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 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()
```

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.

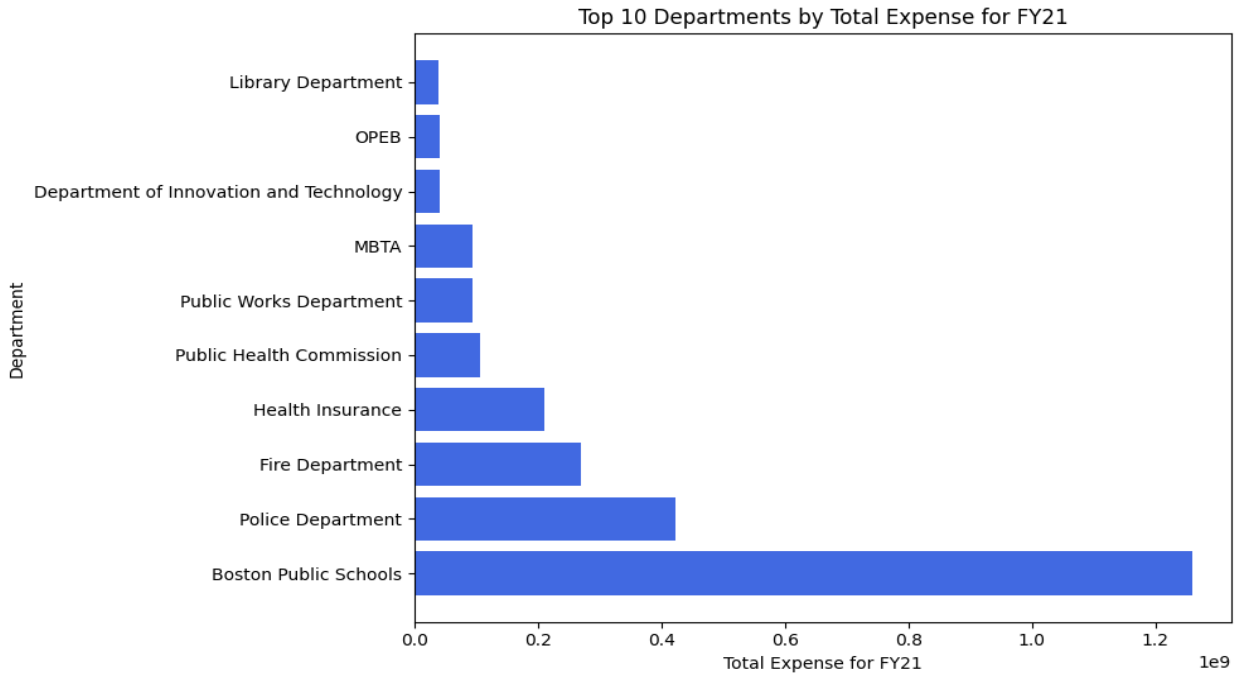
```
# Group by department and sum the expenses for each department
department_spending = operating_data.groupby('Dept').agg({
    'FY21 Actual Expense': 'sum',
    'FY22 Actual Expense': 'sum',
    'FY23 Appropriation': 'sum',
    'FY24 Adopted': 'sum'
}).reset_index()

department_spending.head()
```

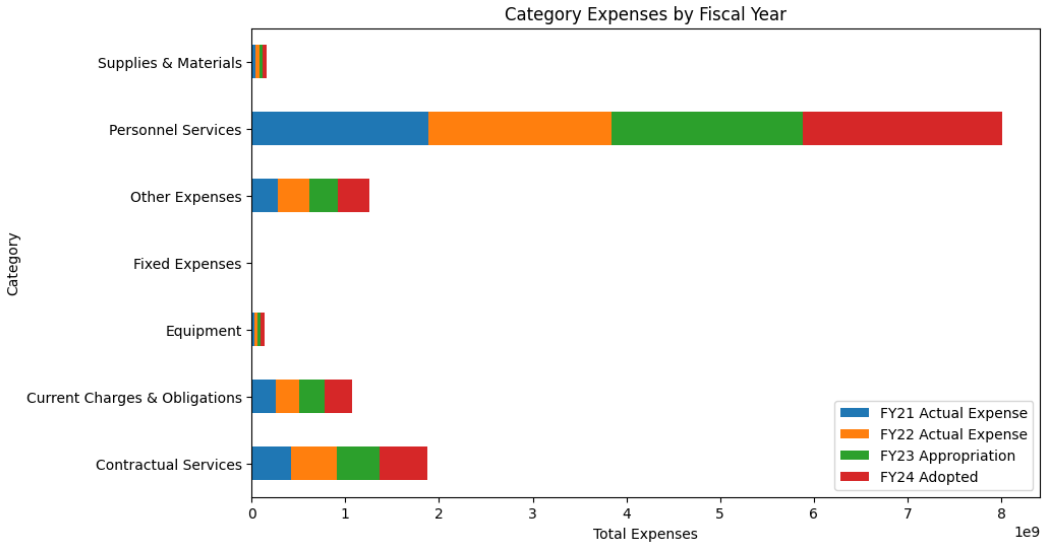
✓ 0.0s

	Dept	FY21 Actual Expense	FY22 Actual Expense	FY23 Appropriation	FY24 Adopted
0	Age Strong	3883451.65	4223184.72	6.044480e+06	7.940771e+06
1	Annual Audit Costs	142850.00	708203.00	7.500000e+05	7.500000e+05
2	Assessing Department	7347192.74	7161565.90	8.283326e+06	8.471223e+06
3	Auditing Department	3127864.80	3045162.77	3.275482e+06	3.697096e+06
4	Boston Center for Youth & Families	26904859.72	26062820.27	3.042908e+07	3.002507e+07

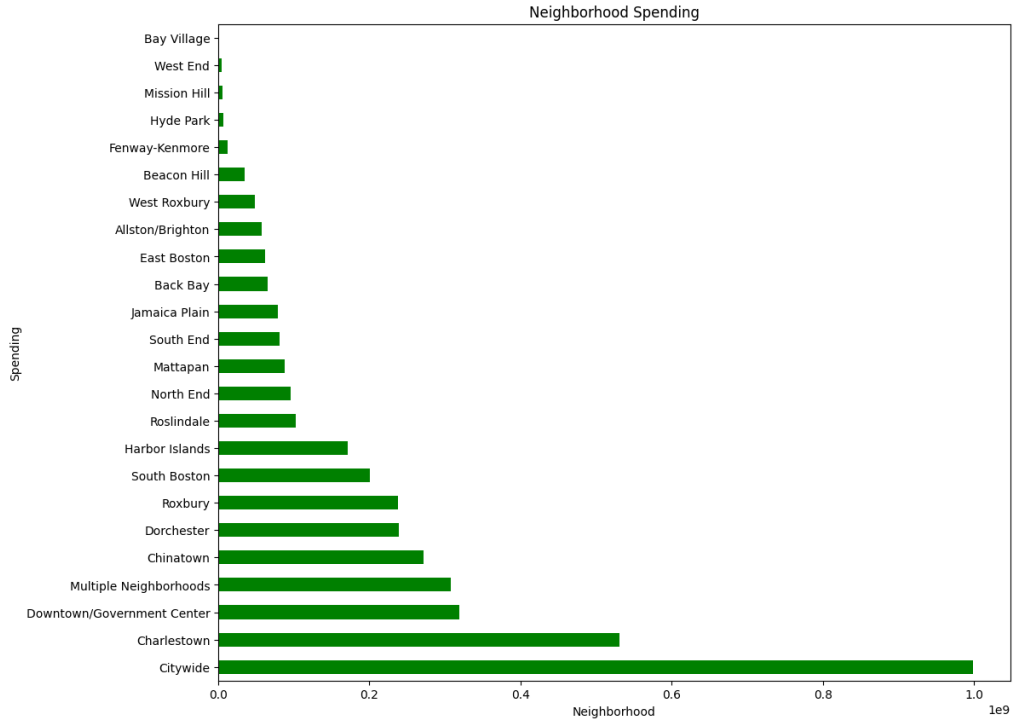
Exploratory Data Analysis



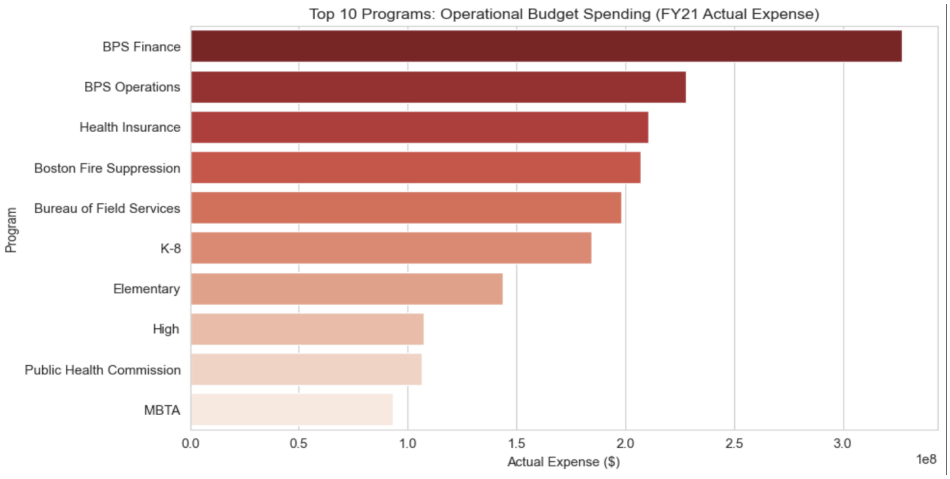
Top 10 Programs by Total Expense for FY21: This bar chart shows the top programs by total expenses in a fiscal year (FY21). It appears that 'BPS Finance' has the highest expenditure, followed by 'BPS Operations' and 'Health Insurance'.

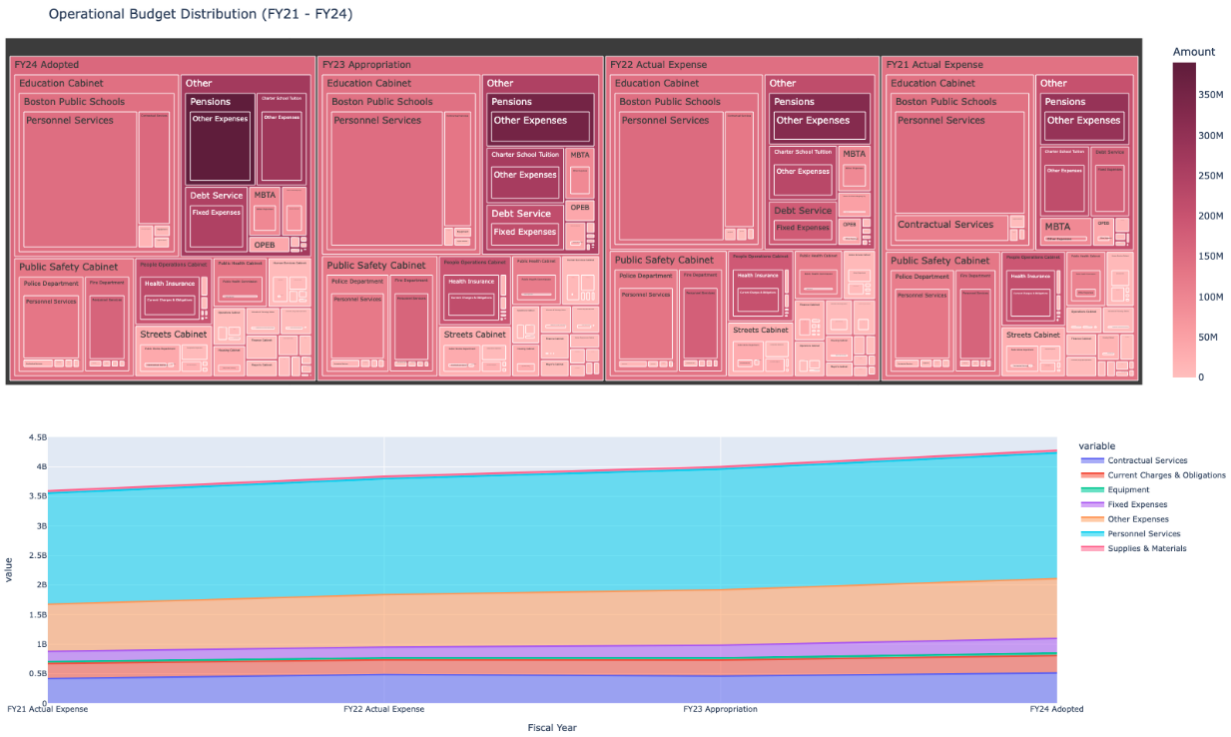


Category Expenses by Fiscal Year: This stacked bar chart compares the expenses in different categories over four fiscal years. 'Personnel Services' seems to have the highest expense across all years by a large margin. There is a visible change in 'Other Expenses' from FY22 to FY24, which suggests a reduction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





Shows Operational Budget Distribution from FY21 - FY24

<u>Extension Project Proposal</u>:

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.

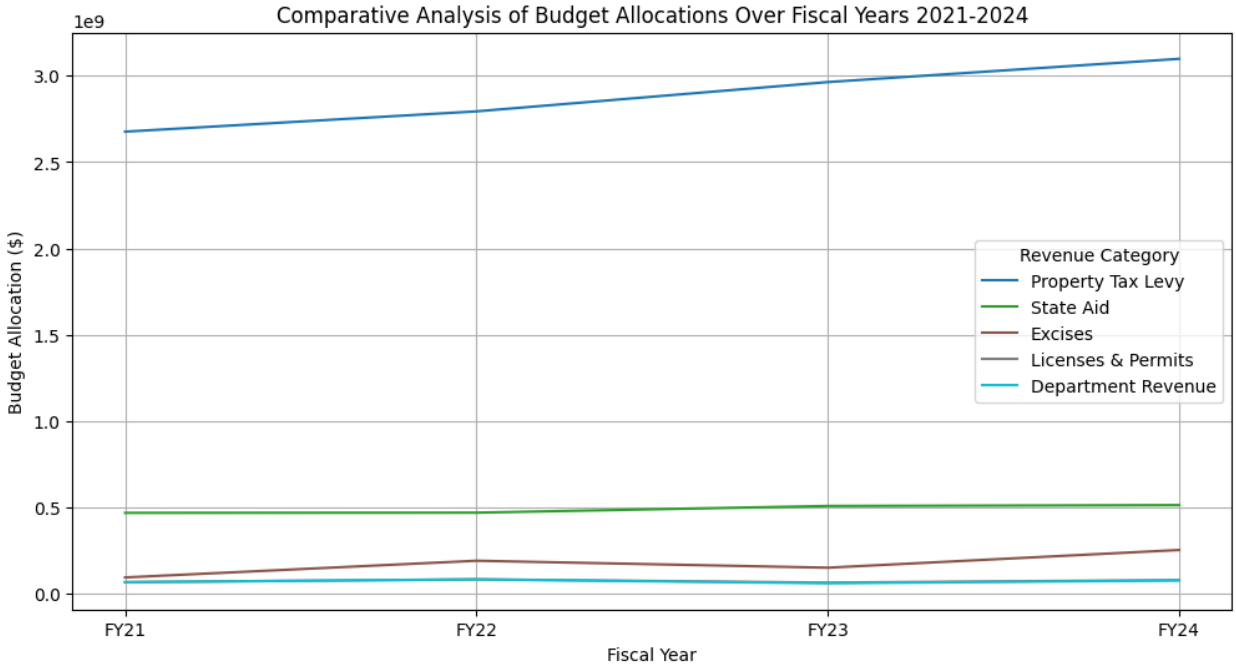
Significance

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

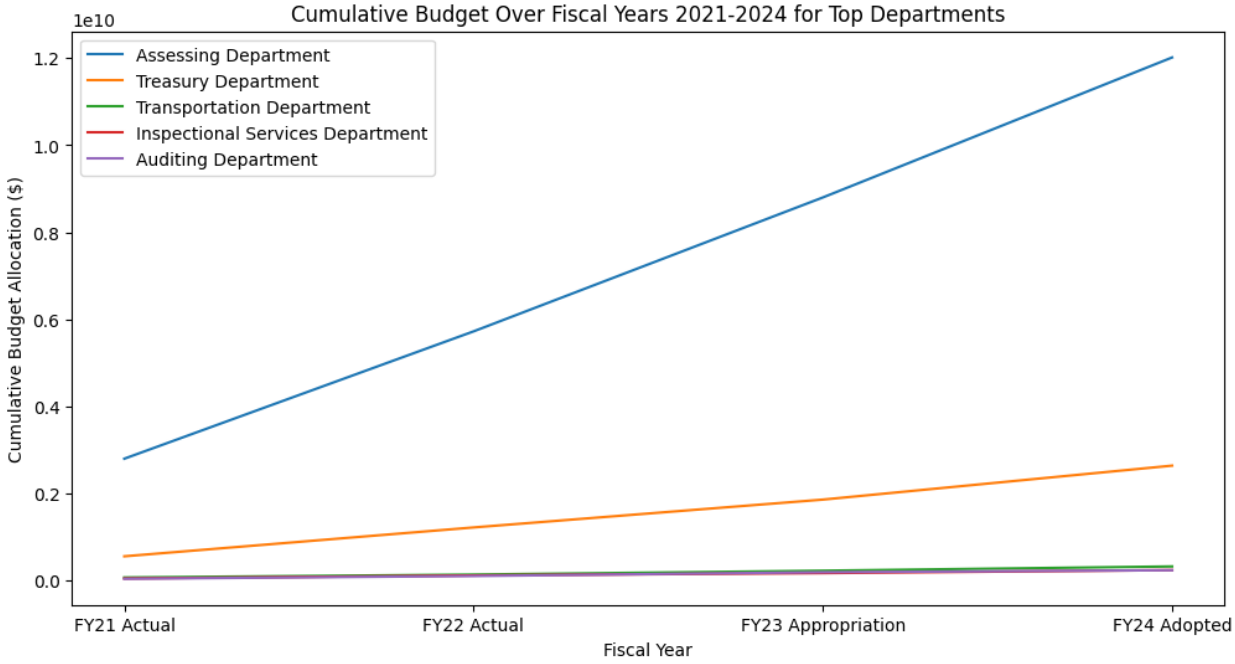
In conclusion, this project aims to provide a thorough and insightful analysis of Boston's budgetary dynamics, offering a clearer understanding of how fiscal decisions affect different aspects of city life. Through meticulous data analysis and visualization, it aims to contribute significantly to the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

Extension Project Early Insights

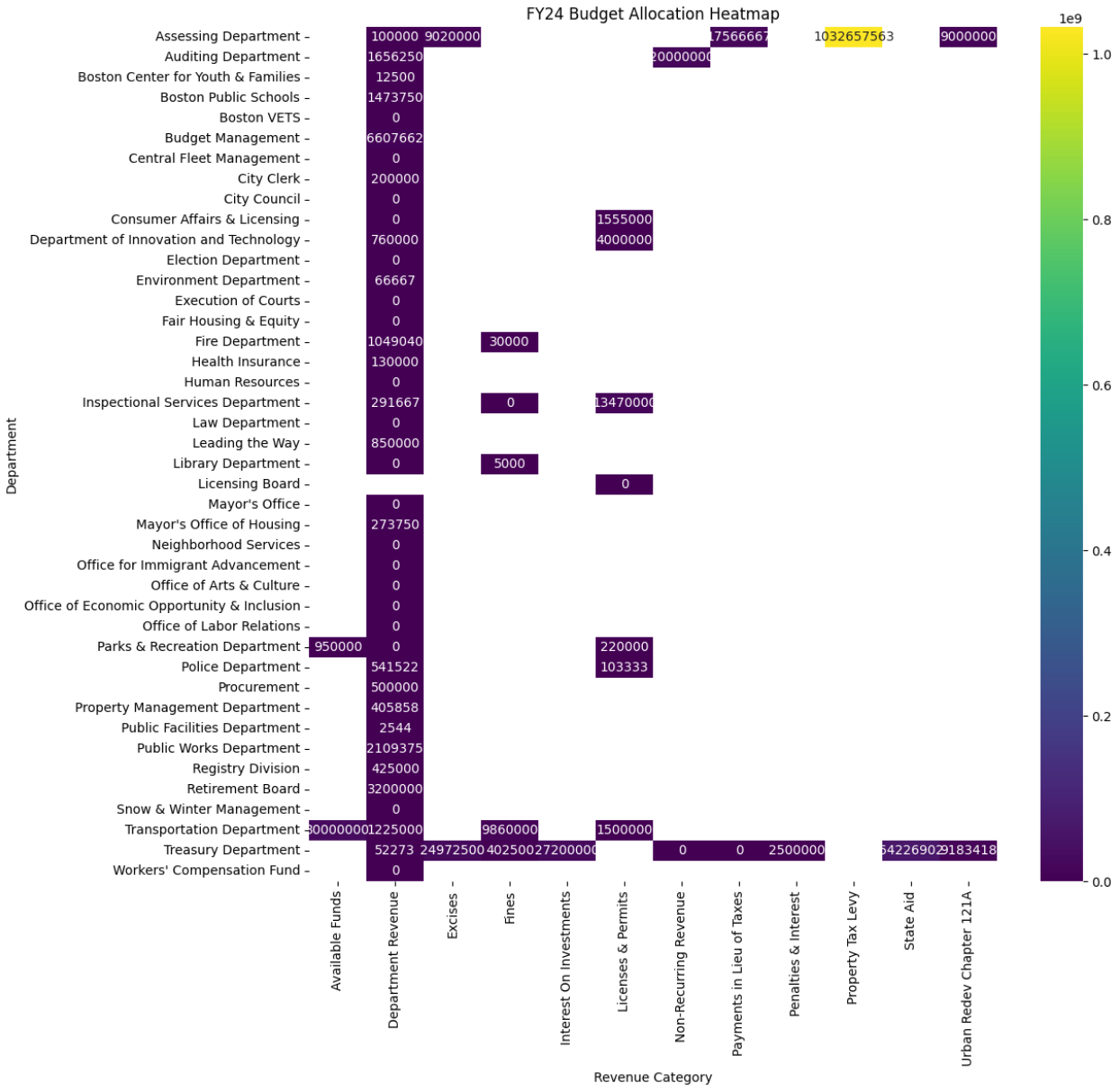


This line graph offers a comparative analysis of budget allocations across five revenue categories over four fiscal years. It's immediately evident that the 'Property Tax Levy' is the predominant revenue stream, exhibiting a steady increase year-over-year, which may reflect rising property values or changes in tax rates. In sharp contrast, other categories such as 'State

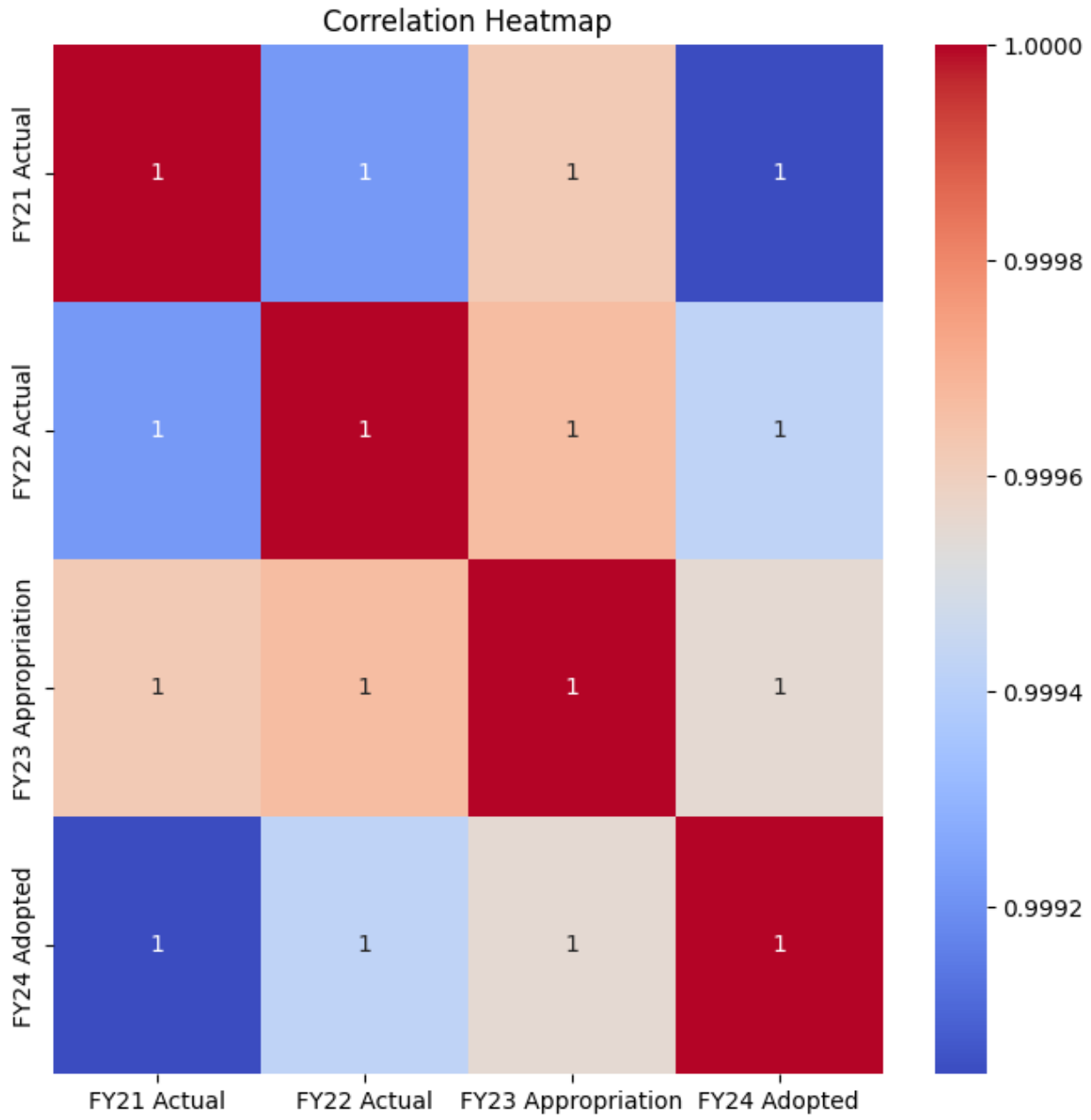
Aid', 'Excises', 'Licenses & Permits', and 'Department Revenue' maintain relatively flat lines with negligible increases, suggesting stable but significantly lower contributions to the overall budget. This visual disparity underscores the city's fiscal reliance on property tax levies and indicates potential 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.

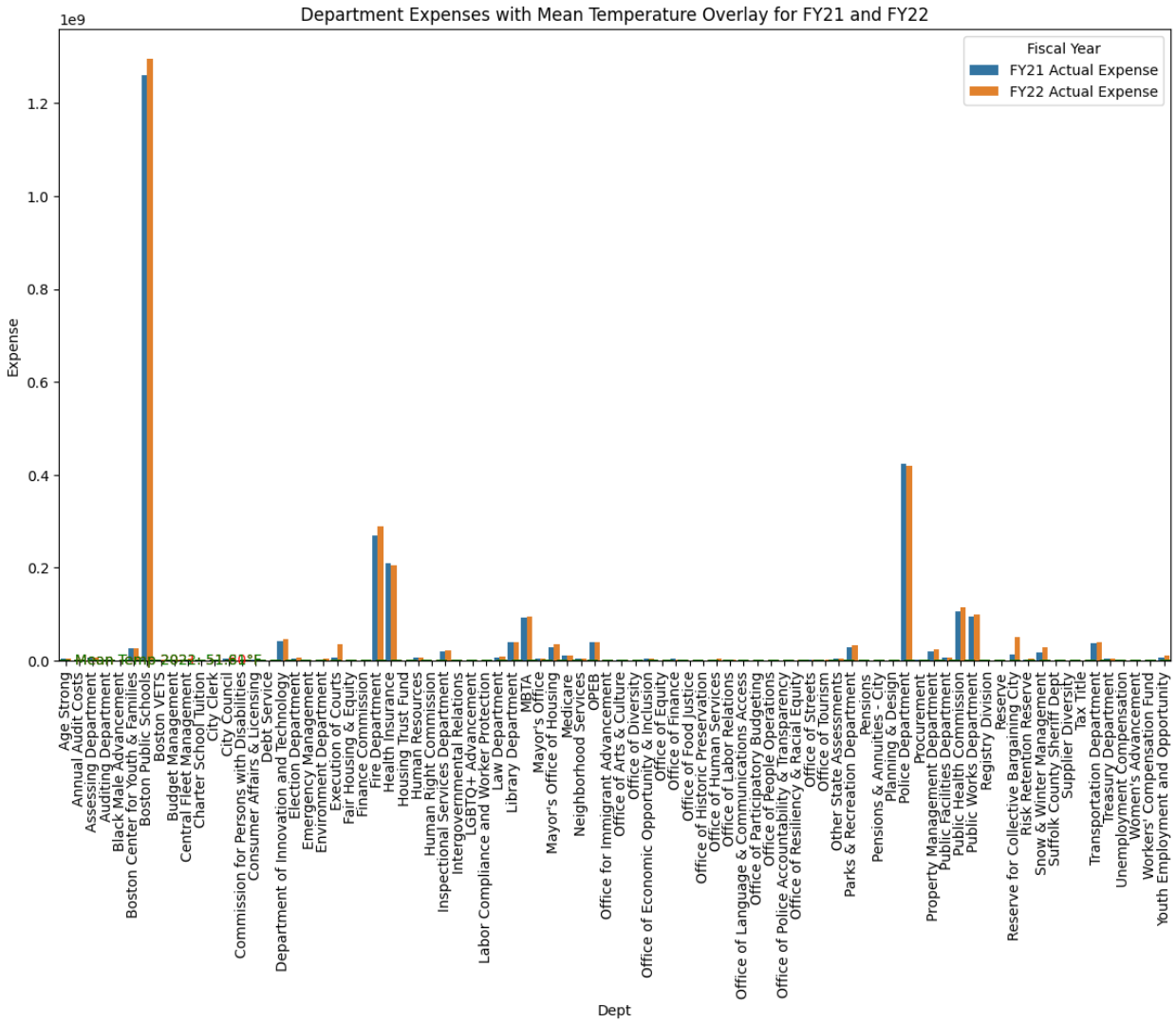


The heatmap provides early insights into the FY24 budget allocations for the city of Boston, revealing significant disparities among departments and revenue categories. It highlights a concentrated investment in the Assessing Department through the 'Property Tax Levy', which is notably higher than any 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:



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.

Contribution

Tony - Extension project proposal + Deliverable 2 Data and Insights
Michael – Extension project proposal + Final Editing
Anh – Extension project proposal
Shiva - Extension project proposal + Early insights on Extension project Weather Data
Will – Extension project proposal + Early insights on Extension project Data