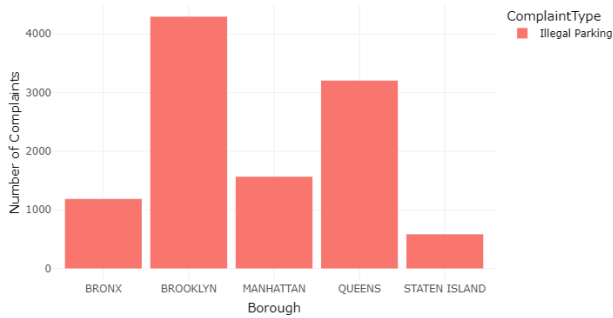


Fig.3 Amount of illegal parking per Borough

Brooklyn had approximately 2.55 million residents, Queen had 2.25 million and Manhattan had around 1.58 million^[1]. Comparing populations, for each 16 residents in Brooklyn 10 resided in Manhattan (1.6:1 ratio). Through the bar plot in Fig. 3 and the number of requests made, the ratio difference between Brooklyn and Manhattan was much more pronounced than anticipated. For each 27 vehicles illegally parked in Brooklyn there were 10 parked in Manhattan (2.7:1). Queens showed a similar outcome where the ratio of illegal parking difference was double that of Manhattan, despite the difference in population having a ratio of only 1.4:1. This suggests that the problem was not solely due to the population being higher in these Boroughs.

This led me to pursue a different dataset in the NYC Open Data, the same public data repository where the information for the 311 requests was gathered. The dataset I found was one containing Issued Licenses in NYC^[2]. This gave us any Business license request with its issue and expiration date, allowing us to know all the legal businesses in NYC at that time. After querying the data to only pertain Garages & Parking Lots in September 2016 the complete dataset contained 976 Observations with their business name and location. The map in Fig. 4 shows all Garages and Parking Lots in the dataset.



Fig. 4 Locations of Garages & Parking Lots in NYC

Looking at the map we can readily see the difference between the number of parking lots in Manhattan than in any other Borough. The dataset revealed that Manhattan had 651

Parking Businesses while Brooklyn and Queens had only 97 and 106, respectively. For each parking lot in Brooklyn there were around 7 in Manhattan. This suggests that Businesses clearly preferred having a lot in Manhattan and favored the more hectic and densely populated borough in New York. Business owners considered it a more advantageous location for their business to thrive in. The difference in the number of lots in these Boroughs is reflected in the illegal parking results shown in Fig.4. While Manhattan residents had a bigger pool and options to legally park their car, Brooklyn and Queens not only had fewer lots but had most of the spaces spread out. This meant many residents had fewer options to park their car, which could lead to a higher number of illegal parking than expected.

C. Homelessness

Another primary challenge faced by New York City is the high number of individuals experiencing homelessness. Based on this, we analyzed the complaint “*Homeless Person Assistance*”, which is among the most concerning issues for New Yorkers and is a crucial factor in improving the city's quality of life.

A detailed analysis of our dataset, combined with visual exploration through dashboards, revealed a significantly high number of complaints related to assistance for homeless individuals. According to the stacked bar chart (Fig. 5), in September 2016, more than 4,000 complaints were registered in Manhattan—considerably more than in other boroughs. Additionally, we included the complaint type “*Homeless Encampment*” in our investigation, which, though less frequent, is directly related to “*Homeless Person Assistance*”. Here too, a predominant concentration in Manhattan was observed (Fig. 5).

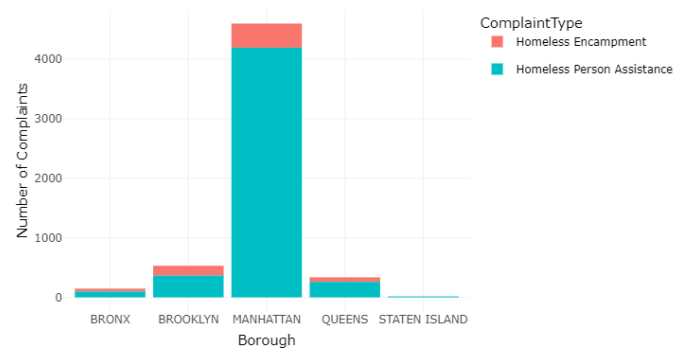


Fig. 5 Number of Homelessness Complaints by Borough

The geographical disparity becomes evident in the geospatial map analysis, showing a higher concentration of complaints in central Manhattan, especially in Broadway (Fig. 6 map on top) and southern areas like the vicinity of Times Square, Penn Station subway station and Grand Central Terminal (Fig. 6 map in bottom).



Fig. 6 Geospatial distribution of Homelessness Complaints in Central Manhattan (upper image) and in South Manhattan (lower image)

This trend is supported by the analysis of ZIP codes associated with the complaints, highlighting 10025, which belongs to Manhattan, as the most central node, with many associated ZIP codes from different boroughs, including some from Manhattan (Fig. 7). The geospatial map showing the ZIP codes reveals that the connected ZIP codes related to Manhattan (green) in the graph (10014, 10024, 10021, 10033) form a connection from the south of Manhattan (10014) to the north (10033), emphasizing the significance of the homelessness issue (Fig. 8).

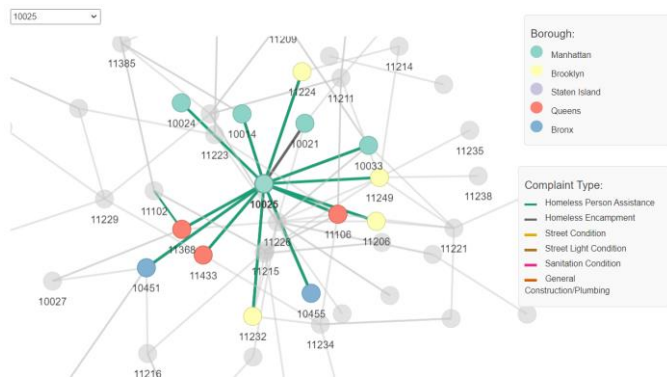


Fig. 7. Zip Codes associated to Homelessness Complaints, focusing Zip Code 10025 in Manhattan



Fig. 8 Geospatial Distribution of Zip Codes

As reported by The New York Times (2024)^[3], many homeless individuals prefer to remain near parks, busy streets, and subway stations due to a sense of greater safety in these locations. Although a general downward trend in complaints was observed throughout September (Fig.9), NYC Home-Stat data indicate that the total number of homeless individuals remained constant during this period^[4]. Additionally, we identified specific spikes during the month, such as on September 5 and 19, when there was a sharp drop in the number of complaints (Fig. 9). On September 5, a Labor Day holiday, the decrease in complaints could be attributed to fewer residents commuting to work, leading to a lower number of complaints.

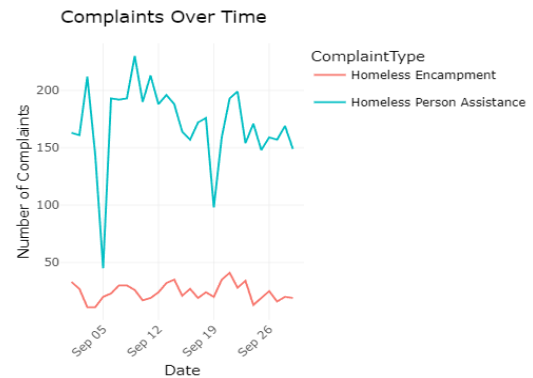


Fig. 9 Distribution of Homelessness Complaints Over Time in Manhattan

Another identified pattern relates to the timing of complaints. Heatmap analysis indicates that most complaints are filed between 8:00 a.m. and 10:00 a.m., suggesting they are predominantly lodged by commuters on their way to work or walking on the streets at that time. These morning complaints occur on both weekdays and weekends (Fig.10).

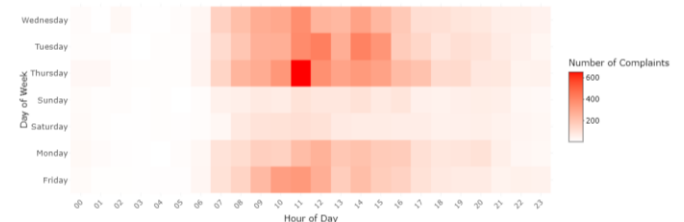


Fig. 10 Distribution of Homelessness Complaints by Hour and Day of Week in Manhattan

The results of this analysis underscore the severity of homelessness in New York City, particularly in Manhattan. According to the State of the Homeless 2016 report^[5], there were over 60,400 homeless individuals in the city at the time, including 24,000 children and 14,000 single adults—representing 14% of New York City's total population that year^[5].

Manhattan faces challenges, as evidenced by Census Bureau data and the 2017 Report on Housing and Vacancy Survey^[6]. The borough has approximately 800,000 to 900,000

housing units, 95% of which are occupied. However, the average rent for a one-bedroom apartment, ranging from \$3,000 to \$3,500 per month, is unaffordable for individuals earning a minimum wage of roughly \$1,005 per month. Furthermore, with Manhattan's poverty rate at 19% to 20% in 2016, a significant portion of this population resides in low-income neighborhoods such as Harlem and the Lower East Side. The situation is further exacerbated by a shortage of affordable housing for low- and middle-income families [6], [7].

Public policy initiatives have been implemented, such as the HOME-STAT program^[8], which provides personalized support for the homeless. However, these measures have been insufficient, as the number of homeless individuals increased by more than 54% between 2011 and 2016^[4]. Therefore, more profound and comprehensive measures must be implemented, including not only shelter policies but also long-term solutions to significantly increase the supply of affordable housing and reduce income disparity in the city.

D. Construction Works

Over this last month, the population growth tendencies of New York continued to increase, with its characteristically fast but frequent construction activity bringing heightened frustration among residents due to its direct impact on daily life. We became surer on this constant by observing the correlation between the 311 complaints in terms of location (latitude and longitude). As we can see on Table 1, 5 out of the 9 entries refer to the complaint “*General Construction/Plumbing*”. This complaint relates to issues with ongoing construction work, which include noise violations, poorly managed sites, or unregulated activities. Other complaints that are frequently associated with construction works and that are present in this correlation analysis are “*Street Light Condition*”, “*Street Condition*” and “*Sanitation Condition*”, which refer to road condition, malfunctioning streetlights and zones with lack of proper sanitation, respectively. All these correlations motivated us to go into more detail to the evolution of these specific complaints during this month.

Table 1. The 9 biggest correlations between unique complaints of the NYC September 2016 dataset

	Complaint A	Complaint B	Correlation
1	General Construction/Plumbing	Street Light Condition	0.995
2	Emergency Response Team (ERT)	General Construction/Plumbing	0.840
3	Emergency Response Team (ERT)	Street Light Condition	0.835
4	General Construction/Plumbing	Street Condition	0.79
5	General Construction/Plumbing	Taxi Complaint	0.789
6	Street Condition	Street Light Condition	0.787

7	Street Light Condition	Taxi Complaint	0.786
8	General Construction/Plumbing	Sanitation Condition	0.768
9	Sanitation Condition	Street Light Condition	0.765

The sharp rise in construction complaints affects the New York inhabitants in plenty of ways, like lack of quality of life, worse public safety, urban deficient mobility and a bad economic impact in the life of the citizens. Considering the proportionally sharp urban growth, it is crucial to investigate the zones of the city where the constructions are causing more damage on a short-term basis than could bring benefits on a long-term basis. In the first place, we opted to visualize the correlations on the map, and the result was consistent with the correlation associated (Fig. 11).

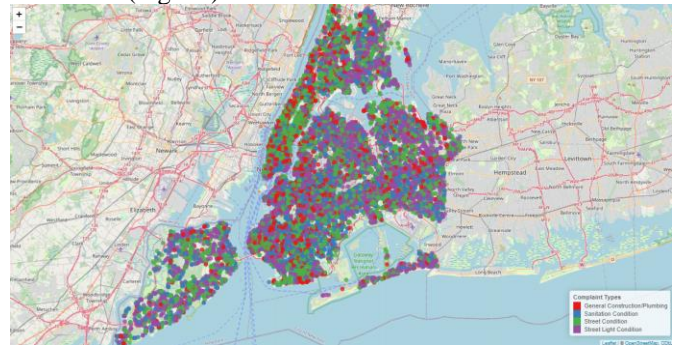


Fig. 11 Broad Geospatial distribution of construction work related complaints in New York

If we go more into the distribution of the complaints in study by regions, the boroughs of Brooklyn, Queens and Manhattan come out as the ones more reactive to their discomfort, as evidenced by Figures 11 and 12.

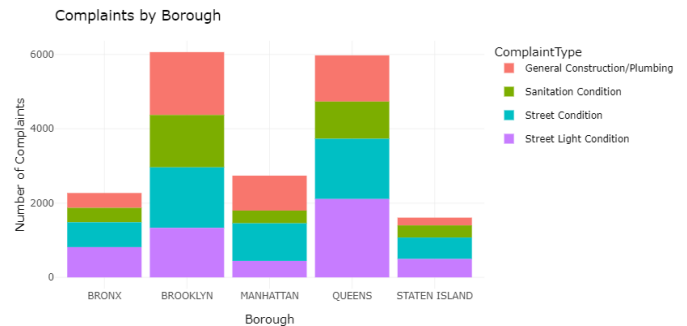


Fig. 12 Amount of construction work related complaints in New York

This tendency can be further confirmed by the closer inspection of those specific regions. The complaints about Street Light, Street and Sanitation Conditions are constantly delimiting geographically the General Construction complaints (Fig. 13), and clearly are events strongly connected between themselves (Fig. 14).



Fig. 13 Geospatial distribution of construction work related complaints in a region of Brooklyn.

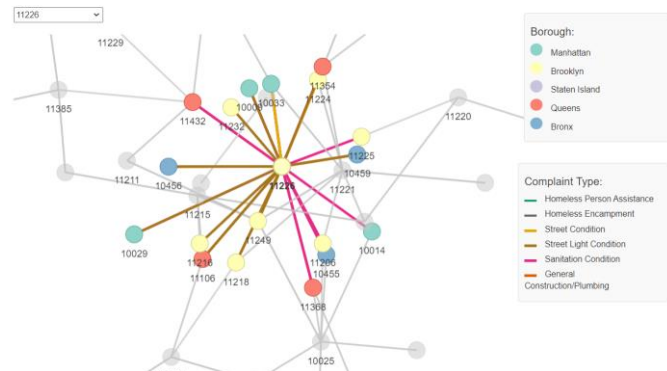


Fig. 14 Zip codes associated to complaints, focusing zip code 11226 in Brooklyn

Addressing the complaints over the hours of a week, we can identify that there are more construction work complaints over the weekdays (peaks on Tuesdays and Thursdays) and concentrated on the schedule of 7AM-6PM, the permissible constructing hours according to the city of New York^[10], but we can also see that, despite these rules, After-Hours Variances, permits issued by the New York City Department of Buildings (DOB) that allow construction work to take place outside the city's standard permitted hours, allowed work at night and on weekends (Fig. 15), contributing to the frustration of residents.

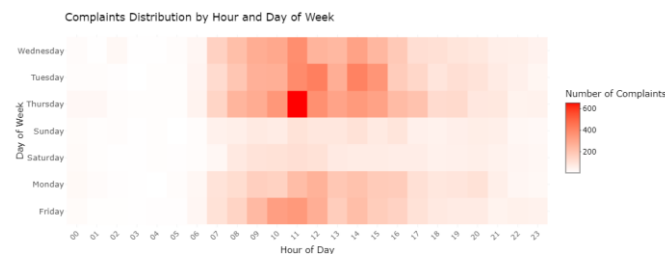


Fig. 15 Distribution of construction work related complaints by Hour and Day of Week in New York

Having gathered this data, we can conclude that this is a real problem that needs more attention put into it. On a short-term, some solutions can be put into work like increasing inspections and implementing stricter noise scheduling, and more on a

long-term view, the city could focus on coordinating better construction schedules, introducing smart construction practices like noise-reducing equipment, and creating public engagement platforms to keep residents informed. These efforts aim to minimize disruptions and ease the complaints of the inhabitants, better dealing with this problem once and for all.

III. CONCLUSION

In Conclusion, the dashboard and its visualizations developed throughout the project helped us further understand the requests made by the NYC's residents and the next step forward when addressing these issues. As far as the Residential Noise related complaints are concerned, most of them occurred during hours and days that correlated with parties and commotion, an increase in security and attention could help address these requests, especially in Queens. The illegal parking issue suggested that there should be an incentive to bring businesses of Garages & Parking lots to the more populated Boroughs of Brooklyn and Queens. The homelessness requests showcase the need for further programs in addition to Home-stat to combat this consistently increasing issue in New York City. Finally, the requests surrounding construction work heavily influence the lifestyle of the population and there must be conditions created to end bad construction working practices and schedules.

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