Impact of the coronavirus pandemic on crime

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Part 1

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) pandemic was a worldwide event. The first human case was identified in Wuhan city, China, in December 2019 (WTO, 2020). In efforts to monitor COVID-19 spreads, John Hopkins University launched its dashboard of this virus. The virus spread mainly when a patient is in close touch with other people. Like other disasters, millions of persons who lose their health, their incomes, and even their loved ones. Up to now, there are 3,026,342 confirmed cases, and 81,000 individuals lose their lives in the United Kingdom (Johns Hopkins ,2020).

To fight against the virus, many countries implemented social restrictions, like social distancing, working from their own home, and the shuttering of numerous businesses (Andresen and Hodgkinson, 2020). On 23 March, intending to reduce the spread of covid-19, British government announces new strict policies applicable to the whole United Kingdom. This first lockdown rules which including some restrictions that individuals must stay at home. Some efforts from the first lockdown can be seen, so the social restriction lift. Some workers return, reopen shops and "eat out to help out" are policies the government implemented to stimulate the economy of the UK (Dunn, P., Allen, 2020). Due to the rapid spread of a new variant of coronavirus, the United Kingdom has to start the second lockdown (BBC, 2020).

As a result of those new measures, various parts of society have been affected, including crimes (Riya, 2020). There are some positive impacts, comparing with the previous month, police recorded crime decreased by 5% in March and then followed by a significant decrease by 20% between March and April (ONS, 2020). During the period of lockdown, Londoners spend more time at home, so the reduction was significant fells in theft crime. However, some various kinds of crime have a significant rise, including drugs offences, cybercrime, domestic violence and fraud (Europol, 2020).

In this paper, I investigate the impact of coronavirus on crime in London, England. I will show the trend of this virus spread by GIS. Responding to the covid-19 with GIS tools, we can project the heavy data to maps. We not only can observe the basic distribution of confirmed cases on London city and other 32 London boroughs, but also address the crimes cases. And the most important purpose of this study is to investigate the different changes of various crimes with the time period. I identified change point occurred in the time of social restriction (the first lockdown). I want to find which kinds of crime have the positively correlate with strict rules within London boroughs. I also checked whether the breakpoints on total cases of crime is consistent with this change point I assumed in the beginning. This research aims to better understand the impacts of changing policies from imposed social restrictions which have an improvement in planning for public safety. Also, we can do well preparation for the next disaster.

2. LITERATURE REVIEW

2.1 Covid-19 and GIS

In recent decades, the organization use geographical information systems (GIS) to understand and predict the impacts and spread of epidemic (Monica Pratt,2020). In 1854, John Snow used geospatial data to track cholera in London. With the GIS tool, he identified the long-misunderstood reason for cholera (Katie Burton, 2020). Especially in this century, GIS is a necessary tool in tracking and helping human to fight with other human coronaviruses, SARS-CoV and MERS-CoV (Monica Pratt, 2020). Not only just using the simple mapping phenomena, GIS capabilities like spatial analytics, location information, health department and government agencies can map confirmed and death cases and recoveries to locate where COVID-19 infections have happened (Yashvendra Singh, 2020; Monica Pratt, 2020). In this paper, I put Coronavirus data and crime data in the same reference system, and GIS will show us the patterns, the relationships and connections that are usually hidden by the heavy data (Monica Pratt, 2020).

2.2 Covid-19 and crime

The better way to understand to the influence of exceptional events on crime is using three main theoretical explanations: social cohesion/altruism, social disorganization, and opportunity theories. About the social cohesion/altruism, people come together to assist each other which is the reason why the rate of the exceptional event keeps the same or decline during a crisis (Barton 1969; Quarantelli 2007; Zahran et al. 2009). For example, Quarantelli (2007) argues that it is rare to observe a decline in opportunistic crime after a disaster. The rate of violent crime remains after the 1994 earthquake in Los Angeles (Siegel, Bourque, & Shoaf, 1999). However, another party holds a different opinion. According to social disorganization theory, when the social order is disrupted, the rate of crime is increasing. For example, in 1977, after the New York City blackout, Genevie et al. (1987) found that the number of looting cases is increasing. The place of crime that happened in the region was already had higher levels of violence offence and unemployment. Two opposite theories lead us to the final theoretical framework which is opportunity theories. And this theory accounts for variation in results from above two theoretical perspectives. The rate of crime (commercial burglary) may increase because the government put less attention on businesses during a lockdown. or rate of crime may decrease like shoplifting because of the loss of opportunities, people must stay at home during a lockdown (Hodgkinson and Andresen 2019). In this case of covid-19, some of the findings imply that the trends of crime types are changing. For example, Eisner and Nivette (2020) reported that domestic violence and child abuse has a significant increase. And they also observe an increase in crime of hating East Asian persons (Eisner & Nivette, 2020). On the other hand, the study of 16 cities from the United States showed no increases in violent crime (Ashby, 2020).

However, many studies should be taken because most of the research is based in North America. And we should consider different opportunity structures that we have not identified before. In the later discussion, we will consider all boroughs in London, England that including all recorded crime cases.

3. METHODOLOGY

Two necessary tools of R and QGIS are used in this paper. And using Excel software to clean and process the data.

3.1 Data collection

3.1.1 the data of coronavirus

The dataset was available on the open data source website which is London Datastore. The CSV file is recorded daily from 11 February 2020 to 26 December 2020. For each day, a dataset including new cases and total cases of all 32 London boroughs.

3.1.2 The data of crime

The open-source we used to be provided from Metropolitan Police Service. This data counts the number of crimes in the borough of London per month. There are ten major categories including arson and criminal damage, burglary, drug offences, possession of weapons, public order offences, robbery, sexual offences, theft, vehicle offences and violence against the person.

3.1.3 The information of London boroughs

We allocate the information from the Greater London Authority (GLA). The polygons made by Official Ordnance Survey showing the boundaries of London boroughs and also the reference codes of those boroughs.

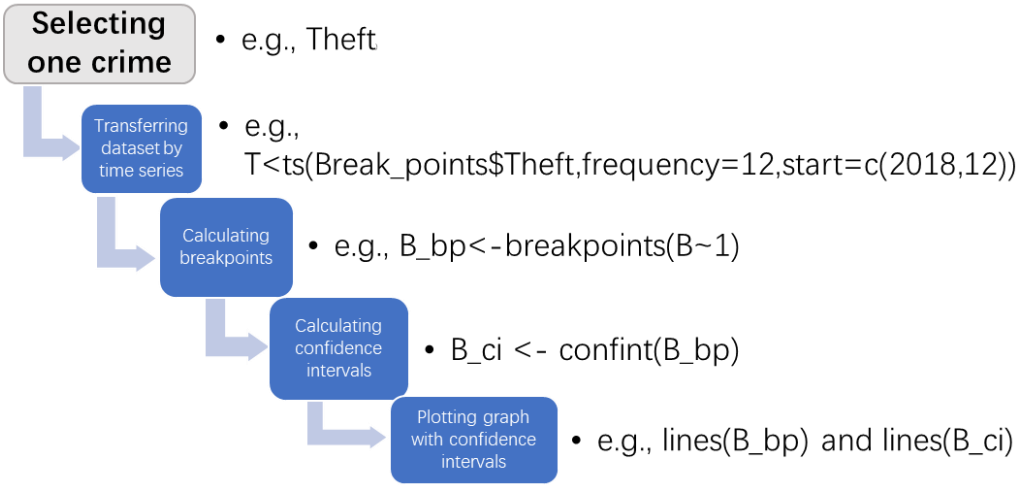
3.2 Data cleaning and processing

The raw data of crimes should be processed by excel. We should create a PivotTable by selecting boroughs as rows. As for columns, we just focus on twelve major categories and record monthly. And I also create a new column called total cases which is the sum of offences in each borough.

3.3 Methods: Structure break

Firstly, simple visualization of data is necessary, such as the summary of statics and histogram. The second part, I used R and QGIS to mapping the cumulative number of confirmed Covid-19 cases to each borough. And also, in the same coordinate reference system, I added the crime information to check their relationship. However, crime is the main part we should consider. I represented the crime data by time series and studied the trend of all 10 major categories. And I also used R package of 'strucchange' to confirm the breakpoints where the data has a significant change. A structural breakpoint was developed by David Hendry which is an unexpected shift in a time series. Flow chart-1 showed that the process of a selected crime type. Confidence intervals were also calculated by R. Then, I checked the trends of different crimes during the time and identified the categories of those crimes. Also comparing to time when government agencies announced various levels of restriction, we can know whether the time is consistent with structural breakpoints.

Flow chart 1：



3.4 Methods: The related change in crime

The last but not least, I calculated the related changes of various offences. The above study is to determine the time points where the trends have differed. However, we have no idea about the actual situation of the changes, like the selected crime was increased or decreased? Or I could explore which offence is changing more significant than others. The related change is a simple metric to describe the size of the absolute change in comparison to the reference value. Because the sizes of various crimes are different, I used the related change rather than absolute change. Finally, the higher related changes were mapped to London boroughs to check the relationship between the region and the picked crime.

A fraction of relative change:

$$related\ change = \frac{absolute\ change}{reference\ value} = \frac{new\ value - reference\ value}{reference\ value}$$

Part 2

4. RESULTS

4.1 Summary and visualization of data

4.1.2 Information about covid-19

Until 26 December 2020, the total number of infections is 317,498 in London boroughs. We can apply the bar chart in R to check the cumulative number in different regions. I matched these data into the map to see the distribution of covid-19 cases clearer. In figure 1, the graph shows that Ealing and Redbridge and Newham are top 3 regions which infected by coronavirus. That information also can be express by colors, more people carried the virus and redder can be seen on the map of the borough in figure 2.

Figure 1:

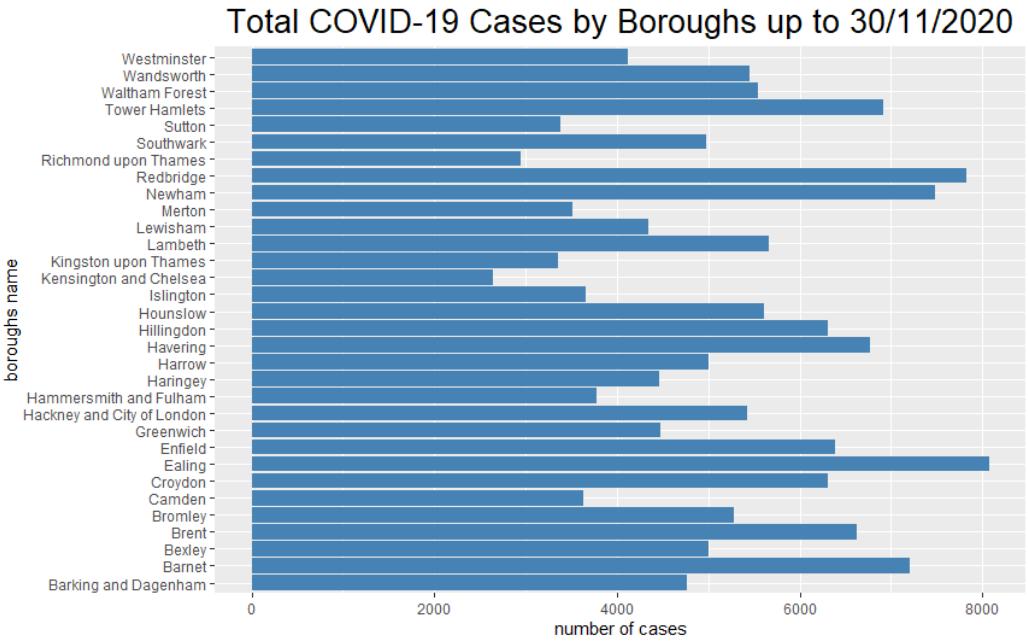
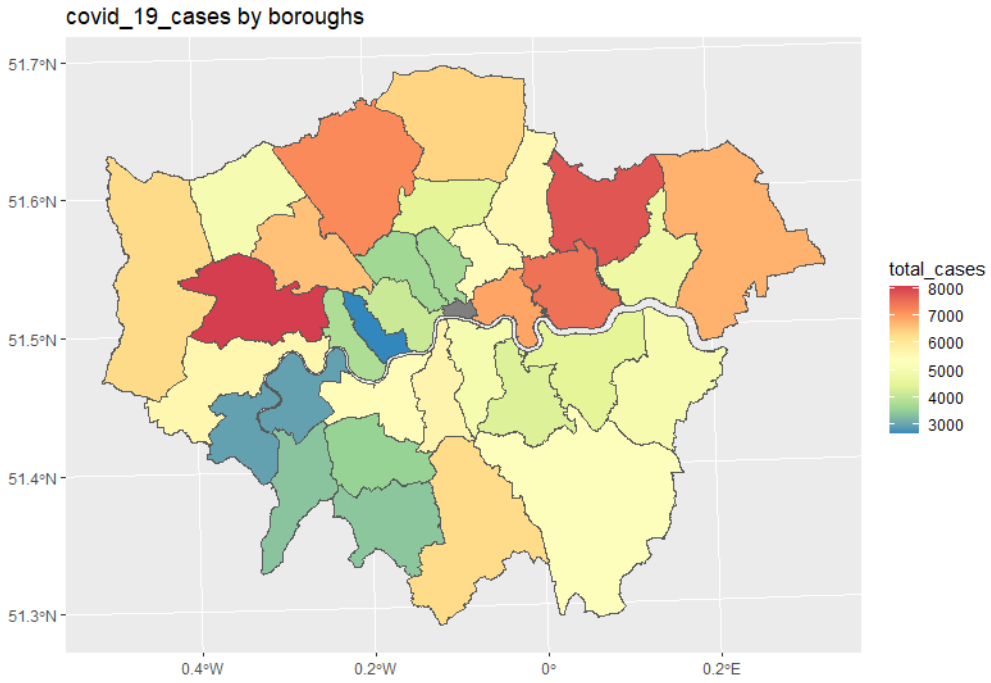


Figure 2:



4.1.3 Information about crimes

In figure 3, there is no doubt that most criminal cases occurred in Westminster. As for more information about various crimes, I made the bar charts of all kinds of crimes by Excel. (Figure 4a and Figure 4b) In every district, a bar made of all of 10 different crimes, and Violence Against the Person is the main ingredient in most regions.

Figure 3:

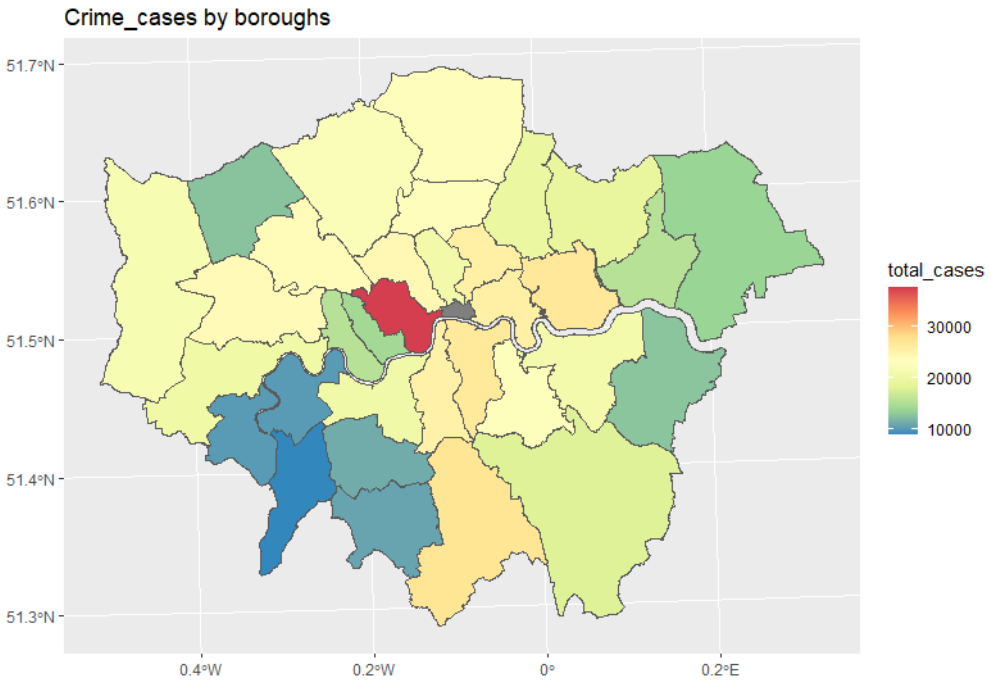


Figure 4a:

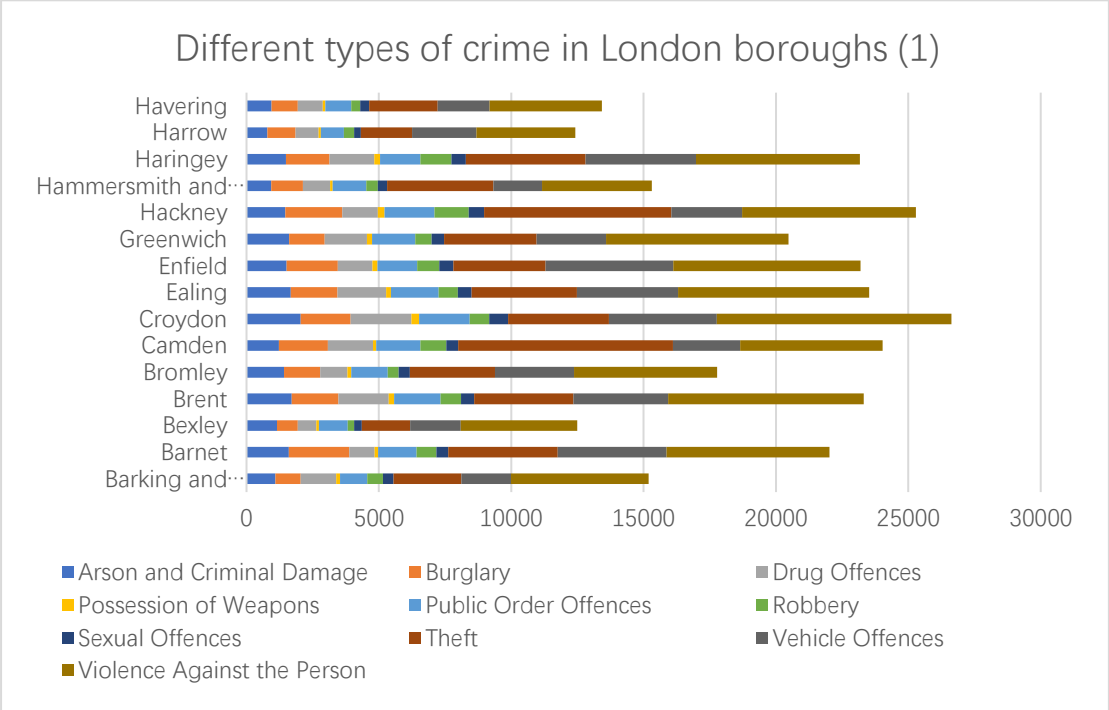
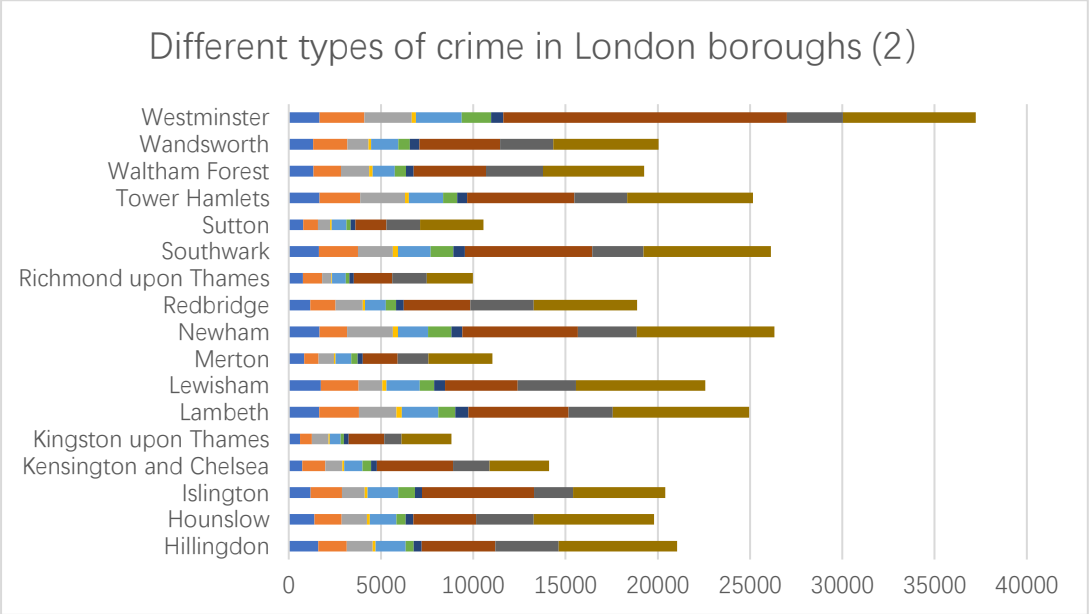


Figure 4b:

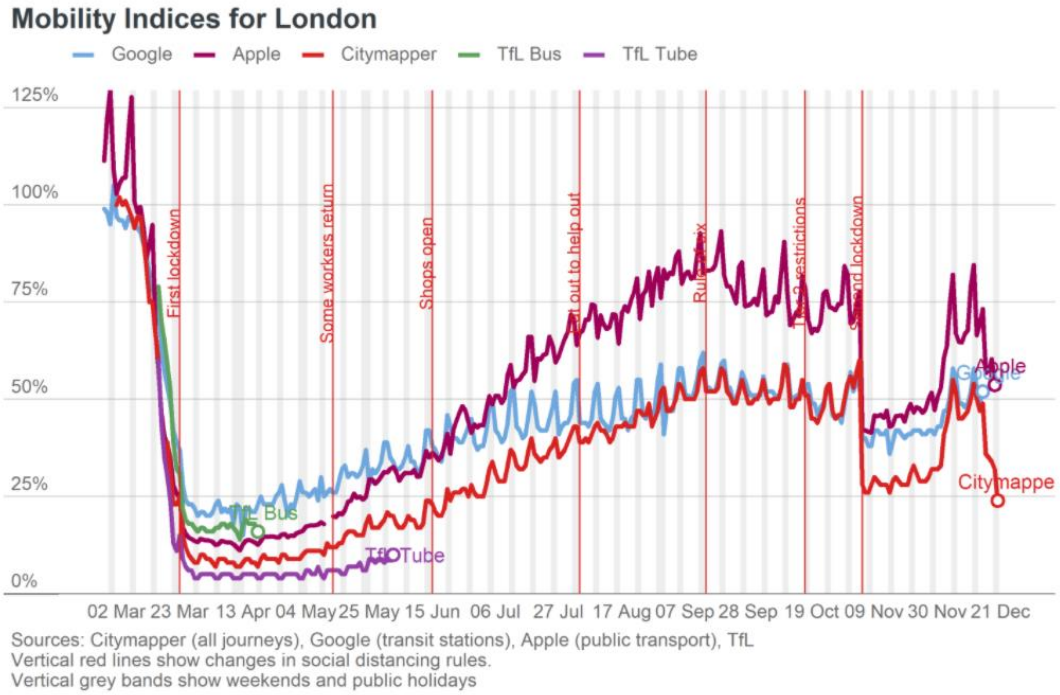


4.2 Structure break points

Movement in London has been affected by the kinds of social distancing rules. In fact, the influence of various control policies also changes the trend of some types of crimes. Apple collected data from app usage and journeys tracked. The minimum value of Apple Mobility Index dropped to 10%, and the sharper recovery can be seen with the restrictions were eased.

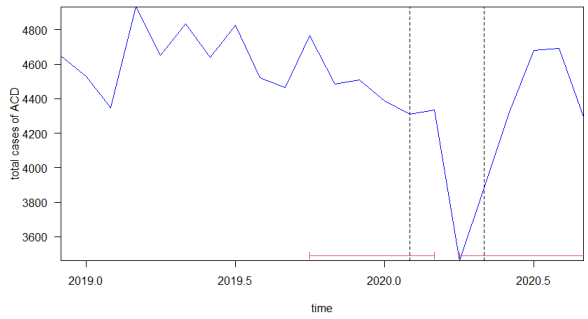
The similar drop can be overserved in Google Mobility Report and Citymapper Mobility Index. After passing the minimum value at the time of the first lockdown, those two indexes show a gentle recovery until October. Figure 5 is the open source from London Datastore (London Datastore, 2020)

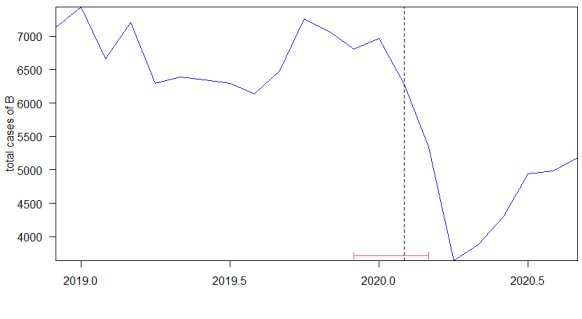
Figure 5:

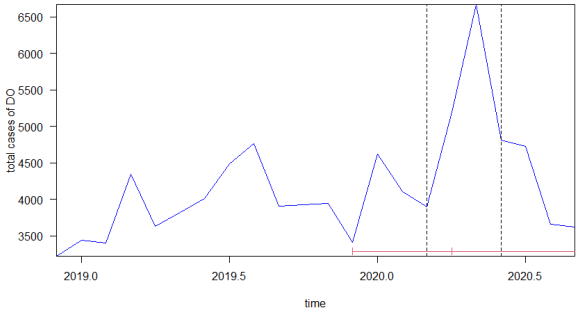


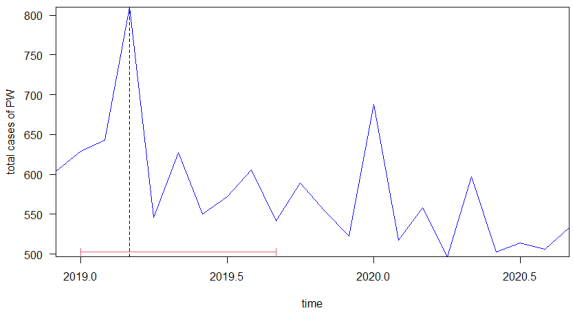
The monthly time series for the various crime types in London boroughs are shown in below 10 outputs. Not just putting the number of cases on the timeline, I added the breakpoints line and confidence intervals of breakpoints. In the covid-19 case, all 10 types are divided into 3 parts. The first situation, there are a expect decrease can be seen on the lockdown period (February in 2020) and then some cases increasing with social distancing rules easing. And this kind of crime including Arson and Criminal Damage, Burglary, Public Order Offences, Robbery, Sexual Offences, Theft, Vehicle Offences and Violence Against the Person. It was reasonable that offenders lose the opportunity to carry crimes because Londoners are in homes. That numbers dropped on February in 2020 and climbed after May in 2020 which is consistent with the time of social restriction carried. Then the second part, according to routine activity theory some changes in crime are unsurprising (Cohen & Felson, 1979). The person spent more time at home, and they have many probabilities to take drugs, so a sharp increase can be noticed in the graph. After May, some rules implemented to stimulate the economics which also cut down the time of Londoners stay at home. And last pattern, the

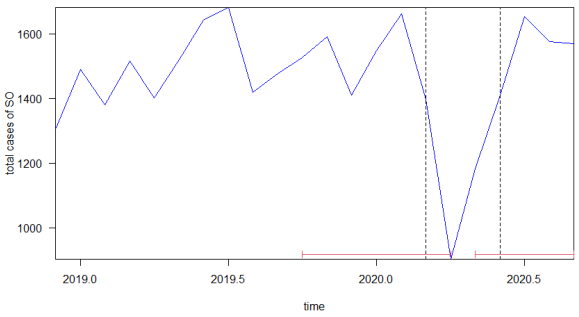
offense of Possession of Weapons exhibit non-obvious change or no-notable changes.

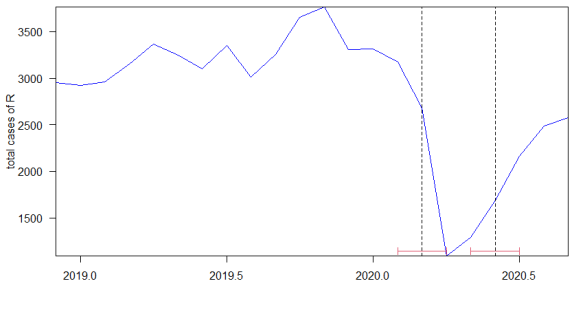


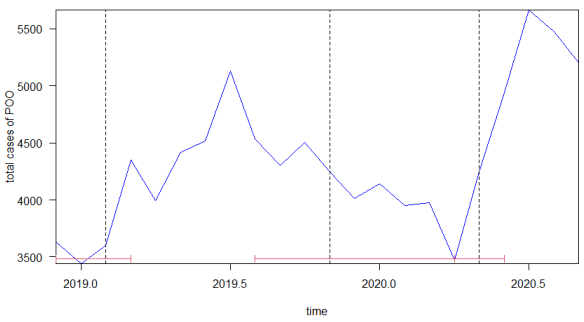


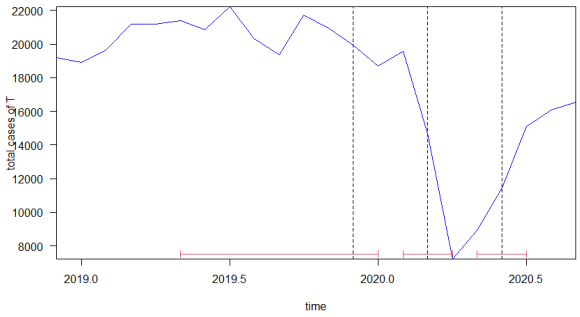


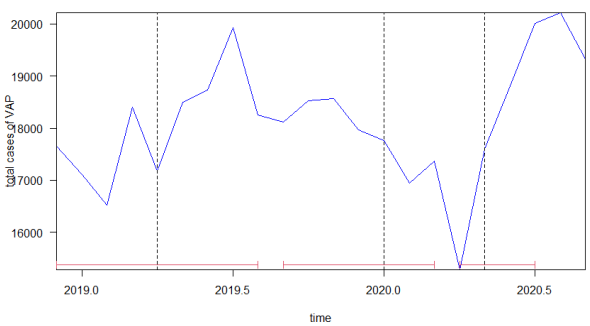


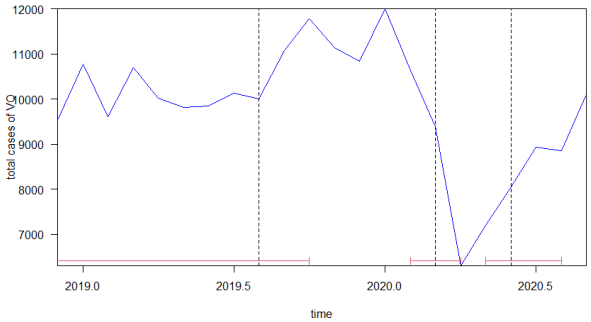












I also calculated the confidence intervals of breakpoints by R. All breakpoints of various offences can be seen on Table 1, and like Arson and Criminal Damage, Drug Offences, Robbery, Sexual Offences, Theft and Vehicle Offences are highly consistent with the time of lockdown and restriction easing.

Table 1: Results with breakpoints and confident intervals

Various crimes	Breakpoints	2.5%	97.5%
Arson and Criminal Damage	2020(2)	2019(10)	2020(3)
	2020(5)	2020(4)	2020(10)
Burglary	2020(2)	2019(12)	2020(3)
Drug Offences	2020(3)	2019(12)	2020(4)
	2020(6)	2020(4)	2020(10)
Possession of Weapons	2019(3)	2019(1)	2019(9)
Public Order Offences	2019(2)	2018(12)	2019(3)
	2019(11)	2019(8)	2020(4)
	2020(5)	2020(4)	2020(6)
Robbery	2020(3)	2020(2)	2020(4)
	2020(6)	2020(5)	2020(7)
Sexual Offences	2020(3)	2019(10)	2020(4)
	2020(6)	2020(5)	2020(9)
Theft	2019(12)	2019(5)	2020(1)
	2020(3)	2020(2)	2020(4)
	2020(6)	2020(5)	2020(7)
Vehicle Offences	2019(8)	2018(11)	2019(10)
	2020(3)	2020(2)	2020(4)
	2020(6)	2020(5)	2020(8)
Violence Against the Person	2019(4)	2018(12)	2019(8)
	2020(1)	2019(9)	2020(3)
	2020(5)	2020(4)	2020(7)

Next part which should be considered is the related changes of crime. Due to the results of breakpoints table, I selected periods of March in 2020 and May in 2020 as my research objects. As for types of crime, I choose the Drug Offences and Burglary which have different performance. The palette of "PiYG" in R is useful to check the signs of index value. It can be observed that the more negative values in field of Burglary in figure 6, which means the crime rate of Burglary remain a low value in the period of lockdown in most boroughs. On the other hand, the more positive values can be seen on the London boroughs in figure 7. Londoners spend more time at home and this also the opportunity for them to take drugs. With the social restriction lifting, the expected deceasing happened on lots of boroughs.

Figure 6:

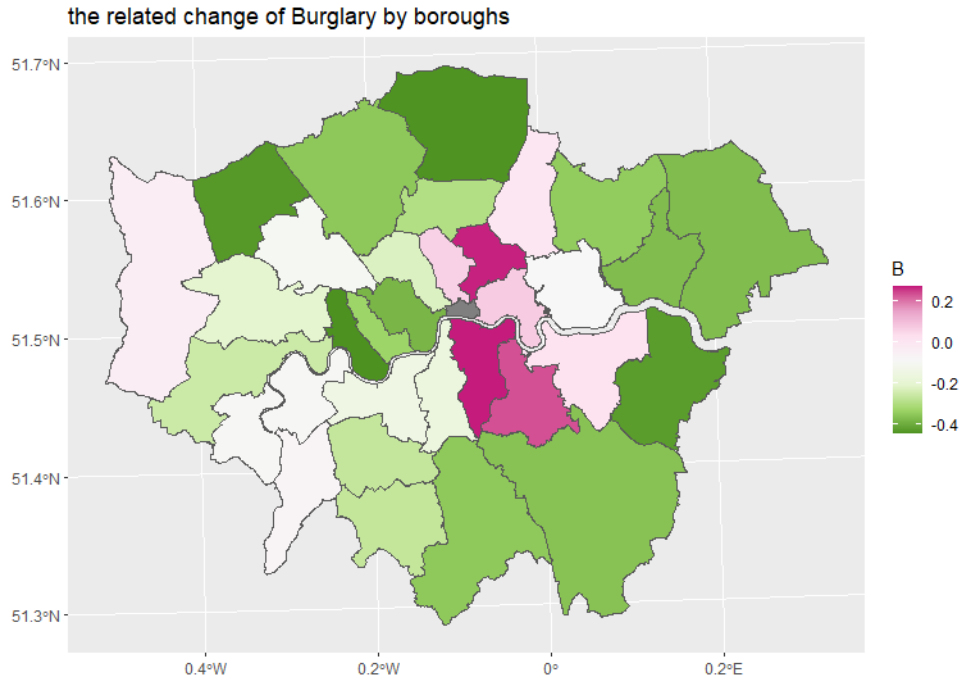
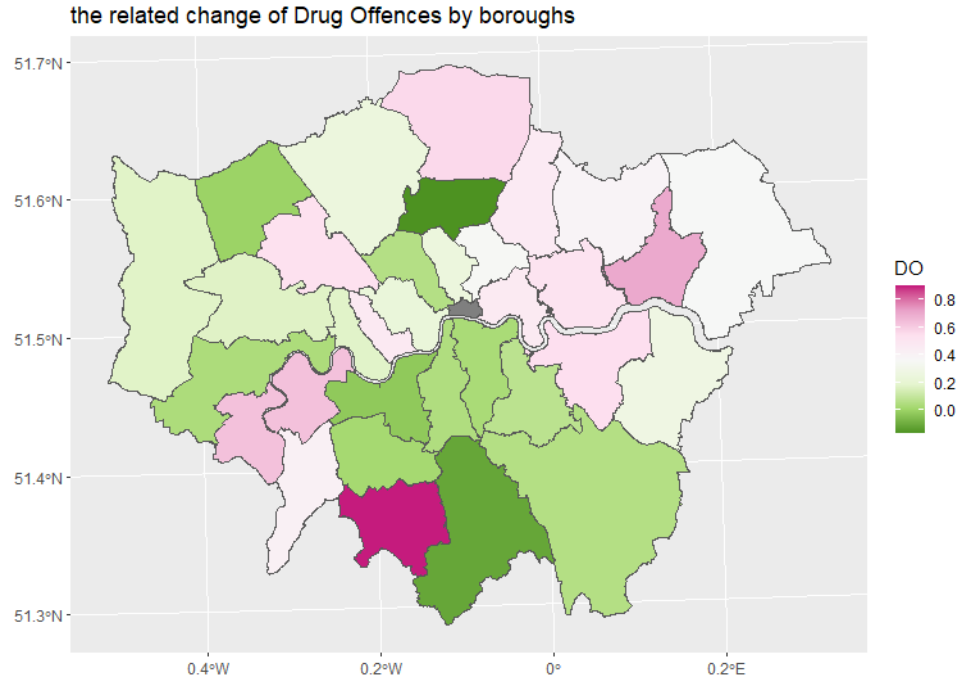


Figure 7:



5. DISCUSSION

The results of this study are consistent with opportunities theories which implied that the offences may decrease or increase depending on the opportunities structure and the feature of exceptional events (Tarah Hodgkinson and Martin A. Andresen, 2020). Due to the impact of coronavirus-related social restrictions, I saw that there was a significant decrease in total crime. According to the ONS (Office for Nation Statistics), crimes dropped by almost a third

in the first two months of lockdown in England and Wales (BBC, 2020). However, some crime showed totally different trends. The ONS said compared with the same time period in 2019, the drugs-related offence rose by up to 44% (BBC, 2020). And this fact was found in my previous study. The crime of domestic abuse has the same opportunities structure with drugs crime which is excluding on my paper. Comparing to the same period last year, the police officer received an extra 12,107 offence cases of domestic abuse (Mayor of London, 2020).

5.1 Limitation and future direction

The first limitation of this paper is that I only studied the crime data which was received by the police. Not all criminal offence was recorded on this crime dataset, like in 2014, the average reporting rate to the police is 31% in Canada (Perreault, 2015). Secondly, this paper was limited to the impact covid-19 has on selected types of crimes. Some other offence should be undertaken to make this study more complete, for instance, cybercrime, children abuse, domestic abuse and so on. Third point, the seasonal or other periodic influence are not considered. The Hodrick and Prescott (1997) filter is the method to check the trend component of the time series.

6. CONCLUSION

We studied 10 various crime across the 32 London boroughs of England, United Kingdom before, during and after coronavirus-related lockdown. During the period of lockdown, drug-related offences increased significantly and subsequently decreased after the social restriction lifted. On the contrary, most crime types, for example, the trends of Arson and Criminal Damage, Burglary, Public Order Offences, Robbery, Sexual Offences, Theft, Vehicle Offences and Violence Against the Person were different from drugs crime totally. And the above results, as predicted by opportunities theories. The areas and the types of crime I explored were limited, we can study more different contexts in future research. These findings will undoubtedly be used to better understand the impact of global pandemic on crime trends, hopefully making cities safer during and after the exceptional events. Even though, we can do well-preparation for the next crisis.

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Declaration of Authorship

I, Hong Yang, confirm that the work presented in this assessment is my own. Where information has been derived from other sources, I confirm that this has been indicated in the work.

Hong Yang

Date of signature: Jan 10, 2021

Assessment due date: Jan 11,2021