When the Bronx was Burning

How the New York City – RAND Institute's Fire Project Impacts Equity Today

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***Abstract*—This article reviews the equity of fire department services in New York City and whether the New York City – RAND Institute's Fire Projects impact equity of service today. This article uses fire response time, number of runs per company and population served by each battalion as indicators of equity. Time series, clustering and visual inspection of maps are used as the primary analysis tools.**

Keywords—Fire Department; Equity; Fire Service; New York City – RAND Institute; "Fire Projects";

I. Introduction

In 1968, New York City was on the brink of financial and social collapse. Race riots broke out throughout New York City and the country and the police department was sent to the neighborhoods to patrol but not stop the looting and destruction of property. At the same time, New York City was in the midst of a financial crisis. The city was experiencing economic stagnation and decline. Population shifts in the 1950s and 1960s to the suburbs led to the decline of the textile and manufacturing industries, which had supported the economy throughout New York City's history. The introduction of container shipping moved much of the port work and the shipping industry into New Jersey and out of New York City's Navy Yard.

When the RAND corporation approached New York City with a proposal to streamline their processes using military models, like the ones implemented by the "Whiz Kids", who had cleaned up Ford Motors, to save millions of dollars by making city services more efficient, the New York City government could not ignore the proposal and the New York City–RAND Corporation was founded. Unfortunately, even after the RAND models were implemented, as a part of the New York City-RAND Corporation's "Fire Project", massive fires swept through low income Black and Puerto Rican neighborhoods, burning some until their were no buildings or residents left.

In 2014, when New York City Mayor Bill De Blasio assumed office, he delivered an important goal for New York City – equity. De Blasio has used the word equity when describing educational programs, health, housing and almost all other programs the city has implemented. This project will review the New York City – RAND Institute's proposals and actions from 1968-1975 to confirm if the proposed actions from the late 60s and early 70s have hindered "equity" for today. Additionally, this project will investigate if the Fire Department of the City of New York (FDNY) is currently an equitable service to all boroughs and neighborhoods.

II. Literature Review

Fire Department service cuts in the late 1960s and early 1970s were meant to save New York City money and make the department more efficient. John Lindsay and John O'Hagan both ardently believed that the RAND models would benefit the city and their department, respectively. The irony of this period is Lindsay, a key supporter (and drafter) of the Civil Rights Act, oversaw the policies that burned down the poorest black and Puerto Rican neighborhoods while O'Hagan, one of the most forward thinking and technologically adept fire chiefs, gutted his own department and the RAND Corporation, built on logic, proposed illogical policies. New York City was "burned by brilliance, idealism and the best of intentions." (Flood, 2010).

More ironic was the New York City-Rand Corporation proposed cuts never saved New York City money. The Fire Department had an increase in costs due to additional injuries and disability pay and overtime to account for lower manpower. The city lost millions in real estate taxes and had to pay for fire victims to be put up in welfare hotels or public housing projects (Flood, 2010). The budget and service cuts were implemented by men, like Abe Beame and John O'Hagan, who could not see the economic forest for the trees. "City Hall wasn't just having a temporary budget problem after a few years of bad fiscal management; it was on the verge of a much deeper decline in revenue thanks to years of backward economic planning," (Flood, 2010). The city was forced to use increasingly complicated financial maneuvers to continue to run. Beame once even suggested sending out teacher's salaries late to save the year's budget $25 million. While Lindsay called the plan "stopgap financial juggling", the checks still went out in July instead of June (Flood, 2010)

While service cuts may have been necessary or potentially more efficient, the manner in which they were carried out was not equitable. "Equity is an issue of distributive justice. It concerns what is fair. It calls for recognition of equal treatment of equals. Conversely, unequal parties should be treated unequally." (Lucy, 1981) Based on this definition, all people should have equitable access to fire services, no matter where they live within New York City. All victims of fires are equal in that they are victims of the same type of disaster; therefore, service must be equal to protect all citizens equally. Lucy continues that equity should consider equality, need, demand, preference and willingness to pay (Lucy, 1981). In the case of New York City, one might even conclude that with the "growing fire problem in New York's ghettoes", (Flood, 2010) lower income neighborhoods had a greater need for fire prevention and protection services.

Instead, the RAND modelers never stepped back from their models. They were "lost in a modeler's world", "divorced from reality" and, as a RAND scientist once said, his colleagues had "stepped through the looking glass where people did the weirdest things and [used] the most perverse kind of logic imaginable" (Flood, 2010). Instead of understanding and using the models equitably, fire stations were pulled from the most fire-prone neighborhoods and moving them to "suburban" Staten Island, where fire was not an issue at the time. Even if the models, themselves, were built equitably, their implementation was not. Chief Elmer Chapman, who worked with the New York City-RAND Corporation and ran the models when New York City-RAND Corporation shuttered, remembered

> "Mostly we used the RAND models for the cuts, but if they came back saying to close a house in a specific neighborhood, well... if you try to close a firehouse down the block from where a judge lived, you couldn't get away with it. In those cases you could simply skip down the list of closings to a company in a poor neighborhood. The models said there were less painful cuts to be made, but the people in those poorer neighborhoods didn't have a big voice" (Flood, 2010)

According to the Fire Safety Journal, fires are "comparable in cost to crimes" however, has received "limited and sporadic attention" (Jennings, 2013) from scholarly pursuits. Despite the lack of research and inconsistencies between findings, "relationships between poverty and housing quality were consistently identified as being associated with greater incidence of fires in residential buildings, " (Jennings, 2013). Additionally, low socioeconomic status increases fire risk and rates of fires. (Chhetri et.al., 2010) The New York City-RAND Corporation models were missing the association between vacant housing, low socioeconomic status and fire risk. The more the low income, ethnic neighborhoods that burned, destroying housing, the more fires would burn in the area. Removing services only exacerbated this cyclical problem.

Another aspect of fire fighting which was left out of the modeling completed by the New York City-RAND Corporation is "relocation". Relocation is when a neighboring fire battalion must cover for a fire battalion that is occupied by another fire.

> "If a fire…occurs in a battalion weakened by either relocation or by assignment of its own units to a multiple-alarm fire, then widespread 'move-ups'— even further relocation—of surrounding units at a further distance may

become necessary, spreading the service deficit even more," (Wallace, 1993).

When fire stations begin closing, the system of relocation begins to fall apart as responses to fires must come from farther and farther away to put the fire out.

III. Structure of the New York City Fire Department

The New York City Fire Department structure is important to understanding the power structure, purpose and equity of the fire service in New York. This section will briefly outline the department's structure for ease of understanding future sections.

The FDNY is divided by borough, each having it's own borough chief. Boroughs are broken down into divisions, typically one, two or three depending on size. Divisions are broken into battalions (3-7 per division). A division is responsible for a geographic section of a borough and the battalion is responsible for a geographic section of the division it is a member of. A firehouse is responsible for a neighborhood within a battalion.

Each firehouse contains 1-3 fire companies. Each fire company will operate a different apparatus or truck (sometimes called a "rig"). The six types of companies are ladder, engine, squad, marine, rescue and HAZMAT companies.

A Captain is in charge of the firehouse and commands each fire company. In a firehouse that contains more than one fire company, the Captain assigned to the engine company is in charge of the firehouse. (D. Perl, personal communication, December 5, 2015)

IV. Data and Methodology

The original data used in the New York City-RAND Corporation analysis from the "fire project" was requested from the New York City Fire Department under the Freedom of Information Law (FOIL). The request for this information is still pending within the fire department.

Due to the lack of original data, the first dataset analyzed was the FDNY Monthly Response Times in the present. Unfortunately, this dataset on the New York City Open Data website only included a few months (from July 2009 to Jun 2010) worth of data. Because of this shortcoming, additional data points were sourced from the FDNY website monthly reports (provided in PDFs) by borough and appended to the comma separated value, or CSV, file for analysis ("FDNY Citywide Stats", n.d.). This CSV has since been submitted to the New York City Open Data platform for consideration of publication to the platform. Due to the time constraints, additional data points were added to this file in excel in lieu of python.

The second dataset analyzed was the number of runs for the 25 firehouses with the most runs per year. This dataset was pulled from the FDNY yearly report for 2012 ("Fire Department City of New York Annual Report 2012/2013", n.d.). The data included was for engine and ladder companies for the years 2009-2011. The final year that this dataset has been made available to the public online is 2012.

The final datasets that used for this analysis was the American Community Survey population data for 2014 in conjunction with the "Atomic Polygons" dataset and the "Fire Battalions" dataset, which are both available via the New York City Open Data Platform. These datasets were merged to review the population served by each New York City Fire Battalion.

Using the FDNY monthly response times data file involved some data cleaning of the year/month columns and the response time columns. The date of the observation (column labeled YEARMONTH) was cleaned using the datetime package and turning the integer representing the year and month into a date. The response time data was cleaned by running a function on each row that turned a "minute : seconds" format into a number of seconds. Once the data was in this format it could be broken out by borough and response time. This analysis used all five boroughs and a citywide grouping but only looked at Structural and Non-Structural fires, eliminating Non-Fire Emergencies, Medical Emergencies and Malicious False Alarms. New York City defines structural fires as fires in commercial buildings, residential buildings, public buildings, and vacant buildings and non-structural fires as brush fires, auto fires and transit fires. ("NYC 911 Performance Reporting - Incident Type Definitions", n.d.)

Once the data cleaning was complete, plots were created of the structural fires by borough, non-structural fires by borough and the combined structural and nonstructural fires by borough. Additionally, this data was clustered on the average response times (by borough) using the K-Means method with two and three clusters.

Using the number of runs data, each firehouse was geocoded with a latitude and longitude based on the firehouse street address into a latitude and longitude that CartoDB could plot. CartoDB cannot plot street addresses, but using some of their other functions, I was able to turn the street addresses into the latitude and longitude and plot each year on the New York City Map. These maps were created for each year from 2009 to 2011. The number of runs is also categorized into 7 categories.

To complete an analysis of the population served by each fire battalion, the three datasets were joined using the Census Block and Census Tract as well as the borough code. The data provided by New York City uses a borough number (1-5) and the Census data uses a state and county code. These two numbers had to be translated before they could be merged. For example, the state code for New York is 36. By removing the number 36 from the GEOid2 from the American Community Survey, the county code could be translated to a borough number. Then by appending the Census Block and Census Tract number, this data can be merged with the responsible fire battalion provided to the block data. Once that merge has been completed, the population can be summed over the fire battalion number and merged with the geographic data for that battalion. This data was plotted on a map as a chloropleth. Additionally, the population was ranked in a table. Including the address and the battalion numbers ranked by the number of people served by that battalion.

V. Results

To review equity, this paper looks at the population served by each fire battalion, the average response time of each borough and the geographic locations where the fire department might be over-worked (calculated using the number of runs and ranked to the 25 firehouses with the most runs). Generalized findings are as follows:

- Brooklyn has faster response times than the other boroughs.
- Lower income areas, such as the South Bronx, Harlem and Brownsville, have firehouses with the most number of runs.
- Firehouses that serve the largest population are clustered in Queens.

These conclusions partially support the theory that the city's fire protection is equitably distributed and partially contradict the same theory. Each conclusion will be examined further in the remainder of this section.

In regard to response times, for both structural and non-structural fires, Brooklyn has the lowest response times of any borough. Figure 1 indicates the response time to structural fires by borough over the response times to structural fires for each borough over the time period of June 2009 to February 2013. Figure 2 indicates the response time to non-structural fires for each borough over the same time period. One theory for the lower

FIGURE 1. RESPONSE TIME IN SECONDS VS DATE

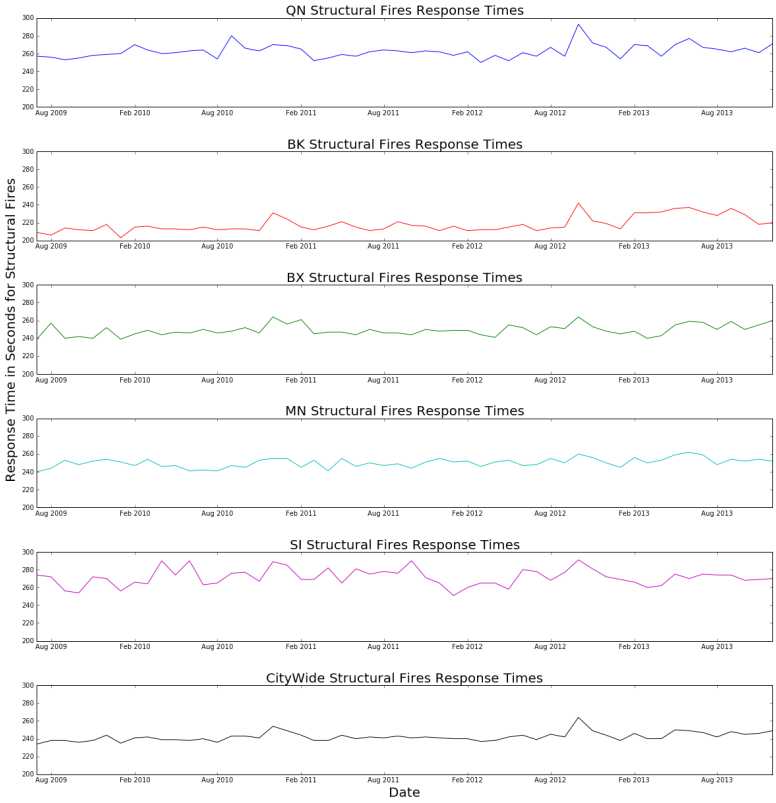


FIGURE 2. RESPONSE TIME IN SECONDS VS DATE

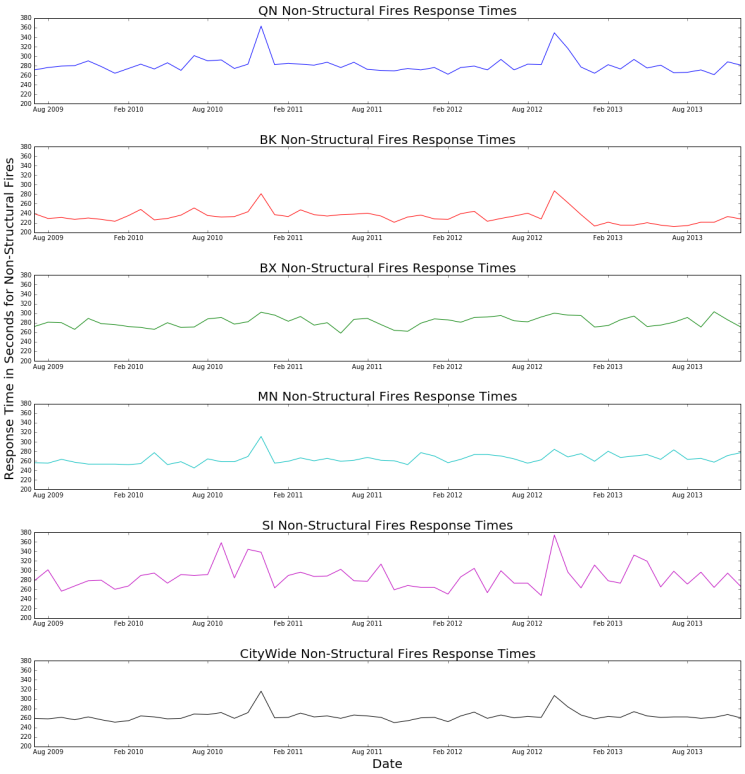
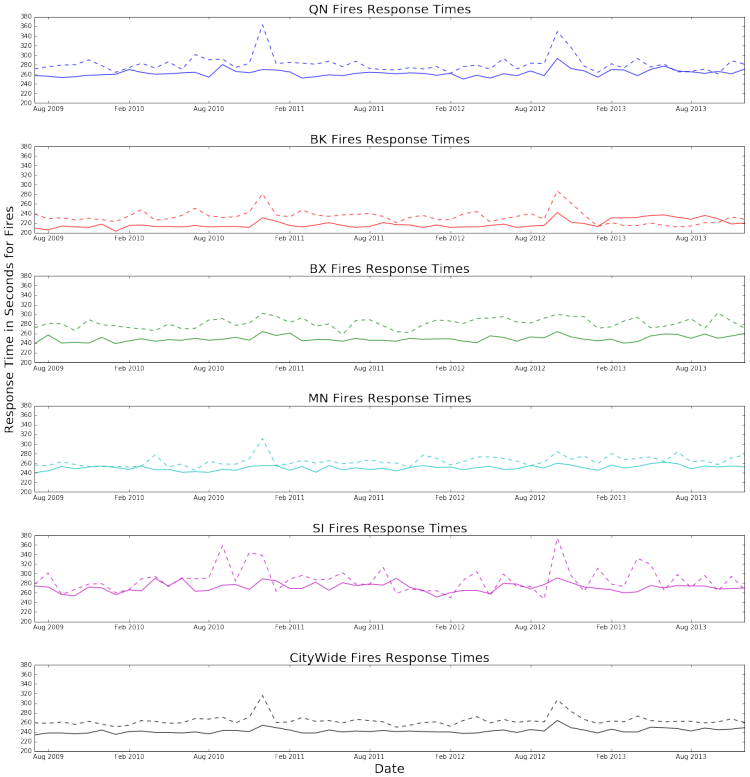


FIGURE 3. RESPONSE TIME IN SECONDS VS DATE



response time within this borough is the relatively high population density and the relatively low traffic rate. More research in this area would be required to confirm why the response time in Brooklyn is so much lower than in other boroughs.

In addition to the response time in Brooklyn being lower, response time in Staten Island is slightly higher than in the other boroughs. This is also likely correlated with population density. Staten Island is mainly single-family homes with generally lower population density than the other boroughs, which means for a fire battalion to cover the same population, it is covering a larger geographic area. Staten Island has only 3 fire battalions, many fewer than any of the other boroughs. Assuming that in Staten Island the driving rate was the same as in Brooklyn, the increase distance will lead to an increased response time.

Figure 3 indicates an additional phenomenon in response time. For all boroughs, the response time to non-structural fires is generally greater than the response time to structural fires. It is unclear what the cause of this discrepancy is, however some of this author's theories include their location (being in less populated, more desolate areas) or that when fires are called in it is known whether they are structural or non-structural and structural fires are deemed more dangerous than non-structural fires.

One way this author sought to evaluate the differences between the boroughs is to perform a cluster analysis. KMeans was used using two and three clusters on the individual boroughs (not including the citywide data). When the data was analyzed in two clusters, Brooklyn was in one cluster and Queens, Manhattan, Staten Island and the Bronx were in the other. This clustering supports the visual information from Figures 1, 2 and 3. When the data was analyzed in three clusters, Brooklyn was in the first cluster, Queens and Manhattan were in the second cluster and Staten Island and the Bronx were in the third cluster.

In the cluster analysis of the boroughs in two and three clusters and with structural, non-structural and both structural and non-structural fire data, the clusters remained the same. Due to the consistency

of the clusters, it can be inferred that the fire response trends for each borough are relatively unresponsive to the type of fires.

The identification and relief of firehouses that are overworked is an area where it appears that New York City has not provided for equity. Areas with relatively low socio-economic status increase fire risk and rates of fires (Chhetri et. al., 2010) and the firehouses in those areas are responding to the most alarms. By plotting the 25 engine companies and the 25 ladder companies that responded to the most alarms, location-based trends emerge. In the years 2009-2011, clusters of engine and ladder companies are located in the South Bronx, Harlem, Midtown Manhattan and Brownsville and East New York. Figures 4 – 9 show the locations of the engine and ladder companies called on the most "runs". In this paper, and in most FDNY reports, runs are defined as apparatus responses. In addition to their location, the number of runs for each company is coded by shades of red.

Higher incidences of fires and alarms can be explained in the South Bronx, Harlem and Brownsville and East New York can be explained by the socioeconomic factors, specifically low-income, which lead to higher risk and incidences of fire. However, Midtown Manhattan cannot be explained by low-income. It is this author's prediction that the best explanation for the volume of runs in Midtown Manhattan is due to the volume of people working there everyday. By logical conclusions, the more people in an area, the more likely someone is to set or spot a fire.

The engine and ladder companies going on the most runs are going approximately 15 runs per day. Assuming that none of these are malicious false alarms and that each one needs to be investigated, on many days, these companies may not stop at their firehouse between runs. When a fire company is busy, they cannot perform routine maintenance,

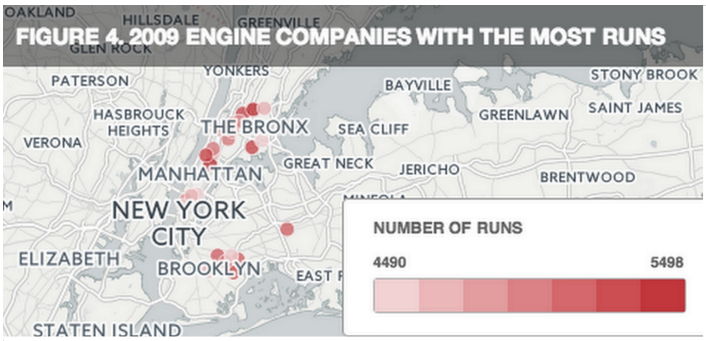


FIGURE 4. 2009 ENGINE COMPANIES WITH THE MOST RUNS

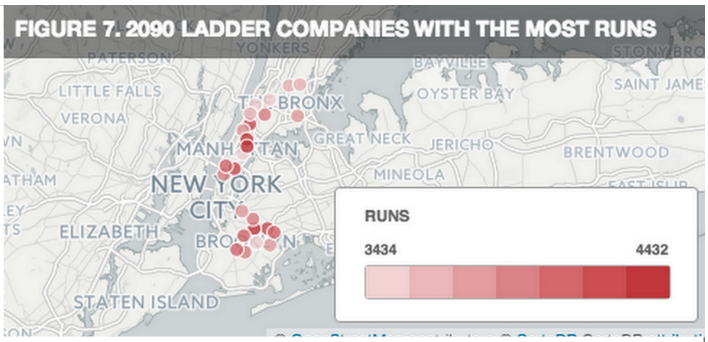


FIGURE 7. 2090 LADDER COMPANIES WITH THE MOST RUNS

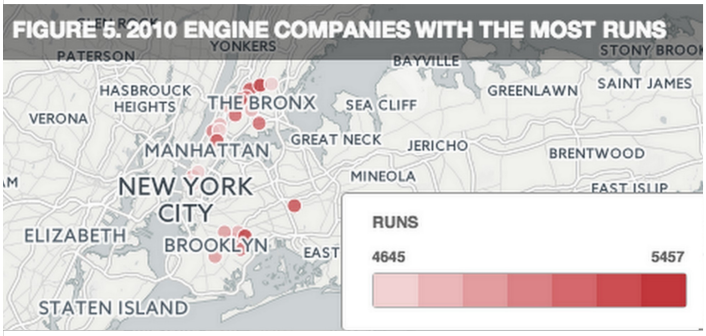


FIGURE 5. 2010 ENGINE COMPANIES WITH THE MOST RUNS

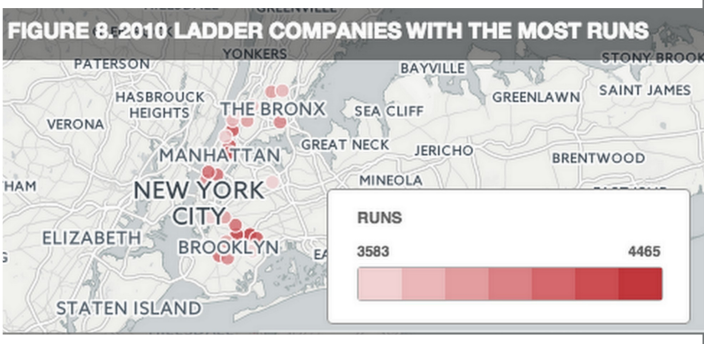


FIGURE 8. 2010 LADDER COMPANIES WITH THE MOST RUNS

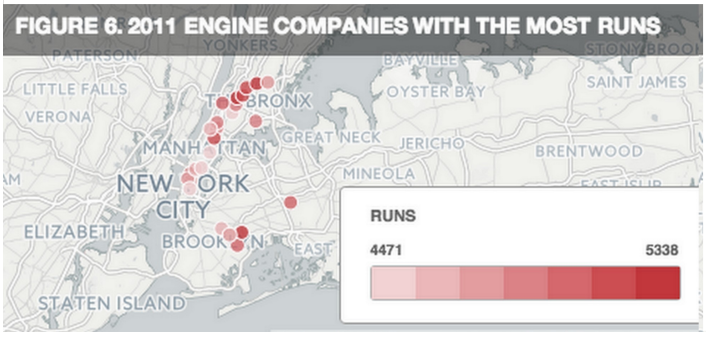


FIGURE 6. 2011 ENGINE COMPANIES WITH THE MOST RUNS

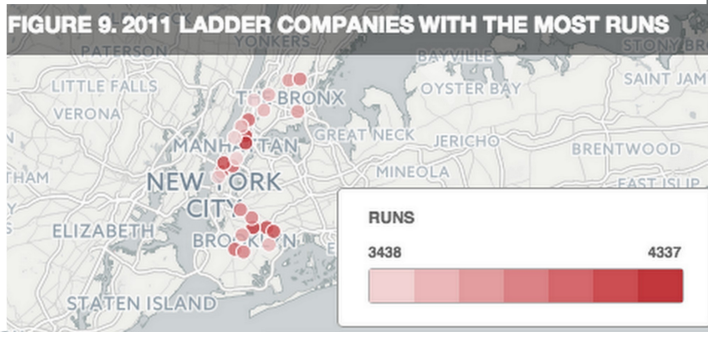
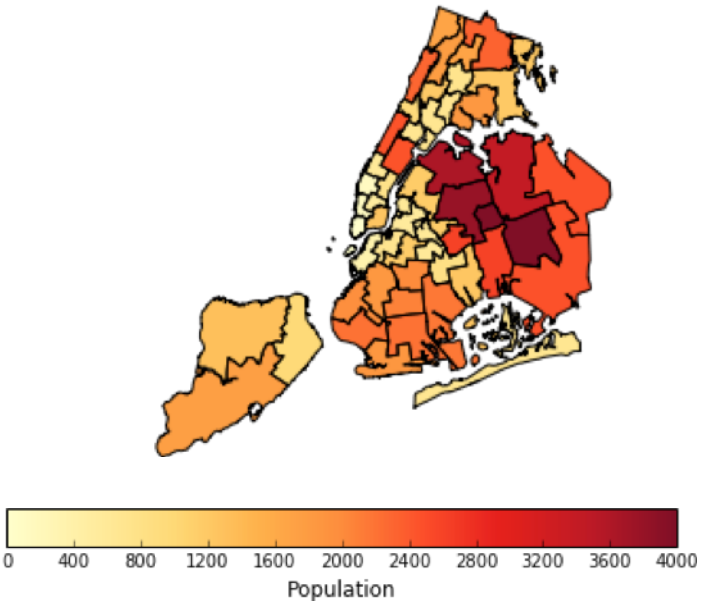


FIGURE 9. 2011 LADDER COMPANIES WITH THE MOST RUNS

fire safety and prevention training or simply rest between the fire fighting they do daily. If the fire company does not perform maintenance on their rig and other equipment, the firefighting quality received in that neighborhood may not be as effective as it could be. If fire prevention and trainings for the community are eliminated because the company is too busy, more preventable fires can occur and more damage can be done to the neighborhood (which could lead to more fires and a busier company due to the correlation between vacant and burned out buildings and higher incidences of fire (Jennings, 2013)). Finally, general exhaustion can lead to sloppiness, mistakes and injuries. Injuries can especially tax the fire department both financially and with personnel shortages. When a firefighter is injured or killed in the line of duty, the city pays disability and/or widow's pensions to the injured and his family, costing the department monetarily. Additionally, another fire fighter might replace the one who was injured or killed, but if one cannot or is not sent as a replacement, the fire company must operate with one less man, stretching resources even thinner.

Figure 10 shows an interesting complement to the discussion of Figures 4 – 9. Figure 10 indicates the boundaries of each fire battalion and the number of people served by that battalion. There is a grouping in Queens of battalions responsible for relatively large populations (colored in dark red) as well as groupings of battalions responsible for small populations in Harlem, Brownsville, East New York, Midtown and the South Bronx. Viewing this from an equity standpoint, it makes sense that the areas with the most fire alarms and runs have the most firehouses per capita. Figure 11 includes the five battalions that serve the most number of people and the neighborhoods they are located in and Figure 12 includes the five battalions that serve the least number of people and the neighborhoods they are located in.

FIGURE 10: POPULATION SERVED BY EACH FIRE BATTALION



While the previous figures do not indicate equity, Figure 10 indicates that the Fire Department has actively attempted to provide equitable fire protection dispatching. In this case equity has been attempted by treating unequal parties (areas with more or less fires) as unequal (providing more or less battalions per capita). The overall equity goals may have been achieved using the metric of response times where all boroughs have similar response times with the exception of Brooklyn, which has very low response times.

FIGURE 11. BATTALIONS SERVING THE MOST PEOPLE

Battalion Number	***Location***	***Population Served***
50	15-311 Hillside Ave, Jamaica Hills	349,149
46	86-53 Grand Ave, Elmhurst	334,517
49	22-63 35th St, Astoria	322,667
52	41-20 Murray St, Queensboro Hill	306,800
51	107- 12 Lefferts Blvd. Richmond Hill	249,060

FIGURE 12. BATTALIONS SERVING THE LEAST PEOPLE

Battalion Number	***Location***	***Population Served***
6	108 E 13th St, Union Square	95,573
32	31 Richards Street, Red Hook	84,431
7	146 W 19th Street, Chelsea	67,718
2	227 Avenue of the Americas, Greenwich Village	67,310
1	100 Duane Street, Tribeca	58,374

VI. Implications

Each dataset analyzed in the previous section, provides a piece of the fire department and fire protection equity puzzle. The results of the above analysis only provide the equity of the indicators, which are not the full picture of fire loss and fire effect in New York City.

Additional research is required into who is at risk for fire and how to provide better services could greatly increase the equity of the FDNY. According to Jennings (2013), "population-based studies to better identify characteristics of – or specific individuals …who are at heightened risk of fire" should be undertaken to provide equity. Wallace and Wallace (2001) have indicated that high risk of fire is likely co-morbid with high risk of disease and crime. Identifying areas and specific individuals who are at a high risk of fire and implementing services to reduce the fire risk could also reduce the incidence of disease and crime.

Other cities outside of New York might also look into their fire department equity to begin the process of ensuring equity in departments. Due to the failure of the "Fire Project" the inequity and racism of the way fire services were provided in New York were known and could be resolved. In other cities without as much notoriety around how services are and were distributed might need to review how the past decisions impact their current service equity.

VII. Conclusion

While many of the reports from the "Fire Project" have been released to the public, there are still many open issues and questions regarding the work done by the New York City-RAND Corporation. The data used for these studies has not been released to the public and the Freedom of Information Law, which requires agencies to provide such information, is a very slow process (currently still ongoing after 4 weeks of requests). Additionally, many of the accounts of why or how these models were built and implemented have been lost or eroded over time.

While the results of this initial study have not conclusively concluded that fire department service is not equitably provided, they have highlighted some of the indicators of equity in city services. They have also created a starting point for future research. This paper has highlighted the response times, population served by firehouses and the number of runs per firehouse for the 25 firehouses with the most runs. More detailed analysis and more detailed data is required to conclude if the fire department is inequitable.

Specific potential areas of research would be into other metrics of equity. The Fire department currently continues to use response time as the main metric of fire companies, which may not be the correct metric. Additional studies or replacements and move ups would be of interest to the equity discussion. Finally, additional work into how other New York City services can identify fire risk and help mitigate that risk.

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