Spatial and Temporal Analysis of Violent Crimes in Las Vegas and Its Applicability to Crime Reduction Through the Cardiff Model

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**Abstract.** According to (Mercer Kollar et al. n.d.), “more than half of violent crime” goes unreported to law enforcement in the United States. This leaves a significant gap in the ability to proactively work in communities to reduce violent crimes where they are most prevalent. The Cardiff Model was initially created to bridge that gap by making unreported hospital data more available to local police and community leaders. By applying the knowledge of previous Cardiff Projects, we aim to partner with local hospitals and leadership in Las Vegas, Nevada to build a model that can help predict where and when violence is most likely to occur. We will be using a combination of both time series and neural network models to achieve this goal. By providing an accurate predictive model in combination with previously created violence heat maps, we hope to provide local leadership with the necessary tools to achieve the same reduction in violence seen in Cardiff Projects across the globe.

1 Introduction

It is estimated that “more than half of violent crimes go unreported” (Mercer Kollar et al. n.d.), This leaves a significant gap in our ability to intervene in the spaces with the highest rates of violent crimes. Both police and community leaders are left with partial views of the big picture. The Cardiff Model aims to bring community leaders together and equip them with more holistic data sources. The primary method has been to partner with hospitals to capture a portion of the other half of unreported violent crimes.

By implementing the Cardiff Model, cities have been able to “reduce police-recorded injuries by 32% and hospital admissions for violence-related injuries by 42%” (Mercer Kollar et al., n.d.). In Las Vegas, Hot spot policing showed to result in a “34 reduction in violent calls for service” (Corsaro et al., 2021). This practice of increasing policing in areas of higher crime is one of the primary tools of the Cardiff Model. By providing better information to the police, we hope to improve on the already proven method in Las Vegas.

While the reduction of violent crimes has an obvious immediate impact on victims and communities, there is evidence to suggest there will be significant long-term gains to reap as well. Violent crimes create a higher likelihood of victims becoming the perpetrators (Averdijk et al., 2016). By reducing the number of victims today, we hope to stop the vicious cycle of victims becoming victimizers. Additionally, Sumner et al., (2015) showed that “exposure to violence increases vulnerability to a broad range of mental and physical health problems over the life course”.

To date, the Cardiff Model has been implemented in several large US Cities. However, it has yet to be seen the benefits that projects abroad have documented. There appears to be a gap in the way the data is being utilized to empower community leaders and police. Obtaining the buy in of these groups is the only way to really utilize the additional information in a way that leads to real change. In partnership with our local representatives, we believe that our predictive time series model will show the vested parties that it is worth further investment into these resources and further data sharing. This will only increase our ability to produce accurate models. It is our hypothesis that sufficient data analysis has not been presented to provide local leadership with answers as to what they can do. By adding the element of time to the already established violence heat maps, we hope to provide an actionable model.

2 Literature Review

**2.1 Las Vegas**

1. “Hot spots policing in Las Vegas: results from a blocked randomized controlled trial in chronic violent crime locations”, Corsaro, N., Engel, R. S., Herold, T. D., Yildirim, M., & Motz, R. T., 2023.
   1. The net result of our findings will likely be more policing in areas with a suspected likelihood of violent crimes. This study helps to show the established effectiveness of hot spot policing in known areas of crime.
2. “What Happens in Vegas: The Influence of Las Vegas on High-Risk Attitudes and Behaviors”, Tiemann, M., 2022
   1. “High-Risk” activities like “binge drinking, casual sex, and substance abuse” (Tiemann, 2022) can increase the risk of victimization. This study will help us understand how Las Vegas is uniquely affected by its adoption of these high-risk activities.
3. “Weekly Crime Concentration”, Curiel, 2023
   1. We’ve outlined the goal of predicting violent crimes by region. We hope to be able to use the findings of this article to provide some domain knowledge on where to find these region correlations. While the data might be provided in zip codes or addresses. It might be better to measure distances from schools or liquor stores.

**2.2 Cardiff Model**

1. "Identifying Locations of Drug Overdose in Las Vegas to Implement the Cardiff Violence Prevention Model", Girard, J., Pandey, S., Bunn, Z., Papesh, C., Cheun, J., & Zhang, Y., 2023
   * Previous work has been done by SMU Data Science graduates to study the locational data of Drug Overdose in Las Vegas. We will be broadening the scope of their study to include other incident types and adding a time element.
2. “External validation of the Cardiff model of information sharing to reduce community violence: natural experiment”, Boyle, Adrian A ; Snelling, Katrina ; White, Laura ; Ariel, Barak ; Ashelford, Lawrence, 2013
   * This is a generalized study on the effectiveness of the Cardiff model in its home country.
3. “Cardiff Model Toolkit”, Mercer Kollar, L., PhD, A. Summer, S., MD, MSc, F. Jacoby, S., PhD, MPH, RN, & Ridgeway, G., PhD. (n.d.)..2018
   * The CDC has done research into the general effectiveness of the Cardiff Model and discussed its application state side.We will be using this study to establish statistical relevance of the Cardiff Model.

**2.3 Aspects of Violent Crime**

1. "Alcohol, Suppressed Anger, and Violence", Norström, T., & Pape, H., 2010
   * The underlying reasons for violence are helpful in informing the features we include in our model. We believe this article can help shed light on the different factors we should be looking at in Las Vegas for predicting violent crimes.
2. “VIOLENCE BEGETS VIOLENCE ... BUT HOW? A DECISION-MAKING PERSPECTIVE ON THE VICTIM-OFFENDER OVERLAP”, AVERDIJK, MARGIT ; VAN GELDER, JEAN-LOUIS ; EISNER, MANUEL ; RIBEAUD, DENIS, 2016
   * While reducing violence in and of itself is important, this article highlights the lasting effects that violence has in perpetuating violent perpetrators.

**2.4 Modeling**

1. “Factors influencing temporal patterns in crime in a large American city: A predictive analytics perspective”, Towers, Sherry ; Chen, Siqiao ; Malik, Abish ; Ebert, David, 2018
   * This study is on the exact method we are trying to replicate for the Cardiff Model in Las Vegas. It will serve as a significant resource in how we go about creating predictive models based on time and location.

By providing a highly accurate temporal predictive model to local police and community leaders, we can achieve similar reductions in violent crimes to those seen in Cardiff Projects in other countries.

3 Method

1. Data  
   Where are getting the data? Or where are you thinking you can find the data?
   * + Our project advisor and sponsor is working on getting access to Las Vegas hospital violent Crime Records.
     + If we are unable to get the required data in time for our project, we will utilize a combination of Nevada Police reports and CDC database records.
2. Methods plan to use
   * We intend to create a predictive time series model using regional subsets that will be defined by the detail available in the dataset.
   * We also intend to create a classification model for the kind of violence by region.

4 Results

1. What do you hope to find in your research? Accept or reject the hypothesis
   * We hope to find that we are able to produce a highly accurate predictive time series model that can show the kind of violent crime, the time, and the place they are likely to occur.

5 Discussion

* Interpretations: What do the results mean?
  + Implications: Why do the results matter? How should the reader apply these findings?
* What stood out as interesting/unique/unexpected?
* Limitations
  + What challenges occurred during analysis?
* Ethics
  + Future Research
* Are there areas of research where others can pick up and go deeper?
* Can the crimes be broken into types (e.g. drug OD, domestic abuse, assault).?
* Defining the means by which to measure the success of the model and updating it moving forward.
* Can we provide suggested solutions to the findings?
* Does the crime seem to be related to specific establishments, days of the week, or events?

6 Conclusion

2 paragraphs max on the overall findings and summary of the research.

**Acknowledgments.** The heading should be treated as a 3rd level heading and should not be assigned a number.

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Appendix

Use if needed for additional information.