Boston City Budget Project Report

Team C Members:

Tony (tonydao1@bu.edu)
Michael (mcao124@bu.edu)
Anh (anhtran8@bu.edu)
Shiva (shivaco@bu.edu)
Will (willzong@bu.edu)

Problem Statement, Data Cleaning, and Collection Step

Problem Statement: The City of Boston annually allocates funds for its operating and capital budgets, covering various day-to-day expenses and larger-scale physical asset improvements. This project aims to analyze and understand how these budgets are distributed across different city departments, neighborhoods, and other attributes. The core focus is to identify trends in the funding allocation over time. The analysis will seek to answer questions related to changes in departmental funding, geographic spread of the budget, and the evolution of financial priorities. This project will also consider the broader social, political, and societal context in which these city services operate. By examining and comparing various sources, including budget visualizations from other cities and general budgeting guides, the project intends to provide insightful data analysis that aids in understanding the dynamics of Boston's budget allocation and its impact on the community.

Data Cleaning and Collection:

We gathered data from the adopted operating budget and the capital budget plan. There was a lot of missing values in our data that had the value #Missing. We thought it would be best to remove them from the dataset since there was nowhere to get the data and if we made it the mean or median of some other value it wouldn't make sense. We also checked for invalid values. We did so by:

```
# Code to replace the #Missing
operating_data = operating_data[operating_data != '#Missing'].dropna()

# Changes columns to numeric
columns_to_convert = ['FY21 Actual Expense', 'FY22 Actual Expense', 'FY23 Appropriation', 'FY24 Adopted']

for column in columns_to_convert:
    operating_data[column] = pd.to_numeric(operating_data[column], errors='coerce')

operating_data.head()
```

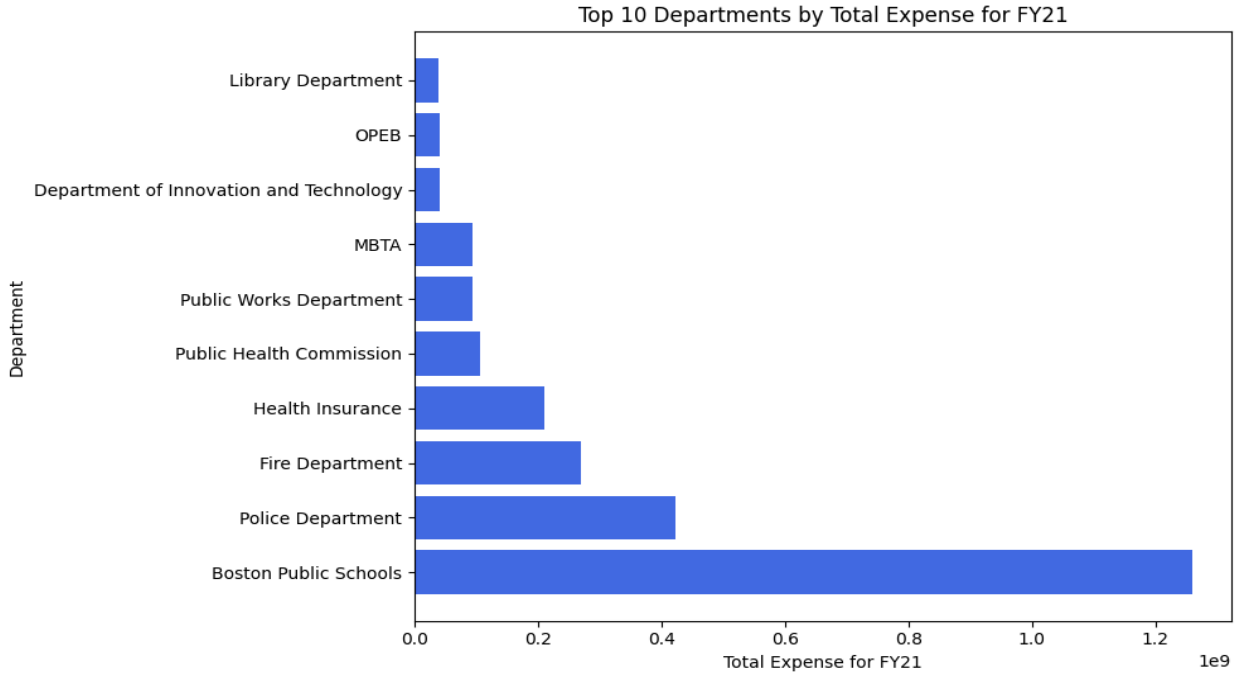
```
# Investigate the "Total_Project_Budget" column to understand why it is an object type
unique_values_total_project_budget = data["Total_Project_Budget"].unique()

# Check for invalid values in numeric columns
invalid_values_numeric_columns = data.select_dtypes(include='int64').apply(lambda col: pd.to_numeric(col, errors='coerce')).isnul

unique_values_total_project_budget, invalid_values_numeric_columns

(array(['2000000', '1800000', '88000000', '2300000', '1000000', '250000',
        '400000', '3075000', '3100000', '22000000', '26300000', '14000000',
        '30900000', '1475000', '300000', '17980000', '4000000', '1090051',
        '35000000', '20000000', '4100000', '4,103,029.00', '15,460,150.00',
        '12,405,592.00', '15,000,000.00', '100,000.00', '1,345,805.00',
        '99,966,532.00', '3,000,000.00', '10,360,000.00', '500000',
        '5000000', '2500000', '740000', '975000', '10728239', '41600000',
        '223591467', '8030325', '6000000', '4185000', '21780705',
        '3000000', '7450607', '6474650', '3490000', '4600000', '12669773',
        '10668049', '9131165', '9411905', '27000000', '1500000', '991720',
```

We performed aggregation based on specific categories crucial for our project, including departments, categories, programs, and neighborhoods. This process allowed us to consolidate spending data, providing a clearer and more accurate representation for further analysis.

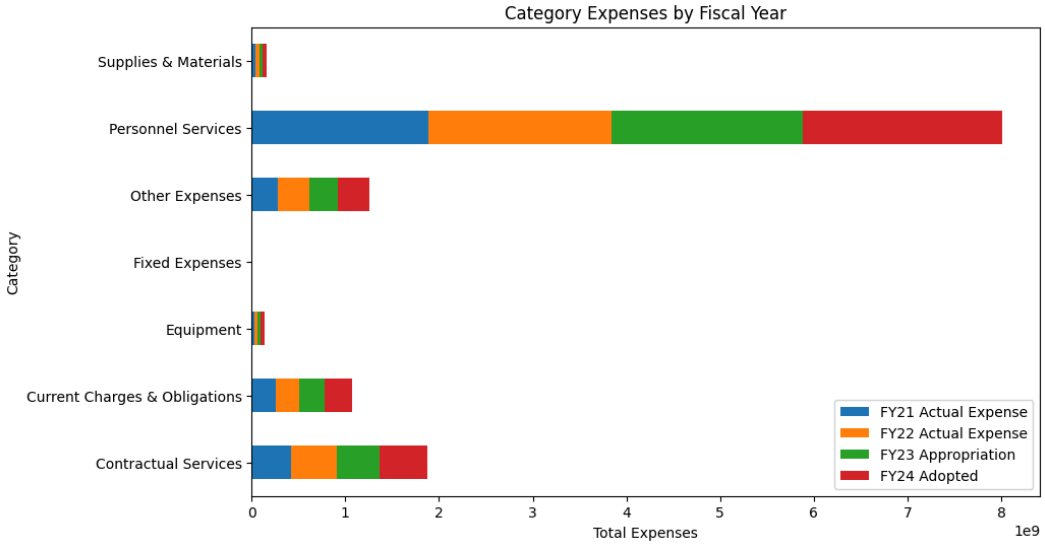
```
# Group by department and sum the expenses for each department
department_spending = operating_data.groupby('Dept').agg({
    'FY21 Actual Expense': 'sum',
    'FY22 Actual Expense': 'sum',
    'FY23 Appropriation': 'sum',
    'FY24 Adopted': 'sum'
}).reset_index()

department_spending.head()
✓ 0.0s
```

	Dept	FY21 Actual Expense	FY22 Actual Expense	FY23 Appropriation	FY24 Adopted
0	Age Strong	2883451.65	4223184.72	6.044480e+06	7.040771e+06

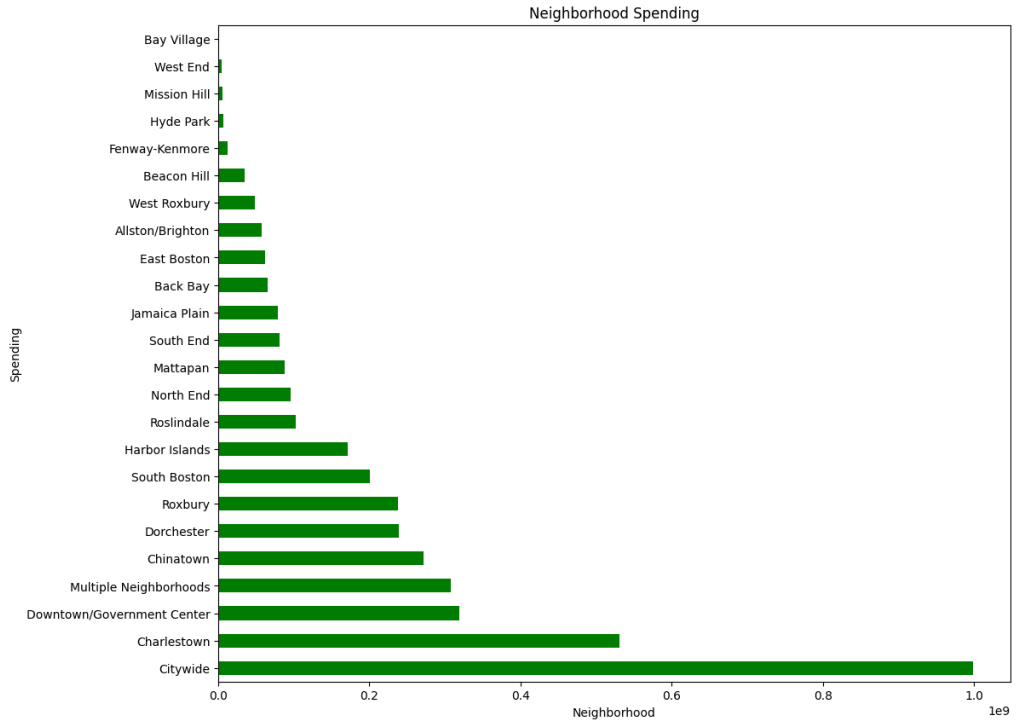
Exploratory Data Analysis (Base questions analysis)



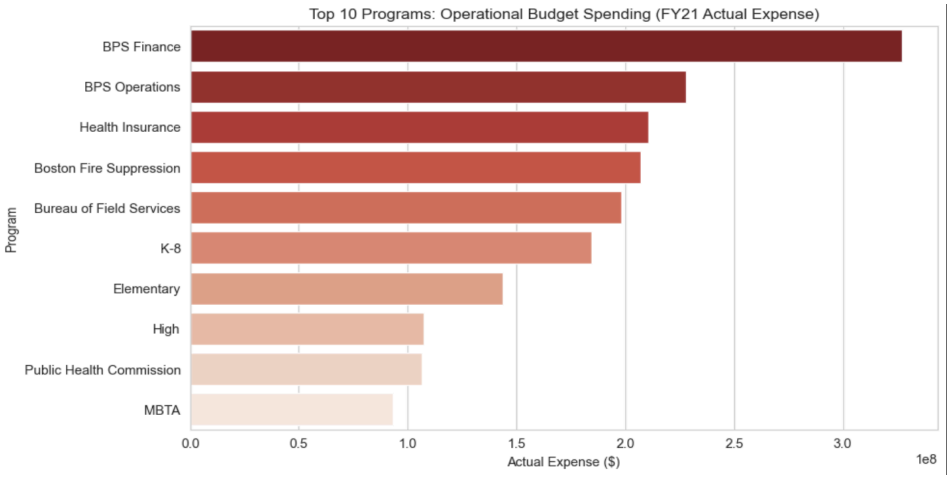
Top 10 Programs by Total Expense for FY21: This bar chart shows the top programs by total expenses in a fiscal year (FY21). It appears that 'BPS Finance' has the highest expenditure, followed by 'BPS Operations' and 'Health Insurance'.



Category Expenses by Fiscal Year: This stacked bar chart compares the expenses in different categories over four fiscal years. 'Personnel Services' seems to have the highest expense across all years by a large margin. There is a visible change in 'Other Expenses' from FY22 to FY24, which suggests a reduction or reallocation in the budget.



Neighborhood Spending: This chart shows spending by neighborhood, with 'Citywide' being the highest. This could indicate either a citywide program or aggregated expenses not attributed to a specific neighborhood. Charlestown is technically the highest budgeted neighborhood, but through research we learned that recently Boston is trying to put more revenue into Charlestown to renovate it.



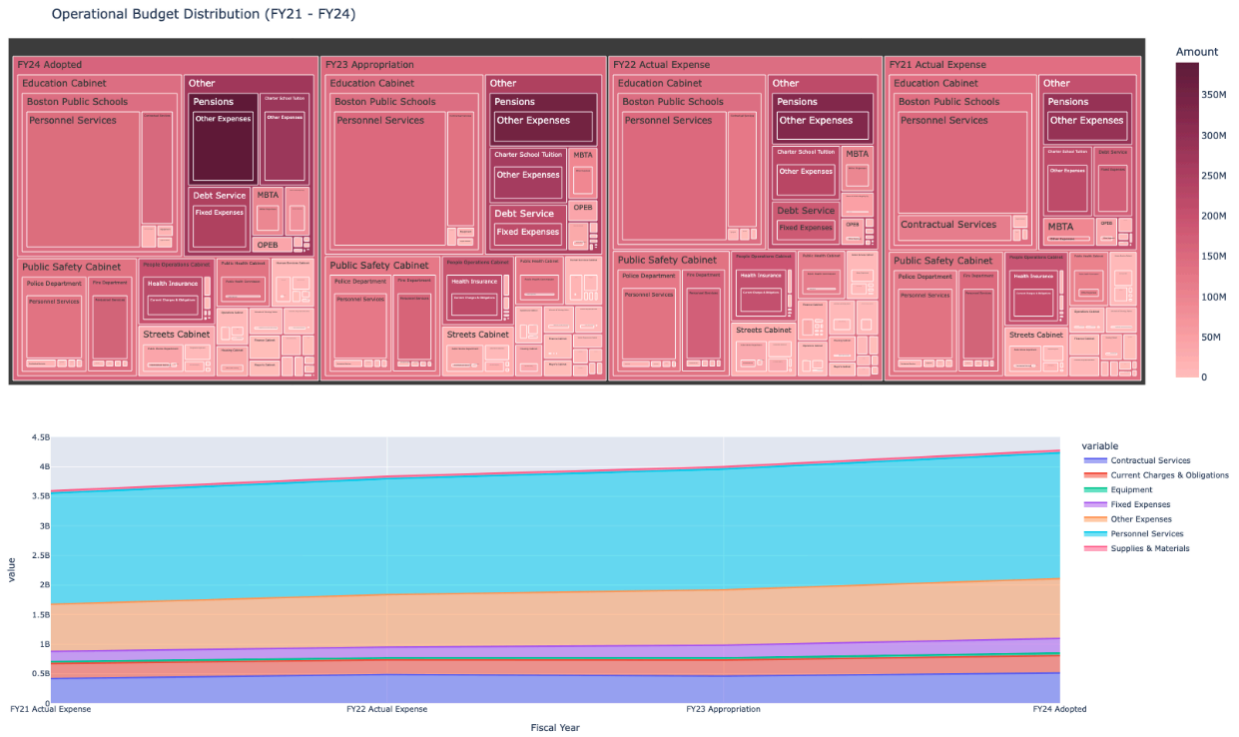


Figure Z: above shows Operational Budget Distribution from FY21 - FY24

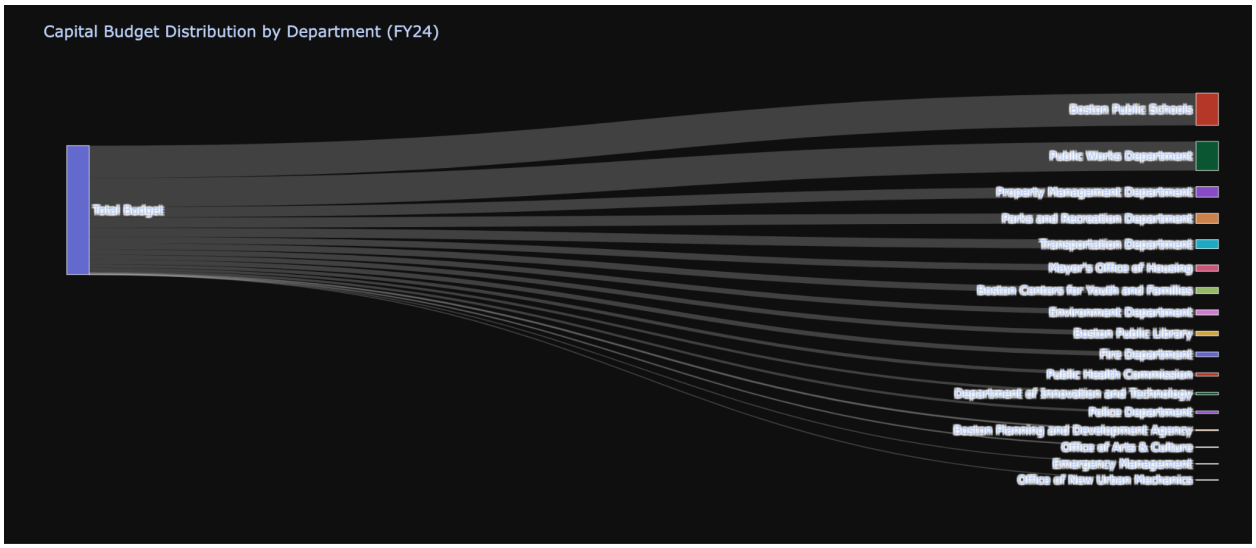


Figure M: above shows capital Budget Distribution by Department (FY24)

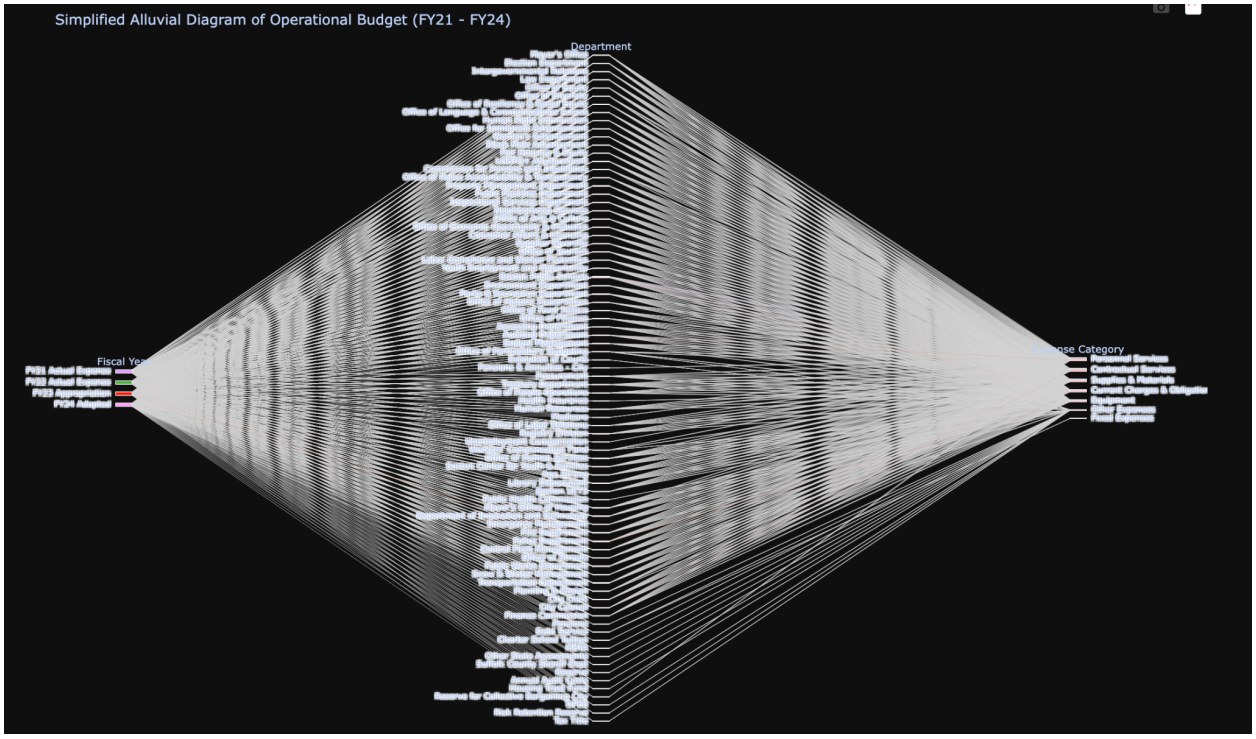


Figure P: Simplified Alluvial Diagram of Operational Budget (FY21 - FY24)

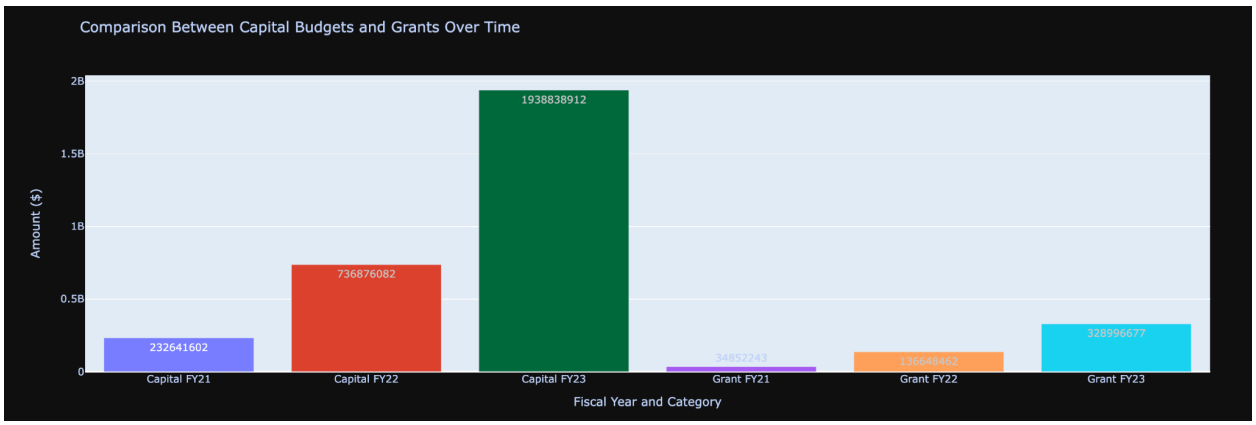


Figure S: Comparison Between Capital Budgets and Grants Over Time

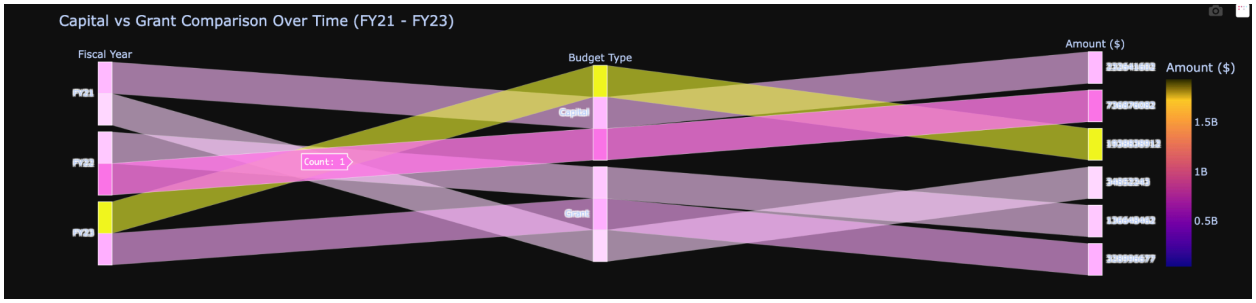


Figure L: capital vs grant comparison over time (FY21 - FY22)
The visualizations are available as images in the github.

Extension Project Proposal:

Introduction

This project proposes an in-depth analysis of the impact of revenue shifts on Boston's city budget, examining the consequences for various city departments, programs, and geographical areas. The focus is on understanding the intricacies of budget allocation and its broader implications for city governance and community services. By scrutinizing these changes, the project aims to offer insights into how budgetary adjustments influence different sectors within the city.

Objectives

The primary goal is to dissect the dynamics of Boston's budget allocation process, revealing how changes in revenue influence departmental funding. This involves a detailed examination of funding patterns over time, highlighting any noticeable trends or shifts in priority areas. The project seeks to unravel the complex relationship between budget changes and departmental operations, providing a clear picture of how financial decisions shape the provision of city services. Furthermore, it aims to identify potential gaps in funding and areas that might require more attention or resources.

Methodology

The analysis will be based on the Fiscal Year 24 Adopted Revenue Budget, augmented with historical budget data, departmental financial reports, and relevant policy documents. Data visualization will play a crucial role in this project, employing line or bar graphs for comparative analysis of budget allocations across different fiscal years. Pie charts or stacked bar graphs will be used to break down departmental funding, and heat maps will illustrate the geographic distribution of budget allocations within Boston. Additionally, the project will incorporate news data to contextualize how the current budget aligns with Boston's strategic objectives and to identify any major policy shifts that might influence budget decisions.

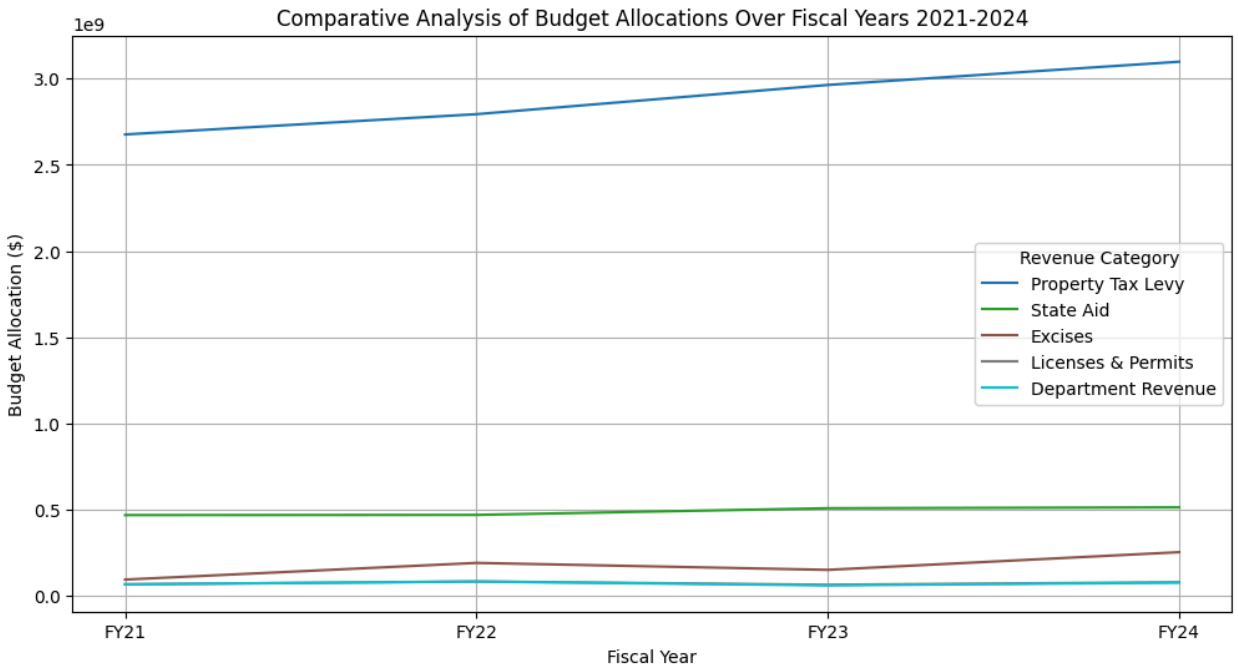
Significance

This project is crucial for promoting transparent governance and effective resource allocation in Boston. By understanding how budget changes impact various city departments and programs, policymakers and stakeholders can make more informed decisions. The insights gained from this analysis will not only illuminate current funding practices but also help in forecasting future budgetary needs and adjustments. This comprehensive study will serve as a valuable tool for city planners, policymakers, and citizens alike, fostering a more nuanced understanding of municipal finance and its direct effects on community services and infrastructure.

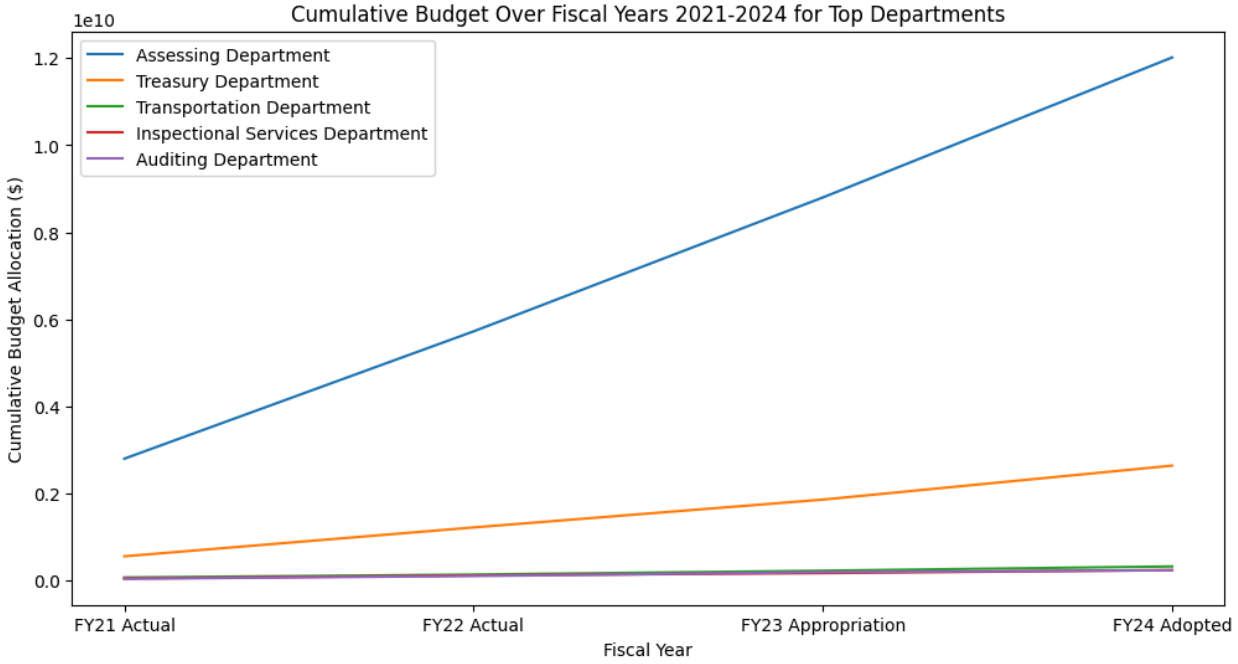
Conclusion

In conclusion, this project aims to provide a thorough and insightful analysis of Boston's budgetary dynamics, offering a clearer understanding of how fiscal decisions affect different aspects of city life. Through meticulous data analysis and visualization, it aims to contribute significantly to the discourse on municipal budgeting and governance, ultimately aiding in the development of more equitable and effective budgetary strategies.

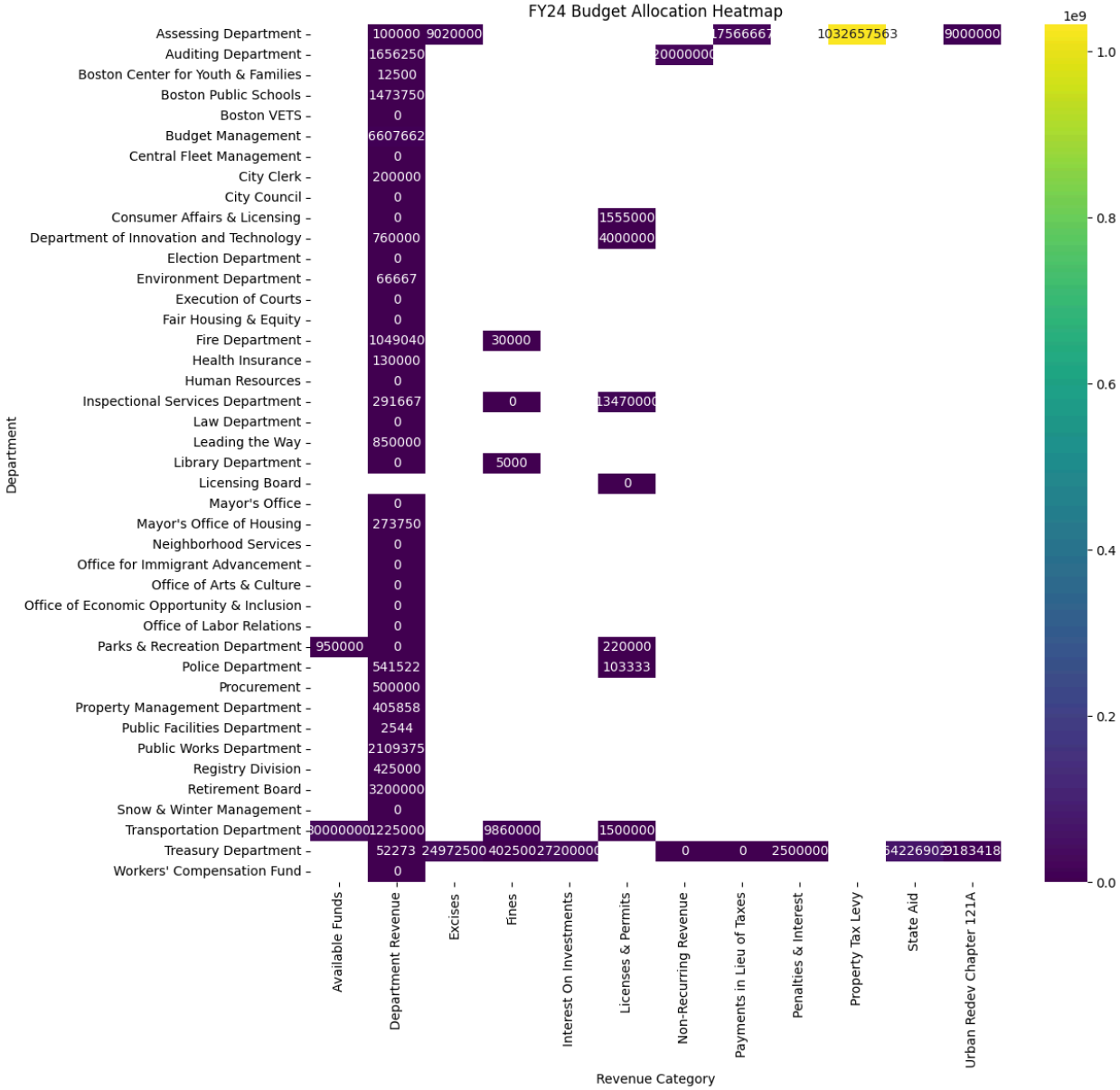
Extension Project Early Insights



This line graph offers a comparative analysis of budget allocations across five revenue categories over four fiscal years. It's immediately evident that the 'Property Tax Levy' is the predominant revenue stream, exhibiting a steady increase year-over-year, which may reflect rising property values or changes in tax rates. In sharp contrast, other categories such as 'State Aid', 'Excises', 'Licenses & Permits', and 'Department Revenue' maintain relatively flat lines with negligible increases, suggesting stable but significantly lower contributions to the overall budget. This visual disparity underscores the city's fiscal reliance on property tax levies and indicates potential areas for diversifying revenue streams or reassessing budgetary dependence.

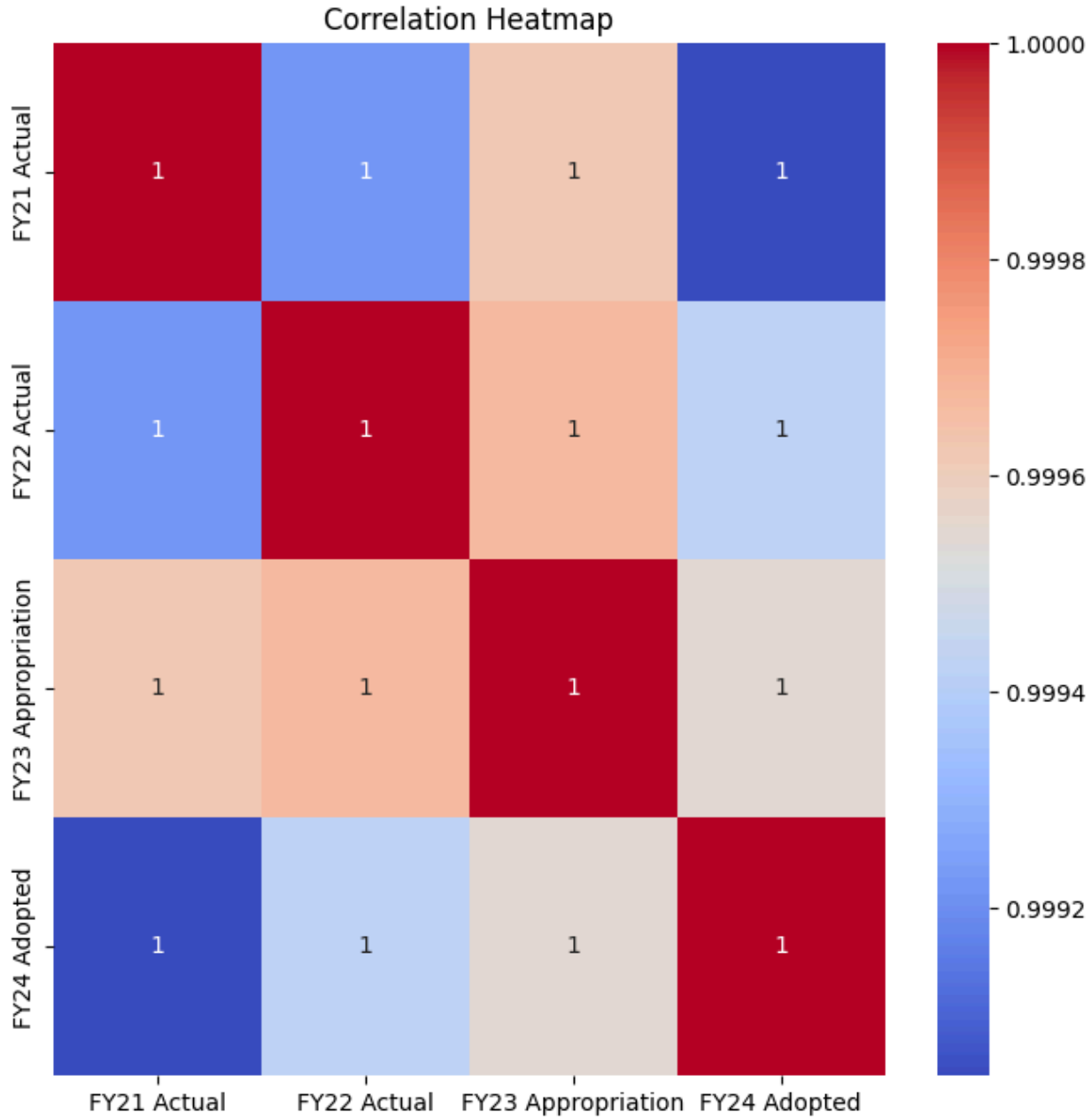


The line graph presents the cumulative budget allocations from FY21 to FY24 for five top departments within a city. The Assessing Department stands out with a steep, consistent increase in budget allocation over the years, indicating a significant and growing investment in this area. In contrast, the Treasury, Transportation, Inspectional Services, and Auditing Departments exhibit relatively flat trends, with the Treasury Department showing a modest increase and the others maintaining consistent budget levels. This suggests a focused strategy on the Assessing Department, possibly due to its role in revenue generation through property assessments, while other departments have seen more static budget growth over the same period. The disparity in the slopes of these lines highlights differing fiscal priorities or departmental roles within the city's overall budgetary framework.



The heatmap provides early insights into the FY24 budget allocations for the city of Boston, revealing significant disparities among departments and revenue categories. It

highlights a concentrated investment in the Assessing Department through the 'Property Tax Levy', which is notably higher than any other department or revenue source. This suggests a heavy reliance on property taxes for funding city operations. Additionally, the Transportation Department and Boston Public Schools command substantial portions of the budget within 'State Aid' and 'Excises', indicating focused funding areas or initiatives. In contrast, many departments show minimal to no funding across several revenue categories, underscoring a potential focus on specific strategic areas. The visualization effectively underscores the heterogeneity in the financial distribution and allows stakeholders to quickly identify which departments and revenue streams are key drivers of the city's budget.



The correlation heatmap reveals very high correlations between budget allocations across different fiscal years, suggesting a strong linear relationship and consistent budget trends over time. When employing linear regression models like AR-1, caution is advised due to potential autocorrelation issues indicated by such strong correlations. It's essential to consider time series analysis techniques that can adequately handle this characteristic to ensure robust forecasting models.

Analysis from using temperature data to find relationships with operational Expense:

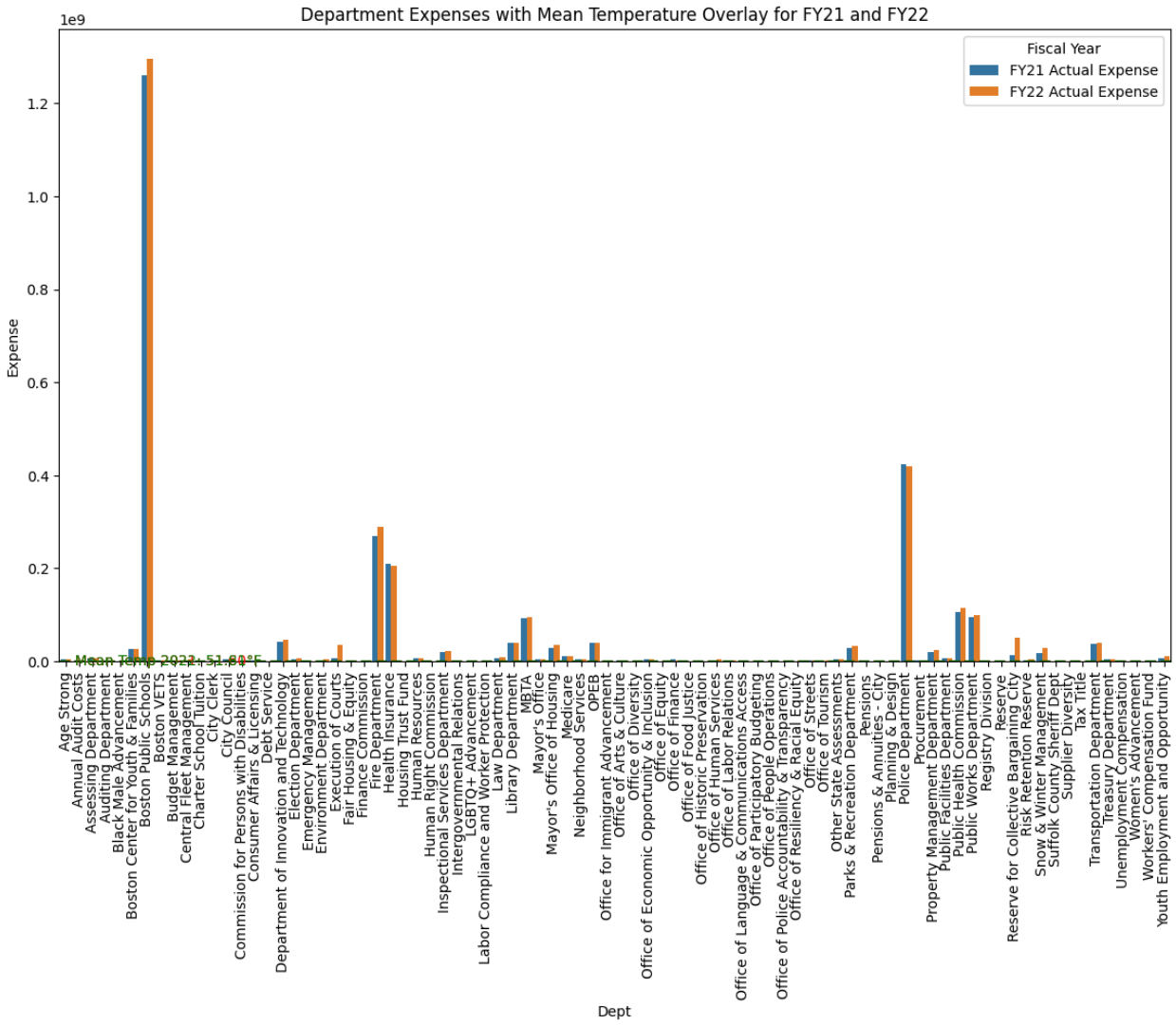


Figure: Department Expenses with unscaled mean temperature overlay for FY21 and FY22. X axis represents the department names and Y axis represents expense.

In 2021, the average maximum temperature recorded was 60.79°F, with an average minimum of 44.36°F, bringing the overall mean temperature to 51.60°F. There was a mean snowfall of 0.22 cm. In the subsequent year, 2022, there was a slight uptick in these statistics; the mean maximum temperature increased to 62.07°F, while the mean minimum temperature slightly

decreased to 43.65°F. Nonetheless, the mean temperature rose to 51.81°F, with a slight decrease in mean snowfall to 0.21 cm.

With the incremental increase in temperatures from FY21 to FY22, a corresponding increase in budget was observed in several city departments. These included Age Strong, Annual Audit Costs, Boston Public Schools, Central Fleet Management, City Clerk, City Council, Commission for Persons with Disabilities, Consumer Affairs & Licensing, Department of Innovation and Technology, Election Department, Emergency Management, Environment Department, Execution of Courts, Fair Housing & Equity, Finance Commission, Fire Department, Human Right Commission, Inspectional Services Department, Law Department, Library Department, MBTA, Mayor's Office of Housing, Medicare, Neighborhood Services, Office for Immigrant Advancement, Office of Arts & Culture, Office of Diversity, Office of Economic Opportunity & Inclusion, Office of Equity, Office of Human Services, Office of Labor Relations, Office of Language & Communications Access, Office of Police Accountability & Transparency, Office of Resiliency & Racial Equity, Office of Tourism, Other State Assessments, Parks & Recreation Department, Procurement, Property Management Department, Public Facilities Department, Public Health Commission, Public Works Department, Reserve for Collective Bargaining City, Risk Retention Reserve, Snow & Winter Management, Transportation Department, Women's Advancement, and Youth Employment and Opportunity. Notably, about 58.5% of the departments experienced a budget increase in alignment with the rising temperatures.

Overarching Project Part 1 – Departmental Spending Dataset

Data Preparation

In the initial stage of our analysis, we focused on loading and preparing a decade's worth of Boston's city budget data, spanning from 2012 to 2023. This process involved meticulous attention to detail, ensuring accurate fiscal year representation and consistent formatting across all datasets. By employing different encoding standards as needed and standardizing column names, we established a robust foundation for our comprehensive analysis. This step was crucial in enabling a smooth and error-free examination of the city's financial allocations over the years.

Total Spending Trend Analysis

Our exploration into Boston's overall spending trends revealed a distinct shift in fiscal patterns. As shown in (**Figure X**), there was a noticeable upward trend in spending that persisted until 2021. Following this period, a downward trend became evident. This pivot in spending behavior could be attributed to several factors, including changes in city leadership or the economic

impacts of the pandemic. This analysis not only reflects the city's evolving financial health but also invites speculation about the driving forces behind these spending trends.

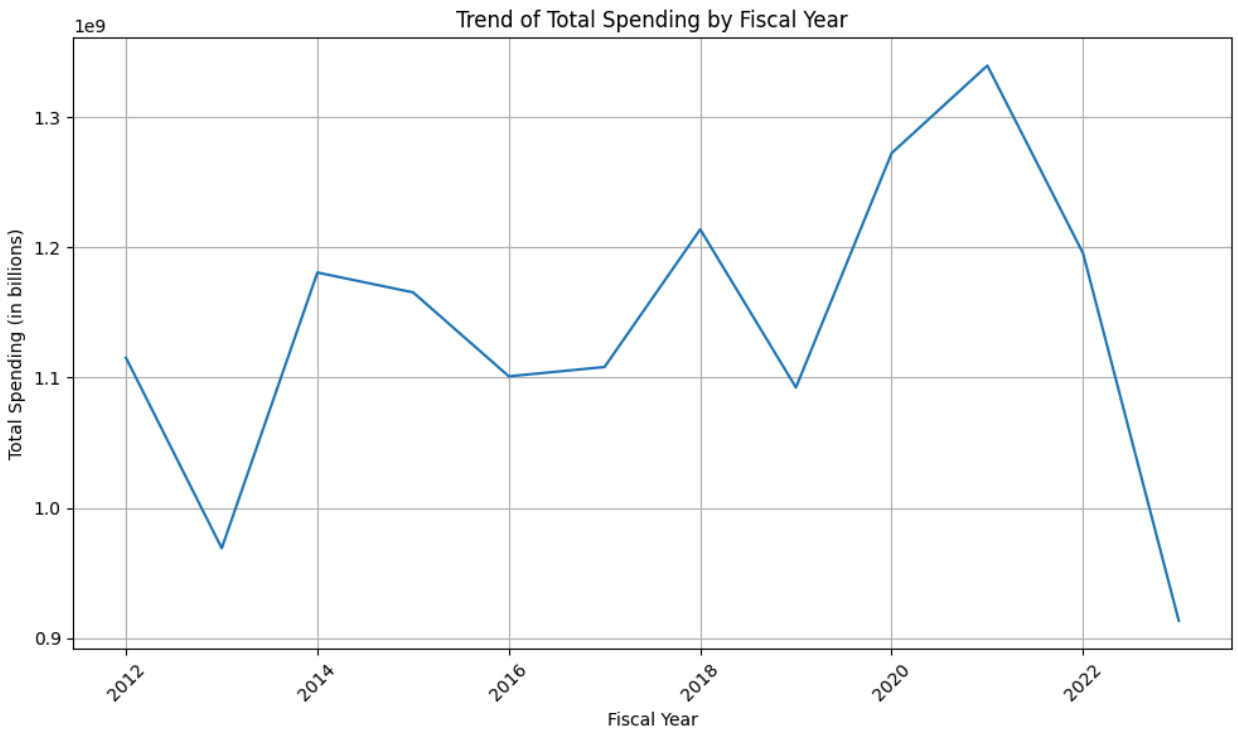
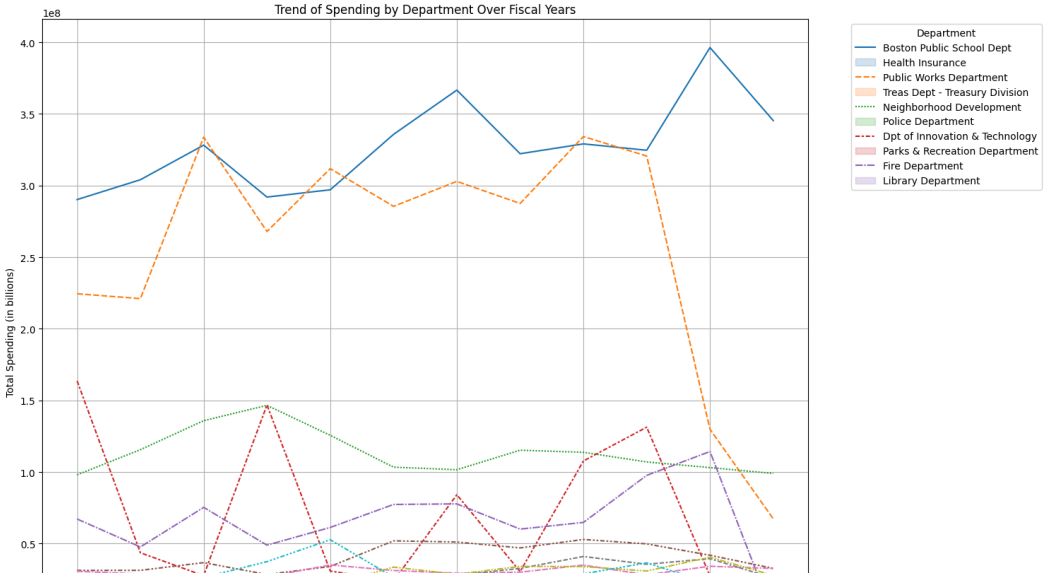


Figure X – Trend of Total Spending by Fiscal Year

Departmental Spending Analysis (Normalized)

When analyzing spending by department, we recognized the importance of contextualizing these figures against the total city budget for each fiscal year. As illustrated in (**Figure** 3), simply plotting absolute spending per department across fiscal years masked the true trends. By normalizing these figures, we uncovered some insightful patterns: there was a notable increase in the budget share for Boston Public Schools, whereas departments like Public Works and the Police Department saw a relative decrease in their share of the budget. This approach offered a clearer understanding of shifting priorities within the city's departments.



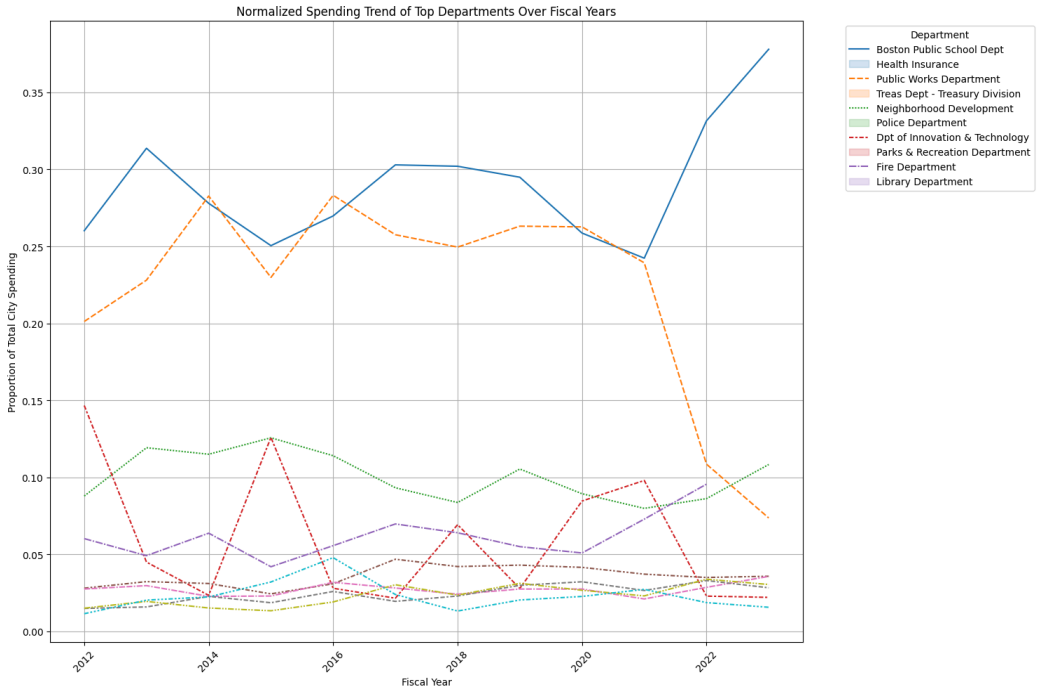


Figure X – Normalized vs. Un-normalized spending trend of top departments across fiscal years

Monthly Spending Patterns

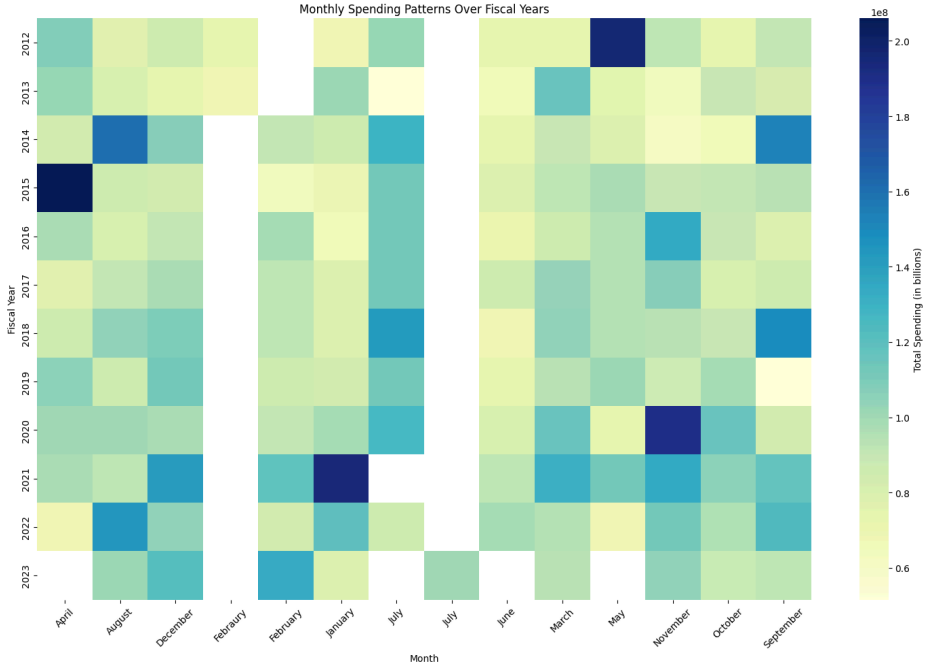


Figure X – Heatmap for Monthly Spending Patterns

To explore the city's spending behavior throughout the year, we delved into the monthly expenditure patterns over the past 12 years. Our analysis, visualized through a heatmap **(Figure)**, did not reveal any pronounced or consistent seasonal patterns. However, a general trend was observed, with spending typically being higher during the winter and summer months. This analysis could be pivotal for understanding the city's operational planning and financial management on a monthly basis.

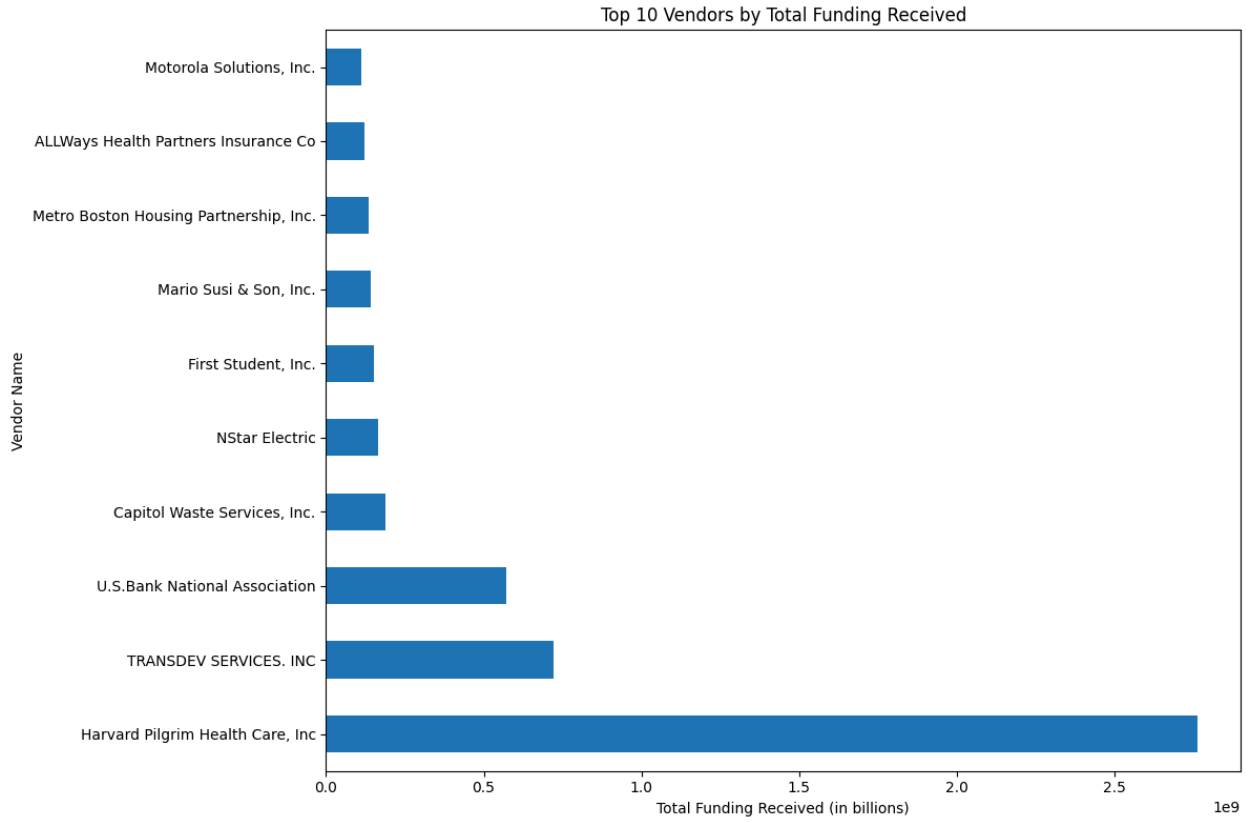


Figure X. Top 10 budget receiving vendors

Vendor Analysis

Finally, as shown in **Figure X**, our focus shifted to the vendors receiving significant portions of the city's budget. By identifying the top 10 vendors based on total funding received, we gained insights into the sectors that command the most financial resources. Notably, the majority of the funding was channeled towards health, banking/insurance, and transportation sectors. Vendors like Harvard Pilgrim Health Care, Inc., TRANSDEV SERVICES. INC, and U.S. Bank National Association were among the top recipients, highlighting their crucial roles in providing key services to the city.

Extension Project: How housing cost or rental price impacted city's affordable housing

Gathering Data

Our research into the housing and rental market in Boston draws upon various datasets, including those reflecting the evolution of housing costs, population changes, and municipal budget allocations for affordable housing. The primary sources of our data are CSV files containing economic indicators and city budget plans.

Economic Analysis

The economic analysis examines the trajectory of housing and rental prices in Boston and assesses their influence on the city's financial strategies for affordable housing. As illustrated in Figure B, Boston's housing prices have experienced a significant increase over recent years. This escalation in housing costs coincides with a notable decrease in the resident population, suggesting potential affordability challenges for the city's residents.

Figure B.

Budgetary Implications

Figure C below demonstrates a marked uptrend in capital allocation by the Mayor's Office of Housing towards affordable housing projects. There is a large increase in the budget plan for the year of 2025. This is likely a direct response to the rising housing costs. The trend indicates that as housing becomes less affordable for a significant portion of the population, the city is compelled to intervene by increasing its expenditure on affordable housing initiatives. Future projections based on the data suggest a continued need for substantial investment in affordable housing to ensure that residents are not priced out of the market.

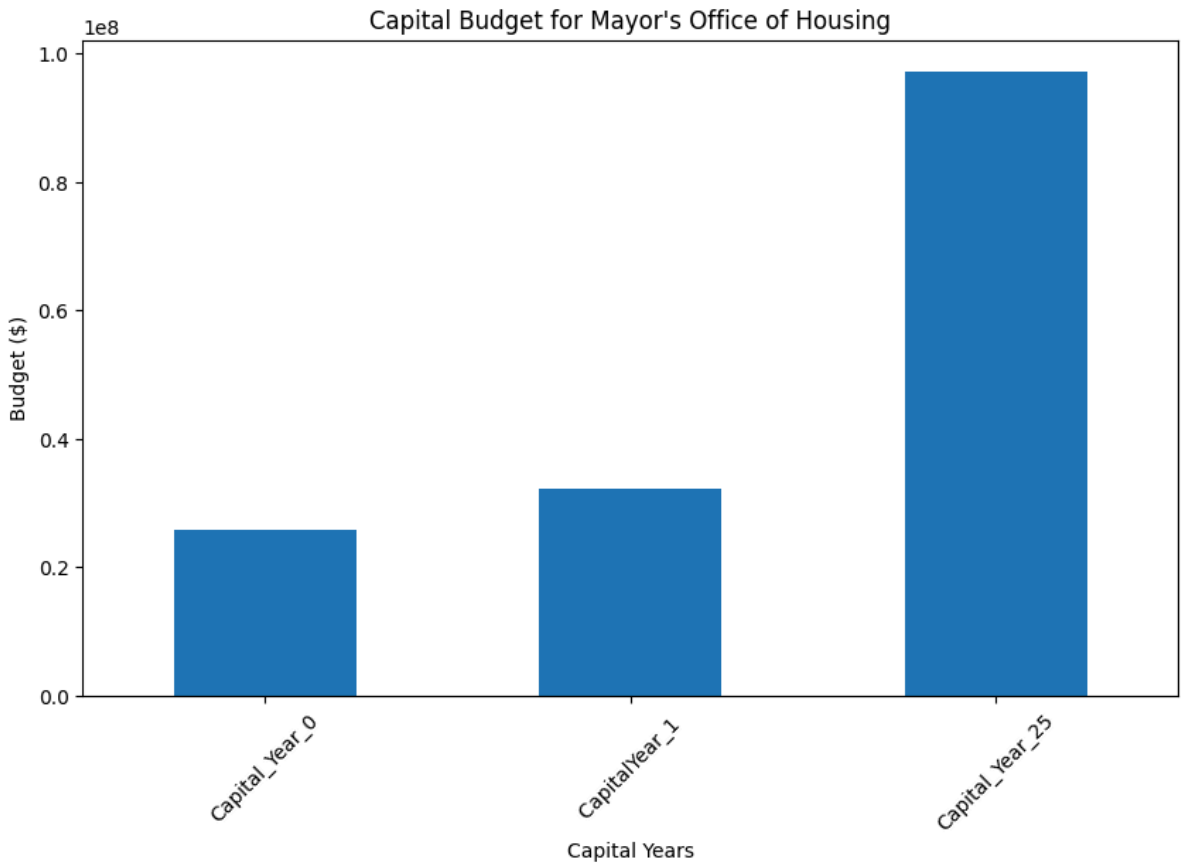


Figure C. Capital Year 0 and 1 is 2023 and 2024 respectively

Implications for Affordable Housing

The current economic landscape, characterized by rising housing costs and a shrinking population, necessitates a proactive approach from the city to maintain and expand affordable housing. The data supports the conclusion that the cost of housing in Boston is a driving factor for increased city spending on affordable housing. This spending is manifest in the development of new structures and refurbishment of existing housing to keep them accessible and affordable for residents.

The trend underscores the importance of ongoing investment in affordable housing to mitigate the impact of rising housing costs and to ensure that all Bostonians have access to safe, quality, and affordable housing options.

Extension Project: Social Economic Analysis

Purpose:

To understand and analyze data on the populations of certain social economic groups in the neighborhoods of Boston and find a correlation to how the Boston City Budget allocates their budget accordingly

Gathering Data:
In the initial phase of my data preparation process, I employed two distinct datasets to delve into the dynamics of neighborhood budget allocation and social vulnerability in Boston. The first dataset, titled "y24-capital-budget-plan-recommended," encapsulated comprehensive budgetary information distributed across various neighborhoods. To extract meaningful insights, I systematically grouped the data by neighborhoods and calculated the total budget spending for each area, thereby providing a nuanced understanding of the financial allocation landscape.

Simultaneously, the second dataset, denoted as "Climate_Ready_Boston_Social_Vulnerability," illuminated the demographic fabric of neighborhoods with a focus on specific socio-economic statuses. My approach involved grouping this dataset by neighborhoods and aggregating population figures within distinct socio-economic categories, including Total Children, Total Adults, People with Disabilities, People of Low to No Income, People with Limited English Proficiency, and People of Color.

Data Cleaning:
To ensure a harmonious integration of both datasets for subsequent analysis, a meticulous data-cleaning process ensued. I undertook a series of refactoring actions to establish a one-to-one correspondence between neighborhood representations. In the capital budget dataset, Downtown/Government Center, Chinatown, Beacon Hill, Multiple Neighborhoods, and Citywide entries were systematically removed to refine the neighborhood granularity.

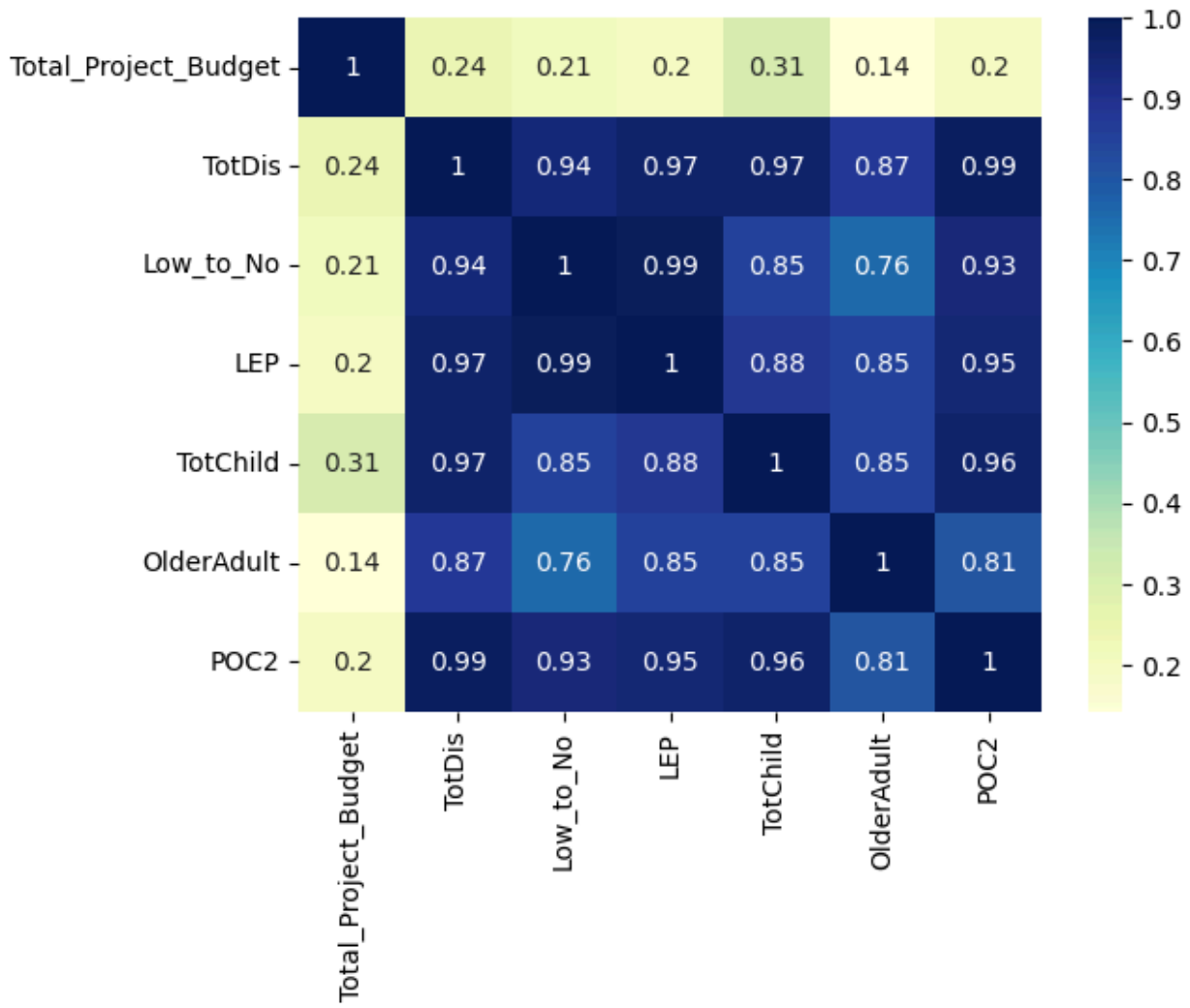
Concurrently, in the social vulnerability dataset, several actions were taken to align neighborhood nomenclature, including renaming Fenway to Fenway-Kenmore and combining Allston and Brighton as well as South Boston Waterfront and South Boston. Additionally, Longwood Medical Area and Leather District were removed to streamline the dataset.

This strategic data refinement and alignment process set the stage for a comprehensive analysis, ensuring that the subsequent exploration of the integrated datasets would yield meaningful and accurate insights into the intersection of budget allocation and social vulnerability across Boston neighborhoods.

Neighborhood	Total_Project_Budget	TotDis	Low_to_No	LEP	TotChild	OlderAdult	POC2
Allston/Brighton	57605000.0	5902	20367	26358	4417	5991	22779
Back Bay	65442299.0	1892	5316	9075	1686	3759	6923
Bay Village	1525000.0	1122	3929	5640	1249	1711	6008
Charlestown	531212390.0	1535	4157	5968	3301	1811	3981
Dorchester	239411239.0	9819	22749	29284	17424	6535	50778
East Boston	62457890.0	5180	13698	17845	8665	4147	25459
Fenway-Kenmore	12750000.0	1240	6681	7177	453	496	9808
Harbor Islands	171778144.0	179	349	361	0	12	370
Hyde Park	6615000.0	2117	2683	4902	3256	2219	11132
Jamaica Plain	78700000.0	4570	12985	17366	7300	4381	22247
Mattapan	87935000.0	5605	9531	13604	8859	4073	28276
Mission Hill	5242212.0	2215	8869	10394	1973	1525	10624
North End	95445000.0	1338	3155	5277	1028	2122	2957
Roslindale	102470000.0	7286	11249	19480	13324	8231	33106
Roxbury	237308325.0	12611	33272	39947	19517	6675	67217
South Boston	200249965.0	2500	6092	8943	3847	2851	4856
South End	81465502.0	1874	4504	5925	2552	1421	6384
West End	5000000.0	472	1412	2184	467	772	1400
West Roxbury	48645000.0	2580	3622	7254	4758	3632	9121

Data:

A correlation heatmap using SNS from the Seaborn library tot find correlation values between Total_Project_Budget and the populations of certain social economic categories.



	Description	Correlation to Total Project Budget
TotChild	Children	0.310910
TotDis	People with Disabiltiites	0.238534
Low_to_No	Low to no Income	0.207937
LEP	Limited English Profiency	0.202076
OlderAdult	Older Adults	0.141965
POC2	People of Color	0.200210

Conclusion and Analysis:

Upon scrutinizing the intricate relationship between Boston's municipal budget allocations and the demographic fabric outlined in the "Climate_Ready_Boston_Social_Vulnerability" dataset, discernible trends emerge. Notably, a discernible correlation manifests between budget

spending and certain socio-economic groups across neighborhoods, underscoring a municipal commitment to addressing the needs of diverse communities. However, a notable exception lies in the realm of older adults, where the correlation is comparatively diminished. Intriguingly, a robust association surfaces when considering the total number of children, unveiling a pronounced emphasis on education within the budgetary landscape. This correlation aligns seamlessly with departmental spending data, revealing a marked dedication of resources to public schools, signaling Boston's prioritization of fostering educational opportunities for its younger demographic. This nuanced analysis thus paints a dynamic picture of how Boston's budgetary decisions intricately intersect with and reflect its commitment to diverse social and educational priorities.

Extension project: Funding sources

Gathering data:
I used Checkbook Explorer data that provides up-to-date financial information about the city's funding where it shows how the city is spending money.

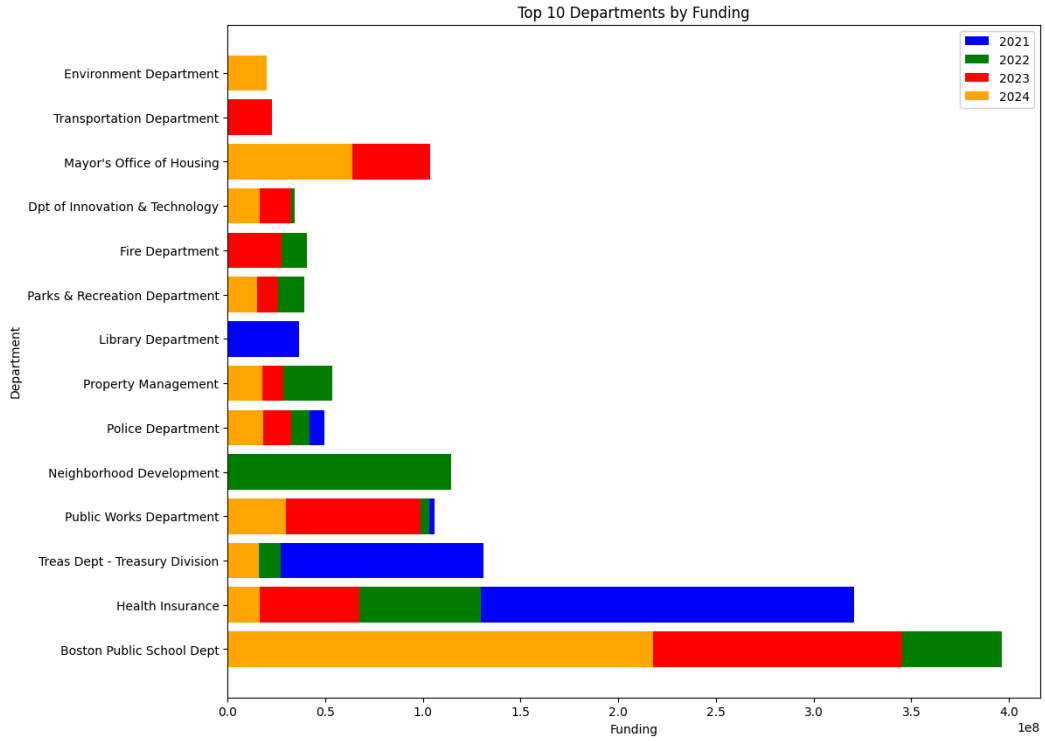


Figure A: Top 10 departments by funding from 2021-2024

Analysis:
The analysis of funding sources (figure A) reveals a consistent trend where the Boston Public School Department consistently has the highest amount of funding, signifying a strong commitment to education development. This allocation emphasizes the critical role of education

in the city's budgetary priorities. Furthermore, the substantial increase in funding allocated in health insurance in 2021 denotes the growing importance and emphasis on healthcare which indicates a response to evolving healthcare needs, possibly due to external factors such as the pandemics or changes in healthcare policies, resulting in a significant rise in allocated resources.

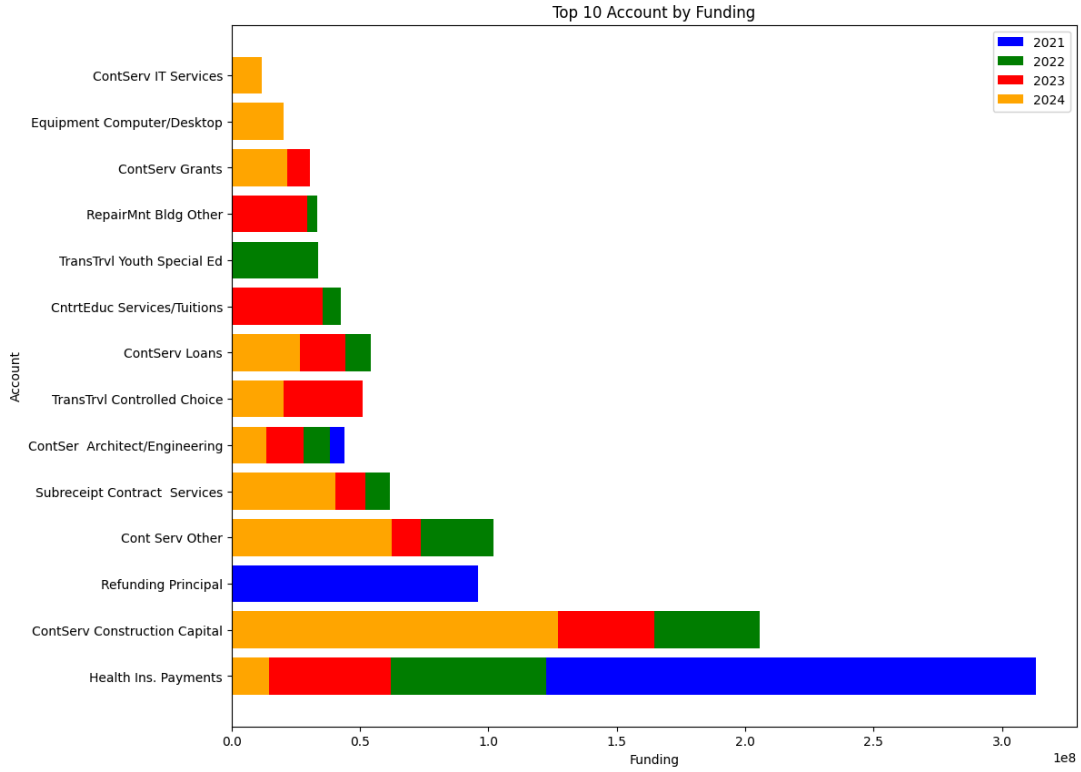


Figure B: Top 10 account description that has the most funding from 2021-2024

Conclusion:

Upon analyzing the funding sources, it is evident that the Boston Public School Department has the highest funding across all 4 years, which highlights the importance of education in the city's budgetary priorities. In 2021, Health Insurance was the second most highest funded entity, displaying a significant increase in allocated resources.

The consistency of the Boston Public School Department is prominence in receiving the highest funding underscores the prioritization of education and its resource requirements. The surge in funding allocated to health insurance underscores its importance within the budgetary framework, emphasizing the significance of healthcare coverage and related expenses.

Extension project: weather data

Gathering Data:
After an extensive search across various websites to gather historical weather data, I selected the data from Open-Meteo.com as the most relevant and comprehensive for this comparison. Open-Meteo.com provided detailed and accurate historical weather records that were particularly suited for comparing with the current task. The site's data included key attributes such as temperature, relative humidity, dew point, and rainfall events, all of which were crucial for an in-depth year-over-year weather analysis. This information from Open-Meteo.com enabled a thorough comparison between the weather patterns of 2021 and 2022. This data is taken by day's mean rather than hours' mean of the year which was taken in the early insights so this analysis is more accurate than before.

Data cleaning:
For the data cleaning process, I took several steps to ensure the accuracy and usability of the weather data from Open-Meteo.com. This process was crucial because raw data often contains missing or inconsistent values that can skew analysis. Here's how I addressed these issues:

Replacing Missing Values:

Where data points were missing, I used zeros as a placeholder for attributes like precipitation, rain, and snow depth. This approach is common when dealing with environmental data where the absence of an event (like no rainfall) can be represented as zero. For other variables like temperature, relative humidity, and dew point, where zero is not a meaningful placeholder, I replaced missing values with the mean of the respective column. This method helps maintain the overall distribution and trends of the data without introducing significant biases.

Selected Columns for Analysis:

The columns chosen for the analysis were specifically selected for their relevance to understanding weather patterns. These columns include:

time: The timestamp for each data record, essential for chronological analysis.
temperature_2m (°C): Average temperature at 2 meters above the ground.
relative_humidity_2m (%): Average relative humidity at 2 meters.
dew_point_2m (°C): Average dew point at 2 meters, indicating the amount of moisture in the air.
precipitation (mm): Total precipitation, including rain and melted snow.
rain (mm): The amount of rainfall, separate from other forms of precipitation.
snow_depth (m): The depth of snow on the ground.

By cleaning the data in this manner, I ensured that the analysis of the weather patterns for 2021 and 2022 was based on reliable and representative data, allowing for a more accurate comparison and understanding of the changes and trends over these two years.

Analysis and conclusion:

In comparing the weather data for 2021 and 2022:

2021 Weather Summary:

The average temperature recorded at 2 meters above the ground was 9.87°C.
Average relative humidity at the same height was 77.49%.
The average dew point, which indicates the amount of moisture in the air, was 5.67°C.
There were 1,378 instances of non-zero rainfall, indicating frequent rain events.

2022 Weather Summary:

There was a noticeable increase in the average temperature, rising to 11.07°C.
The average relative humidity decreased to 72.50%.
The average dew point slightly dropped to 5.57°C.
Rainfall events decreased significantly, with only 1,081 instances of non-zero rainfall.
Key differences include less snowfall in 2022 compared to 2021, and more rainfall events in 2021 than in 2022. This suggests a warmer and drier year in 2022 compared to 2021.

The analysis of various departments within Boston in relation to weather patterns over 2021 and 2022 revealed interesting correlations with temperature changes:

Departments Showing Positive Correlation with Temperature Increase from 2021 to 2022:

Boston Public Schools
Department of Innovation and Technology
Fire Department
Inspectional Services Department
MBTA (Massachusetts Bay Transportation Authority)
Mayor's Office of Housing
Parks & Recreation Department
Public Works Department
Public Health Commission
Transportation Department
These departments showed a positive correlation with the temperature increase, suggesting that their activities or performance metrics might be influenced by warmer weather. For instance, warmer temperatures could lead to increased outdoor activities, impacting departments like Parks & Recreation or the MBTA.

Departments with High Positive Correlation:

Execution of Courts
Reserve for Collective Bargaining City
Snow & Winter Management
These departments exhibited a high positive correlation with temperature changes. The reduced need for snow and winter management in a warmer year is a direct example of how temperature impacts operational dynamics.

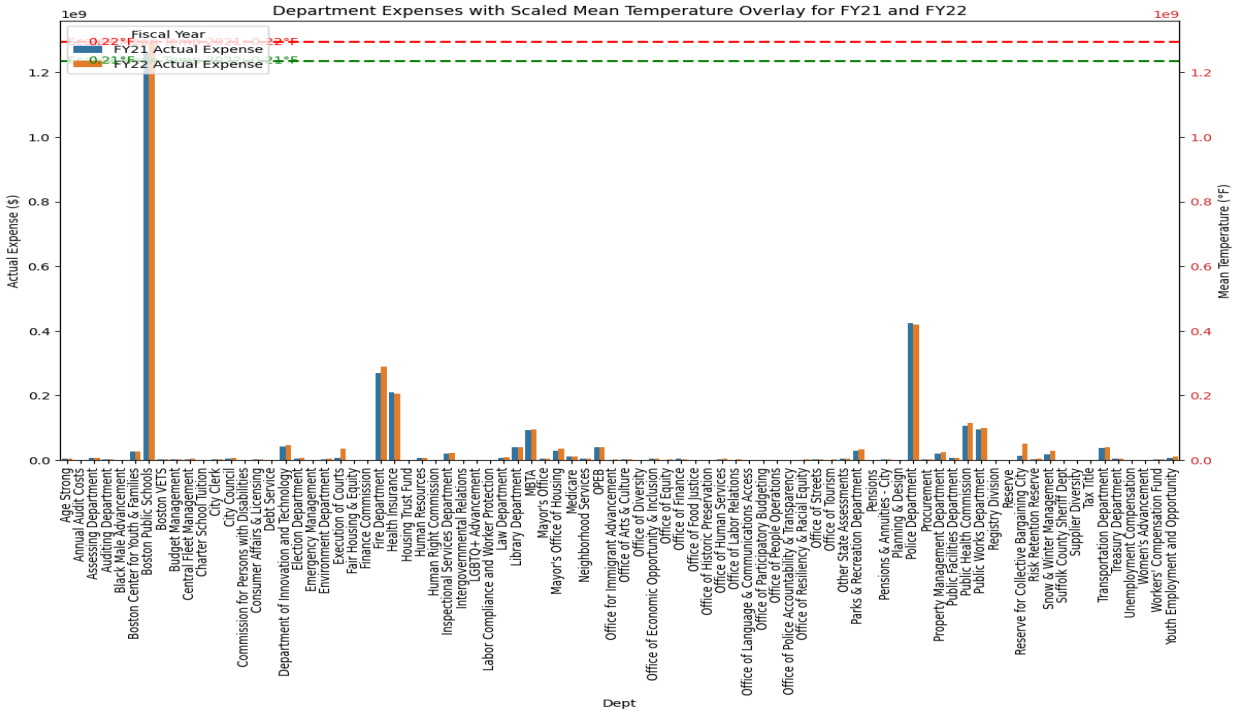
Departments Showing Negative Correlation with Temperature Increase:

Health Insurance
Police Department
These departments showed a negative correlation with the rise in temperature. This could indicate that certain aspects of their operations or resource allocations are inversely related to warmer weather.

Other Departments' Correlation with Temperature:

Most other departments showed a neutral correlation with temperature changes, implying that their operations are not significantly impacted by variations in weather conditions.
Correlation of Other Variables with Temperature:

The analysis revealed that variables like relative humidity, dew point, and rainfall events had an inverse relationship with temperature changes. As the temperature increased from 9.87°C in 2021 to 11.07°C in 2022, relative humidity decreased, dew points slightly dropped, and there were fewer rainfall events. This suggests that as temperature rises, the atmosphere may hold less moisture, leading to changes in humidity and precipitation patterns.
This correlation analysis provides insight into how weather patterns, particularly temperature changes, can impact various city departments and environmental factors. It highlights the interplay between urban operations and natural climatic conditions.



Department Expenses with scaled Mean Temperature Overlay for FY21 and FY22. X axis has the department names and the y axis represents actual expenses. Mean temperatures for 2021 and 2022 are represented in green and red dotted lines.

Answering Key Base Questions(summary):

Q) Changes in the annual city budget over time :

According to our analysis, the city's budget is strictly increasing from FY21 to FY24, which is depicted in Z,M images, and it is also shown in figures M,P which departments have the highest and lowest spending. Capital budget vs grants is shown in Figures S,L where both show a strictly increasing trend from FY21 to FY24, capital budgets being large when compared to grants.

Q: Difference in projected vs. actual spending:

According to our analysis of the operational budget plans and through research we found that the projected spending is fairly close to the actual spending. Through research of the boston.gov datasheet. We found that the projected operating budget of FY21 was $3.65 billion while we calculated out the actual spending of that budget was only $3.61 billion. This shows that the actual spending was less than predicted. However, in 2022 the predicted budget was $3.76 billion, while the actual spending was $3.87 billion. This year the predicted budget was quite a bit lower than the predicted budget, however it was still close to it. We have the approved appropriation for the 2023 budget, however we would not know the actual amount until the end of this year, and same with FY24. However, we believe that it will follow a similar trend in that the predicted will be somewhat close to the actual and have an increase in budget.

Contribution

Tony - Extension project proposal + Extension Project [Affordable Housing] + Deliverable 2 Data and Insights + Answering Key Questions
Michael – Extension project (Social Economic Analysis)
Anh – Extension project (Funding sources)
Shiva - Initial datasets analysis + base question[Changes in the annual city budget over time] + Extension project proposal + Early insights on Extension project Weather Data and Extension project Weather Data
Will – Extension project (Departmental Spending Analysis)