Crime rate in Vancouver, during Coronavirus Pandemic

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Introduction

The purpose of this report is to analyze the changes in dynamics of crime rate in Vancouver due to coronavirus pandemic. Studying the variations in crime rate is always interesting and beneficial, as crime rate effects the social welfare of the community and signals the challenges faced by the community.

Coronavirus or COVID-19 is an ongoing viral disease caused by severe acute respiratory syndrome coronavirus 2. On March 11, 2020, Coronavirus was spreading at an alarming rate across the world, hence World Health Organization declared the novel coronavirus a pandemic (WHO, 2020). This has led to many economic complications. Since, the virus is very contagious, government and authorities across the world have taken actions to prevent further spread of the virus. Social distancing is one of the important steps taken by governments, which has caused many businesses to shut down temporarily or reduce their output and there are further travel restrictions. However, such restrictions had negative implications on economy, the global economy including Canada's experienced a negative demand and a negative supply shock. There are several reasons for this including low oil prices (as demand for traveling has decreased), income loses due to business closures etc. Hence, it is important to analyze how have these economic factors and social restrictions changed the dynamics of crime rate.

Already changes in crime rate in the major cities of the world have been observed. In a report by *'The Marshal Project'* , it was analyzed that in some of the major cities of the United States, the overall crime rate had dropped significantly in the week ending at 22nd March as compared to week before (The Marshall Project, 2020). The reason for the drop is that there are fewer opportunities for crime, since businesses have closed temporarily, and people are trying to 'social distance' by resorting to their homes. In another report it was analyzed that dynamics of crime rate are changing in Canada as result of our current situation, moreover it stated that there had been "fewer traffic violations, less drunk driving, fewer frauds but way more domestic violence, commercial break-ins and stunt driving."(NationalPost, 2020). This further emphasizes the need for looking at dynamics of Crime rate, during our current situation.

By provincial order, as of March 30th in Vancouver, there are restrictions in place which are as follows: no gathering of more than 50 people is permitted, individuals must maintain a distance of 2 metres between each other when outside of the home and all personal service establishments such as hair salons, nail salons, spas, massage parlors, and other similar businesses are closed Bars and clubs are closed (City of Vancouver,2020). Businesses and individuals violating could face up to $50,000 of fine (City of Vancouver,2020). As a result, we observed a sharp decline in overall crime rate as compared to previous weeks.

Data

The data for crime was collected by the Vancouver Police Department's (VPD) open database (VPD,2020). This data classifies crime committed by the type of crime, geo-location of the crime, date and time of the crime. Crime rate variable is Crime rate per 10,000 people of

Vancouver, this was calculated using population data from City of Vancouver Open Data Portal (Open Data portal, 2020). This report only considers data till 17th week of year 2020. The type of crime category classified as "Other Theft" in this report, includes crime classified as Other Theft and Bicycle Theft in the dataset provided by VPD.
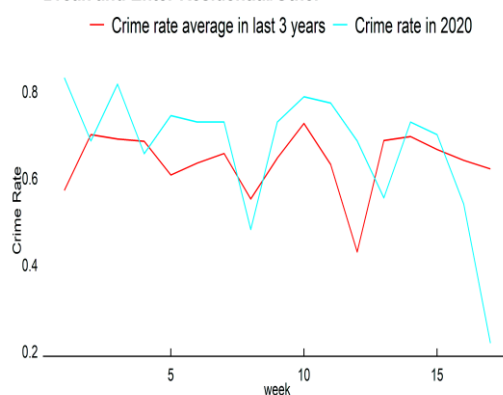
Figures

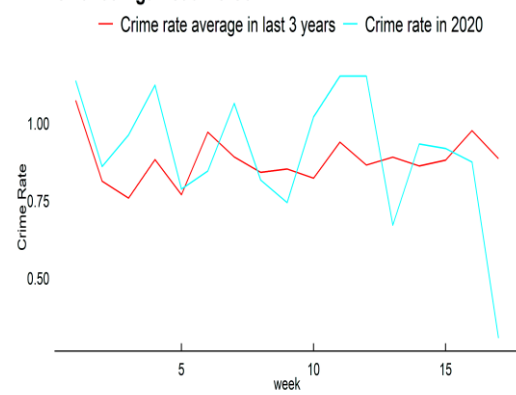**Crime rate per 10,000 people, of different categories of crime in Vancouver**
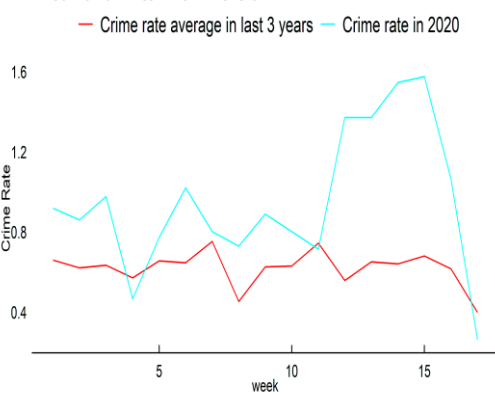
Fig(a)

Fig(b)

Fig(c)
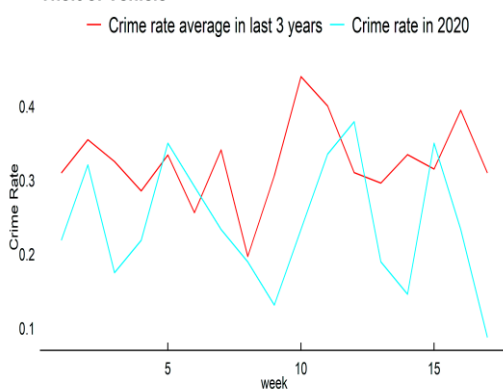
Fig(d)
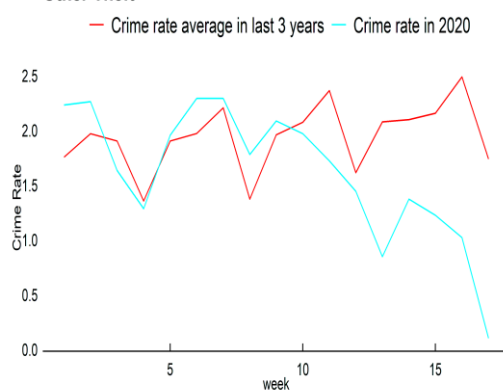
Fig(e)
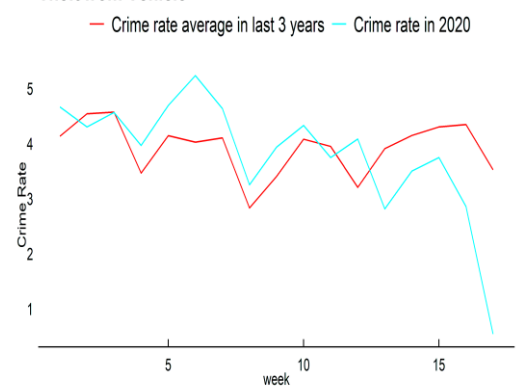
Fig(f)

Break and Enter Commercial

The figure (a) represents crime rate of category 'Break and Enter Commercial'. VPD describes this as crime that includes "Breaking and entering into a commercial property with intent to commit an offence" (VPD, 2020). According to figure (a), there is sharp increase in crime rate at 11th week of this year which peaks at week 15 (relative to previous weeks and average of previous three years). The possible reason for this increase is that commercial businesses that were closed due to social distancing are being taken advantage of, as suggested by Vancouver Police Chief Adam Palmer (VancouverSun, 2020). The restrictions were placed by provincial gov't on 14th week of 2020, but businesses had started practicing social distancing and closure earlier. We observe a drop-in crime rate after week 15. This drop could be because it took VPD some time to adjust to current situation. It could also be that businesses improved their security measures to be precautious, as they became aware of this potential threat. Overall crime rate for Break and Enter Commercial type crime is higher compared to average crime rate of last three years. Additionally, it could be that decrease in other crime meant that VPD could focus more on 'Break and Enter Commercial' related crime.

Break and Enter Residential/Other

The figure (b) represents crime rate of category "Break and Enter Residential/Other" (BNE-Residential). VPD describes this as crime that includes "Breaking and entering into dwelling /house /apartment /garage with intent to commit and offence" (VPD, 2020).

NOTE: The Figures for yearly variation in crime are available in appendix A.

There is significant decrease in BNE Residential crime rate after week 14th of year 2020. The possible reason for this is that more and more people are staying at their residences as result of social distancing, hence it becomes less opportunistic for crime to take place.

Offence Against a Person

The figure (c) represents crime rate of type "Offence Against a Person". This is described by VPD as "an attack on a person causing harm that may include usage of a weapon" (VPD, 2020). As depicted by figure (c), crime rate of this type, decrease significantly after week 14, it decreases at even faster rate after week 15. I think once again social distancing makes it less likely for people to interact, therefore rate of offence against person has fallen drastically. However, this decrease could be somewhat offset by increase in domestic violence.

Theft of Vehicle

The figure (d) represents crime rate of type "Theft of Vehicle". It is described by VPD as any crime that includes "Theft of a vehicle, motorcycle, or any motor vehicle" (VPD,2020). There is sharp decrease in rate of vehicle theft after 15th week of this year to its lowest in week 17th. This must be because less and less people are travelling, as non-essential businesses are closed, very less people are working or are working from home. The decrease in demand to travel is observable across the world, hence we see the lower demand for oil.

Other Theft

The figure (e) represents crime rate of type "Other theft". It is described by VPD as "Theft of property that includes personal items (purse, wallet, cellphone, laptop, etc.), bicycle, etc." (VPD, 2020). We can observe that after 10th week of year 2020, crime rate of type other theft, decreases and remains lower as compared average of last three years. After 14th week,

the crime rate of type other theft, kept decreasing to its lowest at 17th week. This likely because people are practicing more and more social distancing hence, there is very little opportunity for other theft to occur as less and less people are leaving their residencies. People started practicing social distancing before gov't restrictions, hence we see an initial drop from 10th week and then when restrictions were imposed more people had to follow the guidelines and hence, we see a further drop after 14th week.

Theft from Vehicle

The figure (f) represents crime rate of type "Theft from Vehicle". VPD describes this type as crime that includes "Theft of property from a vehicle" (VPD, 2020). After 15th week of 2020, there is sharp decrease in crime reaching its lowest at 17th week. After week 12, the crime rate of 'other theft', remains lower as compared to average crime rate of 'other theft' of last three years.

Economic Theory

According to the Beckers 1986 paper "Crime and Punishment: An Economic Approach", a rational offender will commit a crime if benefit from committing the crime (where offender faces a risk of getting apprehended or punished) is greater than not committing a crime (where he gets no benefit but is risk free. This implies that a rational offender will commit a crime if their expected benefit is greater than expected costs. This means that we can prevent or decrease crime rate by increasing the expected cost an offender will incur if they commit a crime. There are few different options we could take to increase expected cost, some of which are as follows:

1. We can increase the probability of an offender getting caught or arrested, we could do this by increasing number of police in an area, there are multiple papers that show empirically that increase police manpower decreases crime (i.e. DeAngelo and Hansen 2014). We could also use deployment tactics to target high crime areas or high crime type. Additionally, deployment tactics don't always work, it could lead to increase in other crimes or in other areas as suggested by Levit (1998).

2. We could increase the penalties an individual face if they commit a crime.

3. We can increase their income or try to decrease unemployment. Periods of unemployment would create incentives for individuals for criminal activity, either as a means of income supplementation or consumption smoothing or because of psychological strain (Chalfin and Raphael 2011). Essentially, unemployment causes increase in opportunity cost of committing a crime while keeping the expected cost of committing a crime the same. Moreover, crime appears to be sensitive to the existence of employment opportunities for low-skilled men (Schnepel, 2013). Similarly, higher wages would mean lower opportunity cost of committing a crime.

In case of current pandemic, we currently see fall in all crime rates despite the closure of business and lower profits of businesses, as people are still practicing social distancing hence there is very less opportunity for crime to take place. However, this would not be the case when restrictions are lifted and when people stop practicing social distancing because rise in unemployment and lower wages (as profits have fallen for businesses) would lead to increase

crime rate. This might persist for longer period of time, depending on how long we need to practice social distancing and if there would be second wave of coronavirus spread.

Summary and Implications

The coronavirus pandemic has led to decrease in over all crime rate and even individually all crime rate of all crime type observed in this paper has fallen. However, this effect is likely due to restrictions and social distancing, as restrictions are lifted, and people start interacting normally this would unlikely hold. As discussed earlier it is more likely that unemployment and lowered wages caused by negative shock to economy, would cause crime rate to increase.

Our first policy should be that uninsured workers who lost their jobs are provided some financial assistance from government, so that it decreases the incentives for people to turn towards crime. Additionally, VPD should increase manpower as effects of the recession caused by coronavirus are likely to stay for an extended period, this would help increase probability of offender getting prosecuted, hence increasing expected cost of committing a crime. Government should consider increasing the penalties on all crimes, specially the ones that have low penalties.

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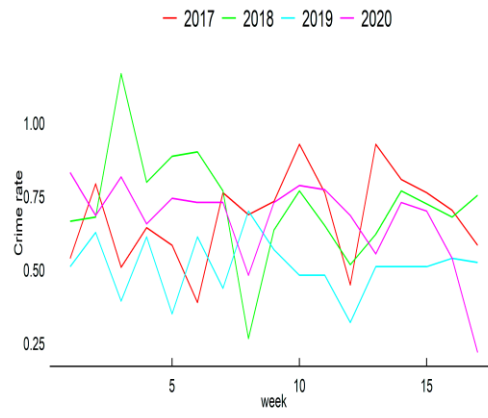*"Labor Market Opportunities and Crime: Evidence from Parolees."* Schnepel, Kevin T. 2013.

"Work and Crime." In The Oxford Handbook of Crime and Criminal Justice, Chalfin, Aaron, and Steven Raphael. 2011. Edited by Michael Tonry, 444–78. Oxford and New York: Oxford University Press.
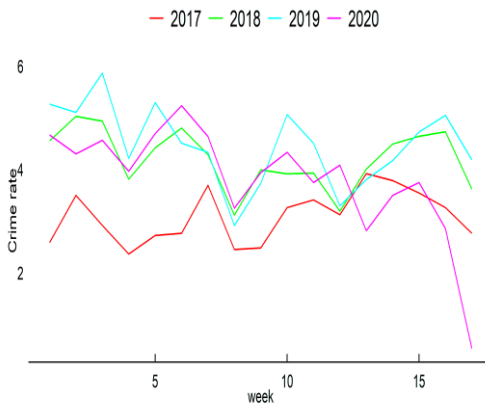
Appendix A: Additional Figures
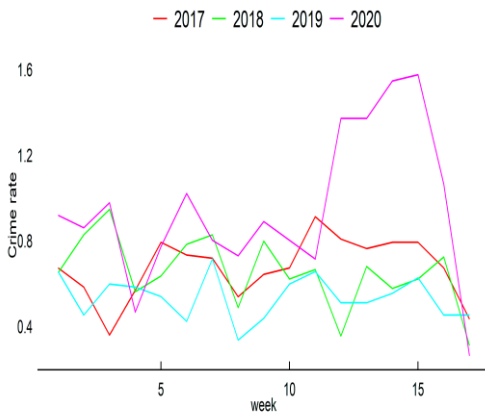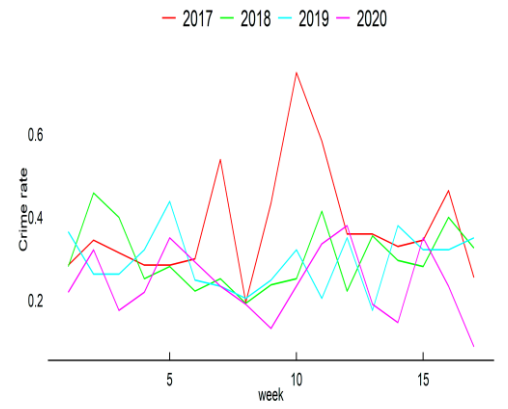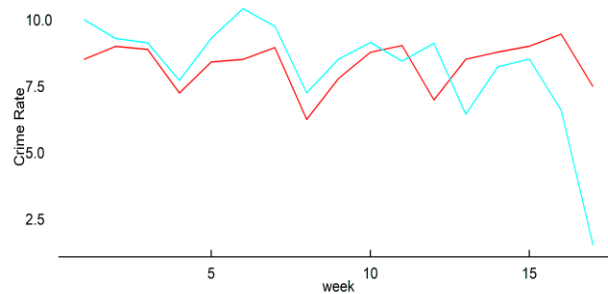
Appendix B: R script to clean data and create all figures

```r
#Libraries needed for this code

library(tidyverse)

library(lubridate)

library(hrbrthemes)

library(ggthemes)

library(cowplot)

library(RColorBrewer)

#Reading in the data

setwd("C:/Users/Muhammad/Projects/Coronavirus/Coronavirus")

crimedata<-read_csv("crimedata_csv_all_years.csv")

pop_data<-read_csv("vancouver_pop_2003to2020.csv")

#Joining two datasets by year and filtering years

names(crimedata)[2]<-"year"

crimedata<-full_join(crimedata,pop_data)

mycrime<-filter(crimedata, year>=2017)

#Redefining Theft of Bicycle as Other Theft

mycrime$TYPE[mycrime$TYPE == "Theft of Bicycle"] <- "Other Theft"

#filtering by weeks and crime type

pop_data1<-filter(pop_data, year>=2017)

mycrime<- mycrime %>%

  mutate(date = make_date(year, MONTH, DAY))

mycrime<-mutate(mycrime, week=week(date))

mycrime<-filter(mycrime, TYPE!="Vehicle Collision or Pedestrian Struck (with Fatality)" & TYPE!="Vehicle Collision or Pedestrian Struck (with Injury)" & TYPE!="Homicide" & TYPE!="Mischief")

#Only looking at first 20 weeks

mycrime<-filter(mycrime, week<=17)

#creating weekly total incidents and crime rate variable

mycrime1<-group_by(mycrime,year,week) %>%

  summarise(total_incidents=n())

mycrime1<-full_join(mycrime1,pop_data1)
```

```
mycrime1<-mutate(mycrime1, CrimeRate=(total_incidents/population)*10000)
```

#Creating a plot for Weekly Variation of crime rate across years

```
ggplot(mycrime1,aes(x=week,y=CrimeRate,color=factor(year)))+
  geom_smooth(se=FALSE)+
  ggtitle("Weekly Variation of crime rate across years")+theme_economist() + scale_fill_economist()
ggplot(mycrime1,aes(x=week,y=CrimeRate,color=factor(year)))+
  geom_line()+
  ggtitle("Weekly Variation of crime rate across years")+theme_economist() + scale_fill_economist()
```


#Creating a plot for Weekly Variation of average crime rate in last 3 years and crime rate in 2020

```
c1<-group_by(mycrime,year,week) %>%
  summarise(total_incidents=n())
c1<-full_join(c1,pop_data1)
c1<-mutate(c1,`Crime rate in 2020`=(total_incidents/population)*10000)
crime2020<-filter(c1,year>=2020)
 c2<-full_join(mycrime,pop_data1)
  c2<-filter(c2, year<2020)%>%
 group_by(year,week,population)%>%
    summarise(`Total incidents`=n())
  c2<-mutate(c2, CrimeRate=(`Total incidents`/population)*10000)
c2<-group_by(c2,week)%>%
  summarise(`Crime rate average in last 3 years`=mean(CrimeRate))
c2<-full_join(crime2020,c2)
c2<-pivot_longer(c2,cols=starts_with("Crime"),names_to ="Crime Period",  values_to ="Crime Rate")
ggplot(c2)+
  geom_line(aes(x=week,y=`Crime Rate`, color=`Crime Period`))+
  ggtitle("Crime Rate in 2020 vs 3 years average")+theme_economist() + scale_fill_economist()
```
#Functions to make plots for yearly variation and 3 year average variation in crime

```
myfunc2<-function(y){
c1<-group_by(mycrime,year,week,TYPE) %>%
  filter(TYPE==y)%>%
  summarise(total_incidents=n())
```

```r
c1<-full_join(c1,pop_data1)

c1<-mutate(c1,`Crime rate in 2020`=(total_incidents/population)*10000)

crime2020<-filter(c1,year>=2020)

 c2<-full_join(mycrime,pop_data1)

  c2<-filter(c2, year<2020,TYPE==y)%>%

 group_by(year,week,TYPE,population)%>%

    summarise(`Total incidents`=n())

  c2<-mutate(c2, CrimeRate=(`Total incidents`/population)*10000)

c2<-group_by(c2,week,TYPE)%>%

 summarise(`Crime rate average in last 3 years`=mean(CrimeRate))

c2<-full_join(crime2020,c2)

c2<-pivot_longer(c2,cols=starts_with("Crime"),names_to ="Crime Period",  values_to ="Crime Rate")

g1<-ggplot(c2)+

  geom_line(aes(x=week,y=`Crime Rate`, color=`Crime Period`),se=FALSE)+

ggtitle(y)+theme_economist() + scale_fill_economist()+theme(legend.title = element_blank())

return(g1)

}

myfun1<-function(y){

c1<-group_by(mycrime,year,week,TYPE) %>%

 filter(TYPE==y)%>%

 summarise(total_incidents=n())

c1<-full_join(c1,pop_data1)

c1<-mutate(c1,`Crime rate`=(total_incidents/population)*10000)

g1<-ggplot(c1)+

  geom_line(aes(x=week,y=`Crime rate`, color=as.factor(year)))+

  ggtitle(y)+theme_economist() + scale_fill_economist()+theme(legend.title = element_blank())

return(g1)

}

# geom_line plots for each crime type through the first 16 weeks of the year for the years 2017 through 2020

graph11<-myfun1(y="Break and Enter Commercial")

graph21<-myfun1(y="Break and Enter Residential/Other")

graph31<-myfun1(y="Offence Against a Person")
```

graph41<-myfun1(y="Other Theft")

graph51<-myfun1(y="Theft from Vehicle")

graph61<-myfun1(y="Theft of Vehicle")

#geom_line plots for each crime type through the first 16 weeks of the year for the year 2020 compared to the average from 2017, 2018, 2019

graph12<-myfunc2(y="Break and Enter Commercial")

graph22<-myfunc2(y="Break and Enter Residential/Other")

graph32<-myfunc2(y="Offence Against a Person")

graph42<-myfunc2(y="Other Theft")

graph52<-myfunc2(y="Theft from Vehicle")

graph62<-myfunc2(y="Theft of Vehicle")

#plotting all graphs

graph11

graph12

graph21

graph22

graph31

graph32

graph31

graph32

graph41

graph42

graph51

graph52

graph61

graph62