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 the where and when of 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 the necessary tools to achieve the same reduction in violence seen in Cardiff Projects across the globe.

1 Introduction

A. What is the topic? Why should we care?

* Cardiff Model
* It is estimated that 40% of violent crimes go unreported. This leaves a gap in our ability to police areas with higher violent crime incidents and community leader’s ability to remove community features that enable violent crime.

B. Why is this topic important to investigate?

* Reduce Violence
* Violence has lasting effects on both victims and perpetrators.
* In order for communities to thrive, our public spaces need to be safe for all.

C. What have the other experts discovered about the topic? (High-level overview)

* 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.).
* Hot spot policing in Las Vegas has shown to result in a “34% reduction in violent calls for service” (Corsaro et al., 2021).
* Violent crimes are often not as simple as identifying the subjects as victim and perpetrator. Those who are victimized had a higher likelihood of victimizing others (Averdijk et al., 2016). By reducing the number of victims today, we hope to stop the chain of victims becoming victimizers.
* “Exposure to violence increases vulnerability to a broad range of mental and physical health problems over the life course” (Sumner et al., 2015).

D. What are the gaps? What is the problem?

* The Cardiff model has been successful in reducing violence in communities outside the United States. However, despite its implementation in some other US cities, it has yet to show the kind of results seen in other countries.
* For the model to have a chance at success, we most partner with local police, hospitals, and community leaders. By pulling together the hospital incident records, we can capture the portion of violent incidents that go unreported to police.

E. How will this research solve this problem?

* This research aims to use time series forecasting to answer the question of when and where violence is most likely to occur.
* It is our hypothesis that sufficient data analysis has not been present 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 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.

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
   1. 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
   1. 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
   1. 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
   1. 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
   1. 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
   1. 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.

What is your Hypothesis

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 Methods

1. Data
   1. Las Vegas, Nevada Police reports portal
   2. CDC database
   3. Local Hospital Violent Crime reports
2. Methods planning to use
   1. Time Series forecasting by regional subset
   2. Violence classification by region.

4 Results

A. 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.

\*\*This Section is for statistical jargon and tables/Figures. Results are facts.

5 Discussion

\*\*\*Do not add New Results. This section applies and interprets the results in lay terms.

\*\*\* **Please write additional questions (than the ones below) you hope to answer in your research.**

1. Interpretations: What do the results mean?
2. Implications: Why do the results matter? How should the reader apply these findings?
3. What stood out as interesting/unique/unexpected?
4. Limitations
   1. What challenges occurred during analysis?
5. Ethics
6. Future Research
   1. Are there areas of research where others can pick up and go deeper?
7. Can the crimes be broken into types (e.g. drug OD, domestic abuse, assault).?
8. Defining the means by which to measure the success of the model and updating it moving forward.
9. Can we provide suggested solutions to the findings?
10. 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.

References

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9. Tiemann, M. (2022). *What Happens in Vegas: The Influence of Las Vegas on High-Risk Attitudes and Behaviors*. ProQuest Dissertations Publishing.

Appendix

Use if needed for additional information