BU CS506

City of Boston: Permitting

Team C

By:

Dima Kazlouski:
Senior
dimak@bu.edu

Aryan Agarwal
Senior
aryan1@bu.edu

Brianna Huang
Senior
brihuang@bu.edu

John Dohyun Kim
Senior
jdkim128@bu.edu

Jasper Hoong
Junior
jasperh@bu.edu

Introduction

The goal of this project is to provide the city of Boston with a better understanding of the data around approvals and denials for permits to build or conduct renovations in order to ensure that residents and businesses are receiving equitable treatment, as well as analyze its effects on housing costs.
Real estate and development are key to economic development and tax base in Boston, as nearly ⅔ of the City's operational revenue comes from property tax. This issue also targets affordable housing in Boston as the supply of housing is an important factor in housing prices and approvals and denials for permits play a huge role in the supply of housing. Unfortunately, obtaining permits and renovating according to the City's process can be challenging for residents and businesses with the many stages required to navigate through it. This project aims to help understand the data around approvals and denials so that residents and commercial entities can receive equitable treatment.

Base Analysis

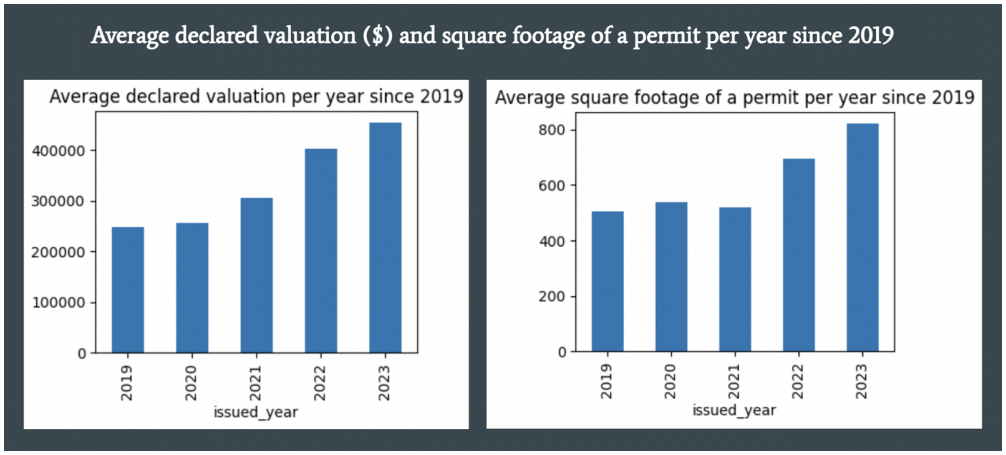
Boston's urban landscape is molded by the myriad of building permits granted each year. Yet, essential questions linger: What types of permits, characterized by work type, valuation, and occupancy, dominate the approvals? How have these trends evolved over the past five years? Beyond the numbers, who are the key players seeking these permits, and what geographical patterns emerge from both the permit requests and the decisions of the zoning board of appeal? As we venture into this analysis, we also strive to uncover the deeper socio-economic layers, probing into the racial, ethnic, and income profiles of neighborhoods where these permits originate.

The graphs and charts below were products of us performing EDA on our data. Once we were able to understand the basic structure of our data and generate key statistics, we were able to create visualizations relevant to our project, specifically relevant to gaining insights into the following two base questions:

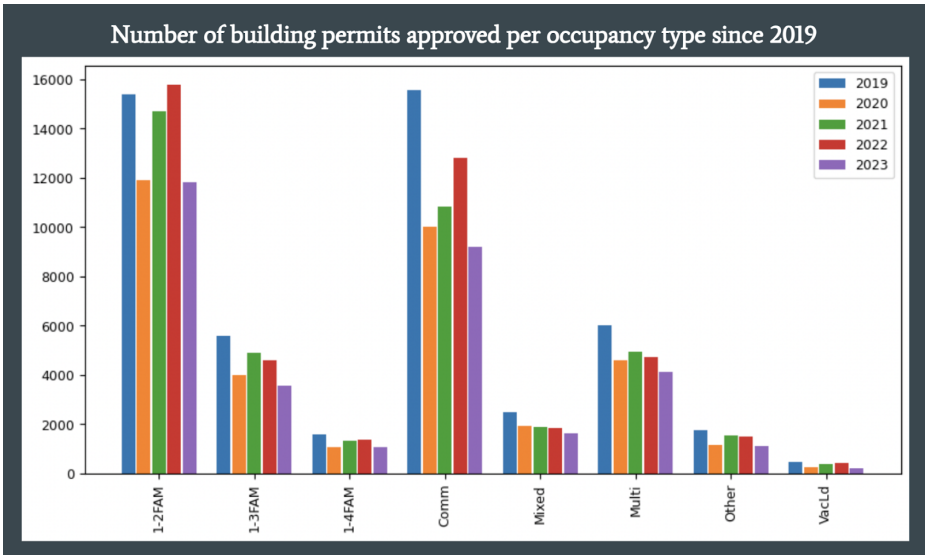
1. What type of building permits are approved each year by work type, description, valuation, square footage, and occupancy type?
2. How have these changed over the past 5 years (a year-over-year analysis)?

The following results are obtained from approved permits data. We aimed to create graphs to emphasize the relationship between the types of permits approved such as valuation, work type, square footage, and occupancy type, and the year it was approved, starting from 5 years ago.

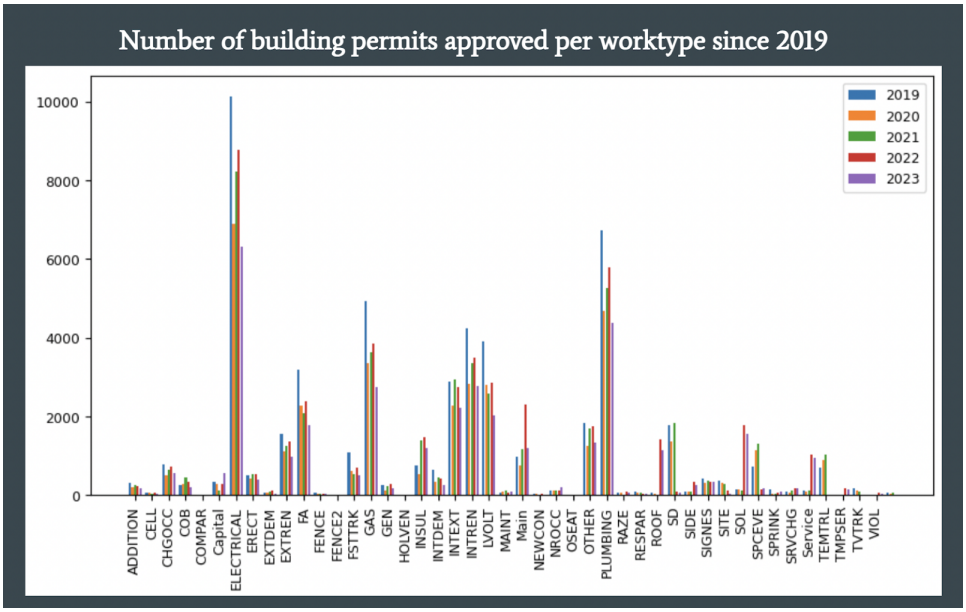
We obtained the dataset directly from the city of Boston's website and were able to download it as a CSV file. From there, we converted it into a Dataframe and were able to preprocess the data and perform preliminary data analysis on the fields of interest. Here are the early results:



As expected, we see a steady increase in average declared valuation in the past 5 years, likely due to an increase in housing costs and thus services for building and renovation. However, the average square footage of an approved permit has also increased, which warrants further investigation.



We see a pretty significant decrease in approved building permits in 2020, compared to 2019 and the following years. We would expect this to potentially be due to coronavirus and the community being quarantined, which would certainly decrease the amount of work and construction being done on buildings. Nevertheless, there remains to be a large amount of building permits for 1-2 family and community buildings compared to other occupancy types. This could simply be because there are more of those types of buildings, but could also potentially be related to accessibility to resources to getting permits approved.

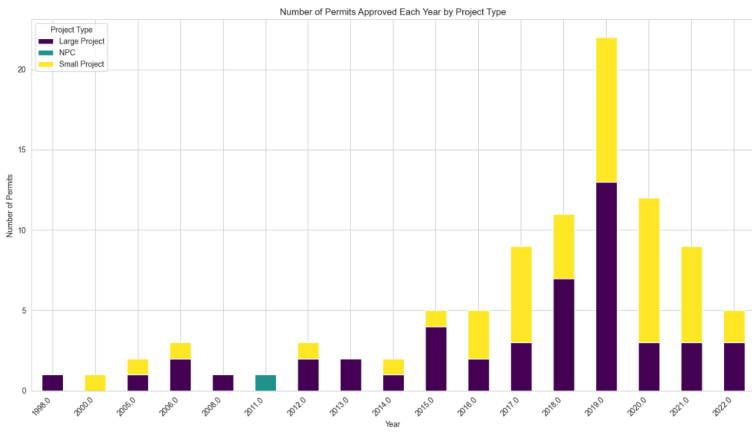


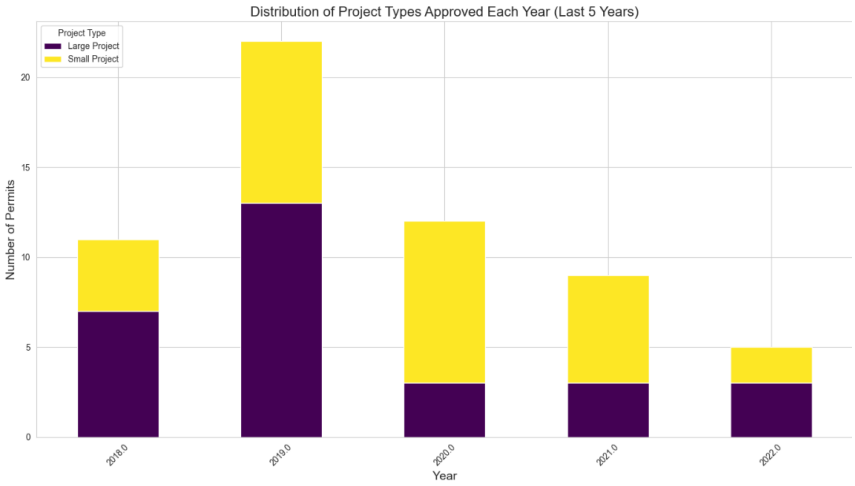
Similarly to the previous graph, we see a significant decrease in approved building permits in 2020 for potentially COVID-related reasons. Otherwise, the approved permits seem mostly electrical or plumbing-related, as opposed to larger construction projects like new construction additions. It is possible that this is due to the long process of getting permits approved by the city, especially for larger projects that are expensive and affect other aspects of the city.

Next, we focused on the remainder of our base project questions:

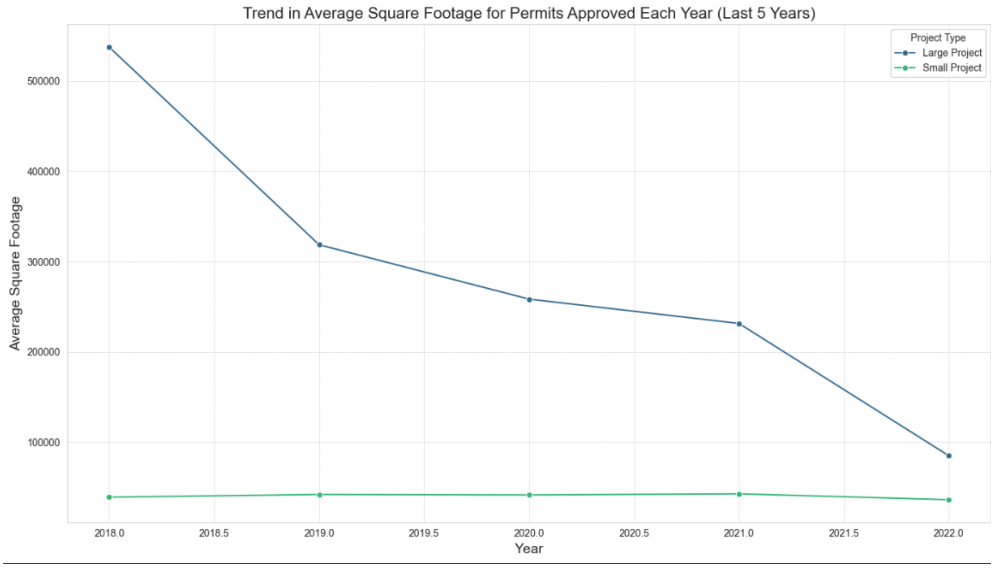
3. Who is applying for building permits by geography (neighborhood, zip code, zoning district)?
4. What are the year-over-year trends visible in the zoning board of appeal approvals and denials by geography (neighborhood - listed as city, zip code, zoning district)?
5. What are the geographic profiles of the census tracts of the addresses for the permits submitted and zoning board approvals and denials (use project address and match to census data)? Specifically look at: race/ethnicity of the census tract income level (average income in census tracts of approved permits)

In regards to Article80 Data, the charts below show the distribution of building permits by project type over the years.

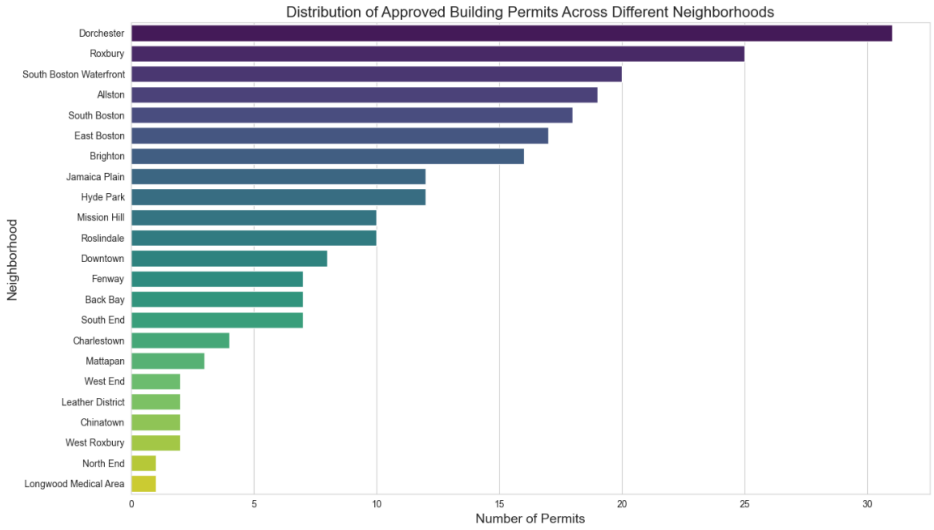




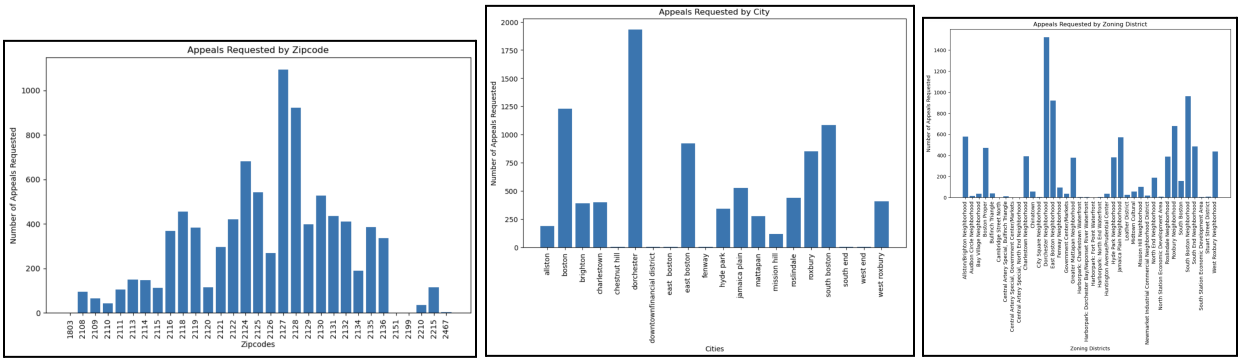
We can observe which project types are more prevalent in certain years, indicating trends or shifts in development focus. Noticeably, over the last 4 years there has been a year-to-year decrease in small projects. There has been a large drop in the number of large projects between 2019 and 2020 but that number has not changed between 2020 and 2022.



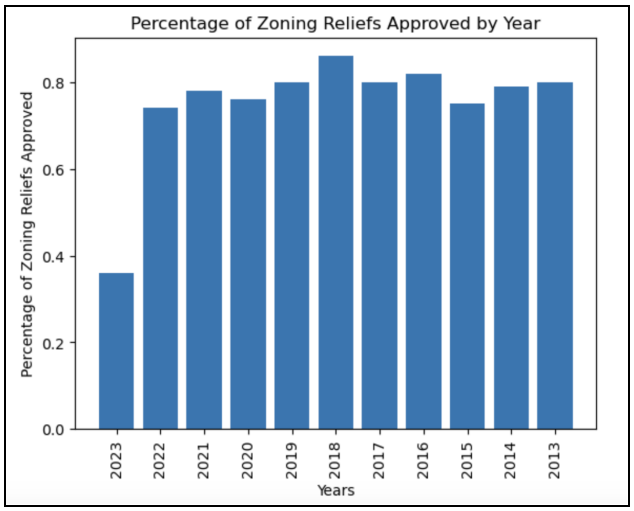
This chart showcases how the average size (in square footage) of approved projects has changed over the last five years. Notably, the average square footage for large projects has been decreasing for the last 5 years, however, there has been almost no change for small projects.

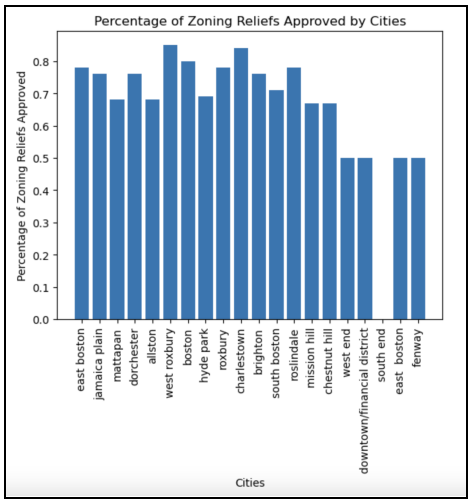


This visualization highlights which neighborhoods have the highest number of approved building permits. It helps identify areas of high development activity. The Article80 data set does not specify which projects get denied, further analysis on the other data sets will be conducted to answer this question.

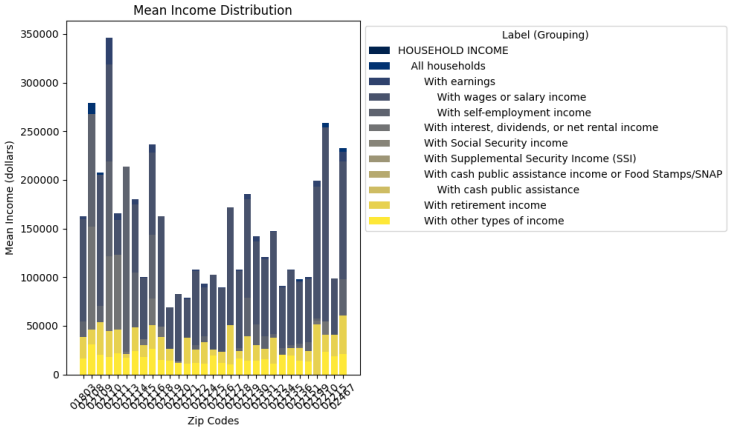


The three graphs above show the number of appeals submitted to the Zoning Board of Appeals by geography, divided into cities, zip codes, and zoning districts. This information helps us to understand who is applying for Building permits by geography. In the graph shown above these three titled, Distribution of Approved Building Permits Across, Different Neighborhoods, we were able to get an idea of Building permits approved by different neighborhoods. However, it did not show us how many were denied. These three graphs from the Zoning Board of Appeals tracker gives us an idea of who is applying for the building permits as the zoning relief appeal is requested once a building permit is denied as the result of a zoning violation. Once the zoning relief is approved, the process of obtaining a building permit can be resumed. It is worth noting that this data is a cumulation of 10 years worth of appeals.





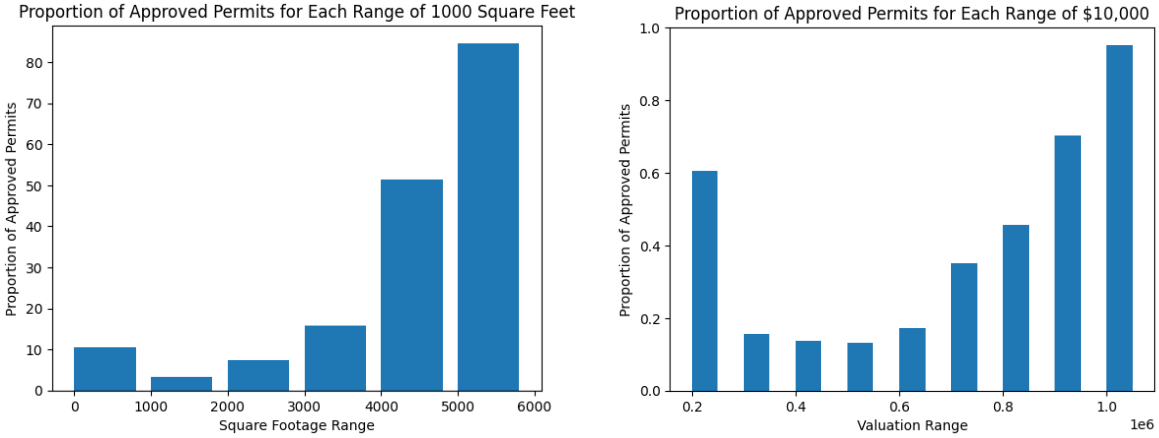
From the zoning board of appeal tracker data, we created two graphs that show the percentage of approved applications. An approval in zoning relief allows the applicants to continue with obtaining a permit hence its importance. The first graph shows the percentage of zoning reliefs granted by year. The second shows the reliefs granted by the city. As displayed by the high percentage of zoning relief approvals yearly, it is likely for the zoning reliefs to be approved (2023 is low because the year has not yet been completed and many requests are still pending). Similarly, zoning reliefs from most cities are approved as well, although some cities have had less luck in getting approved (although it is worth noting that the sample size for some cities was greater than others; for example, South End had very few applications). Having very few application results in the data being rather extreme, as one approval or denial will have a great affect on the data than if there were thousands. Its also important to note that this gives us an idea of the trends visible in the zoning board of appeal approvals and denials by geography in a 10 year period.



Extension Analysis

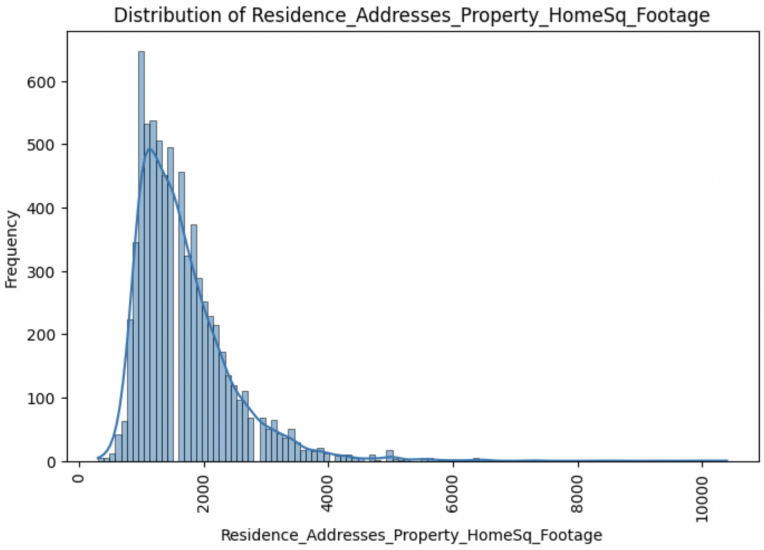
For our extension proposal, we looked into the Voter File for Boston data and conducted analysis in regards to the voting profile for census tracts where there is a high ratio of approved permits and zoning board of appeal decisions. Voting is important when concerning approved permits and the zoning board of appeal as zoning regulations are largely determined by the local government and will vary from community to community. Analyzing this data would show us the correlation between the government and the approval of appeals and whether there are systemic inequalities engrained in municipal politics in permitting. By analyzing the Voter File for Boston data, we hoped to find out how the local government affects approvals.

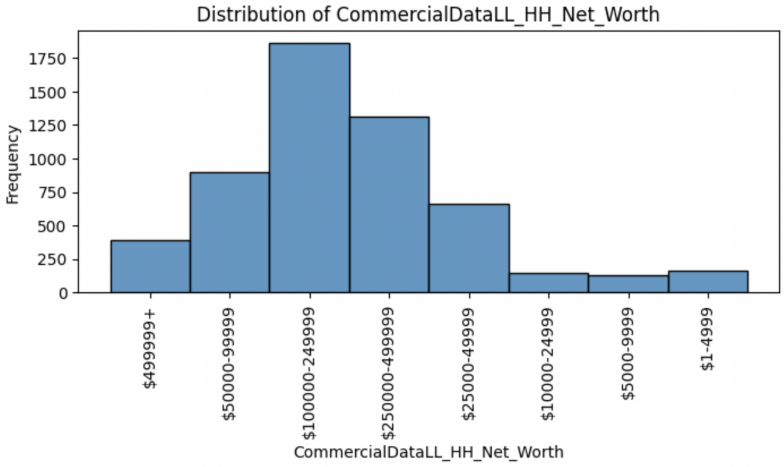
First, we performed basic EDA on the voter data and extracted some relationships between the voters in Boston with the approved permits. Doing so, we can gain some basic insight into demographics of voters and how that may affect the approval rates of permits.



In the figures above, we looked at the relative proportions of approved permits compared to features of voters like square footage and valuation of their properties. There is a significant trend in both these graphs where there is a seemingly exponential increase in approval rates of permits as both square footage and property value are increased. There is an obvious jump in permits approved for permits with a square footage greater than 4000 square feet, and with a value greater than $900,000. This could be because of many reasons– one being that larger, more expensive properties potentially tailor to communities with easier access to more resources. However, there is a higher proportion of very low valuation ($200,000-$300,000) and very low square footage (0-1000 square feet) permits that are approved compared to the following couple of ranges. We hypothesize that smaller permit requests like plumbing or quick fixes have high approval rates since they are easy and potentially a lot cheaper than other requests.

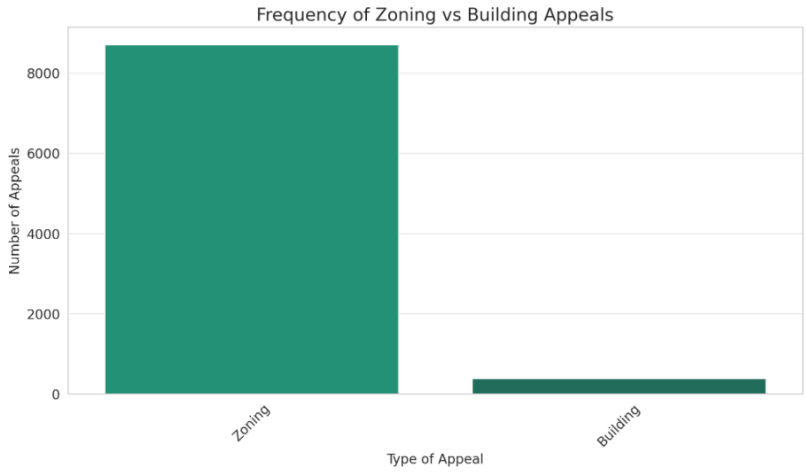
Moreover we have also done analysis looking at how socioeconomic trends of the data we have analyzed for the extension part can indicate insights into the permitting process as a whole:

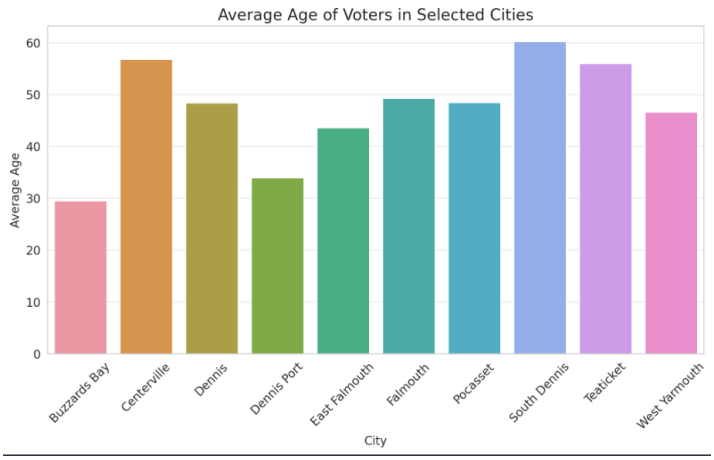




From such we have obtained insights into the trend of how most voters reside in properties around 1000 square feet with a commercial net worth primarily in the range of $100,000 to $250,000. Later in our analysis we will further show how this plays a larger role to gain deeper understanding of how such data plays into the permitting process.

Furthermore, given the complexities of our datasets from the perspective of making connections in data between our 3 Permitting and 1 Zoning datasets to our numerous Voting datasets, we had to run independent analyses on the different data. The graphs below represent the result of that.





The bar chart on the left demonstrates the Frequency of Zoning vs Building Appeals, illustrating the number of zoning and building appeals. It clearly shows that zoning appeals are far more frequent than

building appeals in the dataset. The bar chart on the right demonstrates the Age of Voters in Selected Cities, displaying the average age of voters in a selection of cities. It highlights the variation in the average age of voters across different cities, indicating demographic diversity. Based on the independent analyses of the zoning appeals data and the demographic data we can see how the high frequency of zoning appeals, as compared to building appeals, suggests that urban development issues, particularly those related to land use and zoning regulations, are a significant concern in the areas covered by the data. Considering this with previous Zoning analysis and connecting it all to demographic trends we can hypothesize that areas with younger populations might see a different pattern of zoning appeals for instance more appeals for new residential developments compared to areas with older populations.

The final steps we are currently taking to wrap up our project involve further dissecting our data to extract specific information in regards to the City of Boston. This has been the biggest challenge for us, making sense of the many voter data files and matching the data to permitting, zoning, and other data from our base project. Nonetheless, we are close to concluding this task and will show our results in the final deliverable.

Individual Contributions:
Dima: Gathered, preprocessed data, and analyzed which questions to dig into for the extension projects, looked into creating visuals to gain insights into our extension project.
Aryan: worked on early extension insights, looked into creating visuals to gain insights into our extension project.
Brianna: conducted EDA to gain insights into voter household property, created our README, visualizations for the extension.
John: conducted EDA to gain insights into voter ethnic trends, looking into analyzing data specific to Boston.
Jasper: conducted EDA to gain insights into voter distribution by zip code. Located relevant data that we will use to match our data from the base project to our voting data for the extension project.