CS506

Deliverable 2 Report

City Budget Group E

Problem Statement

Budgeting is an essential part of a functioning city. As one of the largest cities in the US, it is crucial to reflect on Boston's government spending to ensure a healthy balance. The goal is to visualize and evaluate budget change over time, projected vs actual spending, and per capita spending in the following categories: department, budget category, geography and program.

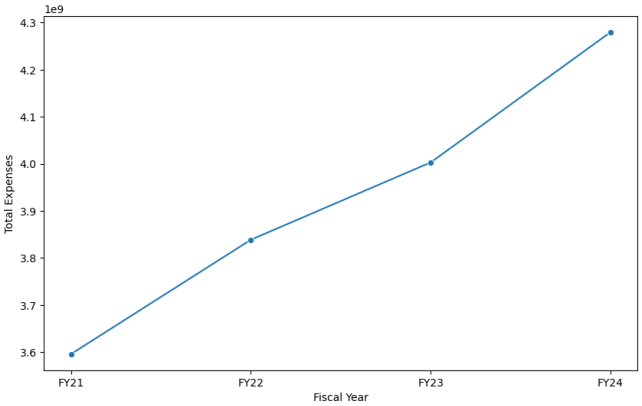
Data Cleaning

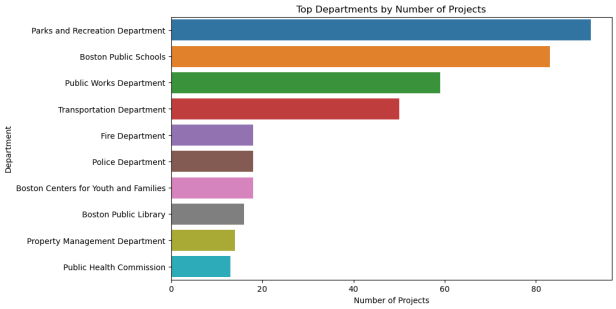
For the base project, the datasets were downloaded from the government website at Analyze Boston. We used both the Opearting Budget dataset and the Capital Budget dataset for the base questions. To begin with, the basic information of the dataset is checked, as well as the number of unique values and missing values, to determine what needs to be done. The result shows that there is no missing data, and a lot of unique data. Noticeably, columns that should be numerical (such as Total_Project_Budget) have attribute objects, indicating that it is imported as a string instead. This value issue is resolved in the cleaning process. The column names are also renamed to eliminate inconsistencies and ensure they are meaningful.

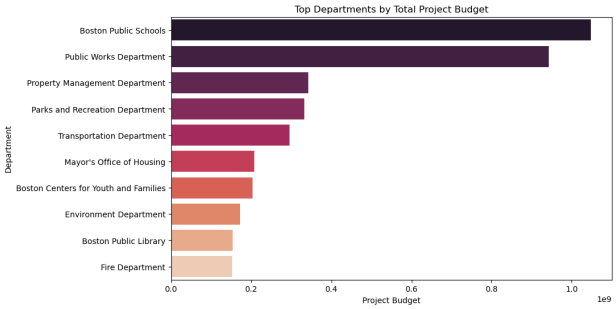
For the extension project, the datasets used are from Analyze Boston. The CSV files were imported with encoding through pandas to avoid any issues, and the datasets were checked for NA values. The NA values are filled with the appropriate month value according to their enter data in the dataset, and the column names were changed to maintain consistency. The dataset was then combined together as the entire spending history of the city of Boston in the last decade.

Exploratory Data Analysis

One of the most significant findings from the exploratory data analysis is that the budget from Fiscal Year(FY) 21 to FY24 is increasing, almost linearly. This is a very significant result as we are interested in how it is changing over time. However, since there were other events concurrently (eg. COVID), it is unknown to us whether this increasing trend has been consistent, or is it simply because of the monetary policy in 2021.

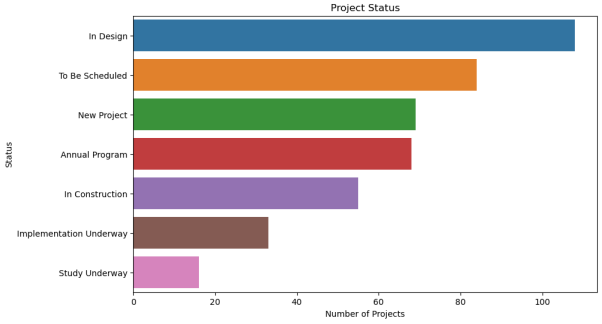






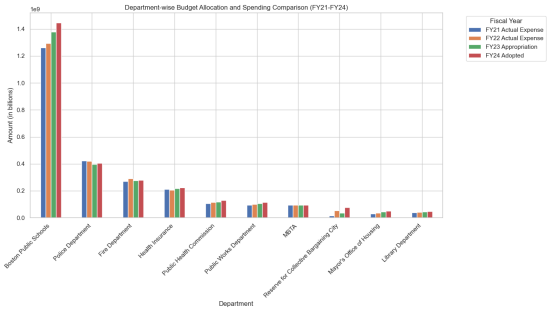
The departments with the most projects are park and recreation and Boston public schools. Not surprisingly, they also have the most project budgets across all departments. Noticeably, Boston Public schools receive the most funding out of all departments, followed closely by Public Works, which potentially indicates that the city of Boston is distributing its budget more towards social benefits of the people.

One other interesting observation is that most projects, excluding annual programs, have status indicating that they will be completed in the future, which implies more social spending has been made in the recent years from the Boston Budget.



Answers to Questions

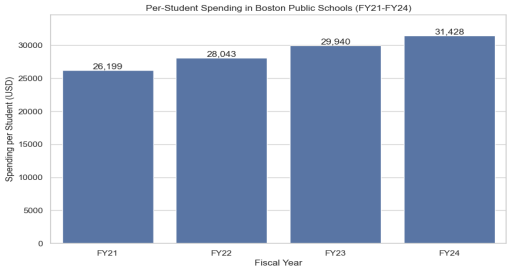
Spending by department



Most apartments show a increasing trend in spending as expected since the overall budget are increasing. The "Boston Public Schools" department which has the highest spending among all the departments shows clear upward trend in spending from FY21 through FY24, reflecting a strong focus on education.

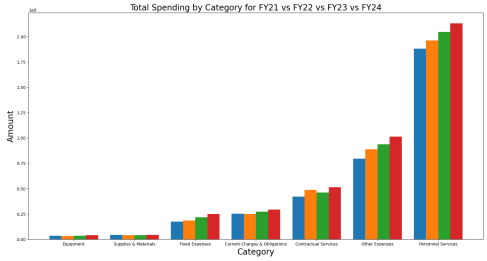
The consistent increase in the Health Insurance budget might be in response to rising healthcare costs or an increase in city employee benefits. This could be a response to public health challenges, possibly influenced by the COVID-19 pandemic.

When comparing the actual spending (2021-2023) and projected spending (2024-2028), we observe some significant differences including the disappearance of some departments and the appearance of new ones. It is possible that the data is incomplete. But assuming the data is correct, this difference may be due to department reorganization by the government.



These figures indicate a significant and consistent increase in per-student spending over the years. This trend suggests that Boston is investing more resources per student each year in its public school system.

Spending by category

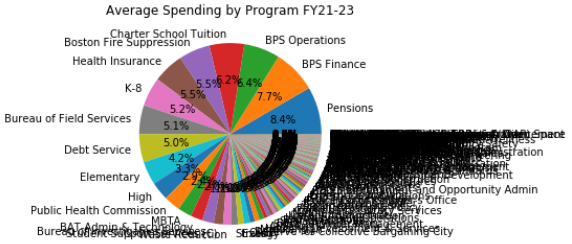


As one might expect, spending by budget category is also trending upwards. Personnel expenses are a significant portion of the budget, which is quite reasonable given that manpower is generally extremely expensive.

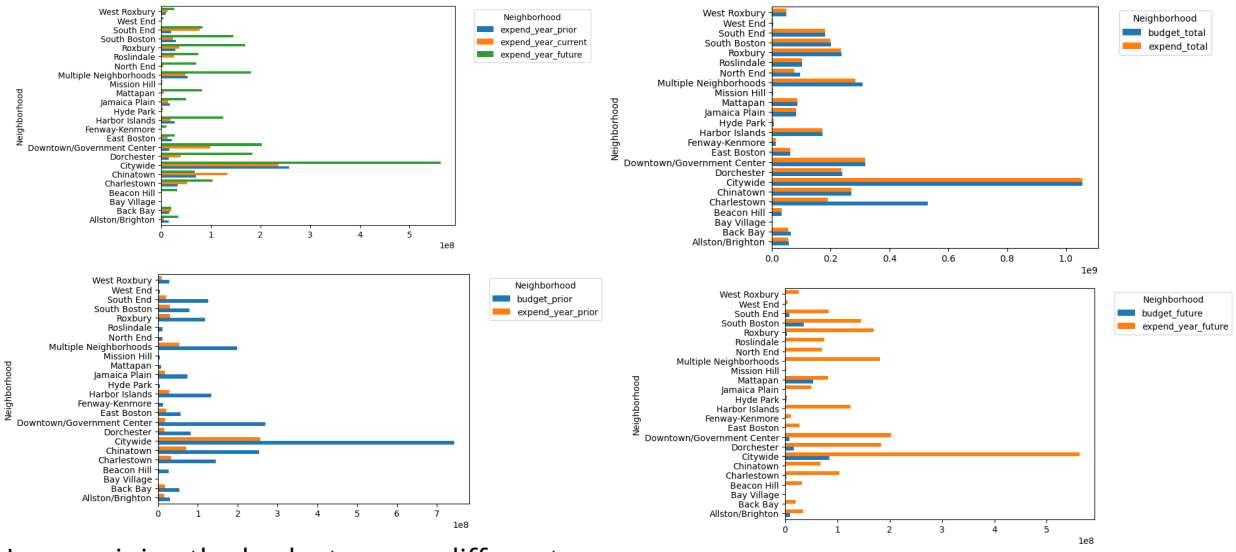
Contractual services dipping for ‘23 is a bit strange, but seems to be resuming its upwards trend in ‘24. Otherwise, not much seems to be out of the ordinary. Spending is relatively in line with projections, with steady growth. Other expenses does make up a large chunk of the city budget, however, and in further analysis we could potentially break down “Other expenses” into more specific categories to better evaluate the spending.

Furthermore, an expanded dataset would help us to better evaluate past and future budgetary trends, as the data we have available is somewhat limited.

Spending by program

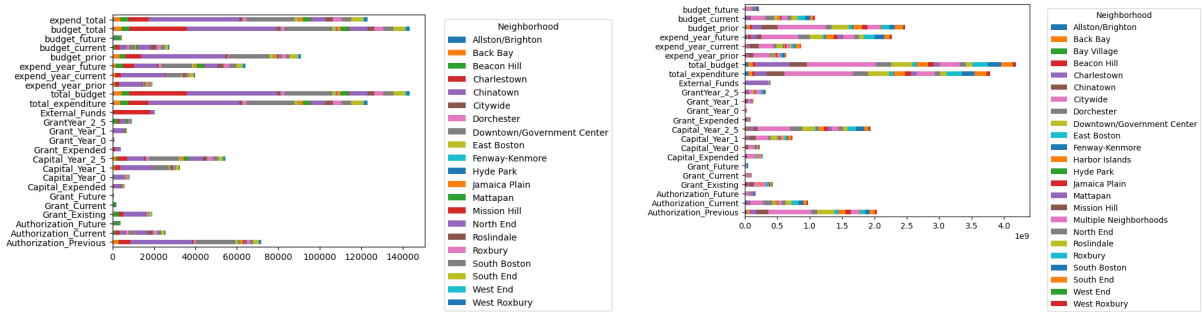


Spending by area



In examining the budget across different areas, the result shows that future funding makes up the majority of the budget (top left). Noticeably, Dorchester and Roslindale are some individual areas with the highest projected expenditure, understanding the underlying reasons could offer some insights to the city project.

Compare between budget and expenditure, it shows that the total amount of projected spending (budget) is at least the total amount of the expenditure. However, they are distributed differently. The budget are mostly set in the prior years for all areas, while the spending would occur in the future years instead.



From the total budget per area (left), city wide projects are granted the most, followed by budget in Charlestown, multiple neighborhoods and Chinatown. However, for the budget per capita per area (right), it is Chinatown that has the highest number, followed by Charlestown and downtown. Interestingly, for Charlestown, external funds make up a majority of the budget, which it would be interesting to see which project(s) this came from.

Extention Propsal

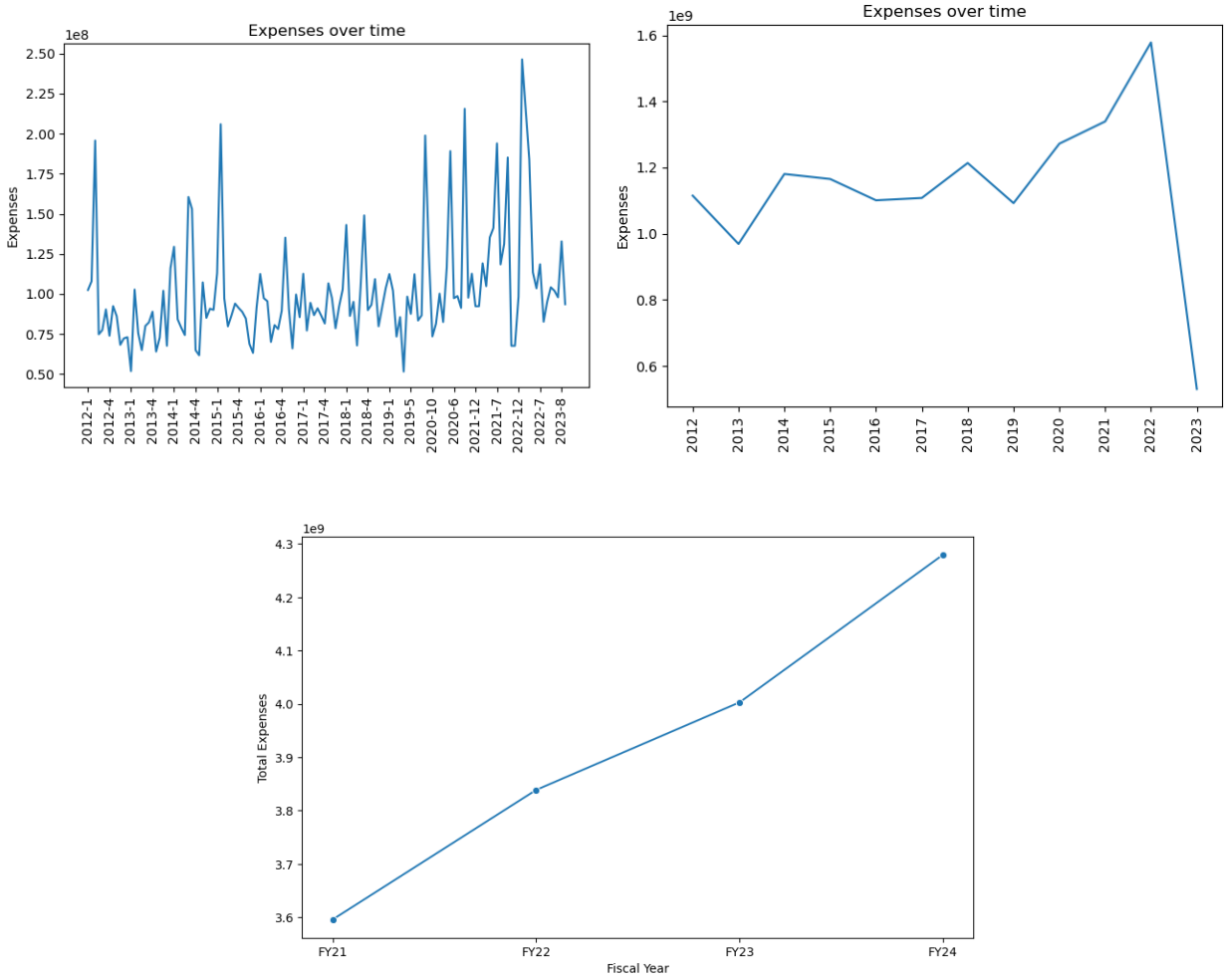
Overall, we see that the budget of the city of Boston has been increasing from 2021 to 2024, across most of the categories. Meanwhile, the expenditure over the times never exceeded the overall budget, indicating that the budgeting in Boston is robust.

Since the data only covers 4 years, it places a limitation of a grand overview of the budget of Boston. We expect to explore more cross the categories for any more potential interesting findings, and to complete a robust examination of the budgeting of Boston. One particular interest we have is to explore more about how the budgeting before 2021, to see how it behaves over time, and to see if our observations from the current years still apply, or it is related more to current events (eg. COVID).

We would like to analyze the past data to find more patterns with regard to the budgeting and spending in time, as well as how the budget changes over a longer period of time. We believe that the general increasing trend would still apply. We will be using the checkbook dataset from Analyze Boston, which includes past budget since 2012. We will examine the budget vs. time, possibly across different departments.

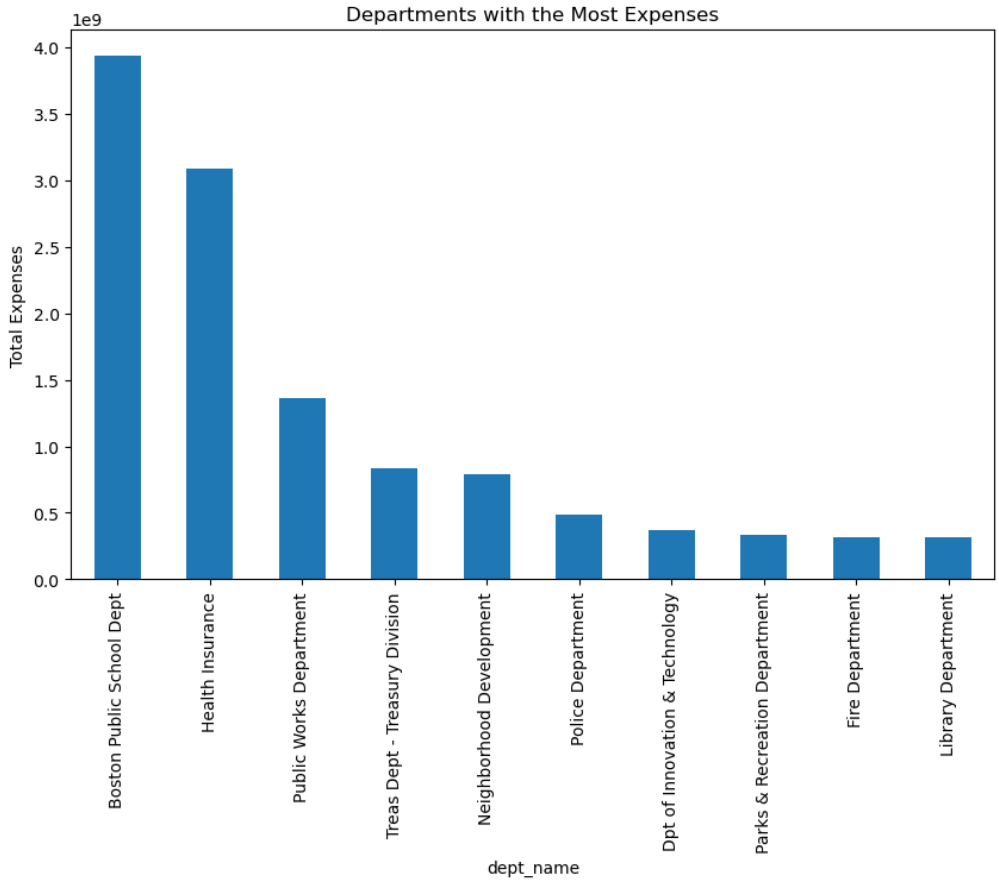
Extension Insights

The dataset for the extension project contains the spending data from the first fiscal month of 2012 to the fifth fiscal month of 2023, which is incomplete for 2023.

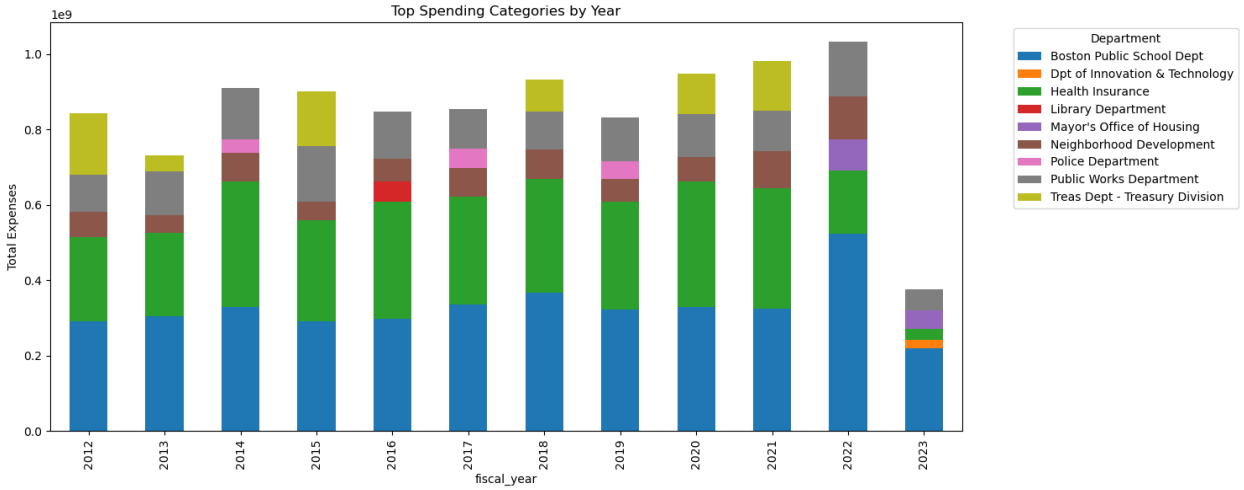


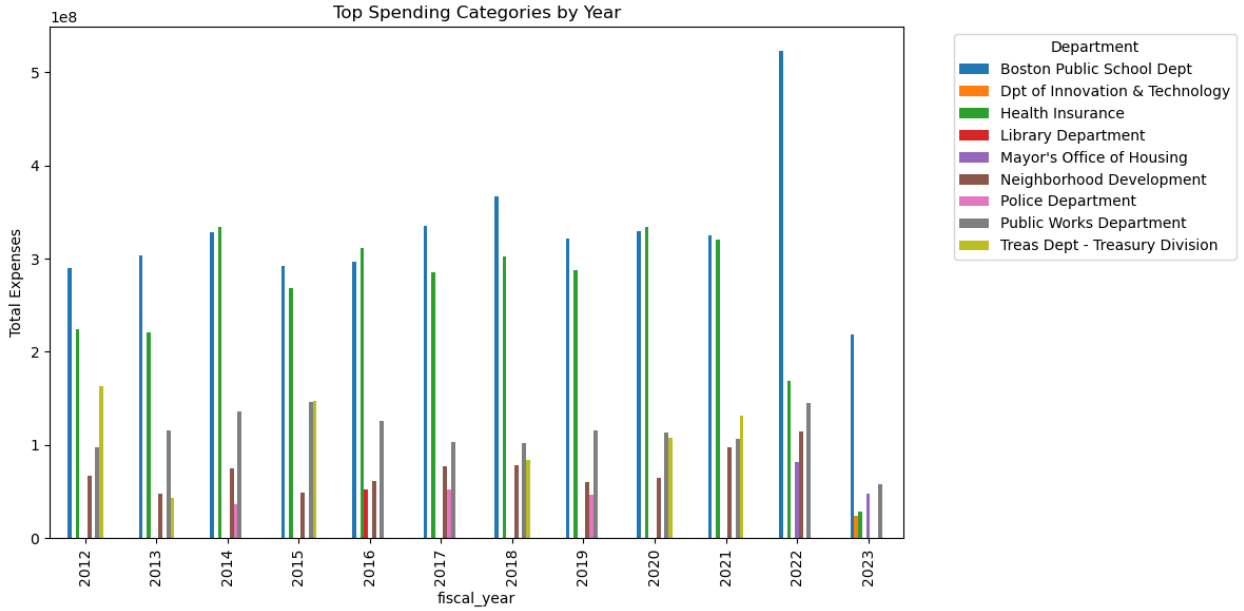
First, the dataset is plotted as a time series data. The fiscal year of 2023 is incomplete, which means the spending for 2023 might not provide much insights overall. The result shows possible seasonal trends by month (top left), with a general increasing trend over the entire period of time. The yearly plot (top right) shows this increasing trend more clearly. However, compared to the recent spendings from FY 2021 to 2024 (bottom), it shows that the trend of spending has really increased drastically since 2019. Before that, the slope of increasing is much more flat. This potentially suggests that the increasing

spending is very likely boosted by the monetary policy since COVID, and perhaps after a few years, this spending would go back to the relatively flat level pre COVID.



Over the past decade, the total expenses across the different departments show that the most funding still goes to Boston Public Schools, similarly to how it is distributed recently. On the other hand, the department with the second most funding over the past decade, which is Health Insurance, did not receive as much fundings from FY21 to FY24. This decline is also similar for the Public Works department. This suggest either the priority of Health Insurance and Public Works has lost in the recent times, or that because Boston has received a lot of fundings since 2021, it has been spending more to other areas. In order to decipher which the case is, their spending each year is compared.





Over the years, the top 2 spending categories have been Boston Public Schools and Health Insurance, in which these two departments have very similar expenses from 2014 to 2021. However, in 2022, it seems that the spending for Boston Public Schools has skyrocketed by about 50%, while the spending for Health Insurance has decreased by about 50%, and seems to continue to decrease more in FY23 (previous results of FY21 to FY24 show that Health Insurance is continuing its decreasing trend). This perhaps is showing a change in emphasis from the city of Boston in distributing the majority of the budget.

The departments that have slightly less budget, such as Treasury, Public Works and Neighborhood Development, continue to have similar budget across the past decade. In

2021 and 2022, it seems like Public Works and Neighborhood Development is receiving more funds than before, especially Neighborhood Development, which shows continuous growth since 2012. These findings would again suggest that the city is shifting its focus, to possibly projects that has more social benefits.

Contributions

Wanchen Hong: Completed data cleaning and EDA, the spending by area sections and its related questions, including all visualizations and analysis, and the extension project so far

Alex Zhang: Completed work on spending by category (Visualizations, analysis and questions)

Zhupei Xu: Completed work on spending by department

Phil Ledoit: Completed work on spending by program (visualizations, analysis and questions)