311 Equity

Boston City Councilor Tania Fernandes

CAS CS 506

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by

Kevin Figueroa kevinfa@bu.edu https://github.com/kevinmiguel97

Brian Lee blee0304@bu.edu https://github.com/bjlee0304

Samantha Puterman samanpg@bu.edu https://github.com/samanthapg

Ryan Yordanoff ryord@bu.edu https://github.com/ryanyord

Introduction

Cities and governments are constantly looking for better ways to connect with citizens. Data-driven technologies play an important role in making this connection, and a frequent way that cities connect with citizens is through 311-style request systems.

311 is a non-emergency municipal notification system that uses telephone, web forms, and increasingly, mobile applications and Twitter to allow citizens to notify government of infrastructure issues and make requests for municipal services. These requests have generated a massive amount of information about the different Districts in the City of Boston. The information serves as a good indicator of how each district is being served by the authorities and as an approximation of how the city resources are distributed among districts.

The goal of this project is to help our client, District 7 City Councilor Tania Fernandes, understand the potential of the dataset. We aim to aid in understanding the needs of the population across districts in the city of Boston and consequently have more sophisticated tools to make budgeting decisions and present level of service in a more transparent manner.

Data Collection

To perform our analysis of how the district requests are being served we used the 311 open data set. This data set, reported on the city of Boston website includes all channels of engagement in which a service request is created and it is updated daily starting in 2011. The data set contains descriptive information of every request submitted such as request status, date it was submitted and date it was closed, subject, closure reason, department (responsible for the request), location, council district, and source in which the request was submitted. As mentioned, the dataset contains labels for the councilor district, which helped filter the data of District 7 from the data of other Boston districts.

The team also used census data reported by the American Community Survey (ACS) to be able to include demographic information in the analysis and get more granular results. Specifically, we used the ACS 5 year data set starting with 2015. The ACS covers a wider range of topics like economic, social and demographic characteristics of the US population, and has many tables containing the information. For our analysis we collected data from the “Race” table and

specifically the population for each race label: “White alone”, “Black or African American alone”, “American Indian and Alaska Native alone”, “Asian alone”, “Native Hawaiian and other Pacific Islander alone”, “some other race alone” and “two or more races”. We also collected some income information labeled as: “Median Household Income in the past 12 months (in 2015 inflation-adjusted dollars)”. All of the census data collected is broken down by census tract so that each row of the census dataset belongs to a census tract in Boston.

Once the team had the 311 data and the census data, we merged both data sets to be able to perform demographic analysis in the service requests data. However, the 311 data set was reported per council district or per longitude latitude, while the census data collected was reported per census tract. To merge them, we used Geopandas which is an open source Python library that facilitates working with geospatial data as well as a shapefile of Massachusetts which contains geographic information (such as a polygon of each census tract) in a geospatial vector data format. The resulting data set then contains the census tract number, and the demographic information of such tract, for each 311 service request collected.

Data Analysis

Frequency of requests

In our preliminary analysis, we began by understanding the behavior that 311 requests have specifically in District 7. Figure 1 shows the timepad of the number of 311 requests in District 7 from 2017 to 2021, by semesters. The data suggests some volatility in requests, ranging from 28,500 in 2017 to 31,500 in 2021. It is important to note that 2020 was an atypical period given the COVID-19 pandemic that affected most aspects of our everyday life, including the behavior of 311 requests.

Figure 2, shows the distribution of the number of requests made in District 7 by month, from 2017 to 2021. From here, it is easy to see that there is a systematic peak of requests during the middle of the year, specifically the months of July, August and September, show a higher frequency of requests than the rest of the months. On the other hand, the last months of the year, November and December represent the lower quantity of requests.

Figure 1.

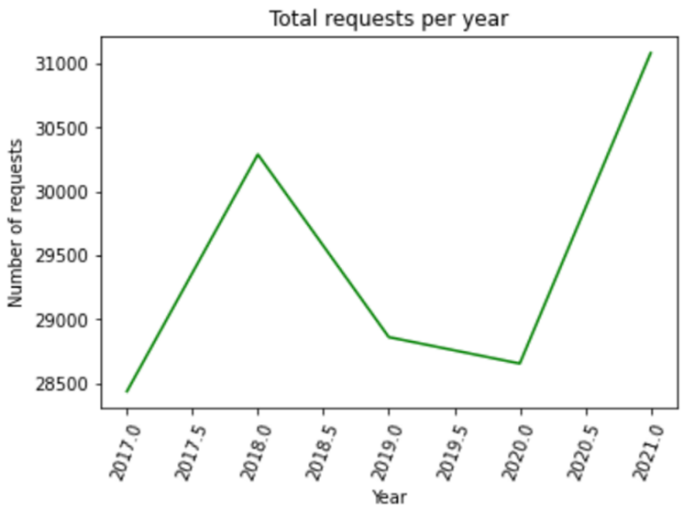


Figure 2.

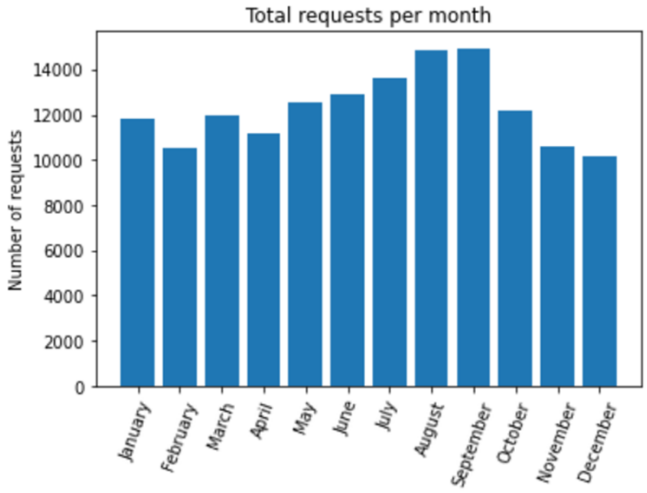
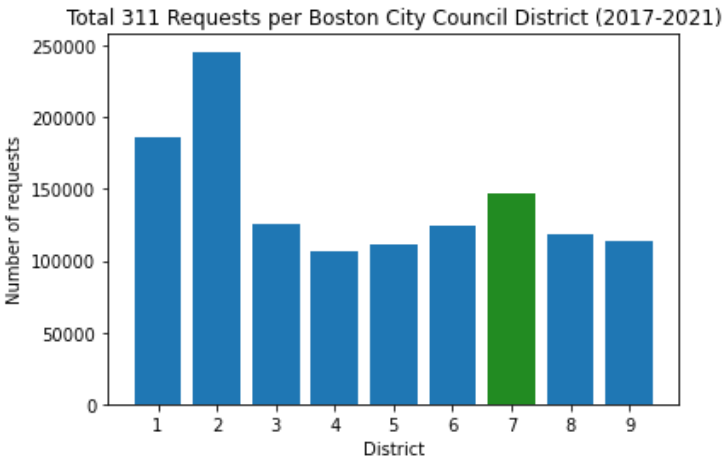


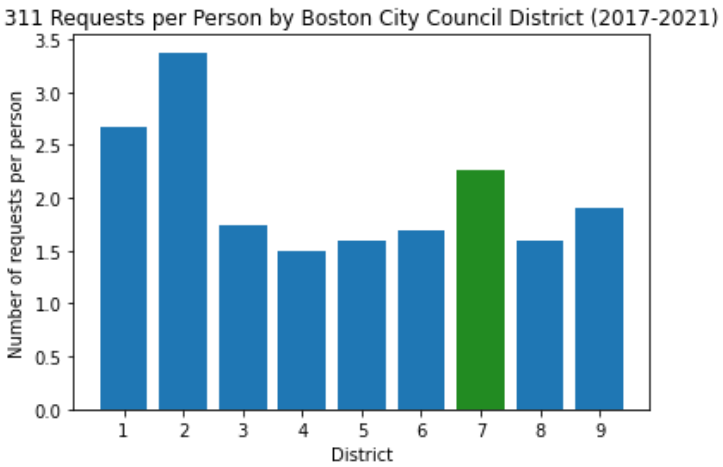
Figure 3 displays the overall request counts for each of Boston's districts. Figure 3A shows the total number of requests in each district, while 3B is normalized to the population of each district, based on population counts tabulated in the 2009-2013 American Community Survey. It appears that District 7 had the 3rd highest request rate, trailing by a large margin to the highest requesting district, District 2.

Figure 3

A



B

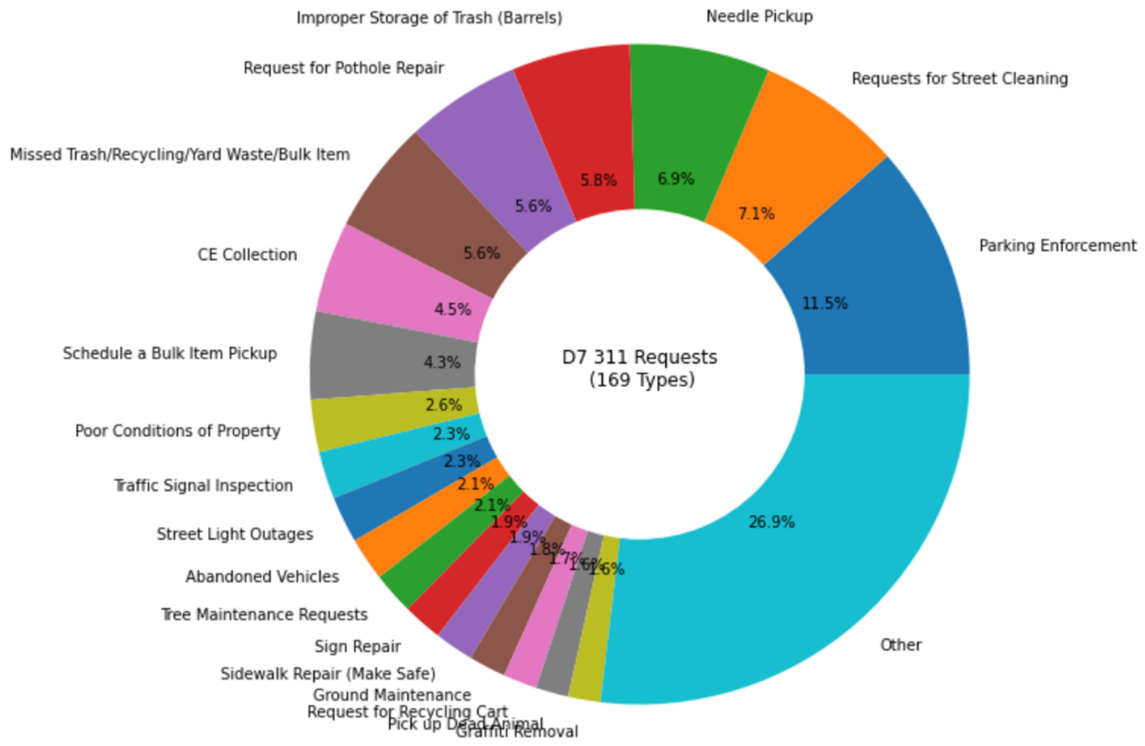


Types of requests

Following the analysis, we looked more in depth at the particular types of requests that are present within each of the districts. Starting with district 7, we can find up to 169 different types of 311 request types. Figure 4 shows how these 169 are distributed among all requests of the last 5 years. To make the analysis understandable and practical, we created 20 specific sections, 19 are the top requested types and the remaining ones are grouped in the "Other" section. Even with this transformation, we are able to capture around 73% of the total requests.

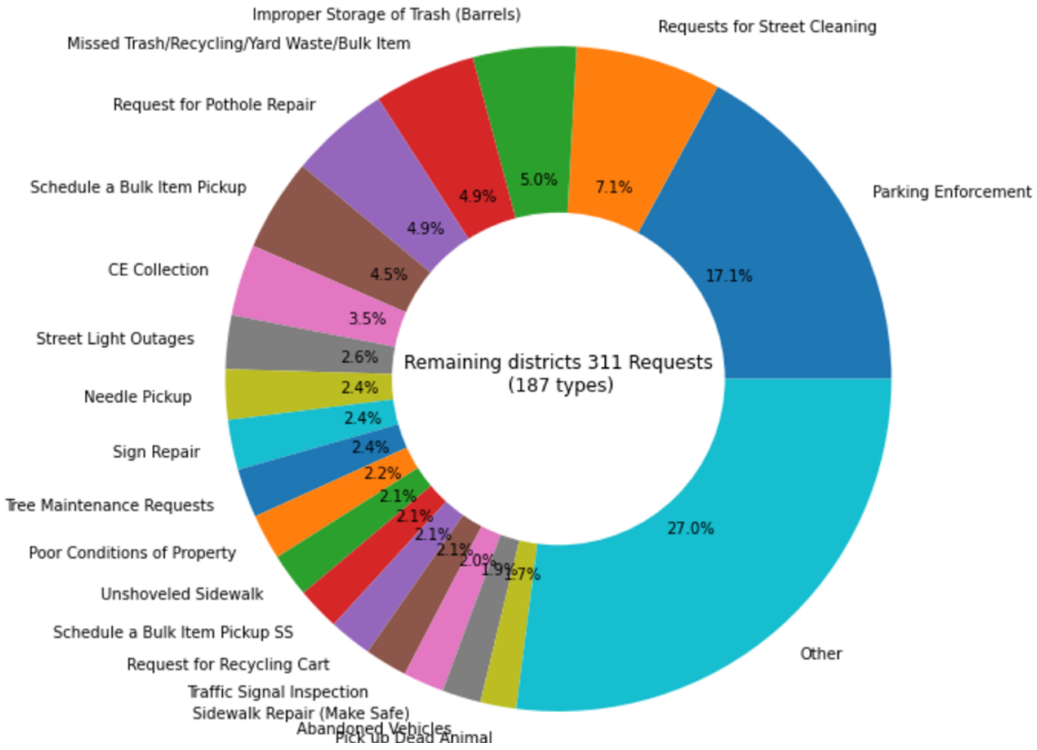
For District 7, the type of requests with the highest frequency is *Parking and enforcement,* representing up to 11.5% of the total, followed by *Requests for street cleaning* (7.1%) and *Needle pickup* (6.9%), completing the top 3, which adds up to over a quarter of the total requests.

Figure 4



A similar analysis was made for the remaining districts, an individual graph, like the one shown in Figure 4, was created for each of the remaining districts individually, however for this report a general version compiling all the districts, but district 7 is presented. Similar to Figure 4, 20 categories were created, and the top 19 contains, similar to district 7, 73% of the total of requests for the rest of the districts. The most frequent type of request, as in district 7, is *Parking Enforcement,* with 17.1% of the total (5.6 percent points less than district 7). Requests for street cleaning (7.1%) is also the second most common type of request for the rest of the districts with the exact same share as in district 7. Finally, improper storage of trash completed the top 3 with 5% of the total.

Figure 5



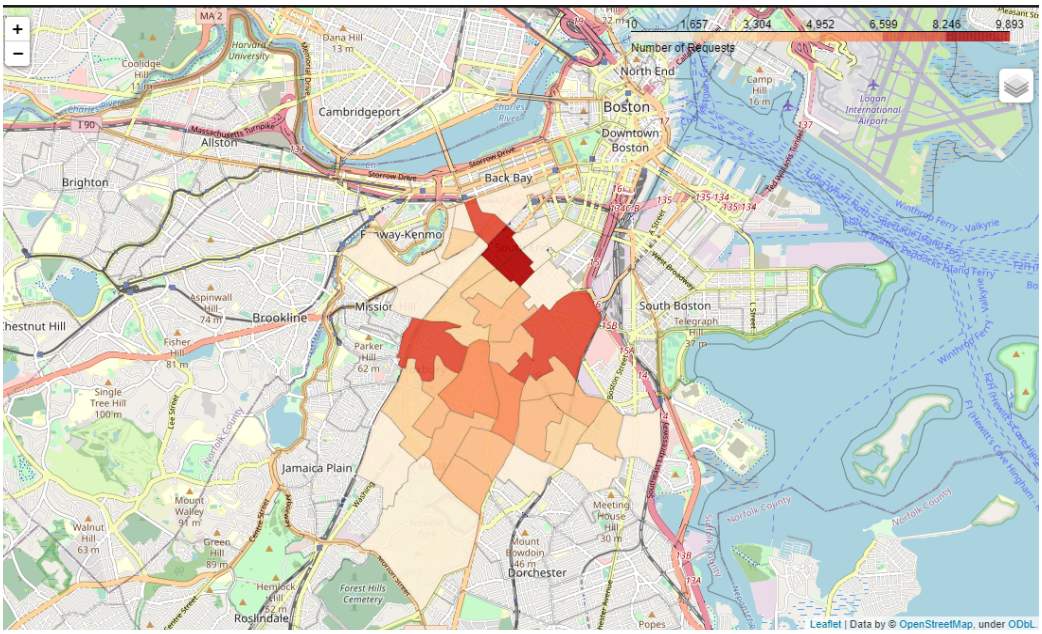
Time of response

To analyze the response times for requests in D7 and all other requests outside of D7, we first had to filter out requests that were never closed from 2017-2021. About 10.66% of requests were incomplete within D7 and 11.83% for all other districts. Once we isolated the requests that were completed, we found that D7 averaged 11.5 days and all other districts averaged 11.17 days to close requests. To get a better understanding of the specific needs of D7 and how it compares to other districts, we then filtered average closing times by the most popular requests in D7. We looked at the 19 most common request types which make up 73% of the total in D7. The types we found to show significant skew towards faster service times outside of D7 were *Requests for Street Cleaning* (33.52 hours for D7, 27.33 outside), *Request for Pothole Repair* (5.11 days for D7, 3.96 days outside), *CE Collection* (10.11 hours for D7, 7.5 hours outside), *Traffic Signal Inspection* (11.14 days for D7, 9.94 days outside), *Street Light Outages* (45.36 days for D7, 36.15 days outside), *Sign Repair* (15.63 days for D7, 12.26 days outside), and *Sidewalk Repair* (20.99 days for D7, 18.24 days outside).

Analysis within D7

After it was understood how D7 requests are being served compared to other districts in the City of Boston, we conducted some analysis to understand how the different areas within D7 are being served. In particular, we generated heatmaps to visually compare the number of requests and the time of response between the different census tracts within D7. There was a wide range in the number of requests between census tracts with the inner part of the district showing more requests. Times of response were more similar between tracts while one particular tract showed a much longer average service time for requests.

Number of requests



Time of response