HEATING FIRE INCIDENTS IN NEW YORK CITY

by

MERISSA LISSADE

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This manuscript has been read and accepted for the Graduate Faculty in Data Analysis & Visualization in satisfaction of the thesis requirement for the degree of Master of Science.

Date	Michelle McSweeney Thesis Advisor
Date	Matthew Gold Executive Officer

THE CITY UNIVERSITY OF NEW YORK

ABSTRACT

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Advisor: Michelle McSweeney

If you have ever had the Citizen app downloaded on your smart phone, then you know how many alerts you receive in a day living in New York City (NYC). Citizen is a mobile app that sends real-time safety alerts based on the location of its user. In my experience having the app, I have seen many notifications of fires caused by heaters during the winter. On the morning of January 9th, 2022, I received a notification of an accidental blaze that took the lives of 17 people from the choking smoke of a 19-story residential building in the Bronx. This fire was the third deadliest the United States (US) has seen in more than four decades.[1] A malfunctioning space heater was the cause of the fatal blaze. The second leading cause of home fires and home fire injuries is heating. It is also the third leading cause of home fire deaths.[2] In a 2017 housing survey, nearly 20% of households in the Bronx utilize a secondary source of heat in addition to their primary source. At 20%, the Bronx currently has the highest rate among all the boroughs.[3]

This capstone project (hosted on the website, https://mlissade.github.io/NYC-Heating-Fire-Incidents/data-sources/index.html) addresses heating fire incidents throughout

[1] (Ortiz 2022)
[2] (National Fire Protection Association n.d.)
[3] (The City of New York 2017)

the NYC boroughs during the cold weather seasons. How many complaints does the Department of Housing Preservation and Development (HPD) get about heat per season? Are there more residential heating fires during the colder months? Are more of these fires in low-income areas? This project would highlight the importance to NYC residents about knowing their rights to proper heating during the cold weather seasons and holding their landlords accountable for making sure it is provided. It would also give insights to the HPD as to how imperative it is for them to investigate buildings that make complaints of poor heating. Most importantly, this urges lawmakers and fire marshals to create and enforce regulations that could prevent incidents like the January 2022 Bronx fire from happening again.

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NOTE ON TECHNICAL SPECIFICATIONS

The visualizations of my project were created on Tableau Desktop then published on Tableau Public so that I could use the embedded code to share them on my project webpage. Tableau Desktop is a business intelligence software tool used to create interactive data visualizations while Tableau Public is a free platform used to explore, create, and publicly share data visualizations online. On my Windows operating system (OS), I have Tableau Desktop version 2020.3 installed and am using a temporary student license for access to the application. Tableau Desktop is available to download on either a Windows or Mac OS.

I used Visual Studio Code as the code editor for building my website. Visual Studio Code can be installed on a Windows, Linux, or Mac OS. The version used for this project is 1.66.0. To deploy the website, I used GitHub Pages which hosts the website directly from my GitHub repository that stores and manages the code. Visual Studio Code has Git commands built in that work with GitHub in source code managing and version control.

CHAPTER 1: INTRODUCTION

When you read articles like the residential Bronx fire that happened in January of 2022, you cannot help but wonder what if the building had sufficient heating? There would not have been a need for that space heater that malfunctioned in the first place then and the lives of 17 people would not have been lost. Unfortunately, fires caused by space heaters is not uncommon in New York City (NYC), especially with buildings built before World War II (1939). The heat in these types of buildings typically use a steam heating system that is usually regulated by the management of the buildings. This means units will receive the same amount of heat but because units are on different floors and are of different sizes it can be experienced differently. Some tenants may find their apartment too hot; some may not find it hot enough and it tends to be those who do not find it hot enough that get space heaters as an additional source of heat. This made me think about just how frequent of an issue is heating and fire incidents caused by space heaters. Should we be bringing more awareness to this situation? This is what inspired the topic of my capstone project.

The first thing I did to build this project was creating an outline of what my research questions would be. I wanted to know how many heating fire incidents has NYC had; when do thy occur more frequently; which neighborhoods file the most heat and hot water complaints / violations; which boroughs had the most home fire fatalities? To answer these questions, I needed to find the data that could do just that. After finding the data, I had to figure out what was the best method of analyzing and visualizing that data and how can I share it in a way that is easily accessible and showcases what I have learned in the Data Analysis and Visualization Program. I decided on creating my visualizations in Tableau then having them displayed on a webpage that I would build using HTML/CSS hosted by GitHub.

CHAPTER 2: ABOUT THE DATA

Majority of my data came from NYC Open Data, a website with free public data published by NYC agencies and other partners. For my project I used data from the Fire Department of New York City (FDNY), the Department of Housing Preservation and Development (HPD), the Department of Information Technology and Telecommunications (DoITT), and the Department of City Planning (DCP). The United States Fire Administration (USFA) is the lead federal agency for fire data collection, public fire education, fire research, and fire service training.[4] The data they collect becomes the source for two of my visualizations. Another data source I use is the National Oceanic and Atmospheric Administration (NOAA). It is their mission to understand and predict changes in climate, weather, ocean, and coasts. Every month, they collect data that provides a global summary of meteorological elements. The data is collected from various stations worldwide but for my project I used data collected at their station located in NYC Central Park (USW00094728).[5] Because all my data comes from various government agencies that shares their data publicly, there were no extra steps I needed to take to ensure the privacy protection of the data.

From the FDNY, I used the Bureau of Fire Investigations – Fire Causes dataset to determine how many fire incidents were caused by portable heaters and what areas do we see more of these incidents in. The dataset is from January 2016 until December 2020 and was last updated on June 22nd, 2021. The relevant fields of this dataset incident date, borough, community district, and descriptions of the cause.[6] Due to the large size of the dataset, I filtered it by the field, "Cause_Fire_Description," containing "portable heater" before extracting a subset of the data from NYC Open Data. After the extract, I had joined another

[4] (U.S. Fire Administration Updated daily)
[5] (Lawrimore, et al. 2016)
[6] (Fire Department of New York City 2021)

dataset called NYC Population by Community District on the community district numbers to get the names of the community districts since this was not provided in the dataset provided by the FDNY. This additional dataset that I had joined is provided by the DCP and was last updated on June 30th, 2021. I had used this data to show the heating fire incident trends during cold weather seasons and to show the incidents broken down by borough as well. For the cold weather season trends dashboard, I overlayed the average monthly temperatures over the heating fire incidents by month to how the reverse relationship that as the temperature drops that we do see more incidents. The data for the temperature came from the NOAA. I used the same date range as the Bureau of Fire Investigations – Fire Causes dataset for consistency since the temperatures were displayed on top of the heating fire incidents by month graph.

In NYC, HPD is responsible for preserving affordable housing while protecting tenants and their rights relating to the safety and quality of their housing. The HPD documents all complaints they have received and any violations they find when they perform their investigations on complaints made. Information that can be made public from these complaints and violations is stored in datasets that are updated on a daily or monthly basis on the NYC Open Data website. The dataset is called Housing Maintenance Code Violations which had three relevant fields: the inspection date of the violation, the violation code types, and the postal code in which it happened.[7] This dataset is very large because there are many different reasons the HPD could issue a violation. The inspection dates also go back as far as 1903 until present day since this is a dataset updated daily. Because of this, I used a subset of this data filtered by the "OrderNumber" and the "InspectionDate" fields of the dataset. The "OrderNumber" field is violation code numbers that refer to the abstract description of the

[7] (Department of Housing Preservation and Development n.d.)

violation condition which cites a specific section of the law which is in violation. I chose to filter by any violation code that relates to heat and hot water which are 664, 666, 670, 964, 966, 907. On the NYC Open Data website, it also provides documentation in full detail as to what each of these codes mean. For the "InspectionDate" field, I filtered the dates to be between 2016 and 2020. After extracting the subset, I used this resulting data to determine what areas have the most violations then see if the amount in those areas is proportional to the number of complaints received.

The 311 hotline is a service by the NYC government that provides resources and general information to NYC residents for non-emergency situations. When 311 receives complaints about heat / hot water, they direct these to HPD. The 311 hotline works with DoITT to provide their data on NYC Open Data which is called 311 Service Requests from 2010 to Present.[8] As the name suggests, this data set has service requests made to 311 from 2010 to present day which makes this dataset very vast. To create a subset to work with, I filtered by the date of the complaint from 2016 to 2020 and filtered the complaint type by "HEAT/HOT WATER." Using this subset, I created a choropleth map of these complaints by zip code during this time. For reference, I made a choropleth map of the violations also by zip code to the right of it. From this side-by-side comparison, it is prevalent that the areas with the most violations seemed to be proportional to the number of complaints and seems to be in the areas popularly known as low-income areas of NYC.[9] I also created a separate subset from the most recent cold weather season which is October 2020 to May 2021 that included all the complaint types. This second subset was to determine if where "HEAT/HOT WATER" fell in

[8] (311, DoITT 2010 - present)
[9] (Citizens' Committee for Children 2019)

the ranking of the complaint type received most. “HEAT/HOT WATER” was number two of the winter of 2020 into 2021.

The USFA website has data and statistics on the fire problem in the US. Their website has a dataset with information on home fire fatalities compiled daily from a daily internet search of US news media reports. In this dataset, each entry is a fatality with the age and gender of the victim. It also includes the reported cause of the fire, incident date, city, and state.[10] Due to the large size of this dataset, I extracted incidents just from NYC with causes reported as “heating,” and the date range from January 2016 to February 2022. The data seemed to have been web scraped from the internet, so the names of some cities were unclear. To clean this up, I decided to create an additional field named borough. I used the city name of the ones that were clear and assigned it to the borough it is in and for the ones that were not as clear, I used the attached media URL field to read the article which stated where incident took place. Using this data, I wanted to show how many home fire fatalities related to heating has there been in each borough using a bar graph and another visualization that showed each individual fatality and their cause of death.

[10] (U.S. Fire Administration Updated daily)

CHAPTER 3: RELATIONSHIP TO FOCUS AREA & APPLICATIONS

When coming up with this project, I had to think about how I can showcase what I have learned in the Data Analysis and Visualization program through my project. This project shows a lot of the skills that I have learned from three of my courses: Visualization and Design Fundamentals, Interactive Data Visualization, and Advanced Interactive Data Visualization Studio. These classes gave me the basic knowledge I needed to use software such as Tableau, Visual Studio Code, and Git. I also used some coding to build the website and embed the Tableau visuals created.

The Visualization and Design Fundamentals course, taught by Michelle McSweeney, showed me how to create different types of visuals and build dashboards in Tableau. Tableau makes creating simple default visuals such as the bar charts, line graphs, bubble chart, and maps very easy. The user just needs to select the type of visualization drag and drop the desired variables into the axes and/or attributes available, then let Tableau do the rest. When making the more complex visuals, more work needed to be done. In my first dashboard that shows the trends during the cold weather seasons, I had to overlay and properly align the Average Monthly Temperature line graph over the Heating Fire Incidents bar graph myself. This task is not something Tableau could do on its own but was not as complex as building the Causes of Fire Incident Fatalities waffle chart.

Tableau has several chart types built into its system like the bar graph and line graph. However, waffle charts are not one of the default charts Tableau recognizes. To build the waffle chart, I had to create an Excel sheet that maps out the structure of the chart then make several

calculations that dictates how much of the chart should be colored in. Unfortunately, the more categories one has for this chart type the less perfect the outcome seems to be because Tableau began to have trouble reading some of the smaller percentage categories which I then had to lump together as one and categorize them as "Other." The waffle chart structure is made available in the GitHub repository and the calculations are easily accessible from the Tableau workbook. Once I finished creating all the desired visuals and dashboards, I posted all my visuals to my Tableau Public profile which allows me to share my visuals using a link or embedded code. The embedded code is written in HTML/CSS and JavaScript, so this made it easy to integrate the code into my webpage.

The Interactive Data Visualization and Advanced Interactive Data Visualization Studio courses, both taught by Aucher Serr, showed me how to create visualizations and the basics of building a website. I used Visual Studio Code to build and edit the code for the website in HTML and CSS. Because my experience in HMTL is still at an intermediate level, I used a template from W3Schools, an educational coding website, to help build the website. The template is coded in HTML and uses a CSS framework by W3Schools that is all free to use easily without any licensing.[11] To host my website, I used GitHub which I also used for version control and source code management using Git. After deploying the project, I made sure to store any data used and the Tableau workbook in the GitHub repository that also stores all the code.

The skills learned in these courses have been very valuable to me for both this project but also in my current career. I continue to use Tableau on the daily to create reports, visuals, and dashboards for my current place of employment. I believe I have successfully shown how much I

[11] (W3Schools 2022)

have learned with this project from these courses that created the greatest impact in my growth as a data analyst and visualist.

CHAPTER 4: EVALUATION & CONCLUSION

I believe the main objectives that I had outlined were captured and achieved. I had speculated that heating fire incidents seem to be a common issue since I received so many notifications about them. My project shows not only that there is a trend with the colder seasons but also a trend with location. I had faced setbacks and challenges along the way that led to the overall success of the project.

The first challenge I came across was finding the right data to answer the questions. I had assumed this would be an easy task knowing that government agencies make a lot of their data public but finding the ones with the necessary fields for analysis got tricky. Originally, I had a longer list of datasets to use for the project however, for sake of time and efficiency in completion of the project I had to ultimately make the decision of which datasets were actually useful and which were just extra information I would have just joined onto another table. HPD had additional data that would have linked the violations to the direct complaint made. This data would have granted me the ability to see how many complaints directly resulted into a violation. The problem with the data was the fact that the information lived in two separate datasets, and they were too large to work with in that way. I had the 311 complaints dataset already so I felt as though this would suffice since 311 complaints related to heat and hot water turn into HPD complaints. However, this excludes any complaints made directly to HPD. It is my assumption though that this may not exclude too large of a number because HPD recommends complaints to be filed through 311.

When creating the visualizations, everything had gone well until I reached the waffle chart. This was my most complex visualization since the waffle chart is not actually a default

visualization Tableau creates. This visualization was my largest setback because of how much calculation goes into creating it. The more categories included in it the harder it gets to have it render the correct information. Eventually with the help of a Graduate Center Digital Fellow, we managed to debug the situation simply by condensing some of the smaller categories into one which would be identified as "Other." I had included asterisk note at bottom of this visualization indicating what categories that "Other" entails.

I had felt most nervous about building the website because although I learned HTML and CSS, I am still at an intermediate level so there was still so much to learn about building a website. When I discovered the templates from W3Schools, this made the process so much easier because I knew I could easily edit HTML and CSS rather than building it from scratch. Building entirely on my own would have caused so many delays. I wanted the website building part of the project to not take up too much of my time since it was just the platform that would display the visualizations I made. I had originally thought this would have been my greatest challenge but ended up being one of the easier parts.

These challenges I faced during my project and finding ways to overcome them strengthened my skills. I believe it is overcoming them that made what could have been failures for me, successes in this project. I am content with the overall outcome, but I do think there is room for improvement and expansion on the project. I believe that when HPD consolidates their data for easier use there is an opportunity there to show how many complaints become violations and if we see any repeat offenders. The HPD claims that they are working on merging their datasets, but this change was projected to take place by January 2022, and I have yet to see the change made. Two months after the Bronx residential fire of January 2022, the mayor signed an executive order

"designed to enhance fire safety enforcement, outreach efforts to educate New Yorkers, and identify safety violations."[12] Another opportunity would be to see if in a couple of years if we see a decrease trend in fire incidents in not only heat related but also in general with this new order in place. My hope is that my project highlights the importance of the consequence of improper heating. Without it tenants feel the need to use an additional heating source that depending on what is used just ends up being a fire hazard that could cost lives.

[12] (Elassar and Westhoff 2022)

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APPENDIX A: LIST OF VARIABLES

311 SERVICE REQUESTS FROM 2010 TO PRESENT

BOROUGH	Provided by the submitter and confirmed by geo validation
CREATED DATE	Date Service Request was created
COMPLAINT TYPE	This is the first level of a hierarchy identifying the topic of the incident or condition

BUREAU OF FIRE INVESTIGATIONS – FIRE CAUSES

BOROUGH	Borough in which the incident occurred
CAUSE_FIRE_DESCRIPTION	Category of fire cause
COMMUNITY_DISTRICT	Community District number in which the incident occurred
INCIDENT_DATETIME	Date and time of the incident being investigated

HOUSING MAINTENANCE CODE VIOLATIONS

BOROUGH	Borough in which the violation was observed
INSPECTION DATE	Date when the violation was observed
POSTCODE	Postal code in which the violation was observed

NEW YORK CITY POPULATION BY COMMUNITY DISTRICTS

CD NUMBER	Community District number
CD NAME	Neighborhoods within the Community District

USFA – HOME FIRE FATALITIES IN THE NEWS

BOROUGH	Borough in which the incident occurred (constructed field based on CITY, STATE, and MEDIA URL)
CAUSE	Cause of fatality
CITY	City in which the incident occurred
STATE	State in which the incident occurred
DATE	Date of home fire incident
MEDIA URL	Media URL reference to the fire incident

NOAA – GLOBAL SUMMARY OF THE MONTH

DATE	Month and year
TAVG	Average Monthly Temperature in Fahrenheit (calculated from TAVG C using the conversion calculation: [TAVG C * 9/5] + 32)
TAVG C	Average Monthly Temperature in Celsius