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## CRIME FREQUENCY DURING COVID-19 AND BLACK LIVES MATTER PROTESTS

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### ABSTRACT

COVID-19 disrupted daily life within the United States and around the world when government restrictions were implemented. During the onset of the pandemic, social unrest developed after the death of George Floyd. Our objective was to study the crime rate during the pandemic and social unrest that resulted after the death of George Floyd. We used data from four cities heavily affected by the pandemic and social unrest: Seattle, San Francisco, Los Angeles, and Philadelphia. Holt-Winters and SARIMA models were used to see if there was any change in crime during the pandemic and social unrest in addition to before and after the social unrest. Los Angeles had the lowest crime frequency of the four cities, whereas Philadelphia had the highest frequency. All Holt-Winters models and SARIMA models showed that around January 2020, when the first COVID-19 case occurred, crime was the same for all four cities except Philadelphia, where crime had dropped for a particular time until it increased again. There was no clear evidence to suggest that crime was affected during the COVID-19 pandemic and the social unrest during the protests.

**Keywords** *COVID-19, crime, Black Lives Matter, protests, social unrest, SARIMA, Holt-Winters.*

### 1. Introduction

As COVID-19 spread from Wuhan, China, to the entire world, the United States not only had to start dealing with the spread of the virus but also dealt with the rise in social unrest over police brutality. The first reported case was on January 20, 2020, in Seattle, Washington, cited in [Ashby \(2020\)](#). Various observations have been made about the number of reported cases and deaths in the United States. [USAFacts \(n.d.\)](#) estimated 24,603,888 known cases, 170,957 reported cases, 409,728 known deaths, and 3,342 newly reported deaths on January 23, 2021. The [Centers for Disease Control and Prevention COVID Data Tracker \(n.d.\)](#) reported 24,876,261 cases and approximately 171,844 new cases; 416,010 deaths and approximately 3,414 newly reported deaths. The [COVID Tracking Project \(n.d.\)](#) launched by *The Atlantic* had reported 24,800,354 cases, 142,949 new cases, and 410,212 reported deaths.

Last, the John Hopkins University COVID-19 Dashboard reported 25,128,825 cases and 419,228 deaths (Johns Hopkins University 2021). On February 29, 2020, the United States recorded its first death and announced travel restrictions (Campedelli et al. 2021). To prevent the spread of COVID-19, social distancing and lock-down policies were issued throughout the United States as it began to spread. Social distancing measures included a mandate that individuals maintain a distance from one another when in public, limitations on gatherings, operation of businesses, and instructions to remain at home (Mohler et al. 2020). Distancing measures simultaneously affected the daily routines and social interactions of millions of people (Campedelli et al. 2021). Daily commuters were forced to spend their days at home; household members shared the same living spaces throughout the entire day; people could not connect to their peers in person but only telematically (Campedelli et al. 2021). Eventually, these restrictions changed when social unrest occurred.

The occurrence of social unrest within the United States started on May 25, 2020, when George Floyd was killed by a police officer from the Minneapolis Police Department, cited in Dave et al. (2020); the officer was eventually charged with murder, cited in Dave et al. (2020). The protests demanded police reform. The first protest took place in Minneapolis, Minnesota, the day after the incident on May 26, 2020 (Dave et al. 2020). By June 16, 2020, the rise of protests had begun nationwide, primarily within larger cities; many lasted more than 3 days and one third saw at least 1,000 participants (Dave et al. 2020). Researchers at the [Armed Conflict Location and Event Data Project \(2020\)](#) analyzed more than 7,750 demonstrations from 2,400 locations between May and August, and found that less than seven percent of the protests were violent (Li 2020). Despite the media focus on looting and vandalism during the protests, there is little evidence to suggest that the demonstrators engaged in widespread violence (Armed Conflict Location & Event Data Project 2020). In addition, when demonstrations did turn hostile, there were reports of infiltrators having instigated violence (Armed Conflict Location & Event Data Project 2020). Between May 24 and August 22, more than 360 counter-protests were recorded around the country, accounting for nearly 5% of all demonstrations (Armed Conflict Location & Event Data Project 2020). Of these, 43–nearly 12%–turned violent (Armed Conflict Location & Event Data Project 2020).

During the pandemic, many states had issued a state of emergency and had set out guidelines to reduce the spread of the virus. Since these guidelines were issued, some academic literature has claimed that crime had decreased, whereas others have claimed that there was no decrease for particular crimes. San Francisco experienced a 43% decline, cited in Felson et al. (2020). New York, San Francisco, Los Angeles, Chicago, and Philadelphia all reported declines in assault/battery and robbery (McDonald and Balkin 2020). According to Abrams (2021), Pittsburgh, New York City, San Francisco, Philadelphia, Washington D.C., and Chicago experienced a drop in overall crime rates above 35%; Cincinnati and Seattle did not see a notable difference. The specific type of crimes that experienced a large decline was theft (28%), simple assault (33%), and rape (38%) Abrams (2021). Meanwhile, other crimes had major increases: commercial burglaries (38%) and car theft in certain cities (Abrams 2021). Violent and property crime saw a 19% decline (Abrams 2021). The sharp rise of nonresidential burglaries is likely associated with property damage and looting at the beginning of protests against police violence, cited in Zhang et al. (2020) For Philadelphia, Los Angeles, and Chicago, there was at least a 25% decrease in stops by the police except for Seattle (Abrams 2021). Cassell (2020) reported an increase in homicides and shootings across the country, starting in late May and continued through June and July 2020. Ashby (2020) reported that there was no evident relationship between COVID-19 and any type of crime between the first case within the United States on January 20 and the beginning of March.

This study examined the changes in the rate of crime during the pandemic and periods before and after social unrest. Based on data collected from January 2018 to after the onset of the social unrest, Seattle, San Francisco, Los Angeles, and Philadelphia were chosen. Holt-Winters and SARIMA models were used to measure crime during the pandemic and before and after social unrest. Data visualizations were then used to determine the areas where crime was most prevalent. This might help reduce crime even further if we know what areas are heightened by crime and what prevents individuals from committing crime.

## 2. Main Text and Analysis

Crime data recorded by each city's police department was collected by using the Open Data sites of the four cities mentioned in this study. To acquire the needed information for Los Angeles, we had to combine two datasets because the Open Data site did not contain one dataset with the relevant data. The pre-processing procedures were executed by using the Python programming language in a Jupyter notebook. Crimes were studied in a generalized sense rather than by selecting a specific one. Because both the pandemic and social unrest are considered different types of events, analyzing the effects of crime rate for both may not provide sufficient information. To address this issue, we developed two cases to see a proper estimate of the frequency of crime before and after the pandemic and

Table 1: The training and test data frequencies for each city and both cases.

Case	Training Set	Test Set	Dates for		
			Training Set	Dates for Test Set	Dates for Test Set
1	Seattle	750	367	Jan 1, 2018–Jan 20, 2020	Jan 21, 2020–Jan 21, 2021
	San Francisco	750	370	Jan 1, 2018–Jan 20, 2020	Jan 21, 2020–Jan 24, 2021
	Los Angeles	750	364	Jan 1, 2018–Jan 20, 2020	Jan 21, 2020–Jan 18, 2021
	Philadelphia	750	370	Jan 1, 2018–Jan 20, 2020	Jan 21, 2020–Jan 24, 2021
2	Seattle	876	241	Jan 1, 2018–May 25, 2020	May 26, 2020–Jan 21, 2021
	San Francisco	876	244	Jan 1, 2018–May 25, 2020	May 26, 2020–Jan 24, 2021
	Los Angeles	876	238	Jan 1, 2018–May 25, 2020	May 26, 2020–Jan 18, 2021
	Philadelphia	876	244	Jan 1, 2018–May 25, 2020	May 26, 2020–Jan 24, 2021

the recent civil unrest. Case 1 focuses on the dates before the pandemic started (January 1, 2018) and the date of the first COVID-19 case in the United States (January 21, 2020). The test data was obtained between the dates of January 21, 2020, and the present time. Through the analysis of case 1, it is expected to see how the coronavirus pandemic had affected the crime rate. In case 2, we focused on the dates between before the pandemic began (January 1, 2018) and when George Floyd died (May 25, 2020). Dates between May 26, 2020, and the present were used to generate the test data. The training and test data frequencies for case 1 and case 2 are shown in Table 1.

The Holt-Winters model for case 2 (Figure 2) shows identical results as case 1 (Figure 1). For case 2, the focus is the day of George Floyd’s death (May 25, 2020) and the subsequent social unrest. Seattle’s crime rate spiked to nearly 800, with an eventual decline after May 2020. San Francisco experienced a slight increase, with a frequency near 400. Los Angeles had the lowest crime rate, below 200, with a slight uptick between May 2020 and September 2020. Philadelphia had a frequency of 400, with an eventual increase after May 2020 to above 800, and sometime after September 2020, reached precisely 800. The SARIMA models (refer to Figures 3 and 4) demonstrate identical outcomes as the Holt-Winters models in both cases. Bar charts and lollipop charts were used to indicate crime-prone areas because the aforementioned models did not reveal such information. The first bar chart (Figure 5) shows the number of crimes versus the types of locations in Los Angeles. The Public Transportation - MTA Line Specific area is the most crime-prone in Los Angeles. Religious institutions, government, and entertainment are the areas with the least crime. It would have been interesting to see what specific crimes occurred where. In Seattle and Los Angeles, we examined which neighborhoods had the highest crime rate. The 77th Street neighborhood in Los Angeles (Figure 6) had the highest incidence of crimes, exceeding 6000, whereas the Devonshire neighborhood had fewer. Meanwhile, Seattle’s Queen Anne neighborhood (Figure 7) had the highest number of crimes, exceeding 8000, whereas the Commercial Harbor Island and Commercial Duwamish neighborhoods had fewer. San

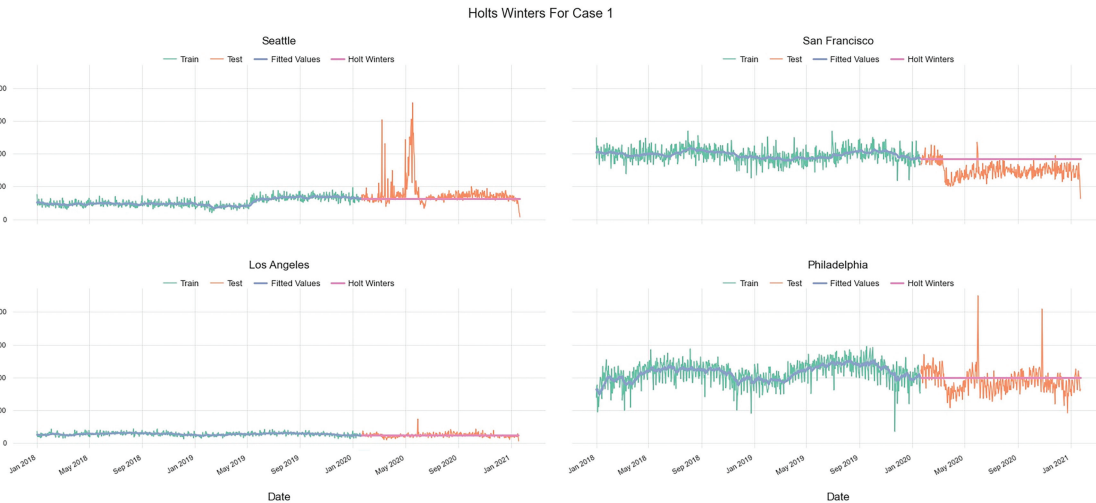


Figure 1: Holt Winters for case 1. Holt-Winters plots for all four cities for case 1.

Holts Winters For Case 2



Figure 2: Holt Winters for case 2. Holt-Winters plots for all four cities for case 2.

SARIMA For Case 1



Figure 3: SARIMA for case 1. SARIMA plots for all four cities for case 1.

SARIMA For Case 2



Figure 4: SARIMA for case 2. SARIMA plots for all four cities for case 2.

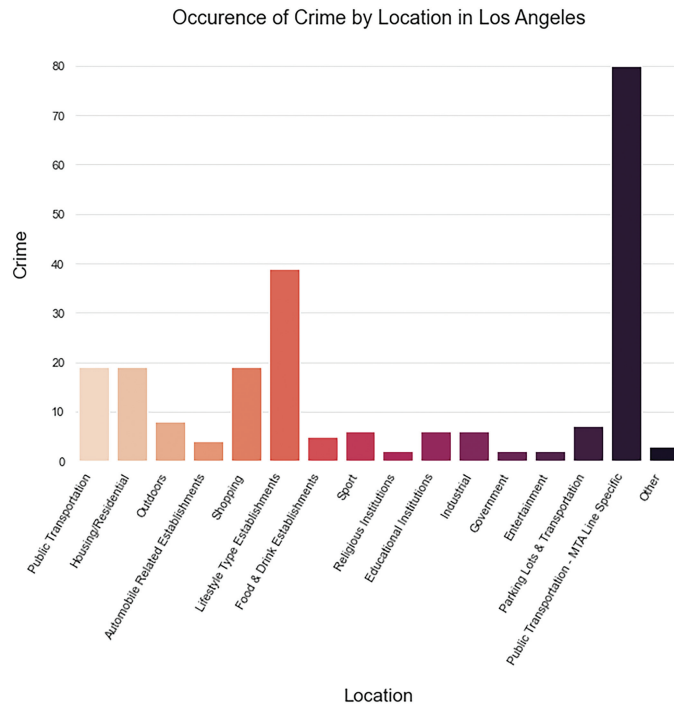


Figure 5: Occurrence of crime by location in Los Angeles. Bar plot, showing the crime frequency based in each type of physical location in Los Angeles.

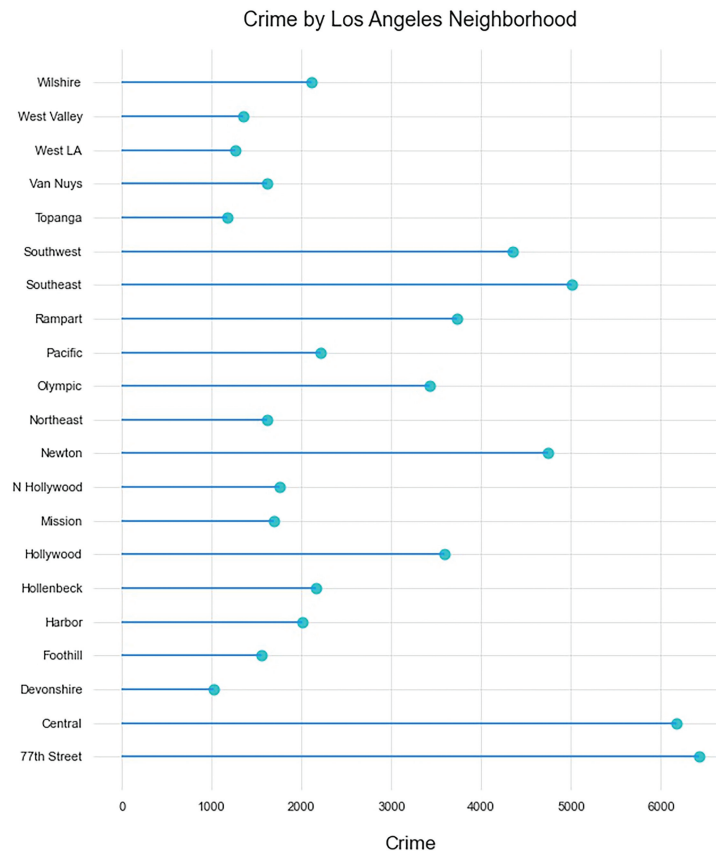


Figure 6: Crime by Los Angeles neighborhood. Lollipop chart, showing the number of crimes within each Los Angeles neighborhood.

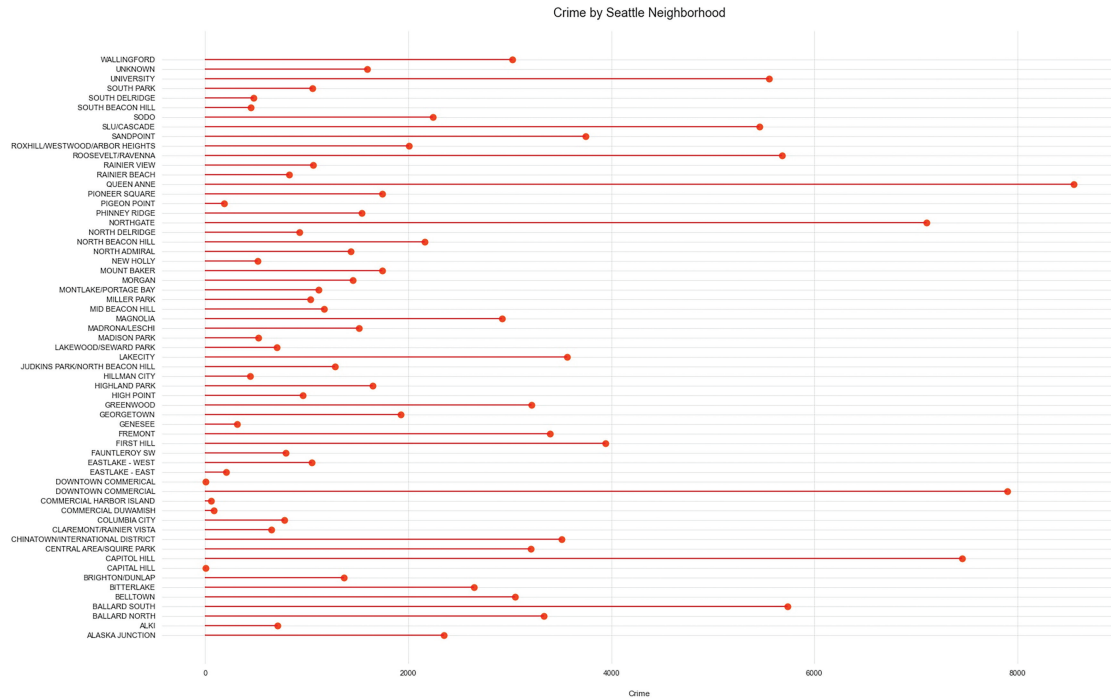


Figure 7: Crime by Seattle neighborhood. Lollipop chart, showing the number of crimes within each Seattle neighborhood.

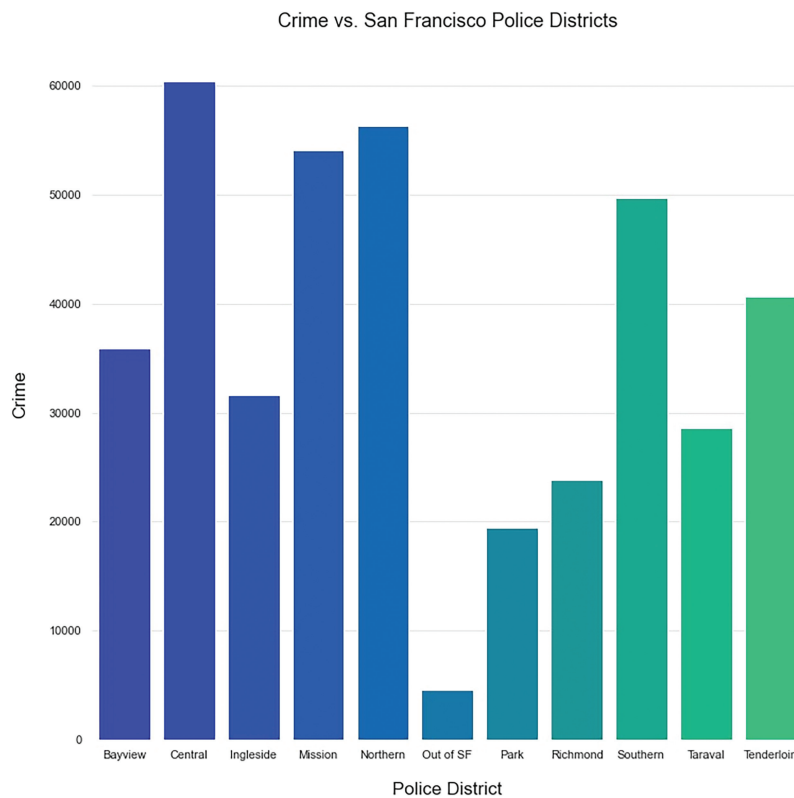


Figure 8: Crime vs. San Francisco police districts. Bar chart, showing the number of crimes within each San Francisco Police District.

Francisco's Central police district had the most crimes compared with other police districts in the city, as shown in Figure 8. The Holt-Winters model used for Los Angeles' training data had the best mean error value, of  $-0.05$ , for both case 1 and case 2 when evaluating the models presented in Tables 2 and 3 (as shown in the Appendix section).

### **2.1. Internal and External Threats to Validity**

There are no internal validity threats present in this research because the research question was answered by using available datasets. It is uncertain if these datasets obtained from existing resources contain inaccurate information. In addition, the external validity of this research may be at risk due to the use of only four datasets. To perform a comprehensive analysis and generalize this research, more datasets from various cities would be required.

## **3. Conclusion**

Based on our analysis, Philadelphia had the highest crime frequency, whereas Los Angeles had the lowest crime frequency. Public areas, including public transportation, especially MTA transportation lines were hot spots for crime in Los Angeles. The 77th Street neighborhood in Los Angeles and the Queen Anne neighborhood in Seattle had the largest number of crimes. San Francisco's Central police district had the most crimes. Despite widespread media coverage of the rioting and vandalism that occurred, the claims were not entirely accurate. There was no significant evidence that indicated any changes in crime within any of the four cities during the pandemic, although we did see a brief uptick in crime during the protests.

There is no actual evidence that suggests how crime behaves during a massive pandemic, however, there is evidence that suggests that crime does change during a massive change in routines (Abrams 2021). For a crime to occur, there must be an opportunity, a potential victim, and a proper location. When neither of these are available, a crime cannot be committed. Due to the restrictions in place, it is difficult for many types of criminal offenses to occur. Social distancing has made it difficult for attractive areas (bars, nightclubs, stores, malls, etc.) for criminal offenses to occur because these places have attracted fewer people. According to Campedelli et al. (2021), members of a community can be modeled as potential offenders, potential victims, and potential guardians, moving around and interacting in a socio-geographical space. In moving from these premises, routine activity theory postulates that offenders and victims (or targets) usually meet during daily, non-criminal activities (Campedelli et al. 2021). Behavioral decisions then determine how the various agents react to each other's presence and actions (Campedelli et al. 2021). Crime occurs in the context of the everyday routines as the three factors converge in space and time: a motivated offender, a victim or potential target, and the absence of a capable guardian (Campedelli et al. 2021). Crime is known to be heavily context dependent, and the contexts of different cities vary considerably (Ashby 2020). Crime opportunities and places where crimes occur are likely to change drastically from past observations and experiences (Ashby 2020).

Understanding relationships between COVID-19 and crime requires some estimate of how much crime would be expected to occur in the absence of the pandemic (Ashby 2020). This is difficult because so many factors influence how much crime occurs (Ashby 2020). There is considerable variation in the nature of violent crimes, from those with greater financial incentive, such as robbery, to those that are often associated with alcohol or drug use, such as assault (Abrams 2021). Assaults with a deadly weapon, homicides, burglaries, intimate partner assaults, and stolen vehicles do not report any significant effect (Campedelli et al. 2021). There is an extensive agreement over the fact that burglars prefer to target unoccupied homes (Campedelli et al. 2021). People forced at home will guard their houses for longer hours, minimizing their exposure to burglaries (Campedelli et al. 2021). There was an increase in non-residential burglaries because individuals spent more time at home and other buildings were left less occupied. The results for car theft and theft from cars varied substantially by city (Abrams 2021). Drops in drug crimes were by far the greatest, with most cities reporting data that showed massive declines of more than 65% (Abrams 2021). Police departments modified policies, including de-emphasizing particular types of crimes, such as drugs (Abrams 2021), and no longer making arrests for some crimes (Abrams 2021). Jails and prisons have seen some of the most severe outbreaks and, as such, a number have released inmates early (Abrams 2021). Courts shut down and deferred cases (Abrams 2021), which may result in fewer prosecutions (Abrams 2021). Together, this has resulted in a change in the opportunities for crime, probability of observation, capture, arrest, prosecution, and penalty (Abrams 2021).

Results of this study suggest that policing should be focused on areas most likely prone to crime, even during a pandemic, to prevent crime from ever happening. We were not able to find clear data on the type of victims, depending on the specific crime and location. This type of data would have further helped see more information on the sort of crimes that would have affected the population within all four cities. For instance, if the 77th street neighborhood in Los Angeles were having more theft specifically within public areas, then more guardianship or policing within that

area would be needed. It would have been interesting to see what specific crimes occurred in which sort of location. There was no significant evidence that suggested that crime was severely impacted during the pandemic. All the cities showed a temporary rise in crime frequency during the protests and social unrest, returning to their previous levels thereafter. Future research should further investigate which locations were possibly impacted by crime during the pandemic because areas with a lack of policing might have been impacted during the pandemic and even the social unrest that previously took place. This sort of data would help understand which areas needed more policing so crimes would eventually decrease overtime. Crime rose as a result of police resources being redirected to areas where the protests occurred, while areas that were typically policed were neglected. When those areas were being policed, there was a control on the frequency of crimes that took place, hence making communities much safer and livable.

## Appendix

Table 2: Accuracy score for all models for each city for case 1.

City	Model	Training Set					Test Set				
		MAPE	MAE	ME	MPE	RMSE	MAPE	MAE	ME	MPE	RMSE
Seattle	Holt-Winters	26.25	12.62	0.299	-5.96	84.42	20.33	37.12	28.49	6.21	84.42
	SARIMA	27.09	15.79	1.35	-4.89	22.58	22.71	36.56	10.59	-7.18	81.84
San Francisco	Holt-Winters	9.27	29.63	-93.88	-1.38	39.01	27.81	74.96	-70.25	-26.70	84.89
	SARIMA	11.74	41.98	6.47	0.487	68.96	26.06	70.75	-62.49	-24.05	82.85
Los Angeles	Holt -Winters	17.54	7.57	-0.05	-3.96	11.65	18.81	8.39	-0.165	-6.08	11.65
	SARIMA	18.73	8.76	1.07	-1.86	11.98	21.85	9.15	-3.16	-12.67	12.43
Philadelphia	Holt-Winters	16.05	43.88	0.885	-3.11	75.30	16.05	56.21	-20.69	-9.02	75.30
	SARIMA	18.61	52.56	6.24	-1.82	73.74	19.23	67.69	-34.49	-12.81	85.59

Table 3: Accuracy score for all models for each city for case 2.

City	Model	Training Set					Test Set				
		MAPE	MAE	ME	MPE	RMSE	MAPE	MAE	ME	MPE	RMSE
Seattle	Holt -Winters	35.57	18.96	0.709	-11.80	139.32	115.59	136.99	-136.99	-115.59	139.32
	SARIMA	37.98	22.84	0.198	-12.29	43.97	269.34	332.17	-332.17	-269.34	351.49
San Francisco	Holt -Winters	14.55	29.92	-84.83	-2.85	38.99	9.46	27.95	10.49	1.95	37.99
	SARIMA	15.18	39.58	5.63	-1.05	65.42	11.72	34.82	25.38	7.05	44.91
Los Angeles	Holt -Winters	19.77	7.45	-0.05	-4.65	12.86	17.39	8.69	3.29	1.18	12.86
	SARIMA	20.38	8.48	0.902	-2.79	11.57	17.89	9.11	5.29	5.46	13.53
Philadelphia	Holt -Winters	17.36	43.77	0.588	-3.42	74.65	14.14	50.35	-16.74	-7.73	74.65
	SARIMA	18.08	50.51	6.20	-2.04	70.29	13.11	48.12	-4.29	-4.28	73.10

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