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Seasonality of Crime in Normal, Illinois: 2004-2017

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Abstract
We will use the publicly available reported data on monthly crime by local police departments to see how crime rises and falls in relation to factors such as temperature and other economic indicators such as unemployment. By studying Normal and its seasonal crime rates, it will show whether research applied on a broader scale can be used to also examine criminal activity in a smaller region. Different types of crime will be examined to see if they show significant variations due to seasonal factors including theft, robbery, burglary, and motor vehicle theft. Economic factors such as an increase or decrease in the availability of jobs seasonally will also be incorporated to observe the specific factors which affect criminal activity. This local research will investigate further into the effects of seasonality crime by focusing on the statistical analysis of crimes in the city of Normal. These findings can help prepare community leaders to mitigate increases in criminal activity when the causes of those fluctuations are determined and bring greater awareness to the general public of the likelihoods of crimes occurring.

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I. INTRODUCTION

Crime is a serious issue that often dominates the news with weekly reports as is often seen in major cities such as Chicago. Shootings in Chicago are increasing with the increases in temperature (Allaham & Marx, 2017), but does this assumption hold true for smaller communities and other types of crime? Gaining a more detailed understanding of how crime changes seasonally can help law enforcement and policymakers plan to mitigate the harmful effects of crime on a community. When studied nationally, criminal victimizations showed seasonal variation in household property victimization of up to 11% (Lauritsen & White, 2014). The study also found seasonal patterns for household burglary and larceny but not for robbery rates.

Crime causes both direct and indirect costs to victims and society that can be hard to determine. Indirect costs include mental health issues of the victims of crime and stress caused by the crime itself. For example, victims of household burglary face both the monetary loss of their stolen items as well as feelings of vulnerability that may cause a loss of sleep and productivity in the future. Direct costs can include the physical property that was damaged or stolen during robberies or household theft. One approach to estimating the costs of various crimes asks what the amount the average household is willing to pay to prevent each individual type of crime (Cohen et al, 2004). Households were willing to pay $280,00 to prevent robbery, $30,197 to prevent burglary, and $84,000 to stop serious assault per crime. When analyzing the cost of crime as a monetary value, it shows that there is significant savings to society in being able to prevent any additional count of criminal activity in a community.

Analyzing the seasonality of crimes in Normal can give more relevant results to assist local law enforcement in understanding crime. In Normal, there was an average of 1,859 total crimes committed every year in the city during the period of 2012 to 2017 (City of Normal). With 450 total robberies from 2004 until 2018, the total cost of those robberies was $126 million in Normal when using the estimated cost of each robbery at $280,000. The high costs of crime show the importance of better understanding crime and its determinants.

We will use the publicly available reported data on monthly crime by local police departments to see how crime rises and falls in relation to factors such as temperature and other economic indicators such as unemployment. By studying Normal and its seasonal crime rates, it will show whether research applied on a broader scale can be used to also examine criminal activity in a smaller region. Different types of crime will be examined to see if they show significant variations due to seasonal factors including theft, robbery, burglary, and motor vehicle theft. Economic factors such as an increase or decrease in the availability of jobs seasonally will also be incorporated to observe the specific factors which affect criminal activity. This local research will investigate further into the effects of seasonality of crime by focusing on the statistical analysis of crimes in the city

of Normal. These findings can help prepare community leaders to mitigate increases in criminal activity when the causes of those fluctuations are determined and bring greater awareness to the general public of the likelihoods of crimes occurring.

II. LITERATURE REVIEW

Studies that have analyzed the relationship between trends in weather and crime rates have differing theories on the causation of crime. One theorizes that the effect of weather on crime can be explained due to frequency of social interactions (Glaeser et al., 1996). It argues that a greater frequency of social interactions leads to increases in crime. When a person commits a crime, their actions cause others they socially interact with to be likelier to also commit a crime. This adds a social component into the general weather-based theory of why crime rises with increases in temperatures. During months with warmer temperatures, people are more likely to be outside and have more interactions with other members of their community, leading to higher occurrences of crimes. Another theory of the causes of crime uses the rational theory of decision making in relation to crime (Jacob et al 2007). In this theory weather becomes a factor that someone uses when considering the costs and benefits of committing a crime. Weather conditions that make it more appealing to commit crimes would lead to higher rates of criminal activity. Rainy days and other conditions that impair visibility could lead potential criminals to attempt a crime when they believe they are less likely to be caught.

Seasonality and its effects on crime have been studied by various works to better understand the potential triggers and causes of criminal activity. Common weather-related factors that have been studied include temperatures, amount of rainfall, and other cyclical conditions and their correlation to reported crimes (Cohn, 1990). Cohn took previous studies that had focused on individual relationships such as heat and assaults and examined the results as a whole to determine how weather factors affect different crimes. The relationship of temperature and crime is debated to either be linear or curvilinear in some works. The linear view is that increases in temperature will always lead to a similar increase in crime while others believe that past a certain point, higher temperatures will begin to cause a decrease in crime.

In addition to these theoretical works, there have been other studies that have looked at both city-wide levels of crime in addition to larger scale national data. Cohn and Rotton (2000) studied levels of crime in the city of Minneapolis over a period of two years. Using reported crimes and weather data such as temperature, wind, and rainfall, they were able to determine that temperature was a minor but significant predictor in the occurrence of property crimes when using hierarchical regression. Similarly, Butke (2010) analyzed weather trends and the rates of aggressive crimes that occurred in Cleveland, Ohio. The crime data used was from local law enforcement and it was found that higher temperatures showed a linear relationship to the amount of aggressive crime in the city by graphing crime and temperature. Additionally, one study that was conducted on a larger scale was by Anderson (1997), where nationwide crime data was collected along with yearly average temperatures to attempt to find a relationship between them. In comparison with the other studies done, it found mixed results due to the limitations of using such broad data to analyze crime on a national scale. The data collected on variables such as seasonal variation or law enforcement vary significantly across the nation, making it

difficult to draw a conclusion.

The data used by the studies that focused on a more limited city-wide scope are similar to my own work in gathering local police reports on crime. The data collected for my own study will utilize the local police data available for Normal, Illinois to test relationship between crime and seasonality. The data for crimes in Normal is on a monthly frequency, in contrast to the more specific time frames used by some other studies, which had daily or hourly data, but this will allow a broader analysis of the trends of crime over the course of a year for a specific community. I will be able to chart the data and look at the trends that emerge in relation to yearly cyclical factors in the weather.

III. DATA AND METHODS

The data I will use to analyze this issue comes from the Normal Police Department. Monthly reports are available for every year from 2004-2017 and are divided into categories for each type of crime reported including theft, vehicle burglary, residential burglary and battery. The data provided by the police department is only for reported crimes and does not include information on arrests or convictions. The crime reporting methodology was modified after 2012, with the crimes reported after 2012 including all reported offenses for every incident. If a crime was committed that included both an incident of burglary and battery, it counts towards both types of crime in the data. This change would only impact crime that involves two offenses committed at once but could still affect comparisons drawn when looking at data from before 2012 and after. Another limitation of the data is that there are not enough observations to analyze the trends over time for some types of crime, such as criminal sexual assault and robbery, which often occur less than 5 times each month. This makes it difficult to analyze the trend of these categories. As a result, the crimes that are being examined are battery and theft.

To find the seasonality of crime in Normal, the monthly data for each selected type of crime was gathered and organized in a linear series chronologically from 2004 until 2017 for a total of 168 observations of 3 categories: total crimes reported, thefts, and battery. The data was uploaded to RStudio and a multiple regression was run to obtain the results.

The equation used to estimate the seasonality of each of the three crime categories in the study included dummy variables for each month with the omission of December. This omission means that the results of the regression will be in relation to the month of December in addition to avoiding collinearity if all 12 months were used in the equation. A value of 1 was assigned to the month in which each observation was reported while a value of 0 was assigned to the remaining months. The dummy variables show how many crimes are expected in each month when compared to December. The coefficients for the warmer months are expected to be higher than those in winter. A time variable was also created to capture a general trend over time for the reported crimes and is expected to be negative showing decreasing crime levels in the city of Normal.

The limitations of this estimation setup are that months are an arbitrary measurement of time, the weather experienced in every month can differ over the years, and that the type of crimes studied are only a legal definition from the police department. In addition, crimes that are underreported to the police cannot be studied and could affect the dataset. The overall equation is below:

$$\begin{aligned} \textit{Reported crimes} = a &+ \beta_1 \textit{January} + \beta_2 \textit{February} \\ &+ \beta_3 \textit{March} + \beta_4 \textit{April} + \beta_5 \textit{May} \\ &+ \beta_6 \textit{June} + \beta_7 \textit{July} + \beta_8 \textit{August} \\ &+ \beta_9 \textit{September} + \beta_{10} \textit{October} \\ &+ \beta_{12} \textit{November} + \beta_{13} \textit{Period} + \varepsilon \end{aligned}$$

This regression was repeated for each of the three categories to test the seasonality of each type of crime and whether the more specific types of crime exhibited more seasonality individually in comparison to the total amounts of crimes reported. The results of each of the three regressions can be seen below separated into three columns in Table 1 in the Appendix.

IV. RESULTS

As seen in Table 1, spring and autumn experience higher amounts of crimes in comparison to the months during the winter and summer. Since coefficients are using December as the baseline month, the expected number of total crimes is lower only during the months of January and February while in the remainder of the year, the total number of crimes is above those levels. February is the low point of the year for total crimes while October experiences the highest occurrences of crime with a positive coefficient of 46.9166. The time variable shows that there has been a declining trend in the number of total crimes over the months studied. High significance levels were found for the months of February, August, September, October, and the Period variable when looking at the number the total crimes. The F-statistic of 10.3438 was highly significant at the 1% value with an adjusted R-Square value of .4017 for the multiple regression model of total crimes.

Looking at the number of batteries and its seasonality shows a slightly different result. The number of batteries and its seasonality followed the same general trend as the previous results for the number of total crimes, with the spring and fall months being the most significant. However, the coefficients for the months of January and February were not negative as with total crimes. With regard to batteries, June was the only month with a negative coefficient. The Adjusted R- Squared declined slightly to 0.3573 when examining this subsection of the data but the F-Statistic remained highly significant at the 1% value. The trend over time was found to be constant for batteries when looking at the result of the period variable.

Moving on to the last category of thefts, the seasonality of the data shows negative coefficients during the months of November, January, February, and March. These months would be expected to have less thefts when compared to January while the remainder of the year was positive. Notably, unlike the other two results examined, the number of thefts are lower in comparison to December in the months of March and November. There also appeared to be less crime during April and May with no significant results found. Significant results were still found during February and March and from August to October following the trends from the other datasets. The F-statistic was 8.7300 and highly significant at the 1% level with an adjusted r-squared of 0.3570.

V. CONCLUSION

In analyzing the seasonality of crime levels in Normal, Illinois, the number of reported crimes were collected and studied. The results from the multiple regressions on the number of reported crimes in Normal show that there are certain months that experience more crimes than others. The months of August through September showed the highest coefficients in the regression for the number of total crimes while the lowest points were found during January and February. Despite previous works find-

ing peaks in crimes during the summer, in Normal the summer is a relatively low period for crime. Crime levels usually rise along with the temperature, and although the summer months are the hottest of the year, they do not show the highest expected increase in crime when compared to December. However, the expected results may not hold true in the city of Normal because of the presence of Illinois State University and its large student body. With the departure of college students during the summer, overall crime levels would experience a drop in the fundamental factors driving crimes. Fewer people living in the city would mean fewer opportunities for thefts or batteries in the area. A smaller population would also negate the influence of the warmer months that encourages more human activity outside or in public.

The findings during the winter months corresponded with previous research with drops in crimes during those months. The month of February showed the largest drops for total crimes as well as for reported thefts. An exception to the pattern found in the other two categories was the seasonality of batteries, which showed no drops in batteries during the winter months. In addition, batteries also did not have a decreasing trend over time when analyzing the period variable unlike the other types of crimes. Looking at thefts during the winter months shows broader decreases in the expected number over a larger number of months from November to March.

This information can be used to help better inform residents of the possible risks of crimes throughout the year. A crime awareness program could remind residents to watch their belongings during the fall and spring. With the amount of expected crime peaking in those months, residents could take precautionary measures to protect their property to discourage possible criminals that are more likely to commit crimes at those times. In addition, police officers could be encouraged to adapt their amount of patrols and readiness according to the expected crime levels of each month. Police officers outside bars can be most effective during April and September to prevent potential thefts or other crimes from occurring but may not be needed as much during months such as June or February.

This study could be expanded by analyzing different crime categories. Different categories of crime could be combined to see if broader categories can yield additional results. Another possible approach would be to combine data from neighboring Bloomington to the existing data from Normal to see if any differences are present between each city. The seasonality of crime could then be seen as is not only applied to Normal but instead shared across the metropolitan region.

APPENDIX

Table 1: Estimation Results of Multiple Regression for Seasonality of Crimes in Normal, IL (2014-2017)

Dependent Variable: Crimes Reported, *N* = 168

	Total Crimes	Batteries	Theft
January	-8.2082	3.7874	-5.8603
	(-.9251)	(1.0874)	(-1.4896)
February	-23.273 ***	1.6444	-11.4444***
	(-2.6237)	(0.4722)	(-2.9095)
March	0.4466	8.6442**	-11.3142***
	(0.0504)	(0.0140)	(-2.8769)
April	18.5954**	19.6440***	2.8873
	(2.0970)	(5.6430)	(0.7343)
May	18.7441**	14.5010***	3.3032
	(2.1141)	(4.1662)	(.8401)
June	8.8215	-.7848	5.4333
	(0.9951)	(-0.2255)	(1.3821)
July	20.7560**	7.3579**	0.9921
	(2.3415)	(2.1144)	(0.2523)
August	36.2620***	8.6435**	13.5507***
	(4.0910)	(2.4840)	(3.4475)
September	33.1964***	18.9290***	6.6095*
	(3.7454)	(5.4403)	(1.16817)
October	46.9166***	17.3574***	11.0254***
	(5.2937)	(4.9989)	(2.8053)
November	6.7083	0.8573	-6.6301*
	(0.7569)	(0.2464)	(-1.6870)
Period	-0.1488***	0.0001	-0.0587 ***
	(-3.9787)	(0.0104)	(-3.5414)
Adjusted R-Squared	0.4017	0.3573	0.3570
F-Statistic	10.3438***	8.7391***	8.7300***

Significance at the 1% (***), 5% (**), and 10%(*) levels (t-values in parenthesis)

REFERENCES

llaham, M., & Marx, R. (2017). Does Weather Influence Crime? The data say yes. Chicago: Chicago tribune.

Anderson, Craig, Bushman, Brad, Groom, Ralph, 1997. Hot years and serious and deadly assault: empirical tests of the heat hypothesis. J. Personal. Soc. Psychol. 73 (6). 1213-1223.

Butke, Sheridan, 2010. An Analysis of the Relationship between Weather and Aggressive Crime in Cleveland, Ohio. Weather Climate, and Society, 2(2), 127-139.

City of Bloomington. (n.d.). Uniform Crime Reports. Retrieved from Uniform Crime Reports | City of Bloomington, Illinois

Cohen MA, Rust RT, Steen S, Tidd ST. Willingness-to-pay for crime control programs. Criminology. 2004;42:89–109.

Cohn, Ellen, 1990. Weather and Crime. Br. J. Criminal 30 (1) 51-64

Cohn, Ellen, Rotton, 2000. Weather, seasonal trends, and property crimes in Minneapolis,1987- 1988: a moderator-variable time-series analysis of routine activities. J Environ. Psychol. 20 (3). 257-272

Glaeser, Edward, Sacerdote, Bruce, Scheinkman, Jose, 1996. Crime and Social Interactions. Q. J. Econ., 111 (2), 507-548.

Lauritsen, J. L., & White, N. (2014, June). Seasonal Patterns in Criminal Victimization Trends. Retrieved from www.bjs.gov: https://www.bjs.gov/content/pub/pdf/spcvt.pdf