

Methods of Advanced Data Engineering

**An Analysis on the Effectiveness of Government  
Emergency Services**

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# 1 Introduction

New York City, with its diverse population and dense urban environment, faces a wide range of challenges that impact its residents on a daily basis. Equally important is how effectively the city's government services respond to these challenges, and whether they are prepared to handle crises, particularly during times of naturally adverse conditions like hurricanes, heatwaves, or severe storms.

Understanding the distribution of these issues, the efficiency of the government's responses, and the level of preparedness for natural disasters is critical in assessing the city's resilience and capacity to support its residents.

Our analysis is primarily aimed to answer the following question; *"What is the distribution of types of issues faced by the residents of NYC, what is the efficiency of the government response services in handling them, and how well prepared are these services prepared for response in times of naturally adverse conditions?"*

The analysis of 311 calls can be of great use for a wide variety of purposes, ranging from a rich understanding of the status of a city to the effectiveness of government services in addressing such calls. Our next step will be to compare the average response time for complaints during storm conditions and otherwise.

## 2 Data Sets

This project will explore the data set provided by *The Mayor's Office of Data Analytics* (MODA) and the *Department of Information Technology and Telecommunications* (DoITT), open data for NYC. The **311 calls data set** publicly available at NYC OpenData[1].

This data set comprises of all calls made to 311 from the year 2010 - Present and contains 311 calls data regarding issues in the city. For our project, we will be taking the data of the previous 5 years only.

The second data set that we will use is the **National Storms Events data set**. We will compare the average response time for complaints during a storm and otherwise. The storm events data set is available at NOAA[2].

Storm Data is an official publication of the (NOAA) which documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce.

All data acquired in the dataset is formally dedicated to the public domain via the Creative Commons 1.0 Universal Public Domain Dedication (CC0-1.0). The details can be found on their data licensing page[3].

## 3 Analysis

### 3.1 Data Preparation

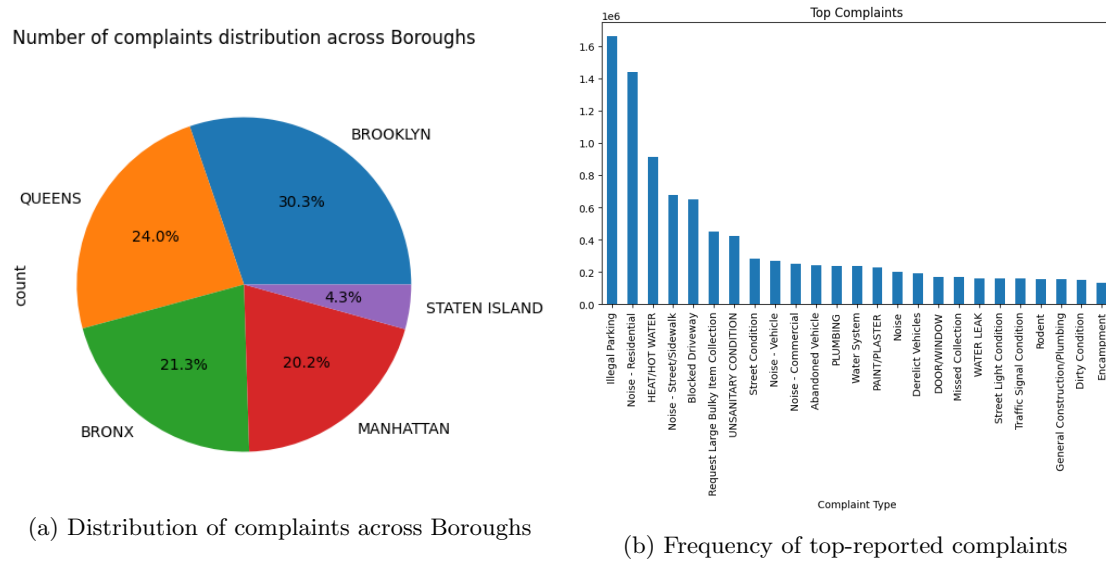
We performed a left join on the prepared 311 calls and Storm datasets to create the final data set to be used in the project. Then we carried out some basic data cleaning operations such as merging, dropping, adding some columns, data type conversions, and checking for nulls. We also put in some sanity data checks such as to ensure that the complaint's created date is not later than the complaint's resolved date so we can have accurate representations in our data.

We create some new columns such as day of the week and month, month, year. Our target variable in the analysis is the **Resolution Time** which we calculate in terms of days by subtracting the **created date** from **closed date**.

The final dataset contains 37 features to be used in the analysis.

### 3.2 Result

By analyzing the dataset, we visualized the distribution complaints in NewYork across boroughs and also found out what type of complaints are generally the most reported ones.



We can see that the most frequent complaints are illegal parking, noise, heating and hot water, and unsanitary/ street conditions, while all boroughs, except Staten Island, share roughly equal share of complaints with Brooklyn having the highest share with 30%

To have better understanding of how the volume of issues reported change through out a year, we analyze the number of complaints received according to the months.

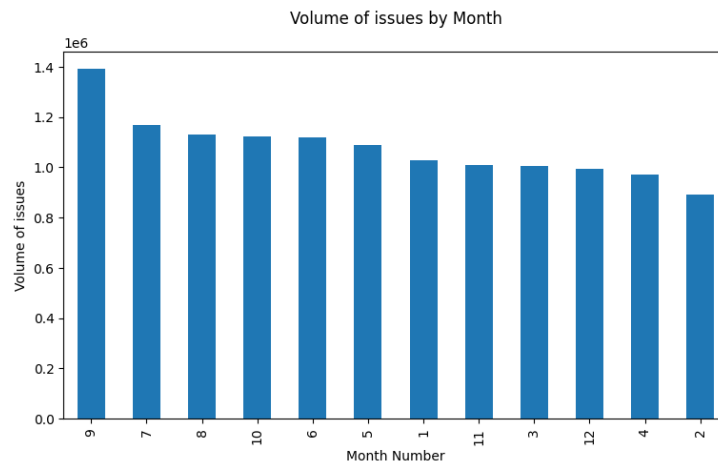
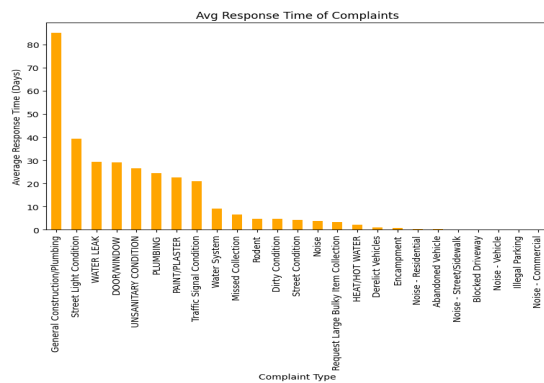


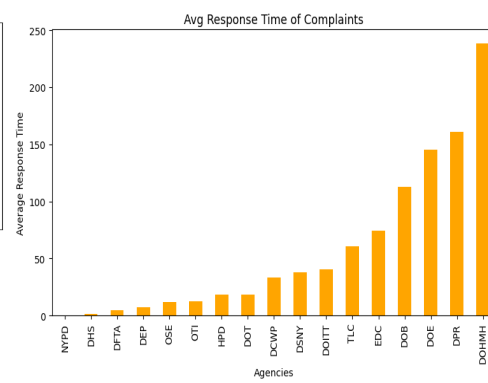
Figure 2: Volume of complaints in New York by months

We can see that most of the issues were reported in the middle of the year - May through October.

We then analyzed the average response time of complaints and checked how swiftly did the agencies react to a complaint call. The average response time for a complaint in non-storm conditions was **25 days**.



(a) Avg. Response time per complaint



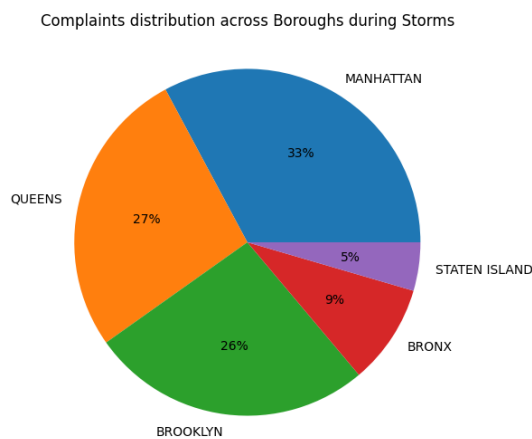
(b) Avg. Response time per agency

Our analysis suggested that complaints like residential noise and illegal parking are resolved within a day while issues like unsanitary conditions, street lights issues, and plumbing etc. take a rather long time to resolve. We also see that *NYPD* and *DHS* are the most efficient agencies among the rest. These are also the agencies, which generally solve the most number of complaints.

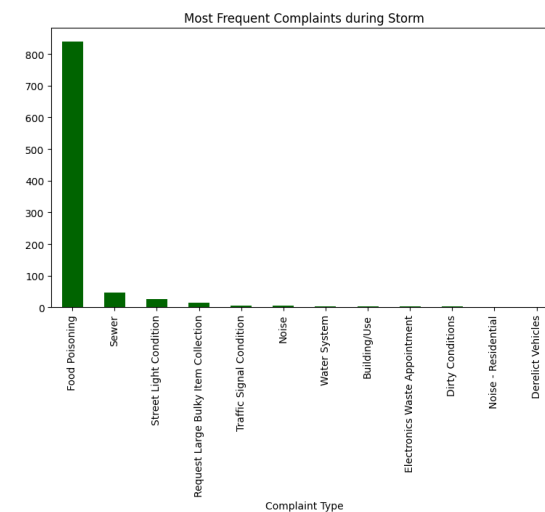
### Work on the National Centers for Environmental Information Storm data set for NYC

We merged the data set of NYC 311 service request and NOAA Storm data set for NYC according to the report dates.

We now performed a similar analysis to find the complaint distribution, most frequent complaints during a storm etc.



(a) Distribution of complaints across Boroughs



(b) Frequency of top-reported complaints

During storms, the emergency services received around 1000 complaints. We can see that during a storm the most frequent complaint was for food poisoning. There is the possibility for a rise in foodborne illnesses like salmonella and *E. coli* after natural disasters, according to the US Centers for Disease Control and Prevention[4], when power outages affect cold storage.

We try to answer the last of our questions for the analysis by comparing the response time of complaints during storms and otherwise. We find that the average response time during storms falls to an average of 8 days per complaint. This is an indication of the promptness and alertness of emergency response services on the state during natural disasters and shows the extra effectiveness of their response.

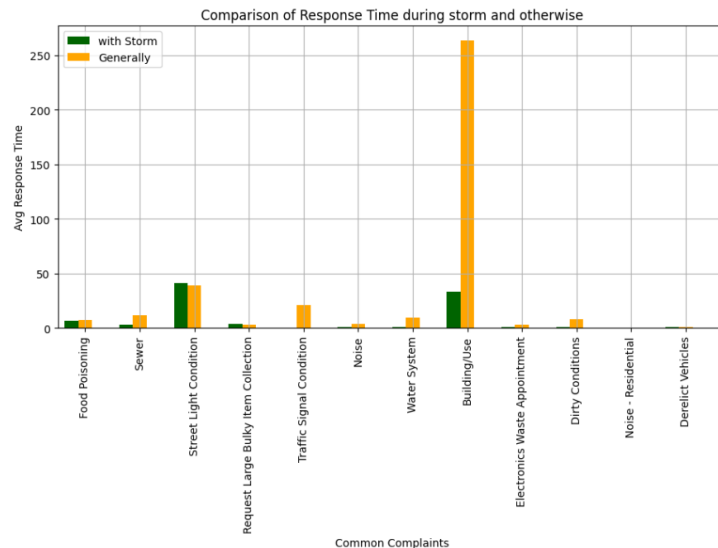


Figure 5: Comparison of Response Time during storm and otherwise

To further highlight the exceptional performance, we see that the average response time of many common complaints such as sewer issues, noise, and traffic infrastructure are resolved on priority basis and hence have an even lesser resolution time during storms.

## 4 Conclusion

The analysis of 311 call data and storm event data in New York City revealed valuable insights into the city's response to resident issues and emergencies. The most common complaints were illegal parking, noise, heating and hot water, and unsanitary street conditions. These issues were distributed fairly evenly across the boroughs, with the exception of Staten Island, and Brooklyn reporting the highest share at 30%. The study also found that complaints peaked during the warmer months, from May to October. While the average response time for complaints was 25 days, the NYPD and DHS were identified as the most efficient agencies.

During storm events, the average response time decreased significantly to 8 days, highlighting the city's preparedness and responsiveness during emergencies. This decrease was particularly noticeable for issues like sewer problems, noise, and traffic infrastructure, which were resolved more quickly during storms. Interestingly, food poisoning complaints increased during storms, potentially due to power outages and compromised cold storage.

While data limitations necessitated filtering for this analysis, the findings underscore the importance of data-driven insights in evaluating and enhancing city services, particularly in responding to resident needs and emergencies. Expanding this research to a larger scale could provide an even more comprehensive understanding of these trends and further inform strategies for improvement.

## References

- [1] NYC OpenData. *Overview and Terms of Use*. Available at <https://opendata.cityofnewyork.us/overview/>.
- [2] National Centers for Environmental Information. *Storm Events Database(For New York Only)*. Available at <https://www.ncdc.noaa.gov/stormevents/>.
- [3] NOAA. *Data Licensing in OCS*. Available at <https://nauticalcharts.noaa.gov/data/data-licensing.html>.
- [4] CNN. “Food poisoning risks rise after hurricane: How to stay safe”. In: (2024). Accessed: 2024-10-06. URL: <https://edition.cnn.com/2024/10/06/health/food-poisoning-hurricane-wellness/index.html>.