

# Mass Shooting Intervals

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## 1 Abstract

This project replicates the research by Lin et al. (2018) Ping-I Lin and Hossain (2018) on mass shooting intervals and looks at how the intervals have continued to changed since the publication. The authors were looking at the time trend and associated risk factors for mass shootings, but their results regarding the time intervals will be the main focus in this project. Regarding intervals between mass shootings, the authors found that the interval has been decreasing in the past three decades with the rate of shootings increasing. Specifically, I will be using the regressions created in the paper to compare the expected intervals of shootings in the past two years with the actual intervals. Visualizing the intervals between shootings is crucial information that could help identify if recent preventative measures have been effective at decreasing the number of mass shootings. It also provides insight for what still needs to be done and if further preventative measures need to be implemented.

This project can be found in my Github repository.<sup>1</sup>

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<sup>1</sup>GitHub

## 2 Introduction

Research surrounding mass shootings and gun violence has been rising in interest, especially among the youth, as survivors of mass school shootings have begun to enter college Jr. (2018) However, as mentioned in the paper, there is still relatively little research around mass shootings that have been published. One cause of this shortage of research might be due to the relatively small amount of data out there related to mass shootings. Out of the three goals in Lin's paper was to look at a few risk factors such as gun ownership and mental health to try and create a model to find a correlation between the factors and mass shootings. However, the results found were largely inconclusive. And one reason for this is just the small amount of data available surrounding mass shootings.

In comparison with other crimes, the actual number of mass shootings is relatively small. Depending on how one defines as mass shootings, there are roughly only a handful each year. A report done by the Everytown for Gun Safety Support Fund identified 194 mass shootings from 2009 to 2018, with is about 19 shootings a year. Gun Safety Support Fund (2019) However, the traumas of mass shootings extend far beyond just the victims and families directly affected by mass shootings. With the increased amount of media coverage around mass school shootings specifically, more and more students are fearing their safety at school. A 2018 survey conducted by the Pew Research Center found that 57 percent of respondents of U.S. teens ages 13 to 17 were somewhat worried or very worried about a shooting that could happen at their school. Graf (2018)

This increasing fear for safety among students is an alarming concern. With the importance of both mental and physical health for our children, there should be a lot more research going into mass shootings, their causes, and what we can do to decrease the number of them. In this project, I will be specifically using the time intervals between the shootings to determine if enough is being done to decrease the number of shootings and how the problem is worsening over time.

## 3 Literature Review

This study resulted from limited published findings in the past and wanted to identify some risk factors associated with mass shootings. As a result, the authors wanted to answer three specific questions related to mass shootings in this paper. 1. "What are the population-level factors associated with the probability of mass shootings?" 2. "Is the incidence rate of mass shooting increasing during the past three decades?" 3. "Is the online media associated with the probable 'contagious effect'?" The specific factors looked at in this paper include: "state-level gun ownership rate, serious mental illness rate, poverty percentages, and gun law permissiveness". To evaluate if there was an increase in mass shootings in the past three decades, the authors looked at data regarding "mass shootings that occurred within the U.S. in the past 30 years". The authors of the paper defined mass shooting "as an act of firearm violence that resulted in at least four fatalities (not including the perpetrator), at the same time, or over a relatively short period of time in the case of shooting spree". The contagious effect is like a copy cat effect, where if one mass shooting occurs, it promotes the increase of "copy cats" or more mass shootings in the time that follows.

The authors findings ultimately reached inconclusive evidence for looking at the relationship between risk factors and mass shootings. One of the main difficulties with looking at risk factors for mass shootings is the relatively small amount data on shootings that researchers have to look at. However, they did find the the interval between mass shootings has been steadily decreasing for the past three decades. Further, they found evidence of possible relationship between the increasing amount of media coverage of mass shootings and this interval decrease. However, the research done by Lin did not look at the specific number of social media posts mentioning mass shootings, only Google search results and Google trends. This is an area where research should be done because of the increasing popularity of social media, especially among the youth. Overall, the research done by Lin provided important information around the decreasing intervals which can be useful for further research to see how the interval trends have changed since the paper's publication.

In the overall category of research related to mass shootings, there have been two areas of main focus, continuing to look at what risk factors relate to mass shootings the most and domestic violence restraining order (DVRO) prohibition laws. In the focus of looking at risk factors, many other papers have also reached inconclusive evidence on many of the same factors that Lin looked at. Other papers have cited similar a

similar issue with the lack of data to provide any substantive conclusions on risk factors. However, a recent Webster et al. (2020) paper found that more firearm purchaser licensing requirements are likely to reduce the number of mass shootings as it makes it more difficult for high-risk individuals to purchase guns. Daniel W. Webster (2020) Regarding the focus on DVRO, there was a lot of excitement around a paper by Zeoli et al. (2017) because he had found evidence that DVRO laws can significantly reduce the number of shootings related to domestic violence. April M Zeoli (2017) This would have been a huge finding since many mass shootings are related to domestic violence. However, the paper by Zeoli et al. was later retracted shortly after due to errors within dates they used which led to the significance of DVRO laws to fade. (???)

## 4 Replication

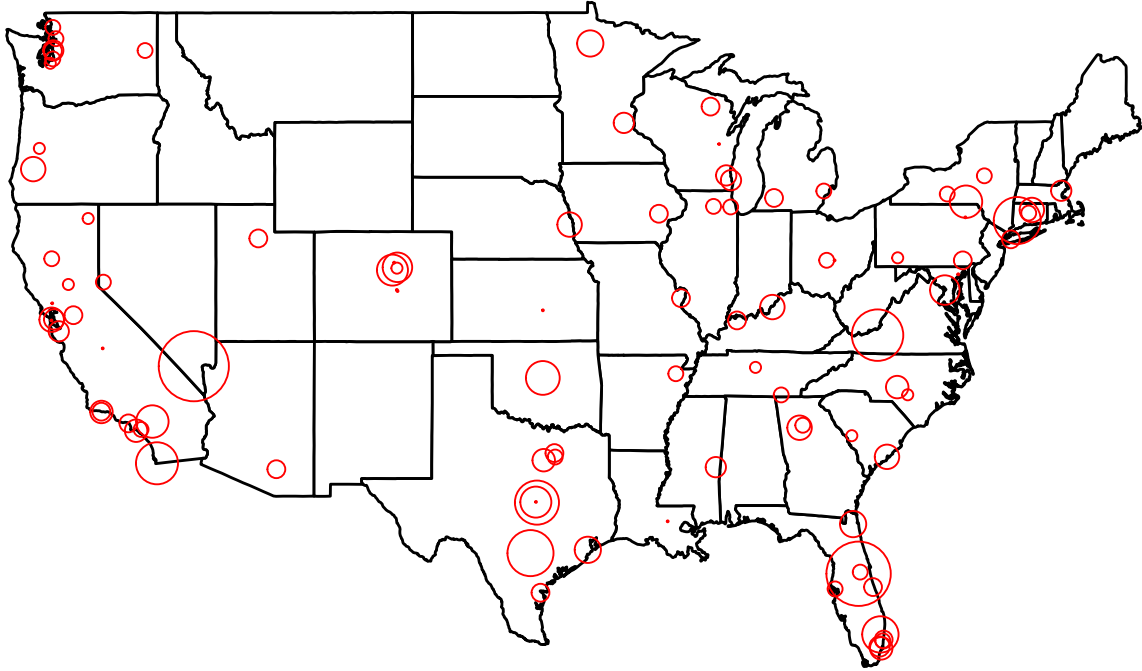


Figure 1. Geographic locations of shootings and respective fatalities (proportional to circle diameter) are presented.

Figure 1 highlights all the mass shootings within the Mother Jones' dataset that was used in Lin's paper. The number of fatalities is proportional to the size of the circles.

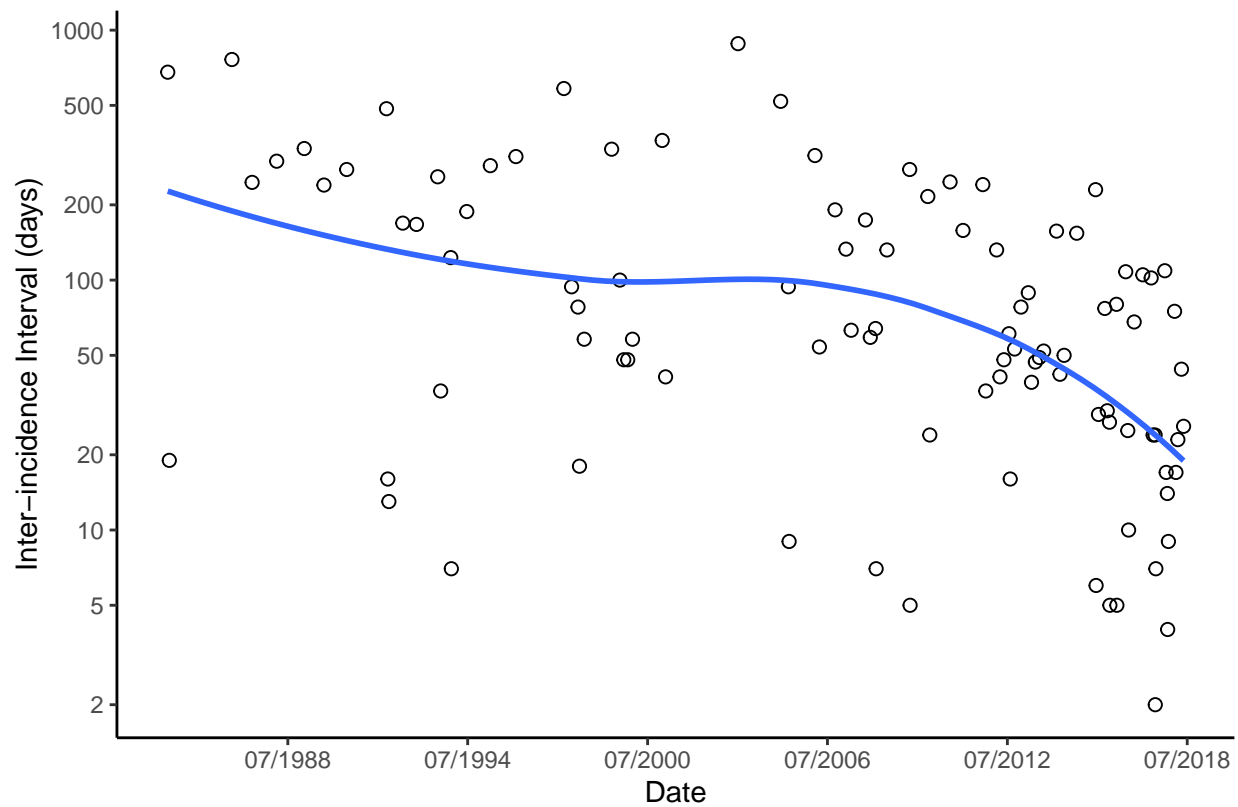


Figure 2. Interval time between mass shootings and its GAM fit for trend is shown.

Figure 2: Interval time between mass shootings and its GAM fit for trend is shown. This is also using the Mother Jones' data and it includes 100 mass shooting in the United States from January 1982 to May 2018. Ping-I Lin and Hossain (2018)

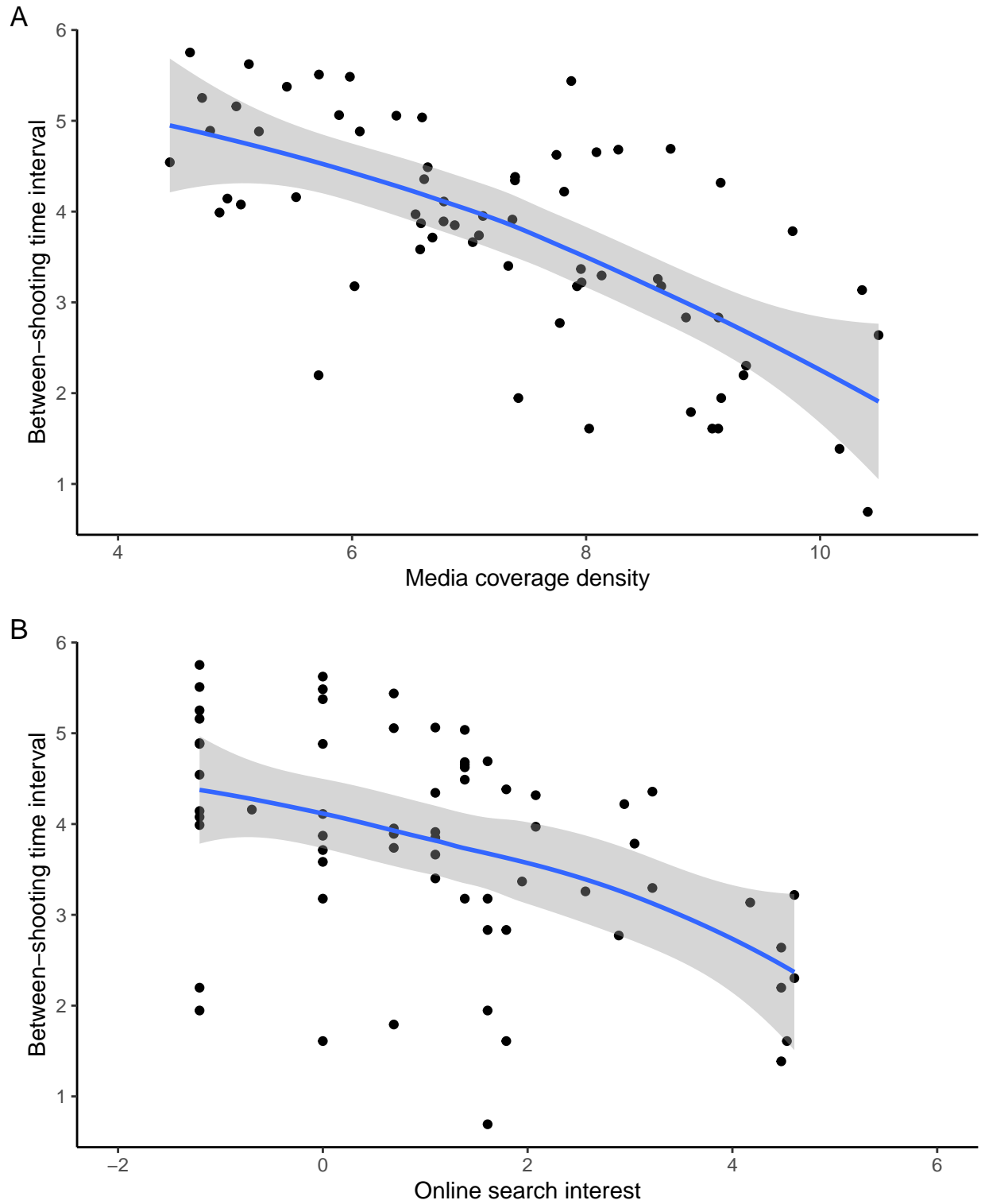


Figure 3 shows two plots related to online interest of mass shootings. The first graph highlights the trend between shooting interval and media coverage density. The second graph shows the trend between shooting interval and online search interest.

## 5 Extension

First, I plan on updating figure 1, the map of mass shootings in the United States with more recent mass shootings that have occurred since this paper was published. What has changed? Have there been more mass shootings in some states over others?

While the model used to try and predict the causes of mass shootings per state ended up being inconclusive due to too many variables in the given situations, the graphs looking at the interval between mass shootings was extremely interesting because it suggested a sharp decrease in the interval between mass shootings starting from 2006 forward. I plan on creating a model to try and estimate the expected values for dates in which mass shootings have occurred since this paper was published (roughly 2017 onward). Then, I will calculate the actual intervals between these mass shootings and see how well the model did in predicting the intervals between mass shootings. If the model did well, then how sharp is this decrease in interval and will it level out? If the model did not do well, then did it over predict or under predict. If it over predicted, then does that mean mass shootings are becoming more and more common? If so, then how concerned should Americans be? What has changed and what should we do to try and prevent this interval from decreasing even further? If it under predicted, then are mass shootings becoming less common? What might be the cause of this?

In relation to looking at the intervals between shootings decreasing, I want to dig further into the relation between shooting time intervals and media coverage and online search interest. First, I would conduct a similar test to the one I did before, making two models and seeing how well those models can predict the shooting time interval based on these two factors. If the models do well, then we can dig deeper into how media coverage and the internet might be contributing to “copycat” mass shootings or inspiring other to participate in mass shootings.

In the paper, one limitation that the authors mentioned about their online coverage is that they did not include any data from social media coverage. As social media grows to play a bigger and bigger role in American lives, especially among children, it is crucial to look at data surrounding mass shootings on social media to see if more coverage on social media also has this negative trendline where more coverage leads to a decrease in shooting time interval. I might get data from looking at Twitter tweets regarding mass shootings or the overall trending topics throughout the years. However, this is already piling up to a lot of things to do for further research, so I might not be able to do all of it.

## 6 Discussion

## 7 Bibliography

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## Appendix

% Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu  
% Date and time: Tue, Apr 14, 2020 - 10:06:02 PM

Table 1: Effect of Treatment, Time Length, and their Interaction on Change in attitude

Statistic	Mean	St. Dev.
Intercept	1.724	1.900
FS/S	−0.007	0.010
Serious mental disorder rate	−0.089	0.084
Poverty rate	0.058	0.036
Gun law permissiveness	0.190	0.144

Table 1: This is a poisson model I created in attempt to replicate the zero-inflated poisson model in the paper. I was unable to fully replicate the model as the code for this paper was not made publicly available.

Within months (t)	P of a shooting Using constant rate	P of a shooting Using regression model
1	0.203	0.374
2	0.365	0.608
3	0.494	0.754
6	0.744	0.940
9	0.870	0.985
12	0.934	0.996

Table 2: This table predicts the probability of at least one mass shooting within the given number of months using the trend the authors found in the paper