CHICAGO CRIME IN THE RAHM EMANUEL ERA

AN ANALYSIS OF VIOLENT AND NON-VIOLENT CRIME 2010 – 2016 UTILIZING DATA EXTRACTED FROM THE CHICAGO POLICE DEPARTMENT CLEAR SYSTEM

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THE DATA SET – DESCRIPTION AND AREA OF FOCUS

We decided to concentrate our analysis on crime in Chicago utilizing the dataset available through the City of Chicago Data Portal[1]. This comprehensive dataset covers crimes that occurred in the City of Chicago from 1st January 2001 to the present time. The data is extracted from the Chicago Police Department's CLEAR (Citizen Law Enforcement Analysis and Reporting) system. The information available on the database includes more than 6 million records and 23 column headings that include the date and time of the crime, its type, classification and location. Some of the key fields include:

Type:

- Primary Type (such as assault, homicide, auto theft)
- Illinois Uniform Crime Reporting (IUCR) code
- Description (e.g. aggravated: other dangerous weapon)

Classification:

- Arrest (Yes or No)
- Domestic (Yes or No)

Location:

- Block (Street name and block number)
- Location Description (e.g. Alley, Street, Residence)
- Beat and District (subdivisions of the city related to policing)
- Ward (subdivisions of the city related to the city council)
- Community Area (77 neighborhoods defined by the Social Science Research Committee at the University of Chicago)
- Latitude and Longitude

Given the size of the database we believed it was important to try and narrow down our area of focus to either a specific period, and / or a subset of the types of crime. Initially we considered an arbitrary time cut-off, such as the last five years, then considered using economic criteria: Chicago had an unemployment rate in January 2008 of 6.4% (U.S Bureau of Labor Statistics), close to the 6.1% level in August of 2016, far below the peak of over 12% in 2010 after the Great Recession. An analysis of trends through this period could highlight the impact of high unemployment on different types of crime. However, after doing further research of crime related issues that dominated the media in this decade, we concluded that 2010 would be the best place to begin our analysis.

Our decision was based on political change. After more than twenty years in office, Richard M. Daley decided not to seek reelection in 2011 as Mayor of Chicago. Rahm Emanuel, the former White House Chief of Staff, won the

[1] https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-present/ijzp-q8t2

election and appointed Garry McCarthy as the new Superintendent of the Chicago Police Department (CPD). Emanuel was reelected four years later at a time when crime was perceived to be declining in the city. But 2015 saw several important events that impacted crime and the CPD. The CPD was forced to substantially modify its extensive stop and frisk policy in the wake of an ACLU lawsuit. In November, video of the police shooting of Laquan MacDonald was finally released, more than a year after it happened. In its wake, Emanuel fired Garry McCarthy, and the Justice Department launched an investigation of the CPD. In the subsequent year, there was a spike in homicides that captured the media's attention. We therefore decided to begin in 2010 as the base year before Emanuel and McCarthy took over, and analyze both violent and non-violent crime to get a better picture of the events of the last six years. In addition, our start year coincided with the final published edition of the CPD Annual Report.

SUMMARY OF ANALYSIS AND CONCLUSIONS

Given the media's focus on homicide, you might have the impression that Chicago is experiencing an unprecedented crime wave. In addition, there has been skepticism that McCarthy exaggerated the decline in crime under his watch.[2],[3] Our review of the data has led us to more nuanced conclusions:

- For the ten months through the end of October, violent crime has risen 22.3% year on year, and homicides has increased nearly 50% over that same period.
- In contrast, non-violent crime has been on a clear decline since 2010, and for the ten months through the end of October declined marginally by 1%.
- There is clear seasonality for all crime, but the amount varies widely by type; crimes such as gambling are strongly seasonal, narcotics is not.
- There is a general trend for crime to occur in the afternoon and evening, with below average crime in the early morning. Specific types of crime have different distributions throughout the day.
- Violent crime is more concentrated in certain areas of the city than non-violent crime, and neighborhoods experience both different levels and types of crime. The distribution of the four categories of violent crime also differs by district, with homicides notably concentrated in Districts 7 and 11. District 11 also has the highest level of narcotics crime.
- The overall arrest ratio has fallen in 2016. Again that decline varies by type of crime. It is important to note that the arrest ratios for crimes such as homicide and deceptive practices were falling in 2015 as well, so this is not a phenomenon specific to 2016.
- There are several possible explanations for the decline in the homicide arrest ratio, but we have insufficient data to draw firm conclusions.
- Given the strong seasonality of all crime over the long term, it is likely that the temperature impacts crime, particularly in the winter. However, other than evidence that crime rates are very low when the mean monthly temperature is at or below 20 F, it is not possible to draw a firm conclusion about the impact of warmer temperatures (20 F to 35 F) on crime in those months.

PART 1: DATASET EXPLORATION AND SANITY CHECKS

Given the size of the full dataset (a csv file of over 1gb), we first tested out the importation of different subsets. Fortunately, the City of Chicago data portal allows you to filter and then export subsets of the entire dataset in various file formats. After importing a smaller csv file, we read the file into a jupyter notebook using the pandas read_csv function and then conducted initial checks. For such a large database, it is impressively complete. There are location coordinates missing for some crimes, but those still have Block, Community Area and other

[2] http://www.economist.com/blogs/democracyinamerica/2014/05/crime-statistics-chicago
[3] http://www.chicagomag.com/Chicago-Magazine/June-2014/Chicago-crime-statistics/

location data. We confirmed the categorical fields. A search of data types indicated that Date was an object, and most of the fields expected to be numbers were indeed either floats or integers. The IUCR four digit codes (which will be explained in more detail below) were the one number field that was an object.

Having checked the validity of a sample import, we then extracted the dataset from the portal with our specified dates: from midnight on the January 1st, 2010 to midnight on October 31st, 2016. Data was available through part of November, but we determined that our year on year calculations would be cleaner using complete months. Importing this dataset into the notebook, we reran the basic checks. This dataset had 2,124,945 rows, with about 1.2% missing coordinate information, though fewer than 0.1% were missing a location description. We then began by adjusting the Date column into a readable datetime format and adding additional columns, such as Day of the Week and Day of the Month that would be used for later analysis.

We wanted a key part of our analysis to focus on the difference between violent and non-violent crime. Our assumption was that we could simply group by Primary Type. But a summary report by the FBI in 2015 on violent crime highlighted that their definition of violent crime is four offenses: murder and non-negligent manslaughter, rape, robbery and aggravated assault. The Primary Type Assault includes simple assaults, which greatly outnumber aggravated assaults, thus distorting any analysis. Instead we needed to focus on the IUCR codes, which are Illinois Uniform Crime Reporting Codes, a much more detailed description of individual crime, and closely aligned with the Federal Uniform Crime Reporting Codes. We then checked the CPD's definition of Violent Crime[4] and utilized their list of 70 IUCR codes to group our dataset into Violent and Non-Violent Crimes. Our one concern was that there had been media commentary about the inaccurate reporting of crimes by the CPD. However, a review of the Inspector General Audit[5] indicated that the main conclusion was that the CPD failed to count each victim in multiple victim crimes, an error that the CPD implied had been corrected in the City of Chicago dataset. While it is certainly possible that there are reporting and methodological differences between the IUCR coding and Federal coding and the CPD's internal CompStat crime reporting system, we do not have the data necessary to make such a comparison and since we are not attempting to compare the City of Chicago dataset to either of these other datasets, do not believe in impinges of our findings in any significant way.

Having created an overall category for Violent and Non-Violent crime, we additionally grouped together aggravated assault and aggravated battery, to be able to mimic as nearly as possible the four FBI violent crime categories mentioned above. In the period under review, the CPD reported on average about ten non-violent crimes for every one violent crime.

The four violent crime categories are:

- Homicide; Criminal Sexual Assault; Robbery; Aggravated Assault and Battery

There are 31 primary types of non-violent covering more than 300 IUCR codes. The top ten most common are:

- Theft; Battery; Criminal Damage; Narcotics; Burglary; Other Offense; Motor Vehicle Theft; Deceptive Practice; Assault; Criminal Trespass

Other researchers have demonstrated that there is a strong positive correlation between overall crime in Chicago over the long term and temperature[6], particularly between 10 F and 90 F. We wondered if it would be possible to show such a correlation over short periods. Our analysis is explained in Part 5.

[4] http://gis.chicagopolice.org/clearmap_crime_sums/crime_types.html
[5] Chicago Police Department Assault-Related Crime Statistics Classification and Reporting Audit 2014
[6] http://crime.static-eric.com/#top

PART 2: OVERALL TREND OF CRIME

IS CRIME ON THE INCREASE OR NOT?
ARE THE POLICE FAILING TO STOP CRIME?

FIGURE 1

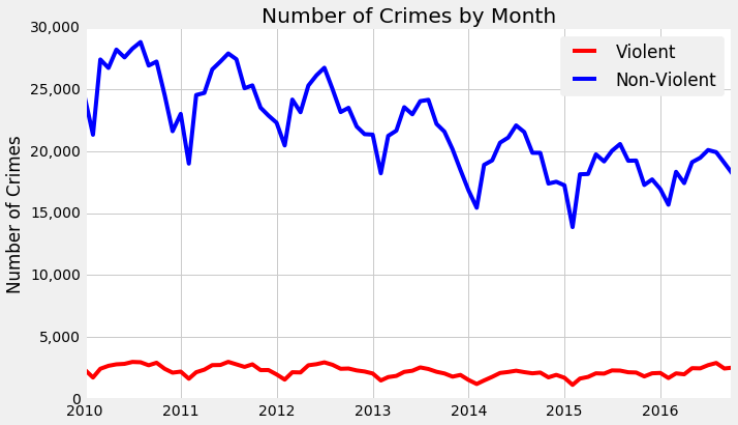


FIGURE 2

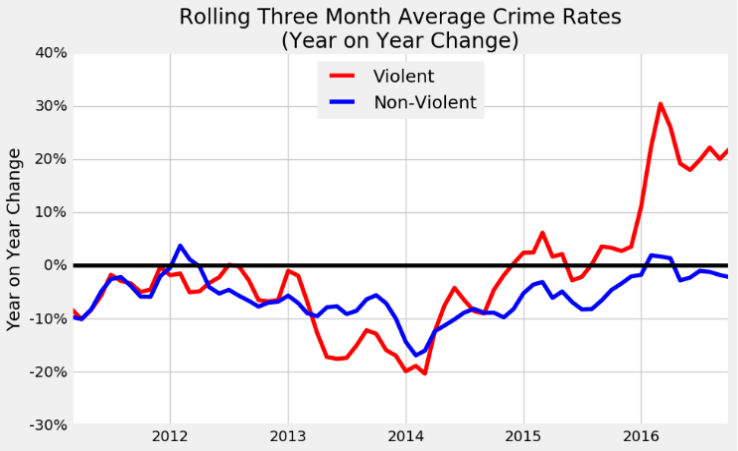


TABLE 1

YEAR	NUMBER OF CRIMES	NUMBER OF ARRESTS	ARREST RATIO
2010	369,997	100,396	27.1%
2011	351,540	96,161	27.4%
2012	335,655	90,510	27.0%
2013	306,685	86,216	28.1%
2014	274,464	79,043	28.8%
2015	262,900	69,338	26.4%
2016 (to end Oct)	223,706	43,023	19.2%

Given the recent focus on the 'explosion' in homicides, we wanted to determine the overall trend since 2010. It seems apparent from figure 1, which shows the overall number of crimes by month, that the general trend has been downward since 2010, particularly for non-violent crimes. That is corroborated by the total number of crimes reported per year, shown in table 1. The rolling three-month average shown in figure 2 better illustrates the jump in violent crime that has taken place since 2015. But it is important to note that this is confined to violent crime – the downward trend in non-violent crime may have ceased, but it is hard to argue that there has been any discernible uptick. In addition, there was a notable drop in violent crime in the middle of 2013 into 2014, which helps to explain the positive spin that Emanuel and McCarthy were putting on crime in the run up to the 2015 election.

Our second question is more complicated. We only have statistics for reported crime. It is certainly possible that unreported crime is on the rise, but we have no way to measure it. Table 1 shows the number of arrests relative to reported crimes. So perhaps a better question would be: are the police solving crimes? It is very noticeable that the arrest ratio was fairly constant through 2015, then drops sharply in 2016. This overall picture hides two important factors: Arrest ratios in general vary widely by type of crime, and the 2016 decline in the arrest ratio has been specific to certain crimes. We will explore this in more detail in Part 5.

Location has changed little over the period under review. The top four categories in 2010 of Street, Residence, Apartment and Sidewalk remain the top four in 2016. Given that certain types of crime are associated with certain locations, it is unlikely that overall location distribution will change unless

there is a dramatic shift in types of crimes committed. Data in the 2011 CPD Chicago Murder Analysis did show a very long term (20 year) trend of an increase in homicides committed outdoors vs indoors. They gave no specific reason for that trend, but it may reflect greater street gang activity.

PART 3: THE TIME OF CRIME

HOW IS CRIME DISTRIBUTED THROUGHOUT THE DAYS, WEEKS AND MONTHS?

Focusing on our breakdown on Violent vs Non-Violent Crime, we now look at the distribution over time. Figures 3 and 4 show a breakdown of the total crimes in the period under review, split into the day of the week that they were reported. Figure 3 shows the total number per day (again reflecting the roughly 10 to 1 ratio of non-violent to violent crime), while figure 4 shows the same data, but split into the percentage of total crime that happens on each day. The thick black line represents an average for the week. Thus, the weekend is the prime time for violent crime, while Friday is the peak day for non-violent.

FIGURE 3

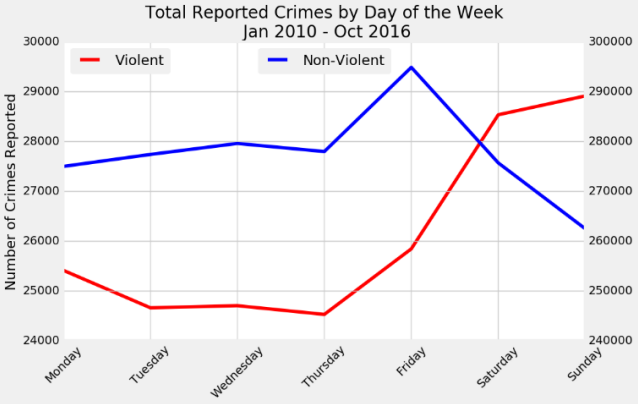


FIGURE 4

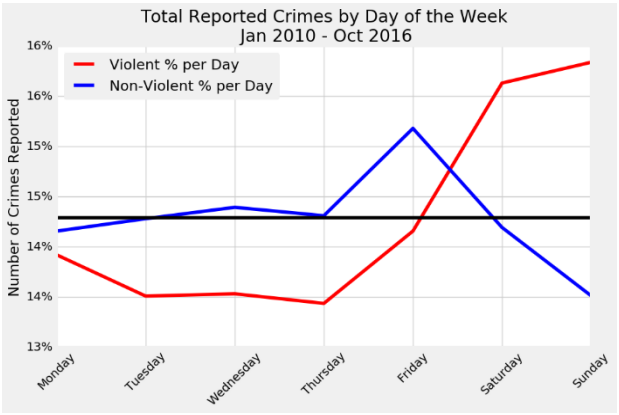


FIGURE 5

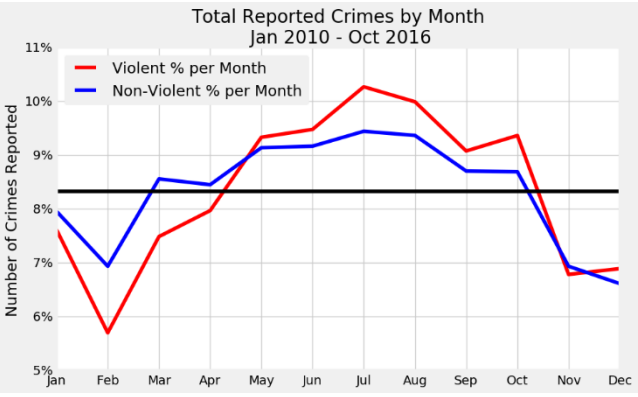
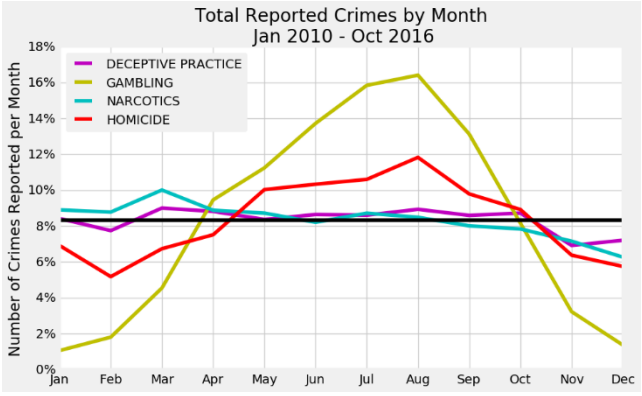


FIGURE 6



Looking at the same totals, but broken down by months, figure 5 shows a clear seasonal trend for all crime, with above average crime in the summer months, and a notable trough in February.

It should be noted that this seasonality varies widely by type of crime, especially for non-violent crimes, as shown in figure 6. Narcotics and deceptive practice have almost no seasonality, and we are unable to determine why there should be a small peak in drug crimes in March.

Reviewing crime by the hour of the day, we thought it would be useful to determine is domestic violent crime had a different profile, given that it would be plausible to assume that domestic crime would be more likely to occur in the evening or morning, when most family members would be at home, rather than overall violent crime, much of which is occurring on the street. As figure 7 indicates, there is a greater proportion of domestic violent crime in the morning as we suspected, but otherwise it generally follows a very similar pattern to overall violent crime.

A review of different types of non-violent crime gave a clearer indication of the reason for the visible bump around noon that you see in figure 7: all three non-violent crimes shown have much lower incidence rates in the early morning hours, then jump at or after 9am. In addition, gambling and deceptive practices are shown as very time specific crimes, with sharp spikes in their time distribution.

FIGURE 7

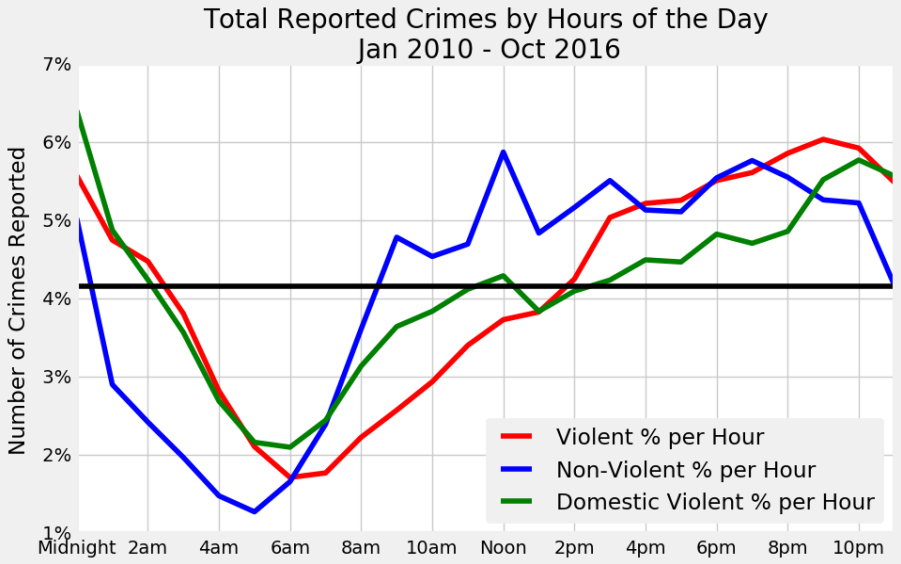
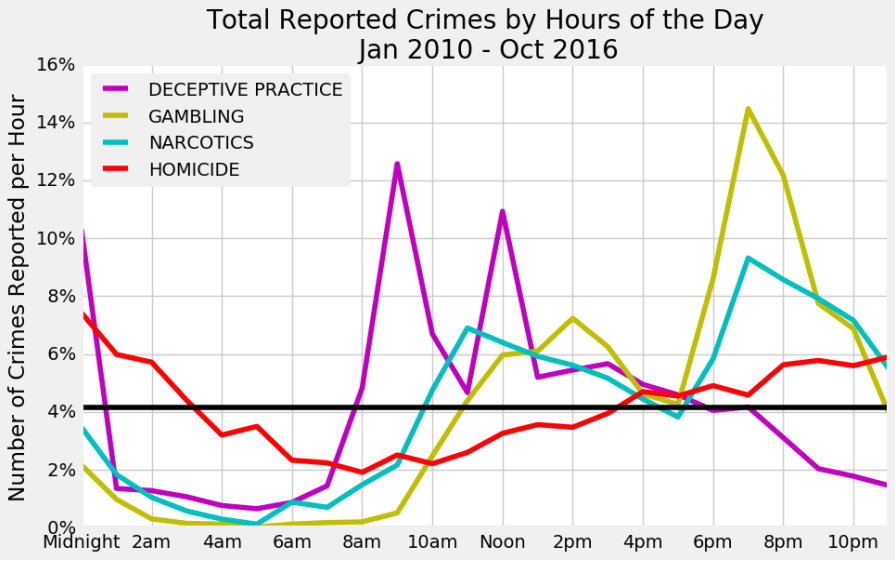


FIGURE 8



PART 4: THE LOCATION OF CRIME

ARE CERTAIN CRIMES SPECIFIC TO LOCATION?
DO RESIDENTS OF DIFFERENT NEIGHBORHOODS EXPERIENCE DIFFERENT CRIMES?

It should be expected that certain crimes will be more prevalent in certain types of locations. Burglaries occur at homes and businesses; drug deals tend to take place on the street. In that respect, Chicago's distribution of crime appears reasonable, as shown in figure 9. Burglaries take place in homes and apartments, and over 40% of non-violent assault and battery is in homes or apartments. Focusing in on violent crime in figure 10, sexual assaults take place mostly in the home, while homicides are on the street. Of more interest is the distribution of crime by district, as shown overleaf in figures 11 and 12.

FIGURE 9

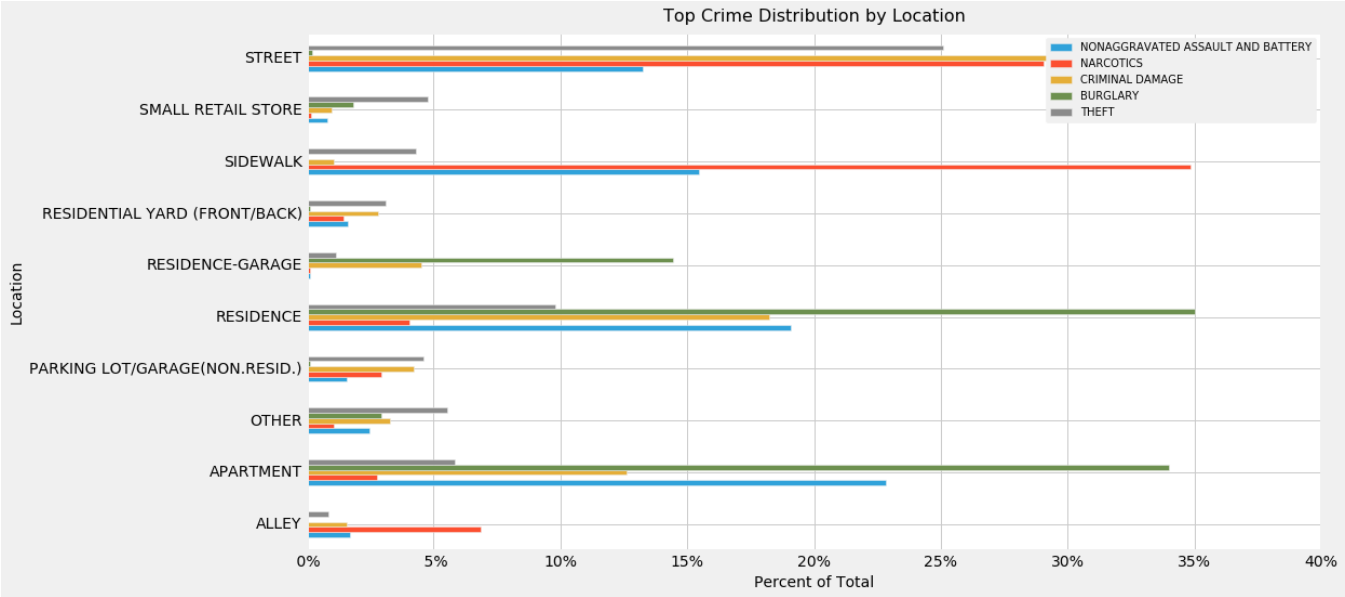
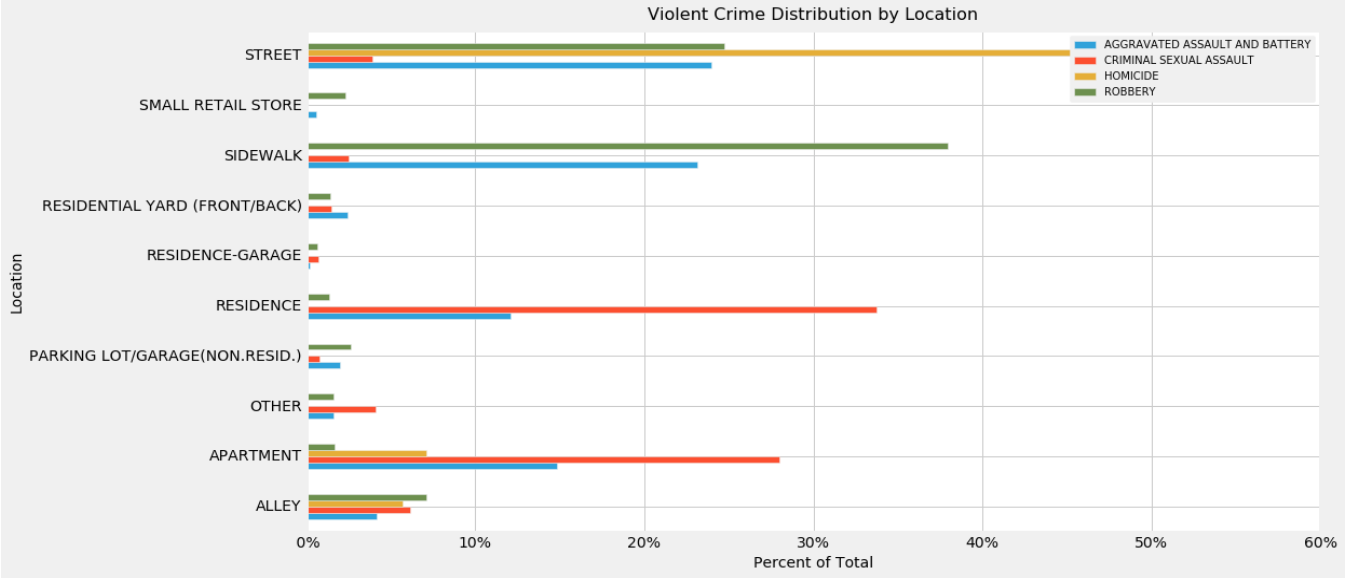


FIGURE 10



The dataset contains a lot of location information, including wards, districts and community areas. Using district gives the widest view of the city. In broad terms, the low numbered districts are on the South Side, and higher number districts are the North Side. See the map overleaf. Two issues stand out from the overall and violent crime distribution: Narcotics crime is very concentrated in two districts, 11th and 15th, and violent crime is more concentrated into certain districts than non-violent crime, excluding narcotics. In the Appendix, there are two maps for violent crimes in 2016, which shows the different distribution of sexual assaults and homicides across the city that can be seen in figure 12.

FIGURE 11

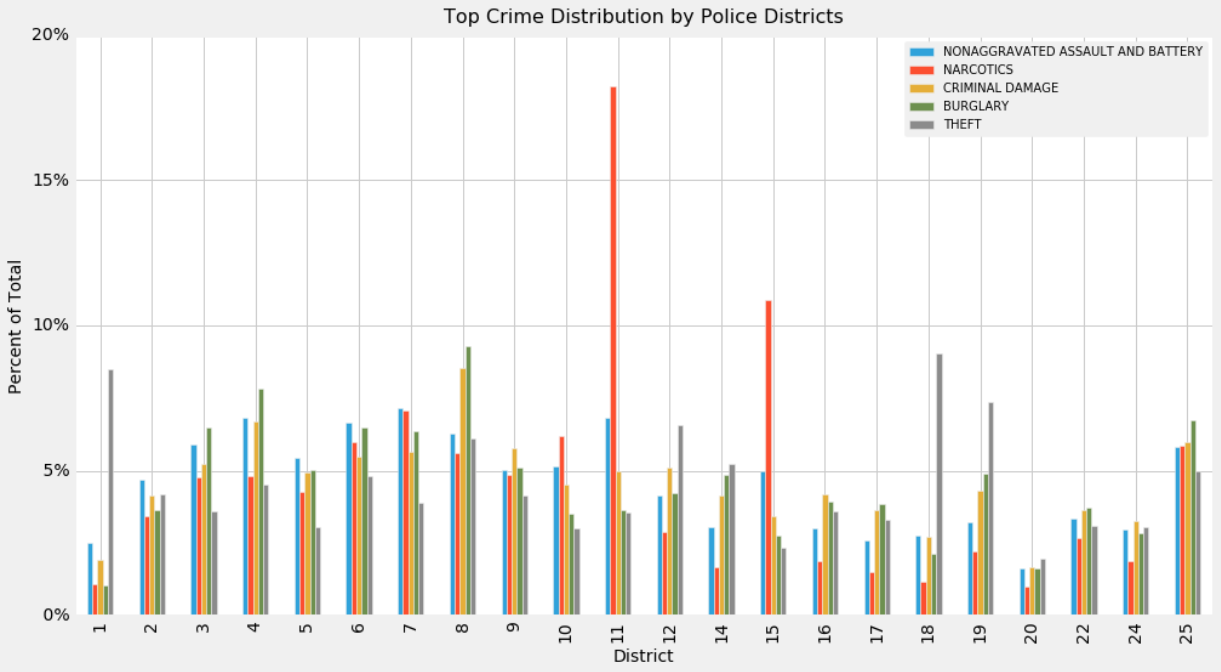
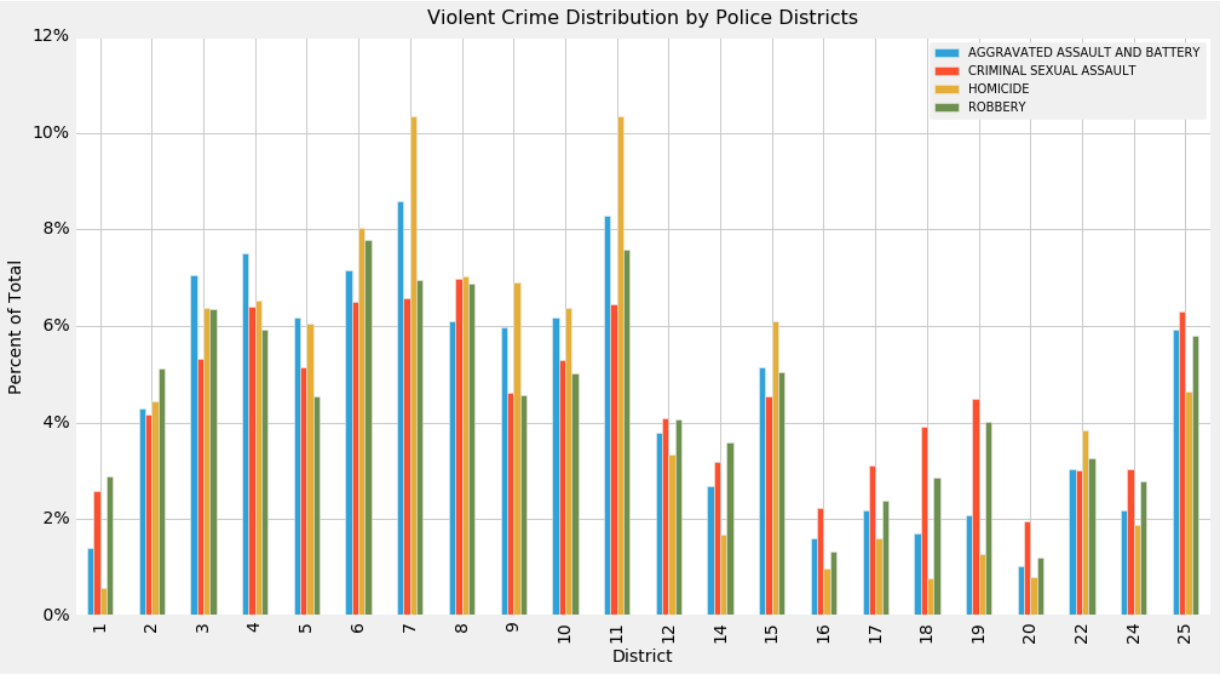
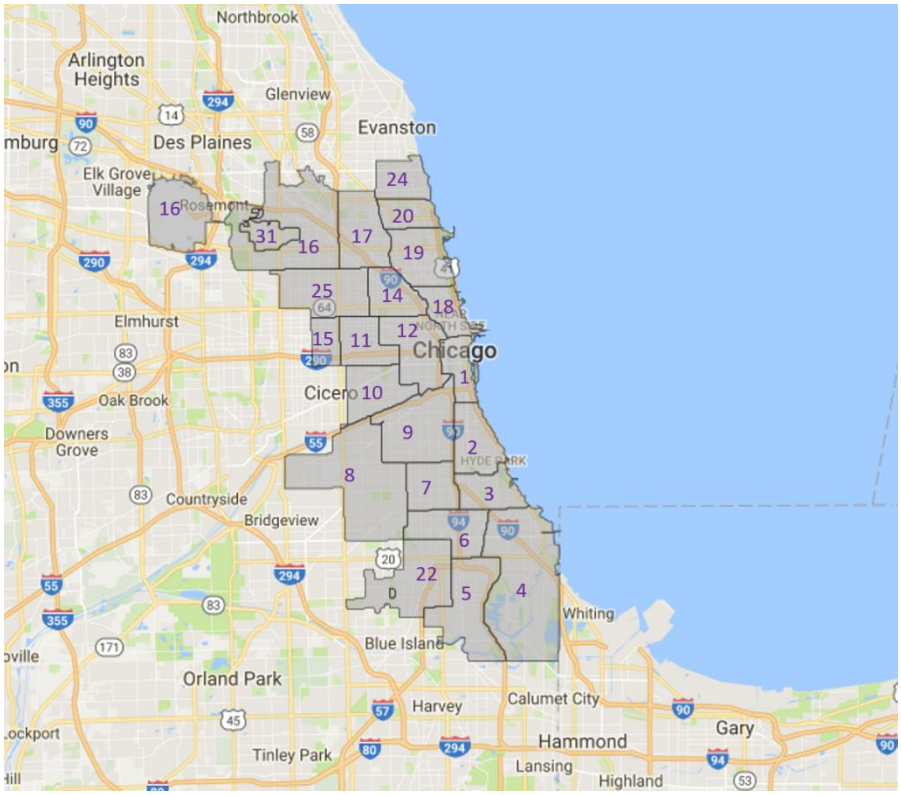


FIGURE 12

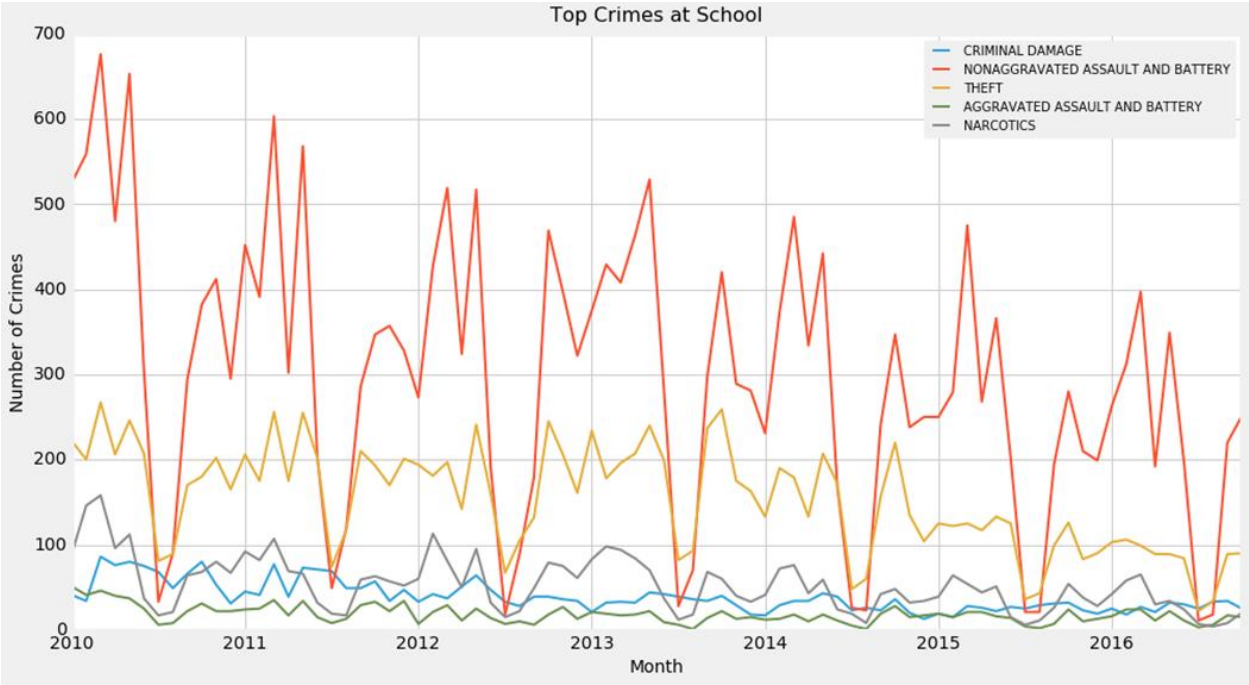




It is notable that homicide rates are very low across most of the North Side (generally Districts numbered 16 and higher). Over time districts have merged, most recently the 13th and 21st, which explains both the apparent gaps in the charts, and the inconsistent numbering on the map.

Our final location analysis is an overview of crime around schools, shown in figure 13. We focused on the most prevalent crimes. Four of the top five are non-violent, and the good news is that in all cases, the overall trend from 2010 on has been downward, with no clear evidence of any change in that trend in 2016. It should be noted that the immense seasonality of nonaggravated assault and battery and theft shown in figure 13 coincides with the school year.

FIGURE 13



PART 5: DEEPER ANALYSIS OF SPECIFIC ISSUES

WHY HAS THE ARREST RATIO FALLEN?
IS THE LEVEL OF CRIME AND ARREST RATIO CORRELATED?
HAS WEATHER INFLUENCED THE SUDDEN RISE IN HOMICIDES?

In Part 2 we showed that the annual arrest ratio fluctuated modestly until the decline in 2016. Over nearly seven years, the arrest ratio was 17.2% and 27.4% for violent and non-violent crime respectively. In this part of the analysis, we focus on three very different types of crime, that have widely different arrest ratios, to see if there is a correlation between arrest ratio and crime level.

We begin with Narcotics, shown in figure 14. It is unusual as the arrest ratio has remained at or near 100% for the entire period. On reflection, this makes sense, as it is difficult to see a situation where a narcotics crime would be reported without an arrest being made. The data is unable to shed light on the more important question: is drug dealing and drug use declining in the city? At first glance, the answer could be yes, but it may be that arrests have fallen because the police are focusing more of their attention on other crime, such as homicide. Given the change in the stop and frisk policy, it seems more plausible that the police are intervening in fewer drug deals, resulting in a drop in reported crime.

FIGURE 14

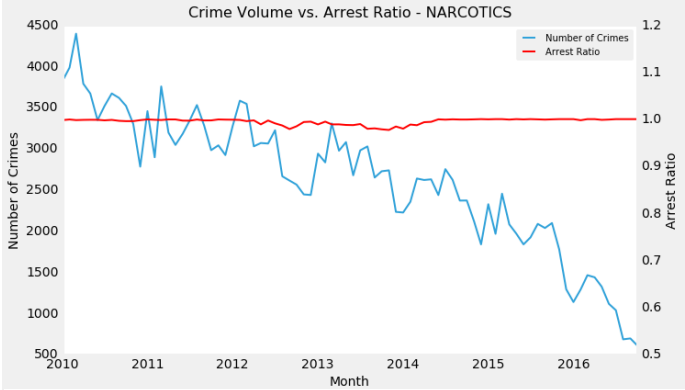
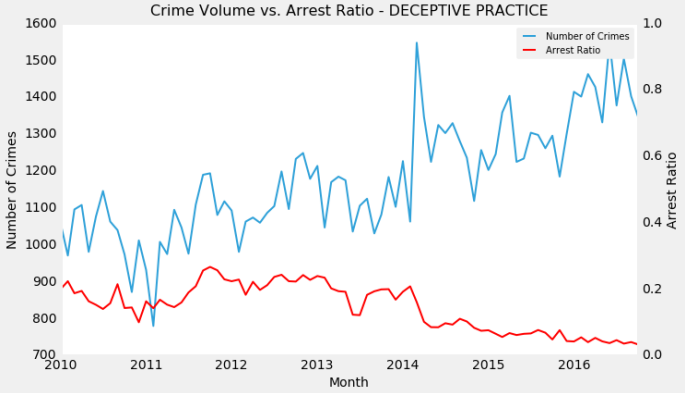
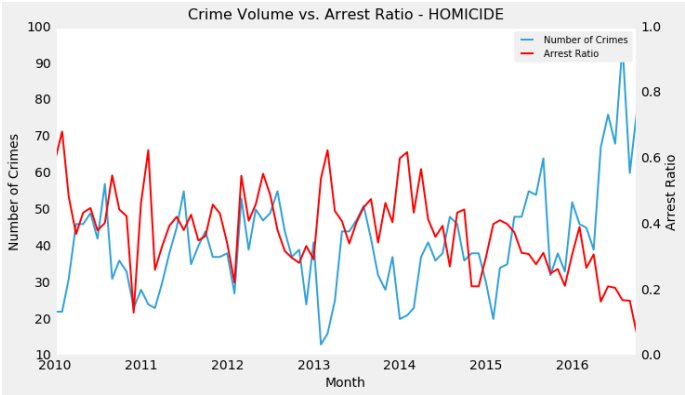


FIGURE 15



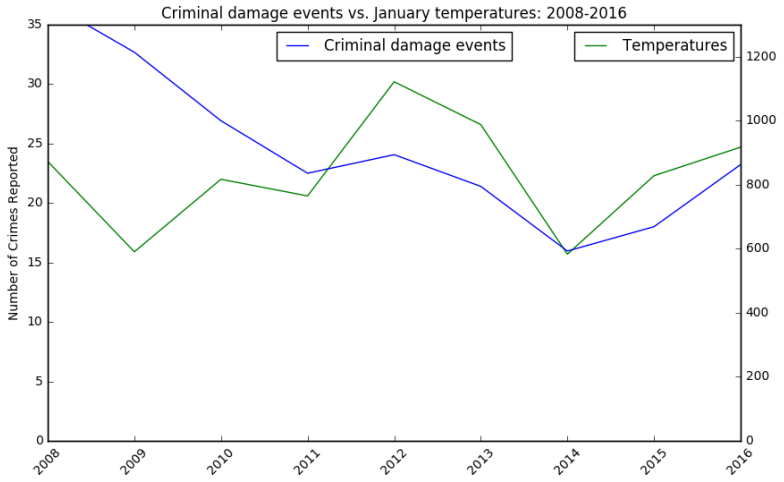
Moving on to Deceptive Practices, shown in figure 15, there was a sharp jump in volume coinciding with a proportionally even large fall in the arrest ratio. That trend continued into 2015 and beyond. It is not clear whether this is linked to a jump in cybercrime, credit card fraud. The crimes are described as 'Financial Identity Theft over $300'. There is certainly a correlation between the fall in arrests and rise in crime, but it is unclear whether there is any causality.

FIGURE 16



Let us now focus for a moment in criminal damage. Criminal damage reveals three striking patterns. First, high levels of non-normality, which suggests that this particular crime is highly concentrated in some districts (see Table 2 which shows the high non-normality of the observed distribution of events through three standard tests). Second, no apparent correlation between the events of criminal damage and the putative increase in temperatures in January and February throughout the years. In January there does not to seem any association between both variables; in February there is more of a case, but in that month the

temperatures were actually falling (see figures 18 and 19). More interestingly for policy, and third, the occurrence of criminal damage does not seem to be driven by the proportion of arrests obtained: note the decreasing trend in events and arrests observed in Figure 20.



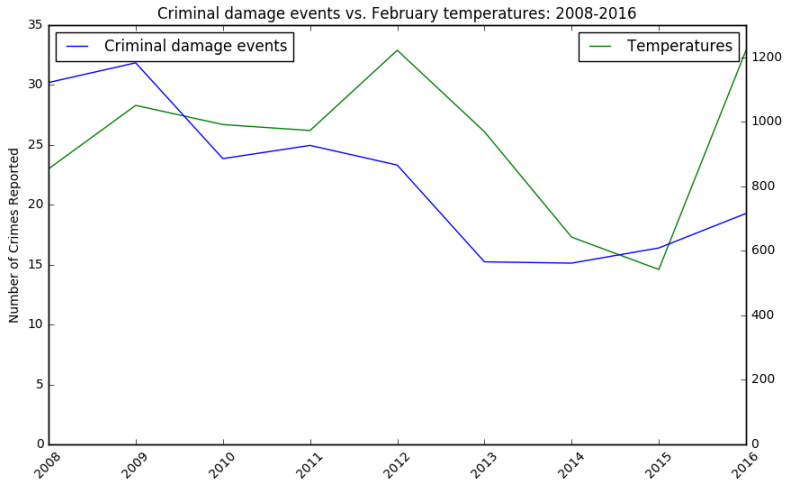


Table 2 - Characteristics of the empirical distribution of criminal damage per district

(2010-2016)

Test	***Result***
Kurtosis	***4.83***
Skew	***4.68***
Modeskew	***0.515***

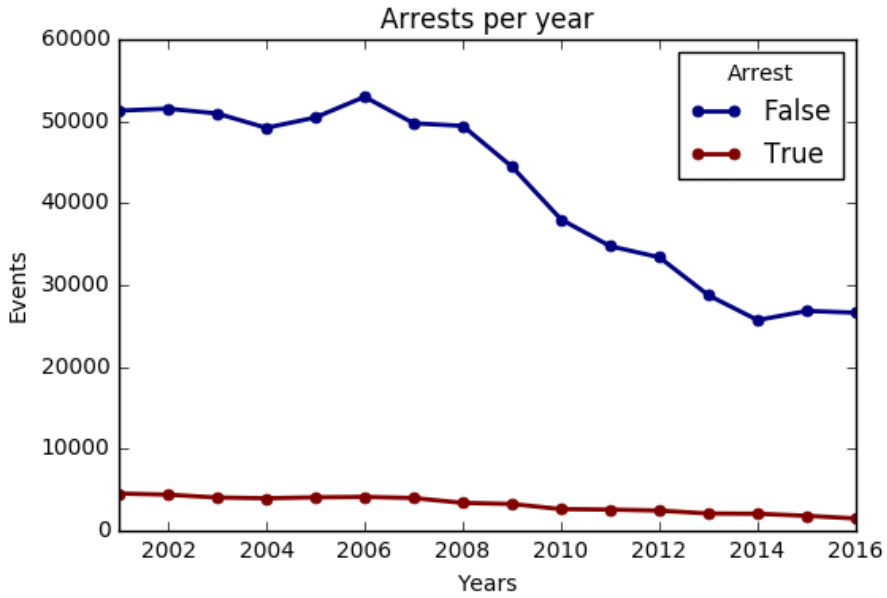
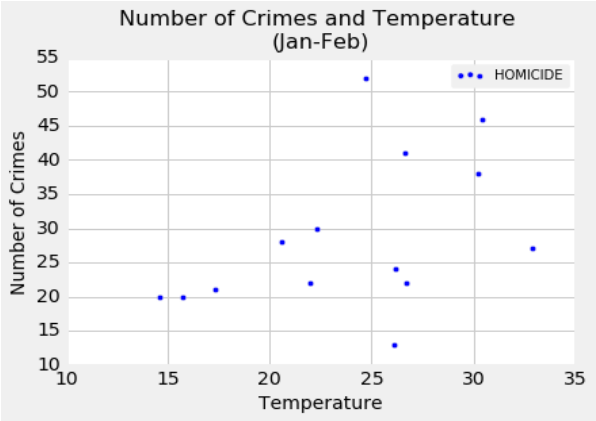


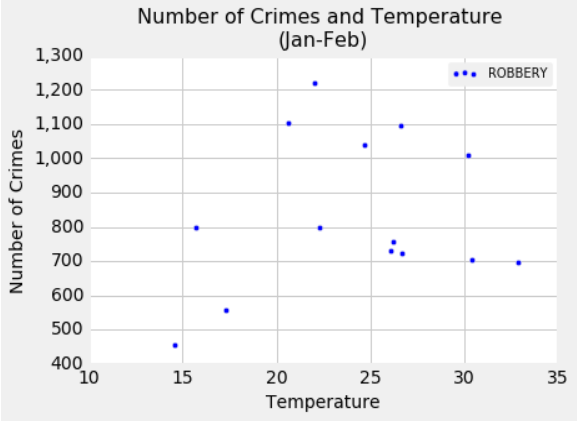
Figure 20

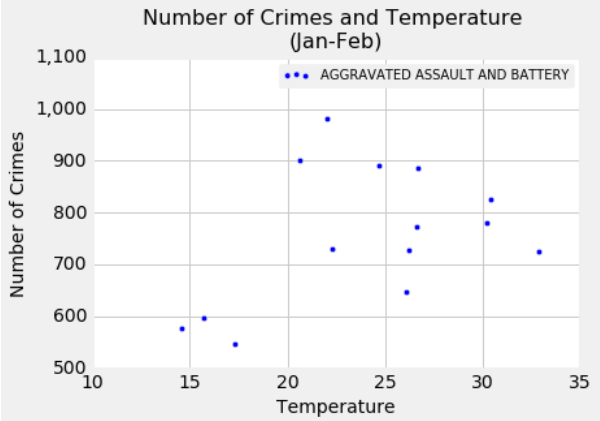
Finally, Homicide, shown on Page 10, in figure 16. In the last five years, there have been short term spikes in the arrest ratio over 50% that have coincided with sharp declines in homicides. But the most notable shift has come in 2016, with the spike in crime and drop in arrests. It is difficult not to attribute this to the changed environment since the release of the MacDonald video, but we don't have hard data to test our three hypotheses, listed below:

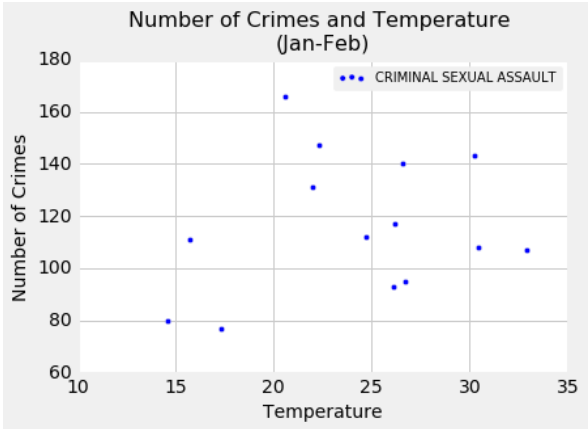
1. The arrest ratio has fallen because witnesses won't come forward. The following quote from the Chicago Tribune highlights this long-term problem, which has likely been aggravated by the climate of distrust between the community and the CPD. "You run into the code of silence in the neighborhood. I've had brothers refuse to identify the killer of their own brother," said Darren O'Brien, a former assistant state's attorney who ran the unit that approved or denied charges in felony cases for nearly a decade ending in 2008. "It's really difficult to pull a case together when nobody is talking."
2. The CPD has too few detectives to solve crimes: A Reuters article in August of 2016 stated that the number of detectives on the Chicago police force dropped to 922 from 1,252 in 2008. In addition, about 8 percent of Chicago's roughly 12,000 police are detectives. In New York City, which has a police department of 34,450, 15 percent are detectives. In Los Angeles, which has a police department of 9,800 sworn officers, 15 percent are detectives. But we could not find a consistent source of employment data, to test this hypothesis in any more detail.
3. The rise in crime is related to street gangs, and those crimes are harder to solve: The last detailed breakdown on homicides published by the CPD was for 2011, when one third of the 433 murders were attributed to street gangs or gangland narcotics. That same year a similar number were undetermined. While there are reports in the media this year that more than half the murders are street gang related, without a consistent methodology or a breakdown of arrest ratio by motive, it is impossible to do further analysis.

Our final analysis looked at the variation of temperature and violent crime for the two coldest months in Chicago – January and February. It is noticeable in earlier charts, such as figures 1 and 5, that there is a sharp dip in crime levels, especially in February. Given that the average temperature for those two months was 27.6 F in 2016, vs 18.5 F in 2015, was it possible that the headline number for year on year increase in homicides was partially influenced by having a relatively cold winter followed by a warm one. The four x y plots below do indicate that low levels of assault and homicide coincide with very cold temperatures (below 20 F). But as temperatures rise, there has been a wide range of outcomes, even in just the last seven years. So recognizing that the sample size is extremely small, it may be reasonable to conclude that the cold temperatures of 2015 may have suppressed crime, but the jump in crime in the milder conditions of 2016 may have little to do with the weather.





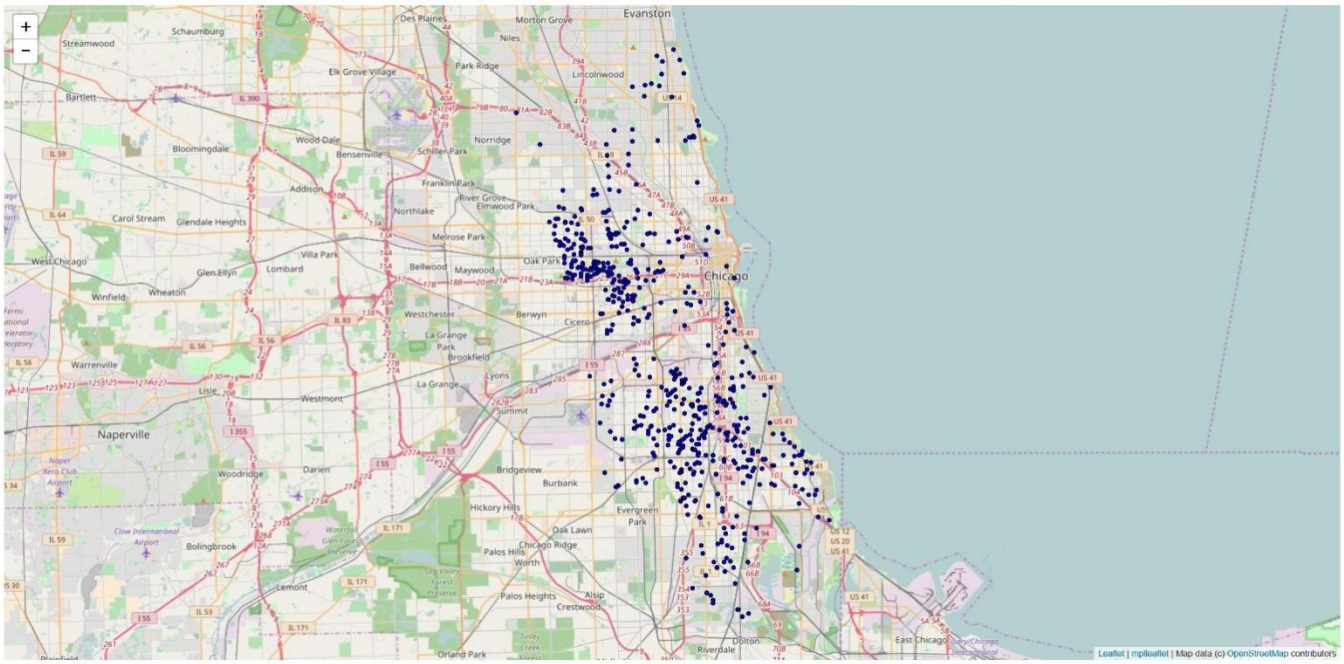




APPENDIX

Maps displaying individual location of homicides and criminal sexual assaults that have occurred in the first ten months of 2016.

HOMICIDES



CRIMINAL SEXUAL ASSAULT