Policing the Budget: Deciphering Earnings and Overtime Allocation in the Boston Police Department

CS506 Final Project - Fall 2023

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1. Abstract

This research delves into the financial intricacies of the Boston Police Department (BPD), armed with an annual budget exceeding $400 million. Our analysis spans year-over-year budget changes, the utilization of injury pay, identification of wasteful overtime practices, and patterns in court appearance overtime. Additionally, we explore the correlation between high salaries and frequent overtime use. Extending our investigation, we examine whether BPD's potential understaffing catalyzes excessive overtime spending, considering staffing levels, crime rates, and overtime expenditures across districts and years. Our research provides nuanced insights into the interplay between budgeting practices, staffing dynamics, and their impact on public safety outcomes. This can contribute to the ongoing dialogue on policing reform, offering insights for policy-makers and stakeholders committed to fostering a transparent and accountable law enforcement system.

2. Introduction and Problem Statement

Policing in the United States has become contentious, marked by growing concerns about potential abuse of power and bias. Recent attention has honed in on the allocation of funds and spending in the Boston Police Department. Some of these expenditures, deemed "wasteful," are allegedly concealed within overtime expenses, prompting the need for a meticulous analysis. In this context, our research focuses on the Boston Police Department (BPD), where the controversy extends to the potential masking of wasteful budgeting and misconduct through overtime. In the extension section, the research addressed an emerging question: is the BPD, like many across the nation, facing understaffing issues, and does this understaffing contribute to the observed excessive overtime spending? This research, encompassing diverse financial facets,

endeavors to provide nuanced insights into the interplay between budgeting practices, staffing dynamics, and their consequential impact on public safety outcomes. The findings offer essential perspectives for policy-makers and stakeholders dedicated to cultivating openness, transparency, and accountability within law enforcement systems.

3. Exploratory Data Analysis (EDA)

3.1. Data Sources

- Data sources provided by the client:
  - Employee earnings data (search police)
  - Campaign contribution data
  - BPD field activity data
  - Overtime data from 2012-2022
  - Payroll Definitions
- Data sources from self-research:
  - Internal Affairs Officer Data
  - Suffolk Brady List Data (2020)
  - BPD Personnel Data
  - Crime Incident Reports
  - Economic Indicators
  - Boston Population 2023
  - Total Real Gross Domestic Product for Boston

3.2. Data Cleaning

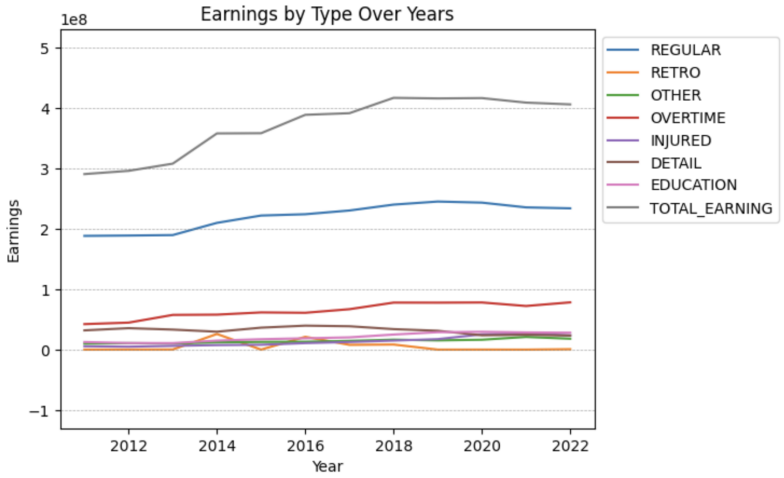
- **Data Type Conversion**
  - Built a function to convert inconsistent data types (i.e.: non-numeric strings in the "overtime pay" field) to a uniform numerical format.
- **Handling Missing Values**
  - Used mean imputation for related data and row exclusion for sporadically distributed and scarce missing values in datasets.
  - Used numerical values instead of strings representing nulls in some provided datasets.
- **Timeframe discrepancies**
  - Addressed inconsistent time frames in datasets by applying mean imputation and row exclusion based on missing data distribution and relevance.
- **Standardization and Normalization**
  - Normalized column names for clarity and consistency within data categories. Extended standardization efforts to maintain uniformity when integrating diverse data types.
- **Dataset combination**
  - Organized yearly datasets by creating lists for each data category, facilitating easy retrieval with a single variable and index corresponding to the year.

- Joined related datasets by unique indicators or values to find correlations between dependent variables.

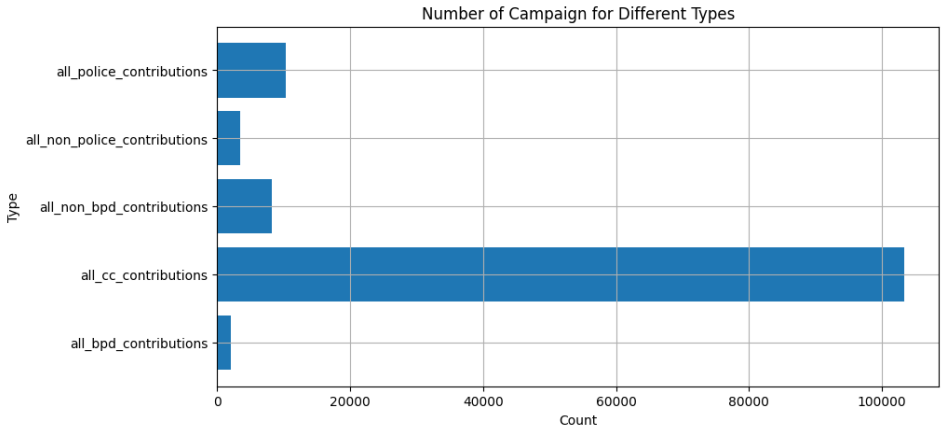
- **Integration of New Datasets**
  - Overcame challenges in integrating new datasets by meticulously aligning structure and format variations, preserving the combined data's integrity.
  - Investigated related datasets for making predictions and gathering evidence to prove hypotheses.

3.3. Preliminary Observations with Visualizations

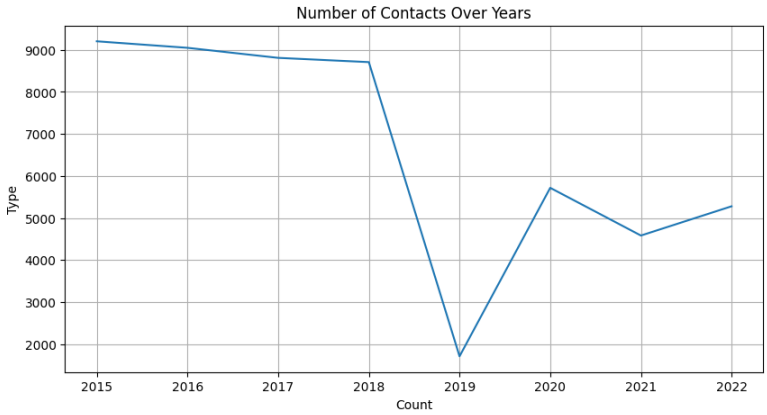
- **Employee Earnings**
  - Provides names, departments, and earnings (regular, overtime, bonuses, etc.) of City of Boston employees in 2011-2022.
  - Total earnings for each type over 2011-2022



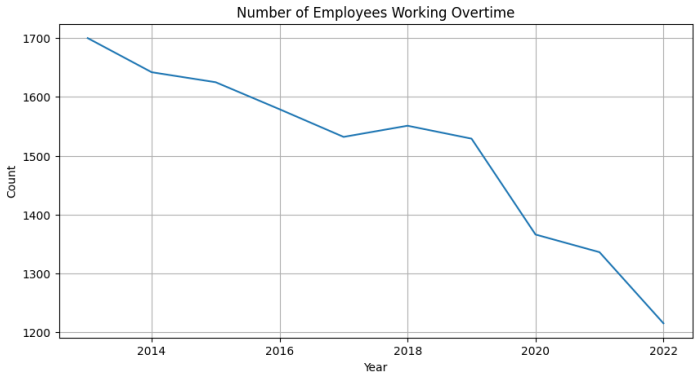
- **Campaign Contribution**
  - Includes contributions to political campaigns (OCPF) in 2011-2022, with names, occupations, employers, contribution amounts, recipients, and other personal information.
  - Number of campaigns for different types graph:



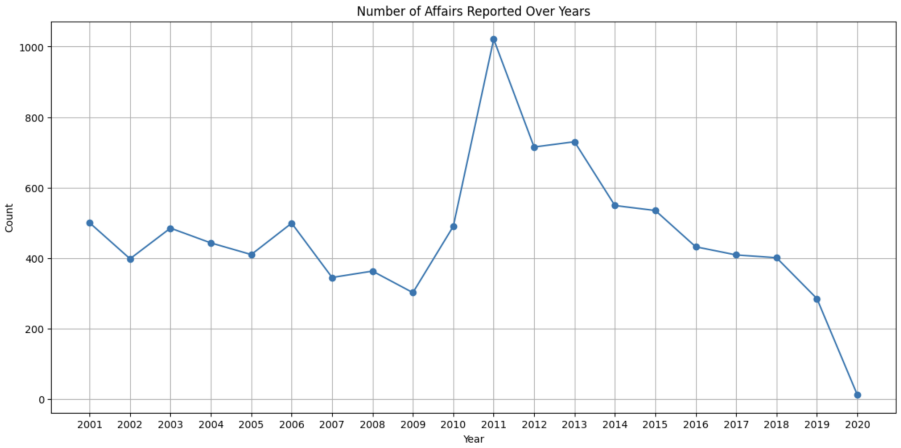
- **BPD Field Activity**
  - Includes interactions between BPD officers and private individuals in 2011 - 2022, with names of individuals and officers, dates, times, locations, and reasons for interactions.
  - Number of Contacts over 2015-2022



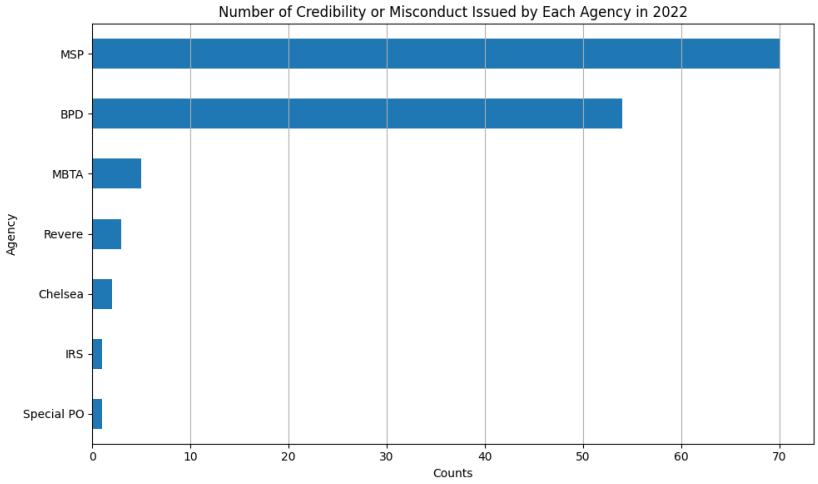
- **Overtime**
  - Includes overtime hours and payments for BPD employees over 2012-2022, with names, IDs, ranks, work locations, clients, hours worked, and pay rates.
  - Number of employees working overtime over 2013-2022



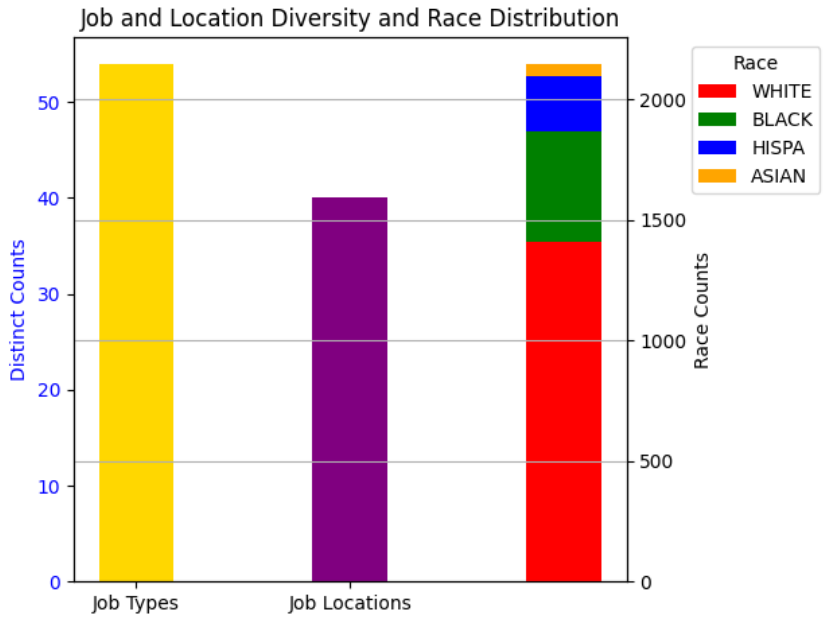
- **Internal Affairs**
  - Provides internal investigations involving BPD officers, with names, allegations, outcomes, and disciplinary actions.
  - Number of internal affairs over 2001-2020



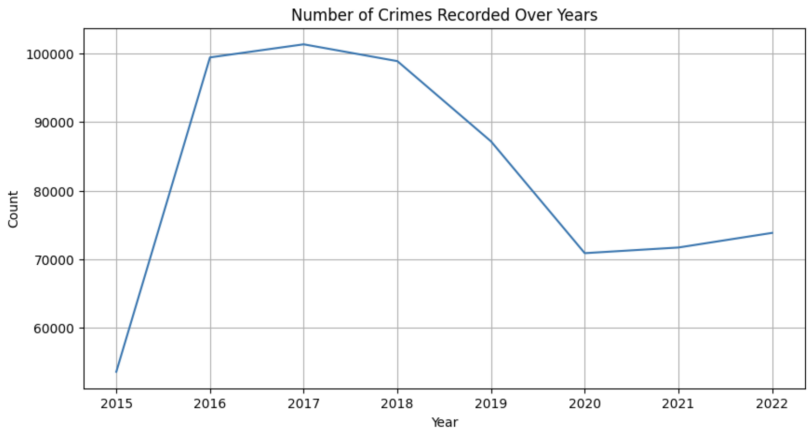
- **Suffolk Brady List Data (2020)**
  - Includes BPD officers flagged for credibility or misconduct issues in 2020, with names, reasons for listing, and other personal details.
  - Number of credibility or misconducts issued by each agency in 2022



- **BPD Personnel**
  - Provides comprehensive information on BPD personnel, including roles, ranks, tenure, demographics, and service years. Helps to analyze the workforce composition and departmental policies.
  - Number of distinct job types, number of distinct job locations, race distributions.



- **Crime Incident Reports**
  - Provides the initial details surrounding an incident to which BPD officers respond, including the type of incident, when and where it occurred, and location.
  - Number of crimes recorded over 2015-2022



- **Economic Indicators**
  - Provides unemployment rate for prediction model training over 2013-2019.

- **Boston Population 2023**
  - Provides Boston Population for prediction model training over 2013-2024.

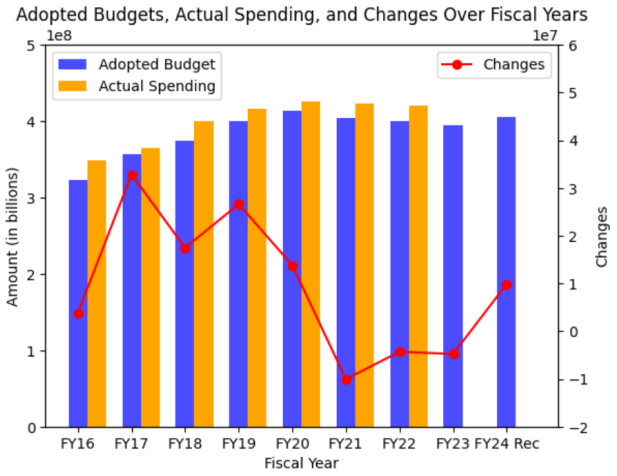
- **Total Real Gross Domestic Product for Boston**
  - Provides GDP data for prediction model training over 2013-2022.

4. Key Questions

<u>Question 1:</u> How has the BPD budget changed year-over-year?

Explanation:

- The adopted budget is determined at the beginning of the fiscal year
- The actual expenditures reflect total spending at the end of the fiscal year
- Data is obtained from ACLU MA.



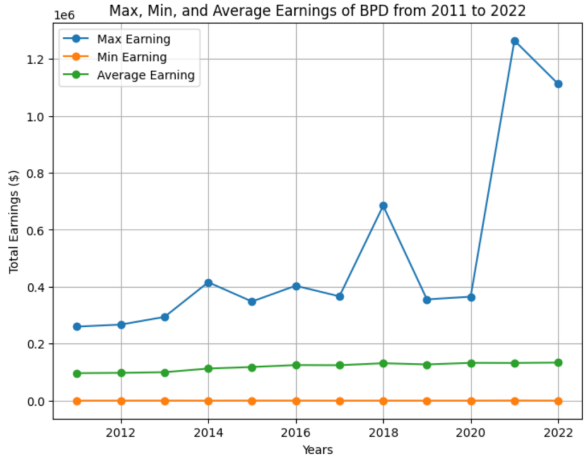
Observations:

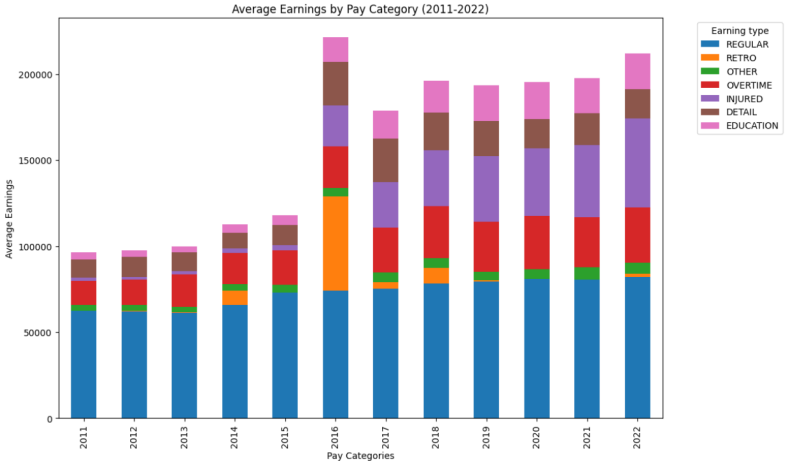
- The BPD adopted budget, and the actual expenditure generally showed an upward trend from FY16 to FY24 Rec.
- The BPD's actual expenditures frequently surpassed its adopted budget over the years.
- The changes in the BPD budget from the previous fiscal year demonstrate fluctuations in the budget growth rate.

<u>Question 2:</u> How have BPD and paychecks changed year-over-year? Provide an earning pay breakdown.

Assumptions:

- The average of "Total Earning" can be used to measure paychecks.





Observations:

- The total earnings for police officers have generally increased from 2011 to 2022.
- The average earnings from education, detail, injury, and overtime showed a relatively consistent upward trend, with noticeable year-to-year increases.
- Starting from 2018, the proportion of average overtime earnings has consistently remained relatively high, ranging from approximately 22.00% to 24.18%. This suggests

that overtime continues to play a significant role in the overall earnings of police officers during this period.

- In 2016, there was a substantial increase in the average retroactive pay compared to the surrounding years. This abnormal increase might be due to specific circumstances and require further investigation.
- Notice an abnormal increase in police earnings between 2020 and 2022. We looked into it and found out that the officer was awarded $2 million in a gender discrimination lawsuit by the Federal Jury.

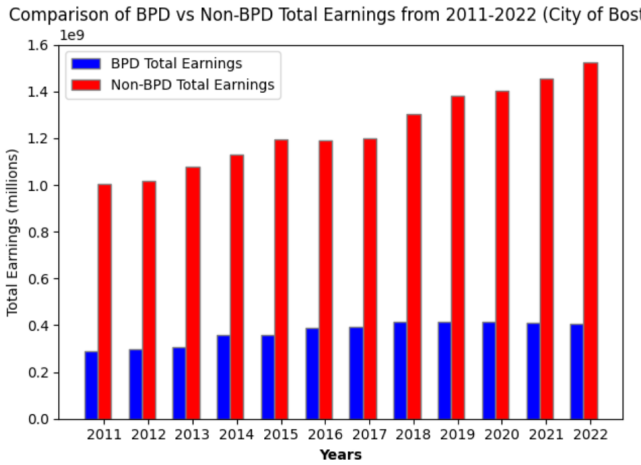
Question 3: Compare BPD paychecks with those of non-BPD employees. How have they changed over the years (the total and the average amount)?

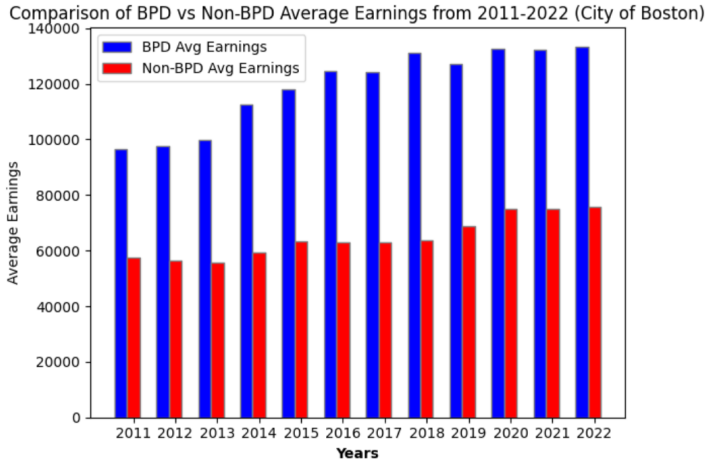
Explanation:

- The non-BPD population includes all jobs in the City of Boston (i.e., cashiers, teachers, etc).

Observations:

- Both BPD and Non-BPD total and average earnings showed a general increasing trend over the years, suggesting overall growth in financial figures for both groups.
- The average salary for non-BPD city workers was approximately half that of BPD employees from 2011 to 2022.



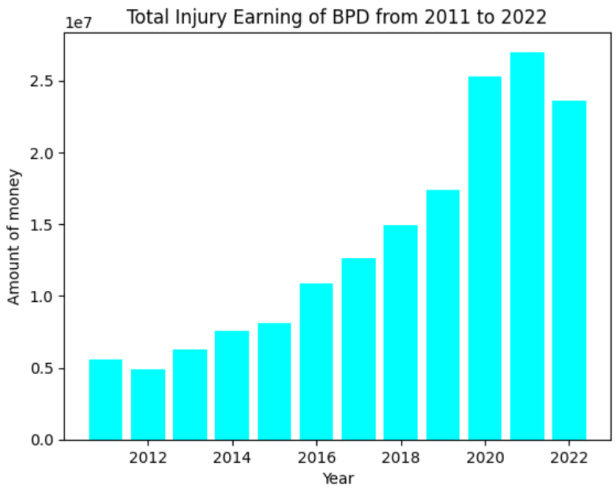


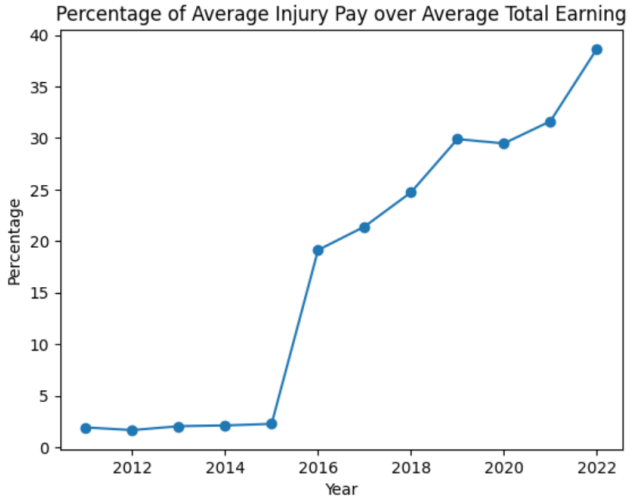
Base Question 4: How much BPD officer pay came from injury pay? What percentage of officers took injury pay in a given year?

Observations:

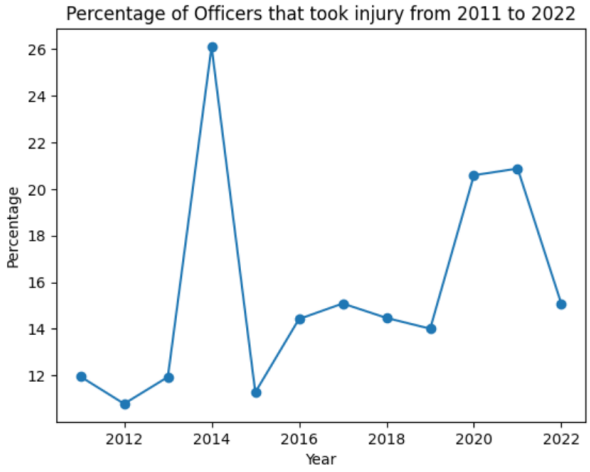
- The absolute value of injured earnings increased significantly from 2011 to 2022, with a notable spike in 2022.

- There was a substantial increase in the injury proportion from around 1-2% in the earlier years to almost 40% in the most recent years (2021 and 2022). This suggests a rising impact of injured earnings on the overall total earnings of the police department.





- The percentage of injury pay for Boston Police officers varies significantly, ranging from 10% to 26%.
- 2014 stands out with a notable spike in injured officers, reaching around 26%. One possible reason for the strike in police injury pay was due to the Black Lives Matter movement following the tragic death of Michael Brown in Ferguson, Missouri, in August 2014.
- In 2020, a dramatic increase coincided with the killing of George Floyd and the COVID-19 pandemic, potentially contributing to an increase in reported injuries.

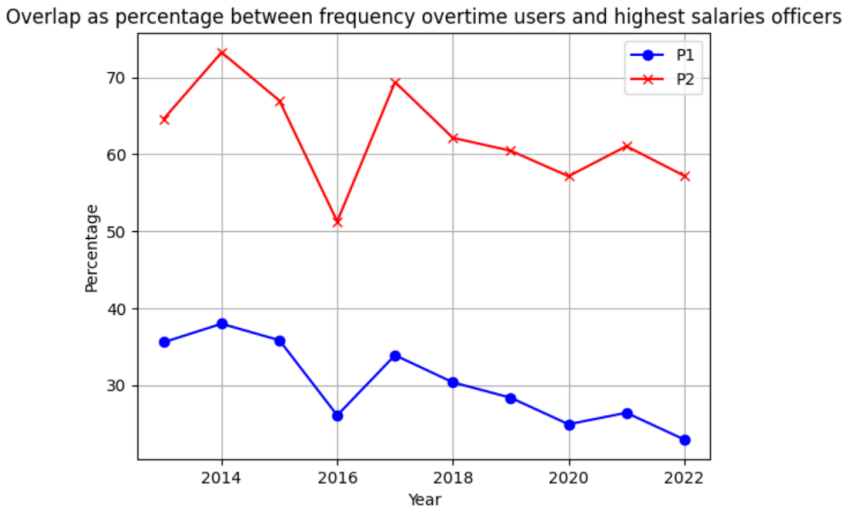


- We acknowledged that while the above social events and movements prompted discussions and changes in policing practices nationwide, connecting it directly to a specific spike in injury pay would require concrete evidence and a thorough investigation.

<u>Base Question 5:</u> How much overlap is there between frequency overtime users and officers who have the highest salaries on the force?

Assumptions:

- Most frequent overtime users set = the top 20% officers who have the highest overtime taking hours (using HOURS_PAID)
- Highest earning officer set = the top 20% highest earning officers
- P1 = Percentage of officers that are in the top 20% of overtime users given that they are in the top 20% of the highest income
- P2 = Percentage of officers that are in the top 20% of highest income given that they are in the top 20% of overtime user



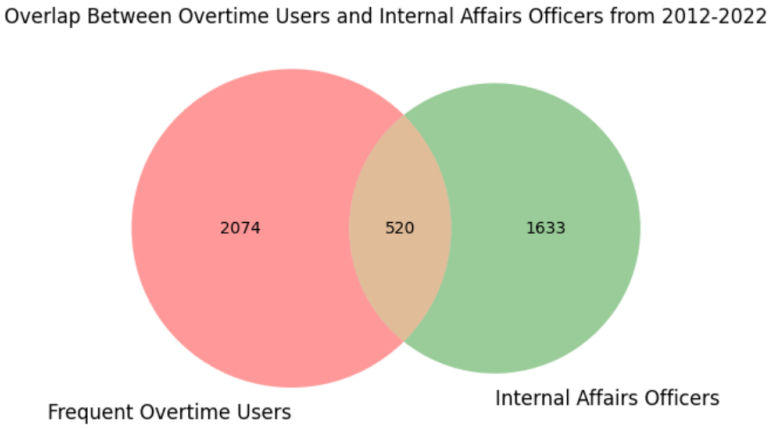
Observations:

- An officer who had a high income was very likely (>50%) to take overtime frequently.
- However, an officer who frequently took overtime didn't necessarily have a high income.

<u>Base Question 6: How much overlap is there between frequency overtime users and officers who have internal affairs complaint records?</u>

Assumptions:

- Most frequent overtime users set = the top 20% officers who had the highest overtime taking hours (using HOURS_PAID)
- The names and the number of officers with internal affair complaint records data was calculated from the internal affairs dataset.



Observations:

- The overlap represents a considerable portion of frequent overtime users and officers with internal affairs

complaint records. This suggests that a significant number of officers are simultaneously involved in both categories.

- The overlap may raise questions or concerns about the work behavior or conduct of these officers. It could indicate instances where officers who work extensive overtime also have internal affairs matters to address.

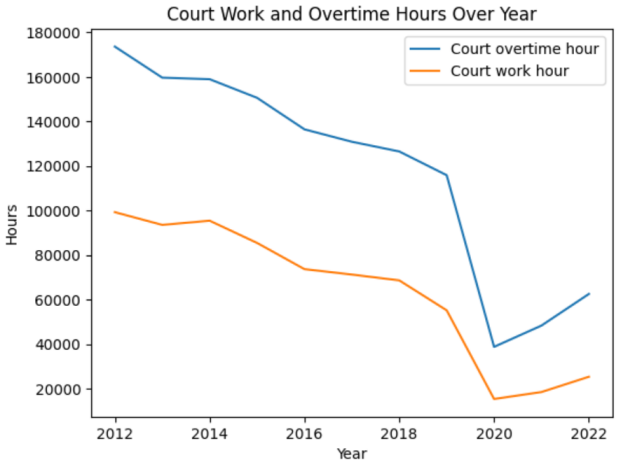
<u>Base Question 7:</u> How has overtime for court appearances changed year-over-year? What is the distribution of overtime paid hours and overtime worked hours?

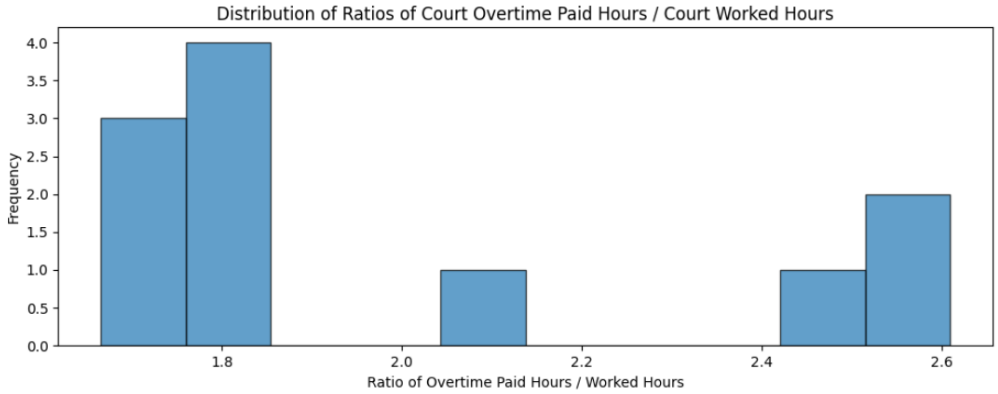
Assumptions:

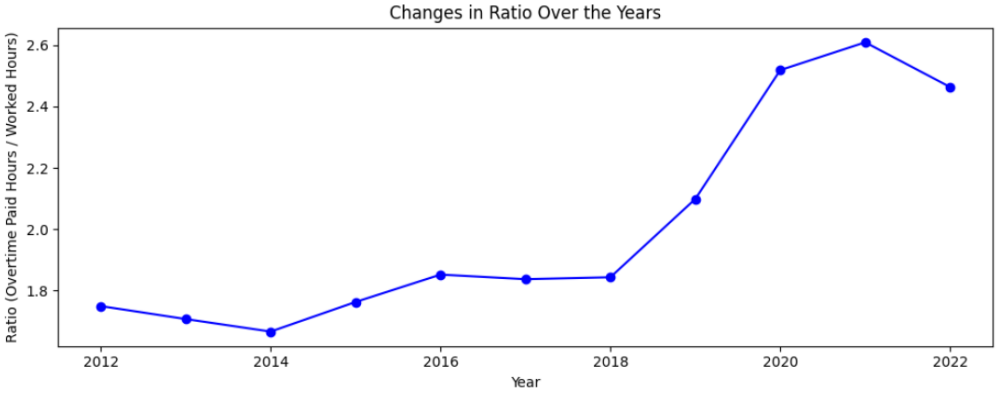
- WRKHRS and OTHRS are used to measure "appearances" in court.

Observations:

- Overall, the total court overtime hours consistently appeared to be twice the total work hours. This can be a result of the 4-hour minimum court appearance policy.
- The year 2012 recorded the highest reported court overtime and worked hours.
- Conversely, 2020 witnessed the lowest reported court overtime and worked hours, potentially influenced by the COVID-19 pandemic and a surge in remote jobs.

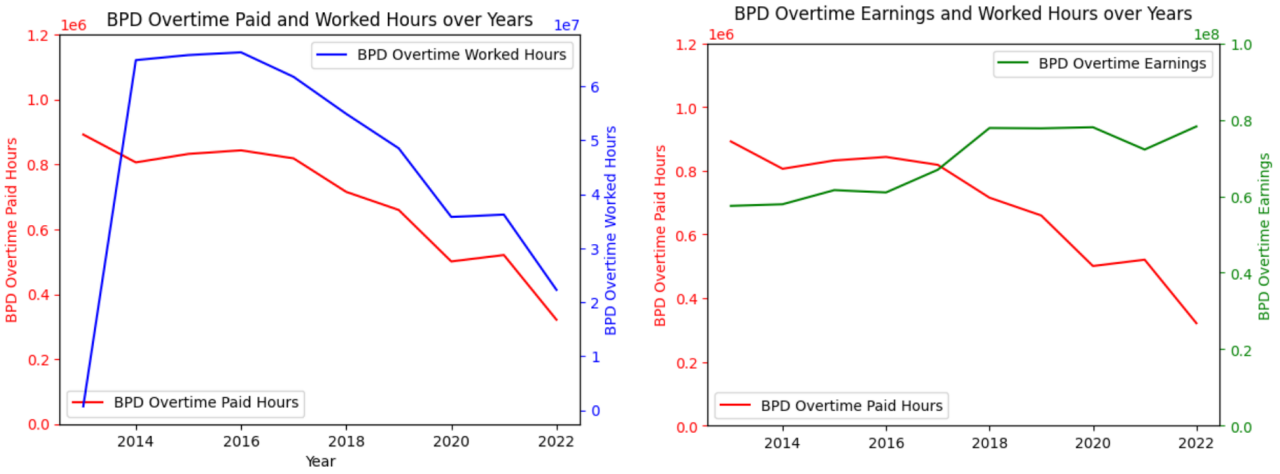






- The ratio of court overtime paid hours to court worked hours was approximately 1.7 for three years (2012, 2013, and 2014). This suggests a consistent level of overtime paid relative to the hours worked during these years.
- For four years, the ratio was around 1.8. This indicates a slightly higher proportion of court overtime paid hours compared to the court total worked hours.
- The years 2020, 2021, and 2022 experienced the ratios of court overtime paid hours/ court worked hours at about 2.5 times. However, if we look at the graph preceding this graph, we can see that both court overtime hours and working hours generally decreased in these years.

Base Question 8: How do overtime hours paid compare to overtime hours worked?



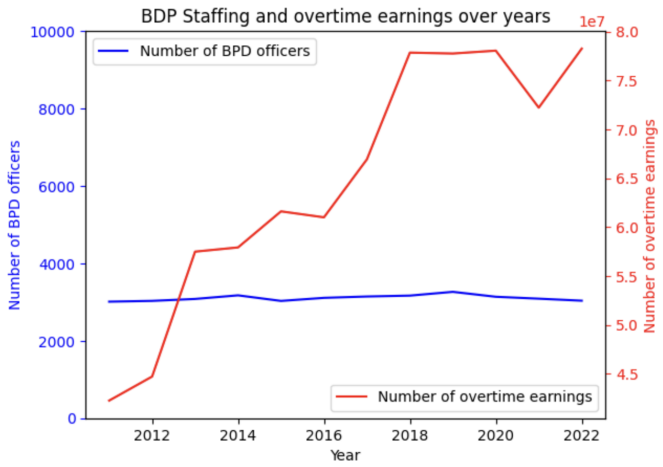
Observations:

- We can see that the pattern for the number of hours paid follows the number of hours worked. In general, the number of overtime hours worked and the number of overtime hours paid both experienced a decreasing trend. On the contrary, the total amount of overtime earnings increased from 2014 to 2022.
- However, if we closely observe the y-axis range, the number of hours worked is much smaller than the number of hours paid, indicating that there exists a waste of money in overtime expenditure to BPD.
- Despite the decrease in the number of hours worked, the total overtime earnings showed an increasing trend. This indicates that there are other factors than overtime hours that financially contribute to the overtime earnings of officers.

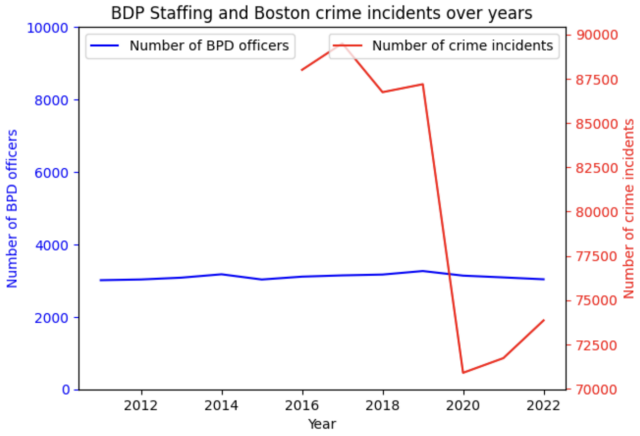
5. Extension Projects

Extension Project 1: Boston Police Department Staffing Analysis	
Extension Pitch	*Investigate the correlation between staffing levels within the Boston Police Department (BPD) and the occurrence of overtime expenditures.* *This extension aims to understand if understaffing is a primary factor contributing to excessive overtime pay, providing insights into workforce management strategies.*
Rationale	*Examining the relationship between staffing levels and overtime spending is crucial for identifying the root causes of inefficiencies and potential misconduct highlighted in recent analyses.* *This extension will contribute to a holistic understanding of the dynamics affecting overtime expenditures during significant social events, helping the BPD optimize resource allocation and improve operational efficiency.*
Questions for Analysis	1. *How does the staffing level within the BPD correlate with the frequency and magnitude of overtime expenditures?* 2. *Analyzing the relationship between the number of police officers and the number of crime incident reports over the years.* 3. *How have different categories of crime incidents evolved from 2015-2022, and what might be the underlying factors influencing these trends?* 4. *How does the distribution of crime incidents across different districts correlate with the allocation of staffing and overtime earnings within the Boston Police Department* 5. *Are there significant differences in overtime spending patterns between BPD and comparable police departments?* 6. *Does the analysis reveal patterns in overtime spending during critical events, such as social protests or major incidents, and how are these patterns linked to staffing levels?*
Data Sets & Sources	1. *Boston Crime Incident Report (Aug 2015 - 2022)* 2. *Portland Crime Incident Report (Aug 2016 - 2022)*

1. ***How does the staffing level within the BPD correlate with the frequency and magnitude of overtime expenditures?***



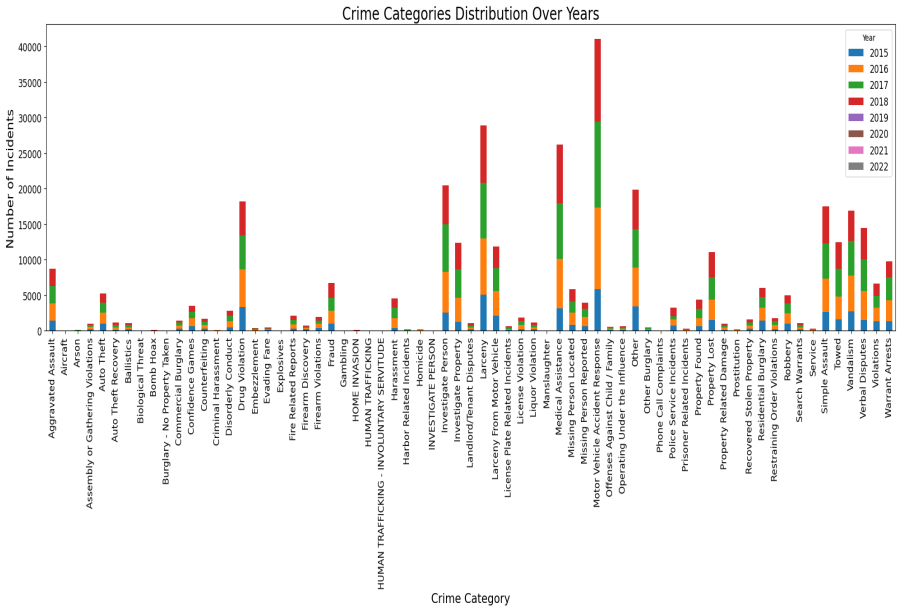
The graph shows that the number of BPD staff stays around the same from year to year. But the number of overtime earnings grew significantly. This indicates that each officer had more earnings on overtime. This can signal that BPD was experiencing short-staffing. Observing the years 2019 to 2020, the number of crime incidents decreased significantly, but overtime earnings still remained within the same range. Thus, there is no obvious relation between understaffing and overtime payments; however, there are similar overtime payments.



2. Analyzing the relationship between the number of police officers and the number of crime incident reports over the years.

We can see as the number of BPD staffing stays around the same value year to year, the number of crime incidents decreased significantly in 2020. However, the decrease in crime incidents does not lead to lower overtime expenditure.

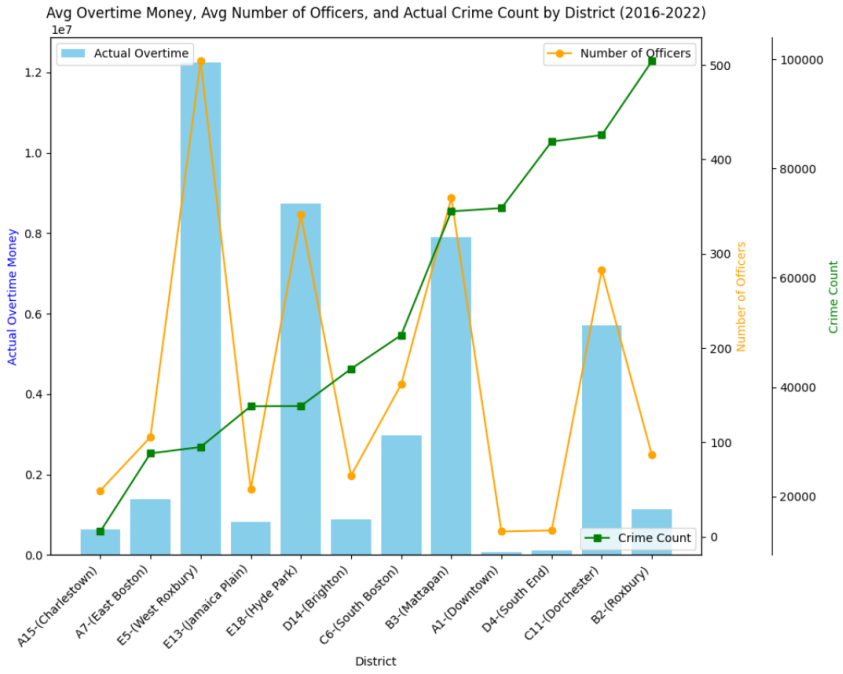
3. ***How have different categories of crime incidents evolved from 2015-2022, and what might be the underlying factors influencing these trends?***



For crime incident reports by categories, it is important to note that most of the reports are for emergency dispatches such as car accidents or requests for medical aid. Incidents that are drug-related, involve larceny/theft, or those

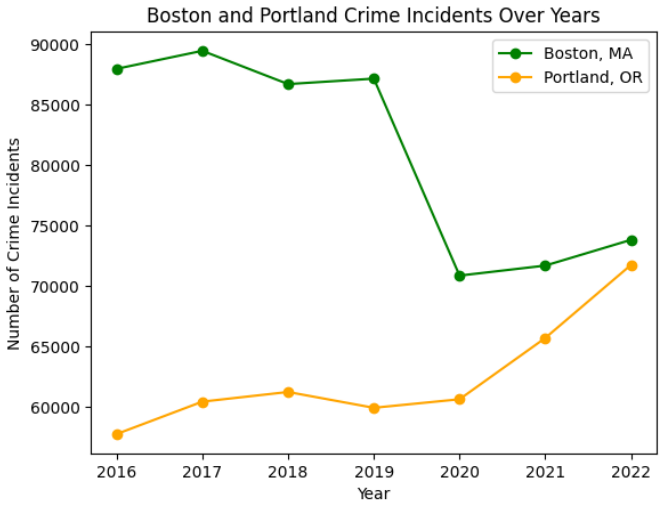
having to do with investigations are the next most common reports. Although the period from 2016-2018 has the most reports, it isn't quite clear why. A possible explanation indicates a gradual rise in reporting that was curtailed by the global pandemic starting in 2019.

4. ***How does the distribution of crime incidents across different districts correlate with the allocation of staffing and overtime earnings within the Boston Police Department?***

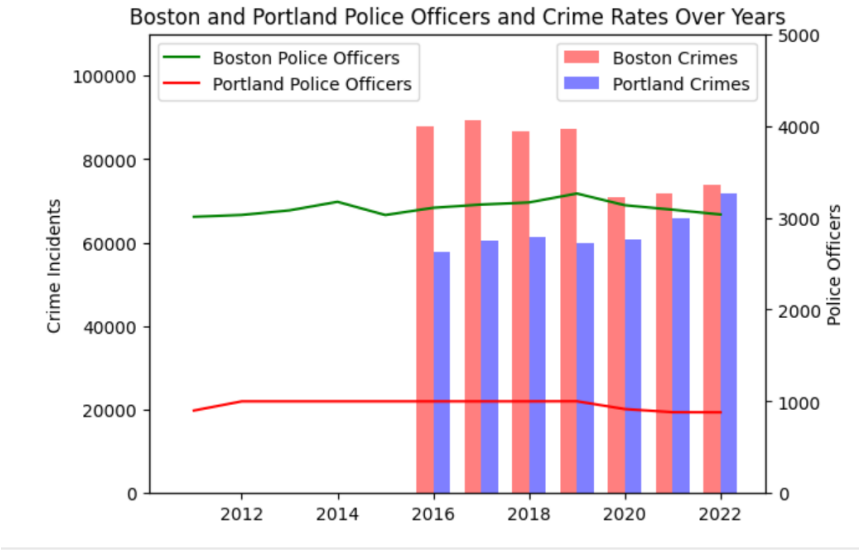


We can see that the amount of money spent on overtime experiences a very similar trend to the number of officers. From the graph, there are higher crime rates in districts with a fewer number of officers. For instance, in Roxbury, the number of officers is small while there is also a high crime rate. However, a district like Mattapan has a higher number of officers yet the crime rate is still high.

5. ***Are there significant differences in overtime spending patterns between BPD and comparable police departments?***



Portland, Oregon was selected due to its population being the most similar to Boston's at around 650k. The data only represents 2016-2022 due to not having access to data prior to these years. Although Boston had almost double the crime incident reports in 2016, Portland has experienced an overall increase in reports while Boston experienced a sharp decrease.

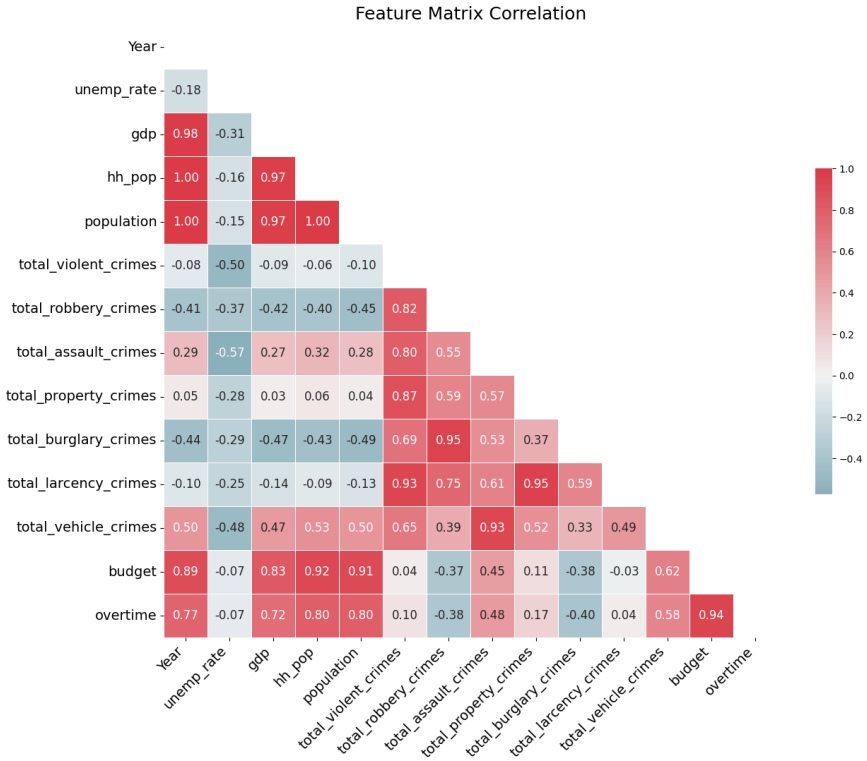


Police understaffing is currently a nationwide issue and doesn't just affect these two departments. Portland PD is regularly said to be offering double overtime as a response to the slow decrease in the number of officers each year. Despite a decline in crime reports, the earnings of BPD officers have seen an upward trajectory while staffing levels have remained relatively unchanged. This suggests that the increase in officer earnings may not be directly linked to heightened workload or understaffing. This could potentially be due to increased revenue streams for both the BPD and the state, with Massachusetts having the 2nd highest GDP per capita of any state. Portland, which is vastly less staffed than Boston, is experiencing a decline in staffing but a rise in crime; a telltale sign of understaffing. Since Boston's staffing is steady while crime is decreasing, it suggests that in the absolute worst case, Boston is adequately staffed.

6. ***Does the analysis reveal patterns in overtime spending during critical events, such as social protests or major incidents, and how are these patterns linked to staffing levels?***

The contrasting trends in crime reports between Boston and Portland during 2019-2020 likely reflect the multifaceted impact of the COVID-19 pandemic and the George Floyd protests. Boston's decline in reports aligns with pandemic-related restrictions that curtailed public activity, whereas Portland's increase may relate to local pandemic responses and intensified public demonstrations. These protests, while mainly peaceful, occasionally escalated to violence, prompting a surge in police presence and, consequently, overtime spending. These events also brought policing practices into the public spotlight, potentially affecting crime reporting and necessitating adaptive law enforcement strategies to maintain public order and community trust.

Extension Project 2: Predicting BPD Total Overtime Earnings for 2024	
Topic Statement	*This project extension aims to analyze and predict the overtime earnings of the Boston Police Department (BPD) for 2024, utilizing the data between 2013-2023 and projected data for 2024.*
Rationale	*The prediction of 2024 overtime earnings is vital to addressing the BPD's financial planning needs in the context of evolving economic conditions and historical spending patterns.* *By accurately predicting the total overtime earnings for 2024, this extension will enable the BPD to plan its budget more effectively, ensuring resources are allocated efficiently while maintaining operational readiness.*
Key Interest	*The central interest of the extension is to understand the trends and drivers behind BPD's overtime costs, thereby enabling better resource management, accountability, and transparency in public spending.*
Model	*The Linear Support Vector Regressor (LinearSVR) model is a statistical tool that projects past overtime expenditure data to forecast future spending. We have trained the model based on data between 2013-2023. The decision to use this particular model was made by extensively testing various options. By setting the random state property of LinearSVR to 42, we ensure the reproducibility of our predictions, maintaining consistency in our analytical process.*



The FRED Boston GDP 2013-2023 World population (Boston Population 2013-2023) dataset was used to make predictions for 2024. This graph reveals a robust positive correlation between the Boston Police Department's (BPD) budget and overtime spending, suggesting that budget increases are closely linked to rises in overtime costs. This

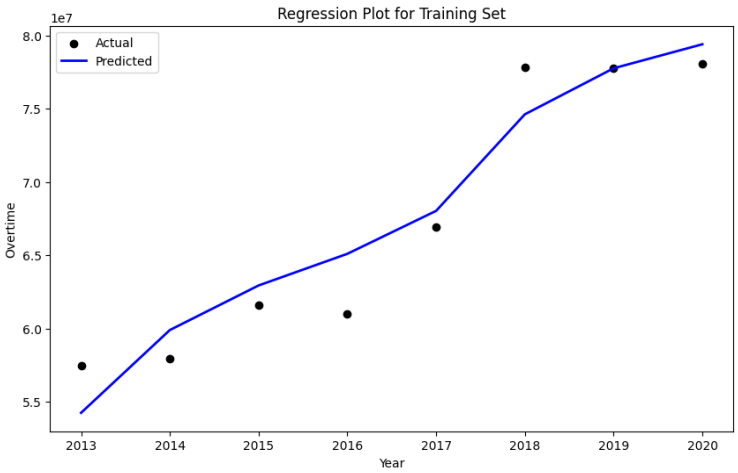
correlation may indicate opportunities for the BPD to enhance financial efficiency. The economic data showed the highest correlation with overtime earnings. The varied relationships between economic indicators and crime rates reflect the complexity of factors influencing crime, challenging the assumption that economic performance straightforwardly affects crime occurrence and police resource allocation.

Features:

The selection of features for model training mainly depended on the availability of the data for 2024 and the connection of those features and total BPD overtime earnings data. The data used for model selections includes Boston's GDP, population, unemployment rate, and BPD budget.

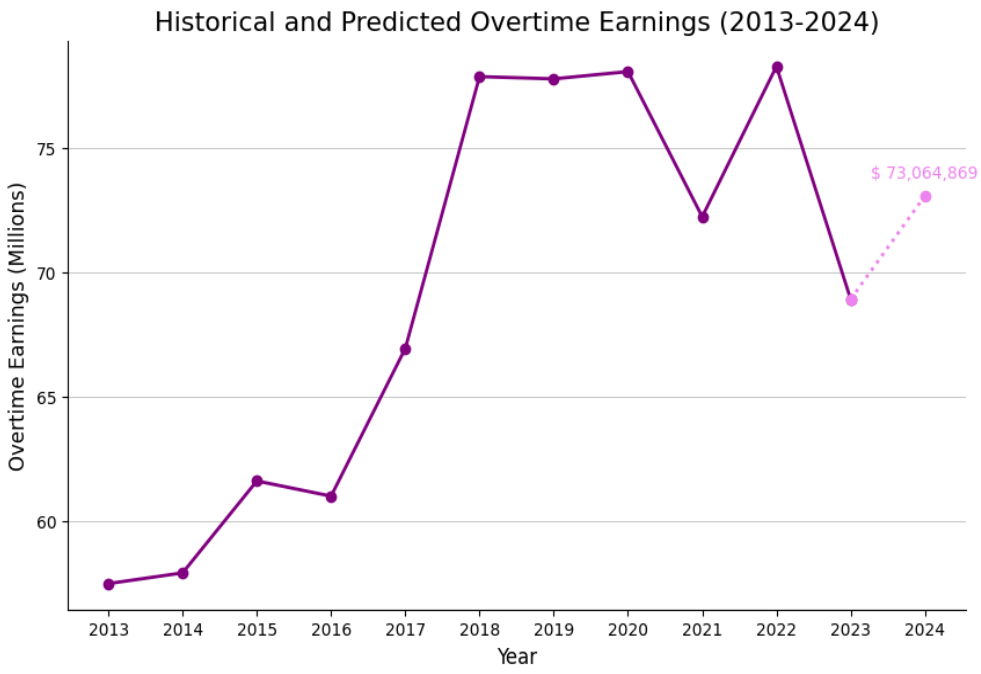
Projection and Missing Data:

- **Population**
  - Population data has provided Boston's population with every 10-year mark. Therefore, we used linear interpolation to find the values of each individual year.
  - A projection of Boston's population data was provided in the source of population data.
- **Unemployment rate**
  - Due to missing values of unemployment for years 2020-2023 we have used the average value of all existing data.
- **GDP**
  - To get the projection data of Boston's GDP and unemployment rate, we used research done by UMASS Amherst.
- **Budget**
  - All the budget data, including the projection, was retrieved from the government website.



Results:

When testing the model, we have used Mean Absolute Percentage Error (MAPE) as the primary evaluation metric. It has performed relatively well, with a MAPE score of 0.041% on the training and 0.034% on the testing sets. These results indicate the somewhat high accuracy of the model and no overfitting. The final prediction of the model for 2024 total BPD overtime earnings was $73,064,869.



The graph showing past and predicted overtime spending might help the Boston Police Department (BPD) see trends and plan for the future. It highlights when spending has gone up, which might be linked to events like festivals or more crime. This information helps make better policies and ensure money spent on overtime is helping to improve community safety. In short, this graph is a valuable guide for the BPD to use its budget wisely and meet its goals.

6. Data Limitations

While our research aims to provide comprehensive insights into the financial dynamics of the Boston Police Department (BPD), it is imperative to acknowledge certain limitations inherent in the available data.

Firstly, the accuracy and completeness of our findings are contingent upon the quality of the data provided by the BPD. Any discrepancies, inaccuracies, or omissions within the official records may impact the precision of our analysis.

Secondly, the scope of our study relies on the data accessibility and transparency of the BPD. If specific financial or staffing details are not publicly disclosed or available, it may result

in data gaps, potentially limiting the depth of our exploration. Additionally, the availability of the dataset on the racial and demographic makeup of officers poses a challenge to us. Access to such detailed information is crucial for addressing questions like whether certain officers, based on characteristics such as race, age, gender, tenure, or rank, are more likely to exhibit lower worked-to-paid ratios. Without this granular data, our ability to provide nuanced insights into potential disparities is constrained.

Additionally, the complexity of policing practices and budgeting intricacies may introduce inherent ambiguities in the data. Interpretation of terms such as "wasteful spending" or nuanced aspects of overtime allocation might be subject to varying definitions, affecting the clarity of our findings.

Furthermore, our project extension, aimed at determining if the BPD is understaffed and if understaffing contributes to excessive overtime spending, faces constraints in accessing comparable datasets from police departments in other cities of similar size to Boston. The absence of such comparative datasets hinders our ability to conduct a more thorough analysis and draw meaningful conclusions regarding staffing levels, crime rates, and overtime expenditures.

Despite these limitations, we strive to conduct a robust analysis within the confines of the available data, recognizing that the results represent a snapshot based on the information accessible during our study and acknowledging their potential impact on the depth and scope of our findings.

7. Future Proposal

Based on the findings from our analysis and the limitations, we propose several future research directions for further understanding of the financial operations within the Boston Police Department (BPD) and to improve the predictive accuracy for overtime spending:

A. Data Quality Improvement

To address potential discrepancies and inaccuracies, future research should include a collaboration with the BPD to establish a comprehensive data quality improvement program. This initiative would aim to standardize data collection and record-keeping processes, ensuring the reliability and completeness of the datasets.

B. Demographic Data Analysis

To better understand BPD spending and earnings, future projects should seek access to detailed demographic data of officers. This would allow for a more in-depth analysis of overtime distribution and pay across different officer groups.

C. Public Engagement

Integrating community feedback into research can result in a more grounded understanding of how policing practices affect different neighborhoods and demographics. Establishing community-engaged research practices can also enhance the transparency and accountability of BPD spending.

8. Conclusion

Based on the observations and assumptions made above, several conclusions about the trends and patterns within the Boston Police Department (BPD) can be as follows:

Year-over-Year Change in BPD and Non-BPD Paychecks

- BPD earnings have been increasing over time, with a notable spike between 2020 and 2022 due to an exceptional case of a gender discrimination lawsuit settlement.
- The average earnings for BPD officers are significantly higher (about double) compared to non-BPD city workers. This disparity suggests that BPD officers are compensated at a much higher rate than other city employees, possibly reflecting the different nature and demands of their roles.

Injury Pay Among BPD Officers

- The observed trends in injury pay among Boston Police Department officers suggest a complex interplay of factors.
- The increase in injured earnings and the heightened proportion to total earnings underscore the importance of effective management and budgetary considerations.
- The variability in injury pay percentages, especially during significant events like the Black Lives Matter movement and the pandemic, indicates the sensitivity of these trends to external circumstances.
- While there are correlations between social events and injury pay spikes, establishing direct causation requires thorough investigation and concrete evidence. The findings emphasize the need for ongoing monitoring, policy adjustments, and support mechanisms to address the evolving challenges faced by police officers and to ensure fair and adequate compensation for injuries incurred in the line of duty.

Overlap Between Frequent Overtime Users and High Salary Officers

- There is a strong likelihood (>50%) that officers with high incomes are also frequent users of overtime. This could indicate that high-income officers are more inclined or able to take on additional hours.
- However, frequently taking overtime does not necessarily correlate with high income, suggesting that overtime hours might not be the primary factor driving total earnings among BPD officers.

Overtime for Court Appearances

- Overtime for court appearances typically doubles the work hours, likely due to policies like the 4-hour minimum court appearance rule.

- Notable fluctuations in court-related overtime hours across years, with peaks and troughs corresponding to events like the COVID-19 pandemic, indicate external factors significantly impact these overtime hours.
- The total number of overtime paid hours and overtime worked hours reported decreased over the years. However, the ratio between the overtime paid hours and overtime worked hours increased from 1.8 to about 2.6 from 2012 to 2022. Additionally, the average overtime earnings per officer experienced an increase over the time period.

Overtime Hours Paid, Overtime Hours Worked, and Overtime Earnings

- There is a decreasing trend in both the number of overtime hours worked and the number of overtime hours paid by the BPD from 2014 to 2022. Despite the decrease in overtime hours, the total overtime earnings have increased, suggesting that the cost per overtime hour has gone up.
- There is a discrepancy between the number of overtime hours paid and the number of hours actually worked. This suggests potential inefficiencies or overestimations in the overtime pay system, possibly leading to financial waste.
- The increase in total overtime earnings despite fewer hours worked suggests that other factors besides the number of hours are contributing to the increase in overtime costs. This could include increased overtime rates, changes in staffing policies, or other operational changes.

In summary, the data indicates that BPD officers generally earn significantly more than other city employees, with overtime and injury pay contributing notably to their total earnings. The system of overtime compensation, especially in relation to court appearances, has inefficiencies. Additionally, there is a complex relationship between overtime work and overall income among officers, with high earners likely to work more overtime but not all frequent overtime workers being high earners.

9. Individual Contributions

[Nurassyl Medeu]

- Assisted with data processing and cleaning
- Reorganize the old workspace, condensing and moving the working code to a new code space
- Performed analysis on BPD and non-BPD paychecks 2011-2022, determining the early change of average paychecks of BPD employees and non-BPD employees
- Performed Statistical Analysis of Campaign Contribution data 2011-2022, calculating and plotting the average amount contributed by BPD employees and non-BPD employees
- Initiated presentation slides and performed recording edits.

[Jiawei Sun]

- Assisted with data processing and cleaning.

- Conducted general analysis on Total Earning Data from 2011-2022, Campaign Contribution for different types, Internal Affairs from 2001-2020, and Crime Recorded from 2015-2022.
- Analyzed trends of total earnings and overtime earnings over years
- Calculated the percentage breakdown of individual earnings.
- Examined the percentage increment of personal earnings over time.
- Performed analysis on the amount of overtime hours paid and overtime hours worked.
- Analyzed the overtime ratio from 2013 to 2022 and examined the outliers. (eg. 35000 overtime earnings per hour)

[Truc Duong]

- Assisted with data preprocessing and cleaning, performing research for new datasets (crime incidents, officers, court, etc)
- Analyzed Regular pay v. overtime pay of BPD paycheck change year-over-year
- Analyzed police total earning statistics (max, min, average, standard deviation) of police officers change over years from 2011-2022
- Performed Statistical Analysis on BDP Earning Data, Overtime, and Regular Earning changes from 2011-2022 (determined average total earnings of a police officer, analyzed changes in average total earnings, examined detailed statistics for police earnings)
- Analyzed differences in overtime type in the overtime dataset
- Calculated overtime for court appearances change year-over-year, and created the distribution of overtime worked and overtime paid in the court OT dataset.
- Initiated project extension, created line visualizations, and produced preliminary observations

[Can Wang]

- Analyze data for injury payment and injury payment ratio 2011-2022.
- Analyze data for the injury ratio of BPD officers per the year 2011-2022
- Did research related to injury ratio and injury payment?
- Assesses if BPD officers have had better subsidies since 2011.
- Research on the ranks of officers and their payment.
- Adding analysis related to the frequency of overtime and highest payment.

[Al Mbaye]

- Performed Statistical Analysis on Total Spending by Category from 2011-2022, determining the amount of total spending of each category, and the average amount of spending of each category
- Performed Statistical Analysis on Total Earning by Category from 2011-2022 (determined the number of total earnings of each category, the average amount of earnings of each category, a ranking of total earnings, and a ranking of total earnings adjusted for inflation)
- Helped with data preprocessing for court overtime
- Imported and pre-processed data for internal affairs officer complaints

- Found an overlap between frequent overtime users and officers with internal affairs complaints
- Implemented analysis on the project extension