Covid-19 Confirmed Cases and Incidents of Crime in Hartford. CT

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Introduction

In the nearly two years since the Covid-19 outbreak, the pandemic is affecting every aspect of our lives. And data analysis related to the Covid-19 pandemic is increasing and the coverage is getting broader, including employment rates, traffic conditions, restaurant ratings, and vaccines, etc. At the same time, some changes have taken place in social security during the pandemic period, which are precisely related to people's daily life. (*Council on Criminal Justice. 2021*) The safety and crime rate of an area are critical to the quality of well-being of local people, and they are also important human-centered concerns. Exploring crime patterns during the pandemic can contribute to providing a basis for crime control strategies. So, I believe it is necessary and meaningful to explore the impact of the Covid-19 pandemic on crime and community safety.

Since last year, governments around the world have implemented lockdowns and mask mandate due to the Covid-19 pandemic, and the impact of these policies on people's lives has gradually become apparent over time. As a human-centered data science project, this study is aimed at exploring the impact of Covid-19 mask mandate on local security and whether there is a correlation between the two factors. The main target location for the research is Hartford city, Connecticut.

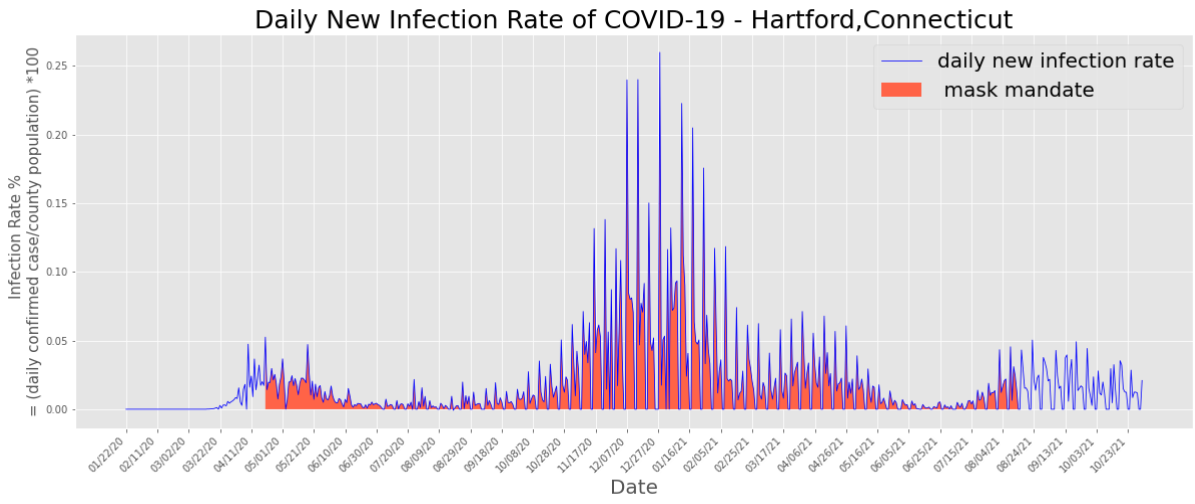
The results of this project showed that there was no significant correlation between the number of crimes and the number of confirmed cases in Hartford. There is a difference in crimes' volume before and after the Covid-19 pandemic, but it is not significant. Meanwhile, through this project, I have completed a practice and application of human-centered data science. The research process deepened my understanding of what I learned in class and expanded my knowledge.

Background & Related Work

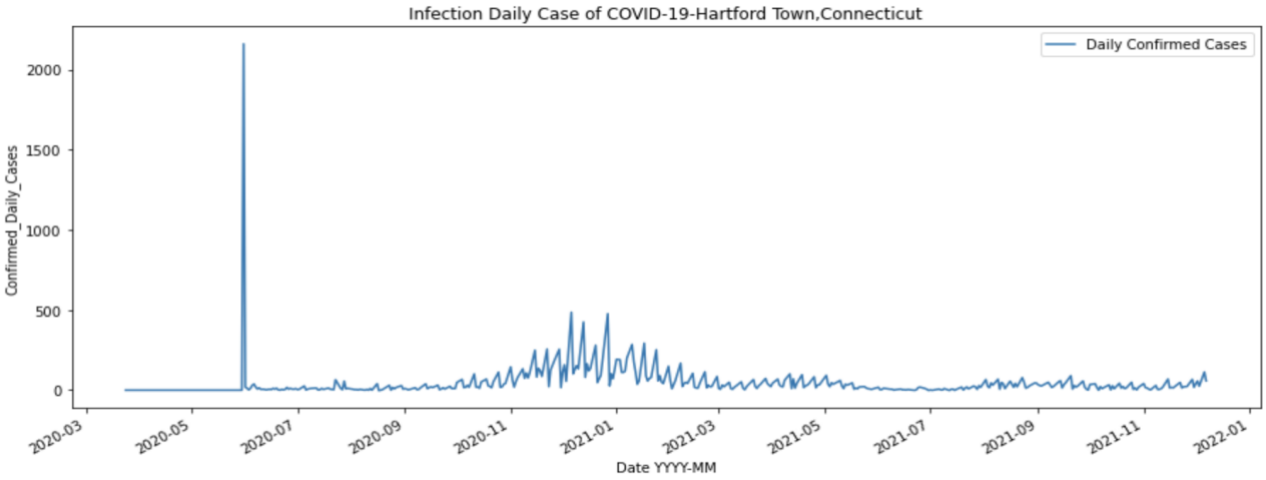
According to a sociological global analysis published in Nature Human Behavior -*Global crime trends during COVID-19*, stay-at-home orders implemented globally due to the Covid-19 pandemic were associated with a 37% decrease in average crime rates in 27 cities in 23 countries. (*Boman & Mowen. 2021*) However, according to the reports from the Council on Criminal Justice, data from 32 U.S. cities indicate substantial declines in certain categories of crime at the beginning of the pandemic, such as property, drug crimes, and burglaries. But since late May 2020, rates of homicide, aggravated assault, and assault with a firearm began to rise significantly, which may be related to the triggering of special events. (*Justice., 2021*) Therefore, I am very interested in whether this finding would also apply to

the period of mask mandate in Hartford city, CT: was the number of crimes during this period higher or lower than before? What is the relationship with the number of confirmed cases every day? Is there any difference in the impact of the mask mandate on the different categories of crime rates in Hartford?

In order to answer these questions, I must first clarify the study time range and understand the infection of Covid-19 in Hartford. The figure below shows the rate of confirmed infection cases of Covid-19 in Hartford County, Connecticut from January 22, 2020 to November 1, 2021 on a daily basis (0~0.25%). The red area below the curve represents the period during which the state's official mask policy was in effect, from April 20,2020 to August 15, 2021.It is clear from the chart that, since the implementation of the mask mandate, the rate of new infections per day has dropped significantly until October 2020. In the following months, however, the daily rate of new infections rebounded rapidly, even though Hartford County still enforced the mask mandate.



The chart below shows the time series trend chart of Covid-19 confirmed cases in Hartford city, CT from May 2020 to the present. Similar to Hartford County, the period from November 2020 to February 2021 shows a significant increase and fluctuation in confirmed cases in Hartford, with confirmed cases ranging between 0 and 500. At the same time, it is worth noting that the data on May 31, 2020 is an obvious outlier, with 2161 cases recorded on this date. I assume this may be because the city started recording Covid-19 cases on May 31. So this is the accumulation of previous cases.



To facilitate comparison with the same period in previous year and to incorporate the duration of implementation of the mask mandate in Hartford County. After excluding the outlier of daily confirmed cases in the city of Hartford, my research will focus on the period between June 1, 2020 and May 31, 2021.

Problem Statement:

Q1: During the implementation of the mask mandate in Hartford, CT, is there a correlation between Covid-19 confirmed cases and incidents of crime?

Q2: After experiencing the implementation of the mask mandate, whether Hartford's crime rate was lower than that of the same period in previous years?

Null Hypothesis: $\mu(2020.06 \sim 2021.05) = \mu(2018.06 \sim 2019.05)$

Alternative Hypothesis: $\mu(2020.06 \sim 2021.05) < \mu(2018.06 \sim 2019.05)$

(μ means the average daily crimes' volume)

Q3: Is there any difference in the impact of the implementation of mask mandate on the number of crimes in different regions of Hartford.

Q4: Is there any difference in the impact of mask mandate on the number of crimes in different categories.

Methodology

All the data mining and data processing in this project is completed on Python. Most of the data visualizations were made in Tableau. Since all data for this project were obtained from the official documents of the relevant departments in terms of quantity statistic and did not include personal information of Covid-19 confirmed cases and crimes. Therefore, the data processing and analysis of this study does not involve privacy, fairness, or other ethical issues.

Time Series (Tableau):

First of all, I will show the time series trend chart of the number of Covid-19 confirmed cases and crimes in Hardford City from June 2020 to May 2021 to observe whether there is a potential correlation between the two. The time series graph will allow the audience and me to have a very direct view of whether they are positively correlated: maintaining a consistent increasing and decreasing trend, or negatively correlated: trending in opposite directions. This is why most studies on Covid-19 choose time series to show the trend of change, because it is more objective and conforms to people's thinking patterns.

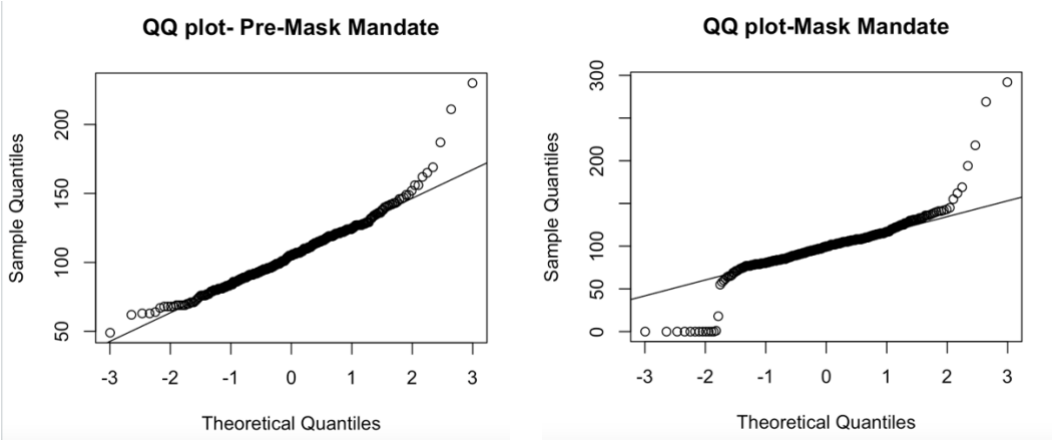
Correlation Test (R):

After exploring the number of confirmed Covid-19 cases and daily crimes, I will further verify the correlation between these two factors through correlation tests. Correlation analysis is mainly used to determine the statistical association between two or more variables, and if an association exists, it allows further analysis of the strength and direction of the association. Since there are only two variables in this section and the data types can be considered as continuous. Therefore, in this part, I used cor.test() in R and chose Pearson correlation coefficient as the basis for the determination.

Hypothesis Test (Tableau & R):

For the comparison of the number of crimes between the mask mandate period and pre-mask mandate period, I will compare the crime data of Hartford city by presenting the results through a simple bar chart in Tableau, as this method can provide a very intuitive overview of the differences in crime. Secondly, I plan to use the method of hypothesis testing in R to figure out whether there is significant difference between the number of crimes in these two years, which will make the study results more rigorous and convincing. It can be seen from the following two QQ plots that most of the samples of these two

datasets are normally distributed. In addition, the sample sizes of the two sets of data are not identical (mask mandate: 353; pre-mask mandate: 365). Therefore, it is more appropriate to use Z-test for hypothesis testing.



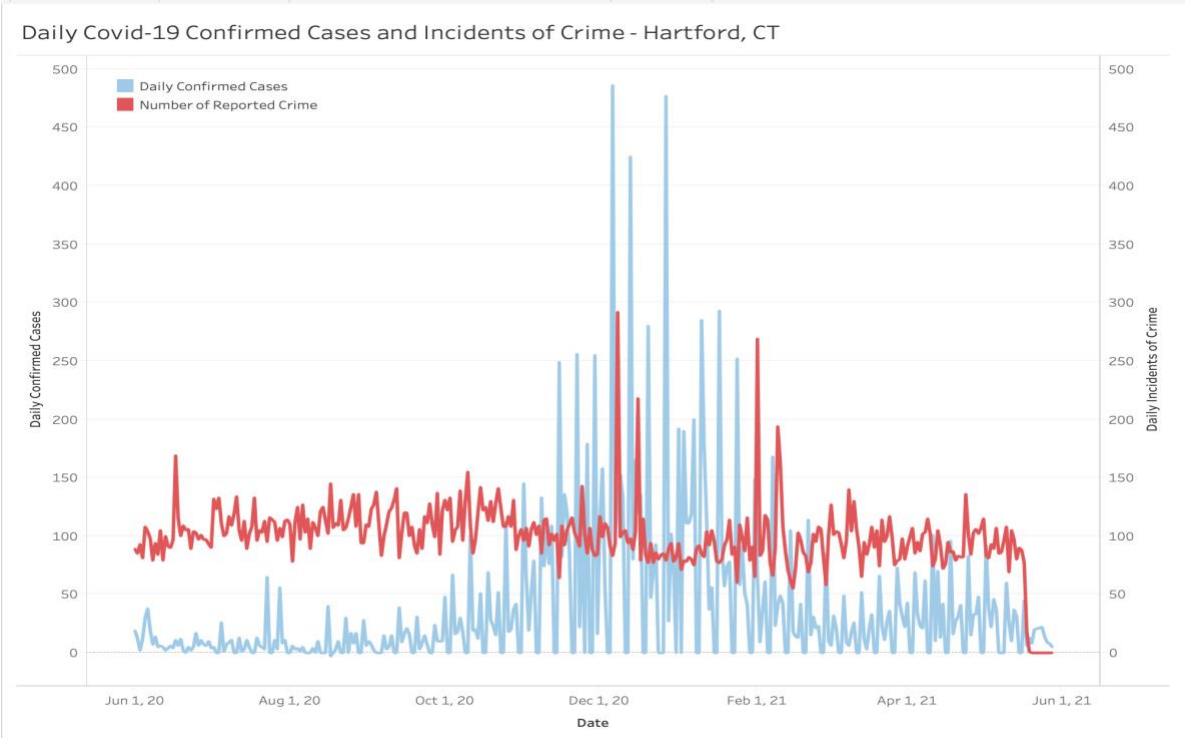
Bar Chart (Tableau):

I originally planned to apply ANOVA test in R and analyze the test statistic score and p-value to figure out the impact of mask mandate on different regions and crime categories. However, since the data sample did not meet the assumptions of the ANOVA test: random and normal distribution. Therefore, for this part of the analysis, I simply obtained the total amount of crime in each region and category during the mask mandate period and compared the difference with the total number of crimes one year ago. Then display the results in the form of comparison bar charts. This allows for a clear observation of which areas and types of crime in Hartford city have significantly changed in terms of number of crimes.

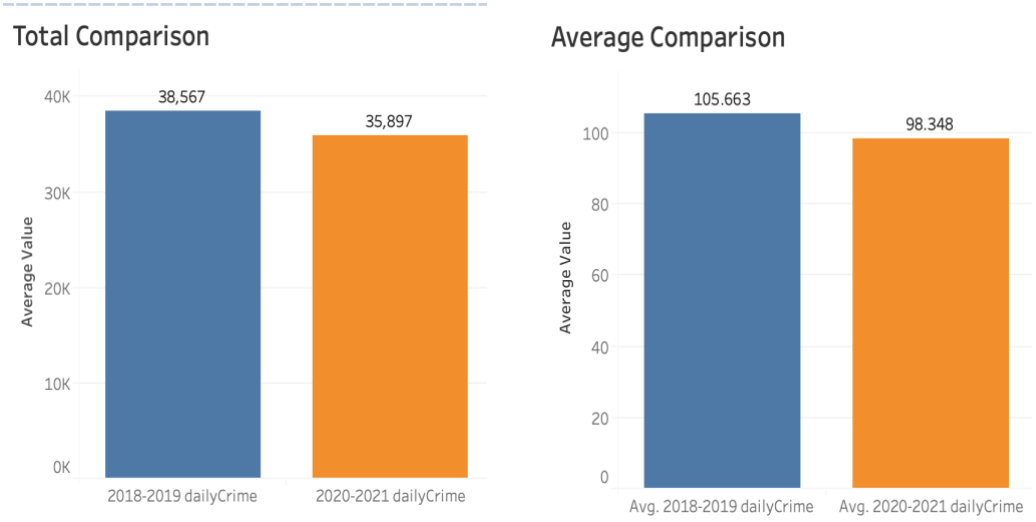
Findings

As can be observed from the time series graph below, both the number of crimes and confirmed cases fluctuated more significantly between November 2020 and February 2021. During the rest of the mask mandate period, the daily crime volume in Hartford city basically remained within the range of 50 to 150. The daily confirmed cases fluctuated again from April to June 2021. This trend is in line with the trend of daily new infection rates throughout Hartford County mentioned in the section of ‘Background & Related Work’.

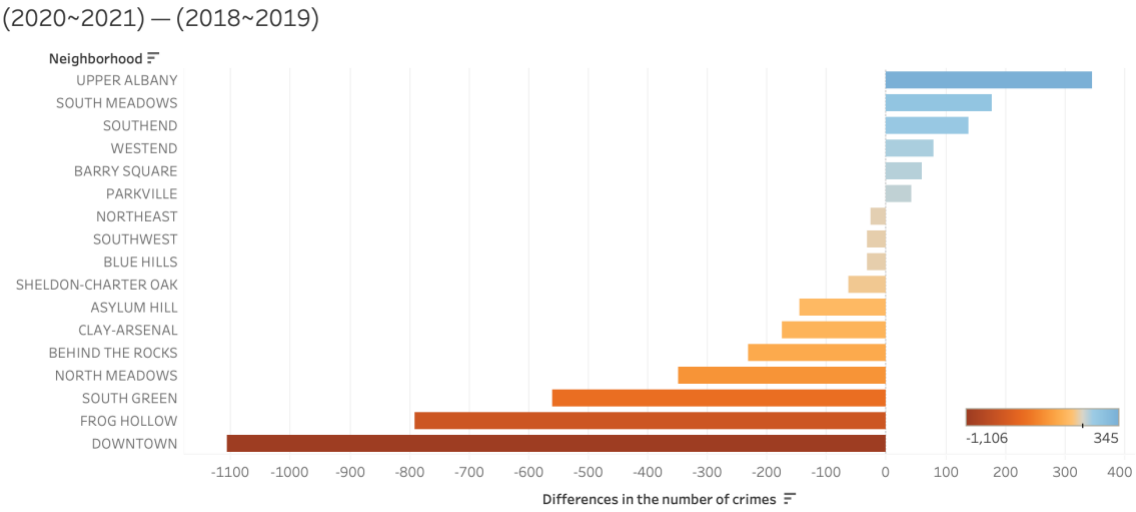
From the results of the correlation test, the correlation coefficient between the two variables is -0.089, which is very weak and can be ignored. The 95% confidence interval is between -0.191 and 0.015, which means that 0 is included in this interval. The p-value of the correlation test is 0.092 > 0.05, and this also implies that the correlation between these two variables is not significant at all.



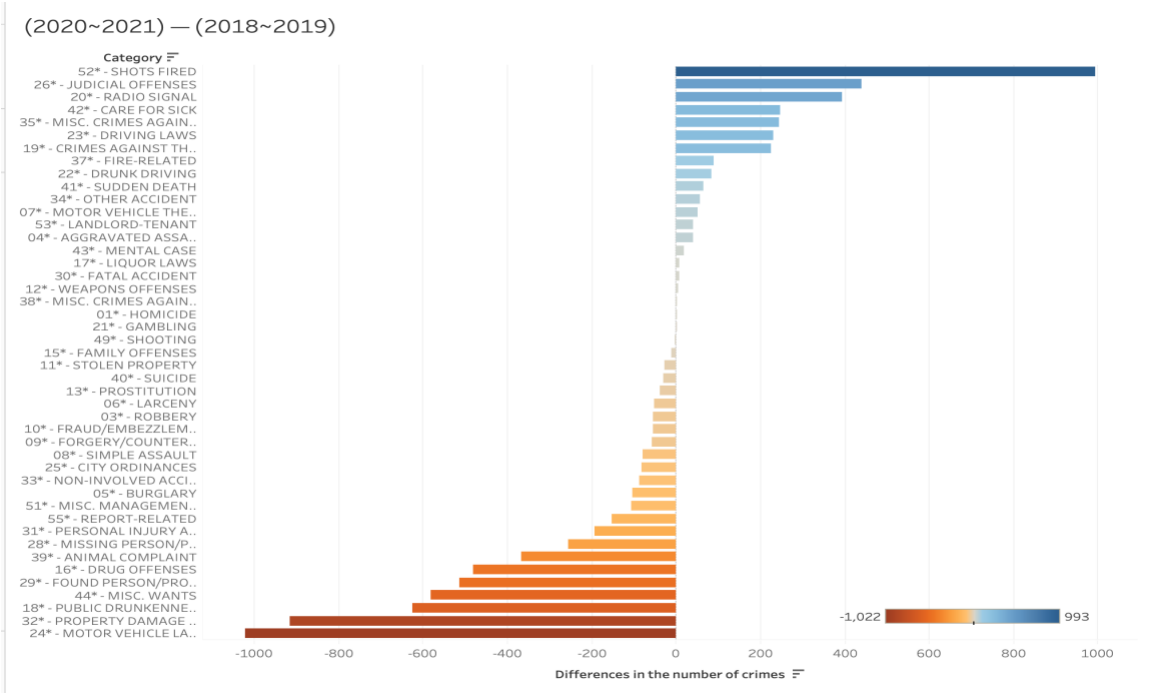
With the two bar comparison charts below, we can understand that during the mask mandate period, both the total and the daily average amount of crime incidents have decreased compared with the previous year. The results from the hypothesis test show that the difference does exist. Even though the z-score is -3.663, which is located in the rejection area, and the 95% confidence interval is (-11.230 ~ -3.401) which means 0 is not in this interval, the p-value of the hypothetical test reaches 0.45, which proves that the difference is very insignificant.



In terms of the Comparison of the Number of Crimes by Region, Among the 17 areas in Hartford City, 11 regions experienced a decrease in the number of crimes during the mask mandate. The area with the most significant decline was downtown (-1106), Frog Hollow (-792), and South Green (-560). The region with the most significant increase in the number of crimes during the period of mask mandate was Upper Albany (345).



For different types of crimes, the number of crimes in more than half of the categories has declined, such as Motor Vehicle Law (-1022) and Property Damage Accident (-917). However, there are also some types that have seen significant growth, such as Shots Fired.



Discussion & Implications

In the process of data mining and data processing, the original crime report of the city of Hartford contains the specific latitude and longitude of the crime location. Out of consideration for ethical issues such as privacy, I did not use this information for data analysis.

In the previous section, it was mentioned that the number of crimes in Hartford city and the confirmed cases of Covid-19 both showed substantial fluctuations between November 2020 and February 2021. The changes in both variables may be related to the holiday season. Due to holidays, population movements are more frequent than before, which has accelerated the spread of the epidemic. This may be one of the reasons for the increase in confirmed cases. According to the results of the National Crime Victimization Survey (NCVS), certain specific crime types increase in December, such as robbery and personal theft. (NCVS, 2020) In addition, some special social events may also trigger more violent crimes. For example, the 2020 US presidential election and the subsequent Capitol riots, which could be a trigger for a spike in crime. This phenomenon in Hartford reminds us to be alert to and take precautions against a surge in specific categories of crime when we encounter special social events in the future.

The number of crimes in the Hartford city did decrease during the period of the mask mandate, even if the difference was not significant overall. For all regions of the city, the most significant drop in crime was in the downtown area. I think this may be due to the impact of the pandemic. The flow of people in the city center has suddenly decreased, so the number of crimes related to this has also decreased accordingly, such as traffic accidents, theft, and robbery, etc. For future research in related areas, we can continue to explore whether this phenomenon is applicable to other regions and cities in the United States on this basis. In particular, it is very necessary to continue to dig into the reasons for the decrease in crime, as this will provide a basis for developing better crime control strategies in the future.

When comparing the differences in changes across crime categories in the City of Hartford, I found that the most significant increase in numbers was the category of 'Shots Fired', which is consistent with the results from the Council on Criminal Justice's report mentioned in the section of 'Background'. However, the report also indicates that the number of homicides also increases during the pandemic, which is the opposite of what happened in Hartford: during the mask mandate period, the number of homicides in Hartford has decreased slightly. This comparison of results reminded me to be more cautious when applying the findings of data science, because the specific circumstances of each case are different. A risky application of the results to other areas may create biases that could affect the improvement of crime-control strategies, and this is also contrary to the human-centered principle of data analysis.

Limitations

This study only compared data from one year prior, which is easily confounded by accidental elements. Comparison with the average of the past five or ten years will make the study more accurate. Besides, the number of crimes can be affected by many factors, such as unemployment rate, triggers of special events, etc. The potential influence of these factors couldn't be excluded in this study. It is worth noting that, due to statute, crime incidents in Hartford City do not include sexual assault. So, this has caused the incompleteness of the research on the number of crimes. Moreover, sexual assault is an important factor that endangers the security of the community, so it is necessary to study the pattern of sexual assault during the pandemic for future research.

In terms of statistical analysis, since the daily Covid-19 confirmed cases in Hartford are not strictly normally distributed, the Pearson correlation is not particularly rigorous when

performing correlation tests. In addition, Because the samples of the number of crimes in each region and category do not fully meet the assumptions of the ANOVA test, ANOVA analysis could not be performed in the comparison part, and it could not be statistically demonstrated whether the effect of the mask mandate on the number of crimes in Hartford city was significantly different by region or by category.

Conclusion

Through this project, I explored whether there was a correlation between the number of crimes in Hartford city and Covid-19 confirmed cases during the period of the mask mandate? Was there a significant decrease in the number of crimes during this period compared to previous year? Were there differences in the impact of the mask mandate on crime regions and crime categories? In summary, by researching the number of crimes and Covid-19 confirmed cases in the city of Hartford, I have come to the following conclusions. Firstly, both the number of crimes and confirmed cases fluctuated more significantly between November 2020 and February 2021. Secondly, during the implementation of the mask mandate in Hartford, there was no significant correlation between the number of crimes and the number of confirmed cases; Thirdly, there is indeed a difference in the number of crimes before and after the Covid-19 pandemic, the latter is lower than the former, but it is not significant; Lastly, the number of crimes has decreased in most regions and more than half categories.

As a human-centered data analysis project, this study attempts to uncover the dynamic mechanisms of urban crime in the context of Covid-19, in order to provide appropriate and robust safeguards for the safety of people's daily lives. This project enables us to strengthen crime-control strategies and take targeted prevention.

For future research, I am still interested in the impact of stay-at-home orders on the number of crimes, particularly the first phase of the policy. At the same time, due to the lack of the category of sexual assault in crime data, I hope to have the opportunity to explore the situation of sexual assault during the pandemic. It is also essential to continue to explore the reasons for the growth and decline in certain types of crime, such as shots fired. Uncovering the reasons behind these changes will help us understand the formation mechanism of crimes and prevent and control them more effectively, thereby making our communities safer.

References

1. Boman, J. H., & Mowen, T. J. (2021, June 11). Global crime trends during COVID-19. Nature News. Retrieved December 13, 2021, from https://www.nature.com/articles/s41562-021-01151-3.

2. Justice., C. on C. (2021, July 16). NCCCJ - Impact Report: Covid-19 and crime. National Commission on COVID-19 and Criminal Justice. Retrieved December 13, 2021, from https://covid19.councilоncj.org/2020/07/28/crime/.

3. National Crime Victimization Survey (NCVS). Bureau of Justice Statistics. (n.d.). Retrieved December 14, 2021, from https://bjs.ojp.gov/data-collection/ncvs#documentation-0

4. Pandemic, social unrest, and crime in U.S. cities. Council on Criminal Justice. (2021, December 8). Retrieved December 13, 2021, from https://councilоncj.org/impact-report-1/.

Data Sources

1. **COVID-19 data from John Hopkins University**
   https://www.kaggle.com/antgoldbloom/covid19-data-from-john-hopkins-university?select=RAW_us_confirmed_cases.csv
   License: Attribution 4.0 International (CC BY 4.0)
2. **Mask Mandates by County from CDC**
   https://data.cdc.gov/Policy-Surveillance/U-S-State-and-Territorial-Public-Mask-Mandates-Fro/62d6-pm5i
   The license of dataset is not accessible.
3. **Crime Incidents of the City of Hartford**
   https://data.hartford.gov/Public-Safety/Police-Incidents-01012005-to-Current/889t-nwfu
   License: Creative Commons license (CC0 1.0 Universal)
4. **Covid-19 Cases by Town, Connecticut**
   https://data.ct.gov/Health-and-Human-Services/COVID-19-Tests-Cases-and-Deaths-By-Town-/28fr-iqnx
   The license for this dataset is unspecified.