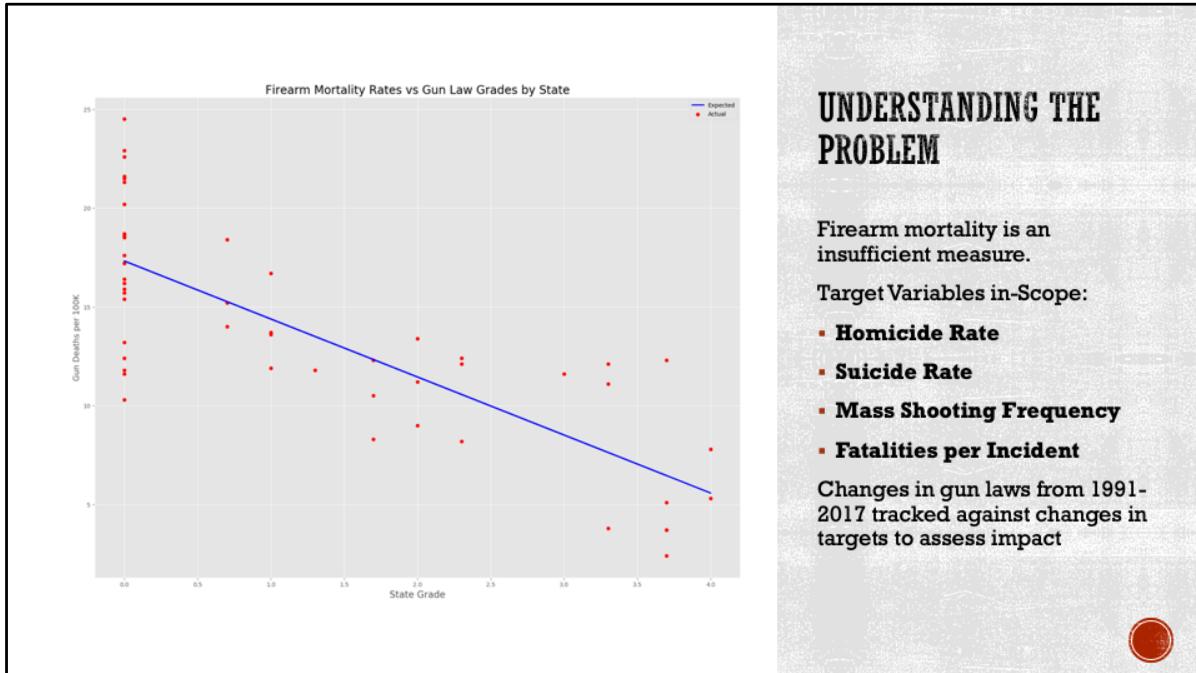


Today we are going to discuss a sensitive topic in American politics: gun violence. This topic has many dimensions to it, and I want to make clear that the objective here is not to determine which side is correct. Instead, we will focus our energies on one specific question: are gun laws effective? As we'll soon see, the answer is not a simple yes or no. The first task is determining what we mean by "effective."



The most common metric used to justify the effectiveness of gun laws is the firearm mortality rate. Using the Gifford Law Center's rating of gun laws by state in conjunction with CDC data, we see that as scores increase, firearm mortality rates decrease. The problem here is that it tells us nothing about other forms of mortality. If firearm homicides go down, but other types of homicide go up, has anything really been accomplished? Not really. Based on this, we can conclude that firearm mortality is an insufficient measure of gun law effectiveness.

For this reason, we are going to use the overall homicide rate as our primary metric, with suicide rates and mass shootings as secondary metrics. And rather than rely on an opaque grading scale, we want to track changes in specific features of gun laws. To do this, we leverage a database from Everytown Research that tracks changes in state gun laws since 1991.



FEATURES OF GUN LAWS



IMPACT OF NEIGHBOR STATE LAWS



MOST SIGNIFICANT FEATURES



MASS SHOOTING ASSESSMENT



RECOMMENDATIONS / NEXT STEPS

AGENDA

We will start by conducting a brief overview of the information and structure of the database itself. We'll then move onto a discussion about the impact of weak laws in neighboring states. With these items in place, we can zero in on the features of gun laws that result in the most significant reduction in homicide rates. Following this is an assessment of the regulatory impacts on mass shootings. Finally, we will close out with some recommendations and next steps.

FEATURES OF GUN LAWS

Background Checks

Criminals

Domestic Violence

Drugs & Alcohol

Mental Illness

Minimum Age

Permitting Process

Other

The Everytown Research database frames features of gun laws into a collection of 85 of yes/no questions. Each question falls into one of eight categories, including mental illness, domestic violence, criminal history, etcetera. To give you a sense of the general types of questions included, let's look at a few.



SAMPLE QUESTIONS

Criminals	Does the state prohibit people under felony indictment from having firearms?
Domestic Violence	Does state law disqualify boyfriends and girlfriends under final domestic violence restraining orders from having firearms?
Mental Illness	Does state law disqualify people who have been committed to a psychiatric hospital for emergency care from carrying concealed guns in public?
Other	Does state law prohibit people who have renounced their United States citizenship from having firearms?



For criminality: are felons prohibited from having firearms? Are people with domestic violence restraining orders against their significant others allowed to have guns? What about individuals committed to a psychiatric hospital for emergency care? Or those who have renounced their US citizenship? As you can see, these questions leave little room interpretation, but we need to be aware of the fact that not all responses are universally applicable.



POSSESSION



PURCHASE



HANDGUNS

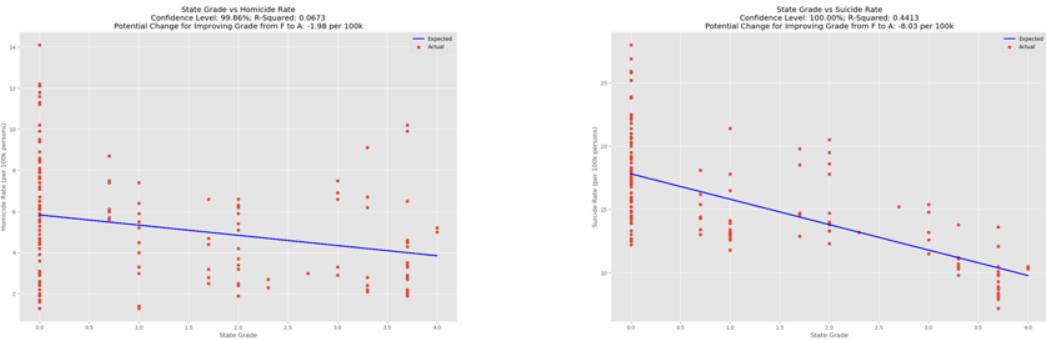


LONG GUNS /
RIFLES

APPLICABILITY

For some states, the answer may be yes for possession, but not for purchases, or vice versa. Type of gun matters, as well. If state law prohibits domestic abusers from purchasing handguns, that doesn't necessarily prevent them from buying a rifle. Nor does it mean they necessarily have to relinquish any guns they already have.

So, for each question, there are, in reality, four dimensions. And we treat each dimension with equal weight. If a state responds to a question with, "Yes, but only for handgun purchases," we give a score of 0.25. A "yes to all" response yields a score of one.

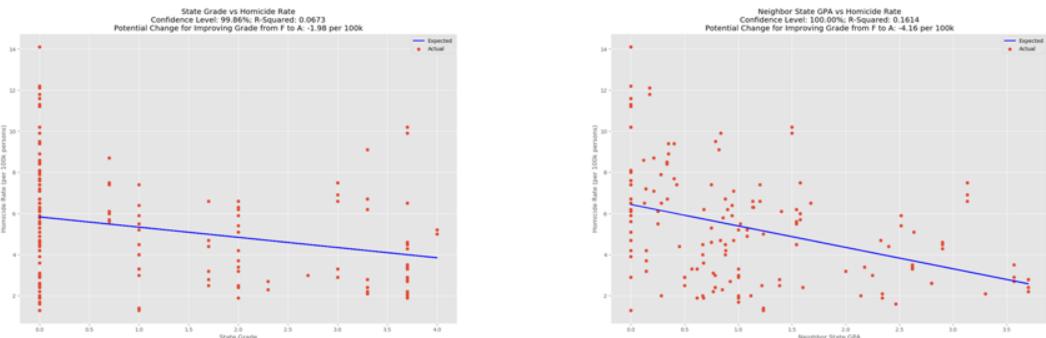


IMPACT OF NEIGHBOR STATE LAWS



We also consider the strictness of neighbor state laws. To illustrate why we examine the relationship of Giffords Law rankings with homicide and suicide rates. On the right, we see a clear correlation between suicide rates and gun laws. But on the left, we should feel a bit apprehensive. Though there is a clear downward trend, there are an awful lot of exceptions. We quantify this relationship with the use of the r-squared value: 0.067, indicating that the grade explains only 6.7% of the variance in homicide rates.

Some posit that neighbor states with weak laws undermine the laws of states with strong laws. Let's test this theory by looking at the GPA of neighboring state grades. We will compare these grades with homicide rates in the target state.

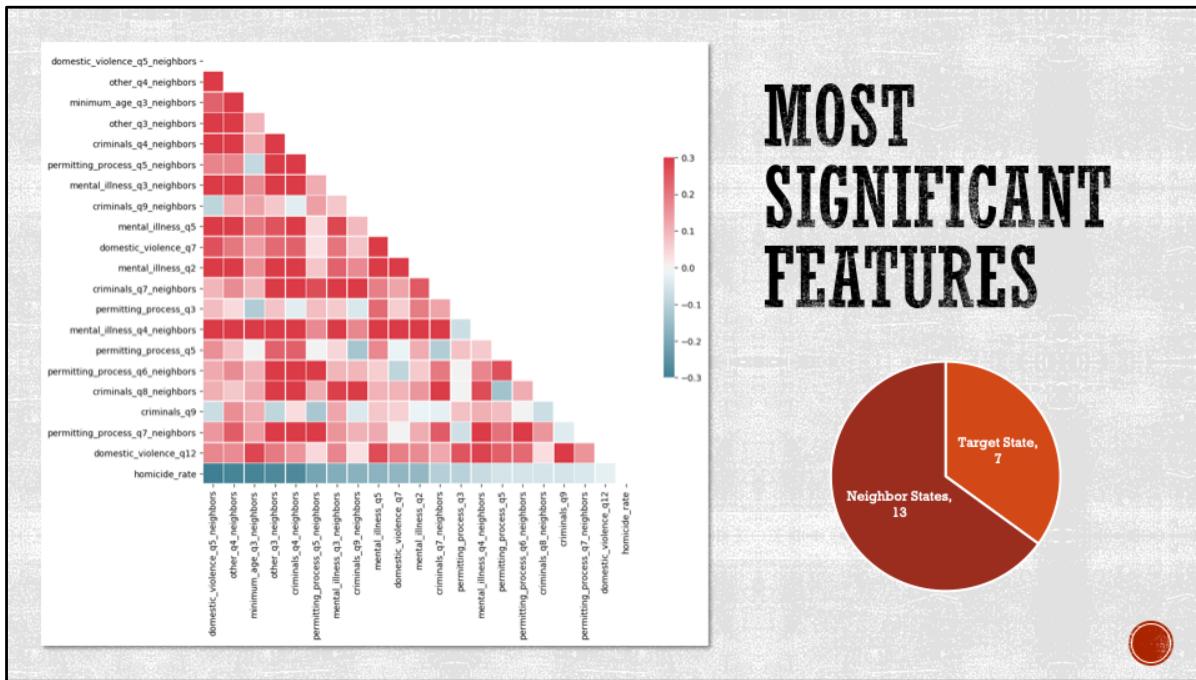


IMPACT OF NEIGHBOR STATE LAWS



Now, I could talk all day about this chart, but let's acknowledge the fact that the downward trend here is more prominent than when looking at the graph to the left. To better understand what this says, consider a state with strong gun laws: California. The implication is that the laws of Nevada, Oregon, and Arizona are better predictors of the homicide rate in California than California law itself.

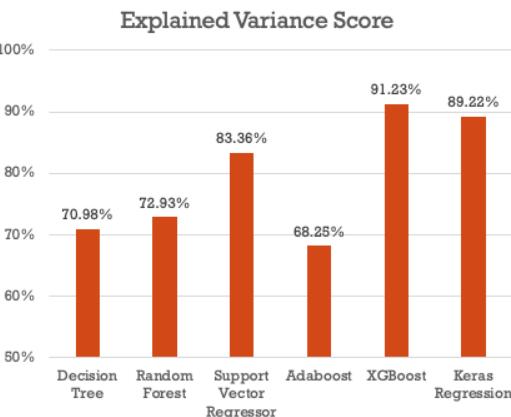
With this in mind, we'll now attempt to identify the top 20 features of gun laws using backward elimination and multilinear regression analysis.



This is a correlation heatmap that shows how each variable moves with one another. The bottom row represents feature correlations with homicide rates. Blue values indicate that affirmative responses to questions are associated with lower homicide rates. Red shows the opposite effect: an affirmative answer would increase homicide rates. Because we are searching only for laws that reduce homicide rates, we don't have any red boxes in the bottom row.

We won't go into the specific questions yet, but I want to draw your attention to the suffixes of each variable. In 13 of the 20 features, neighbor state responses are more important than target state responses. This is further evidence that weak laws in neighboring states can undermine strong laws in a target state.

Let's plug this data into a few machine learning models and see how they perform at predicting homicide rates.

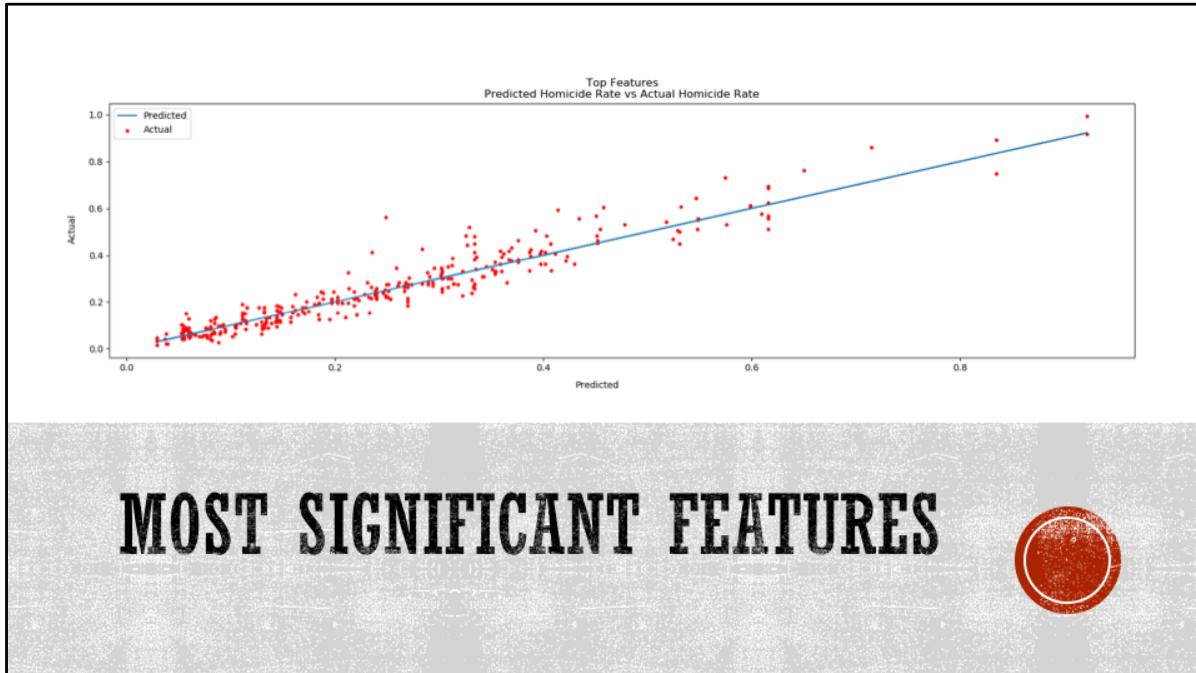


MOST SIGNIFICANT FEATURES



Five traditional machine learning models, as well as one deep learning model, were engineered using a grid search. Each model was trained to optimize the explained variance score, which is precisely what its name implies. How much of the variance in homicide rates can be explained by changes in these 20 features of gun laws? Let's find out how well each model performs.

Here, we can see that XGBoost outperformed every model, including Keras Regression, which is the deep learning model. Using this model, XGBoost was able to achieve an explained variance score of 91.23% on test data. Let's visualize this.



In this chart, red dots represent a random selection of actual homicide rates since 1991. The blue line represents homicide rate predictions of our top model. Keep in mind the units are scaled here such that one represents the maximum observed homicide rate, and zero represents the lowest.

So, from this, it is clear that gun laws do seem to have a significant impact on overall homicide rates, not just firearm mortality. But what we don't yet know is just how big that impact is.

POTENTIAL REDUCTION IN HOMICIDE RATES

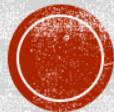


We can estimate the potential reduction in homicide rates by comparing model predictions when all responses are "yes" to when all are "no." Since gun homicides have historically accounted for 67% of all homicides, this is the highest number we should expect to see. Where do we end up? 54.2%. That is a considerable difference that implies an approximate 80% reduction in firearm homicides.

So, which features of gun laws are the biggest drivers of this reduction? Ultimately, we can boil it down to 7 questions.

#	Feature / Question	Relevance	
		In-State	Neighbors
1.	Does law enforcement have the authority to prohibit people from carrying a concealed gun on the basis that they pose a danger or threaten public safety?	Yes	Yes
2.	Does state law require all people under final domestic violence restraining orders to turn in their firearms when they become prohibited from having them?	No	Yes
3.	Does state law prohibit all people under temporary domestic violence restraining orders from having firearms?	Yes	No
4.	Does the state require firearm training in order to carry concealed guns in public?	Yes	No
5.	Does law enforcement otherwise have the authority to prohibit a person from carrying a concealed gun at their discretion?	No	Yes
6.	Does state law prohibit fugitives from having firearms?	No	Yes
7.	Does state law disqualify people from getting concealed carry permits based on other criminal history?	No	Yes

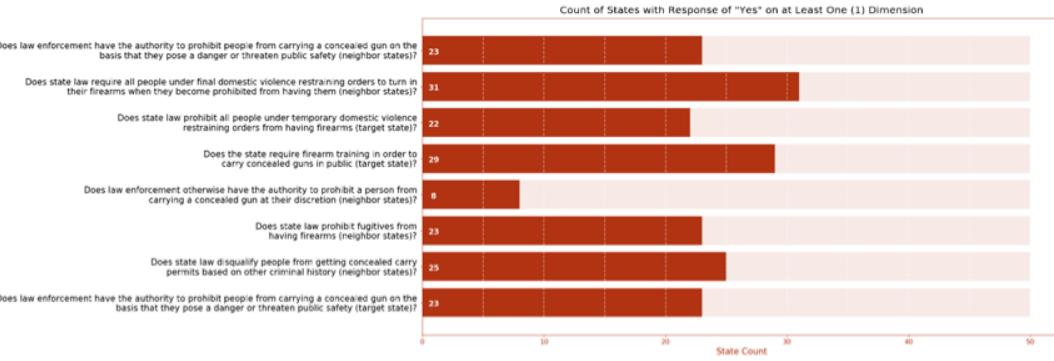
MOST SIGNIFICANT FEATURES



Now, I'm not going to read these off one at a time. Instead, we'll talk about some of the common themes. So for now, feel free to pause the video for a few minutes to read through these and get a sense of what ties these questions together.

So, you'll notice that 4 of the 7 questions are related to concealed carry. Of those, two (and maybe three) are related to discretion of law enforcement. It's unclear who decides what qualifies as "other criminal history." This finding is deeply problematic in that such laws are unlikely to get much support from either end of the political spectrum due to distrust of government and distrust of law enforcement. Though such laws may be effective, they may come at too great a cost. We'll consider a potential solution to this conundrum later.

We also notice two of the top three questions relate to those who have domestic violence restraining orders. And there is one question relating to fugitives being prohibited from owning firearms. These questions are, perhaps, the most revealing. The idea that a state wouldn't prohibit domestic abusers and fugitives from having firearms is almost incomprehensible.



MOST SIGNIFICANT FEATURES



But as we can see here, fewer than half of the states have any prohibitions on fugitive firearm possession. And in 19 states, individuals prohibited from having firearms due to domestic violence restraining orders are not required to turn-in their weapons. These counts are as of this year: 2019.

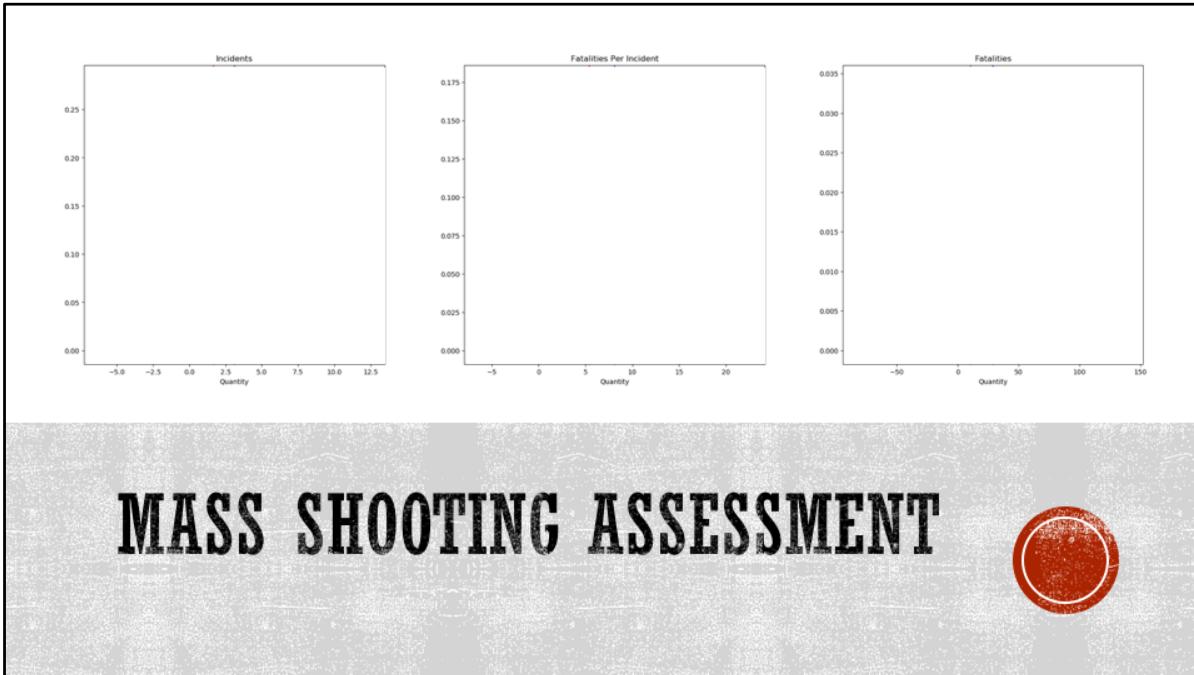
So, there's a lot to chew on here, and I'll let you sit with it for the time being. In the meantime, let's shift gears a bit and talk about mass shootings.

MASS SHOOTING ASSESSMENT

Public Safety and Recreational Firearms Use Protection Act

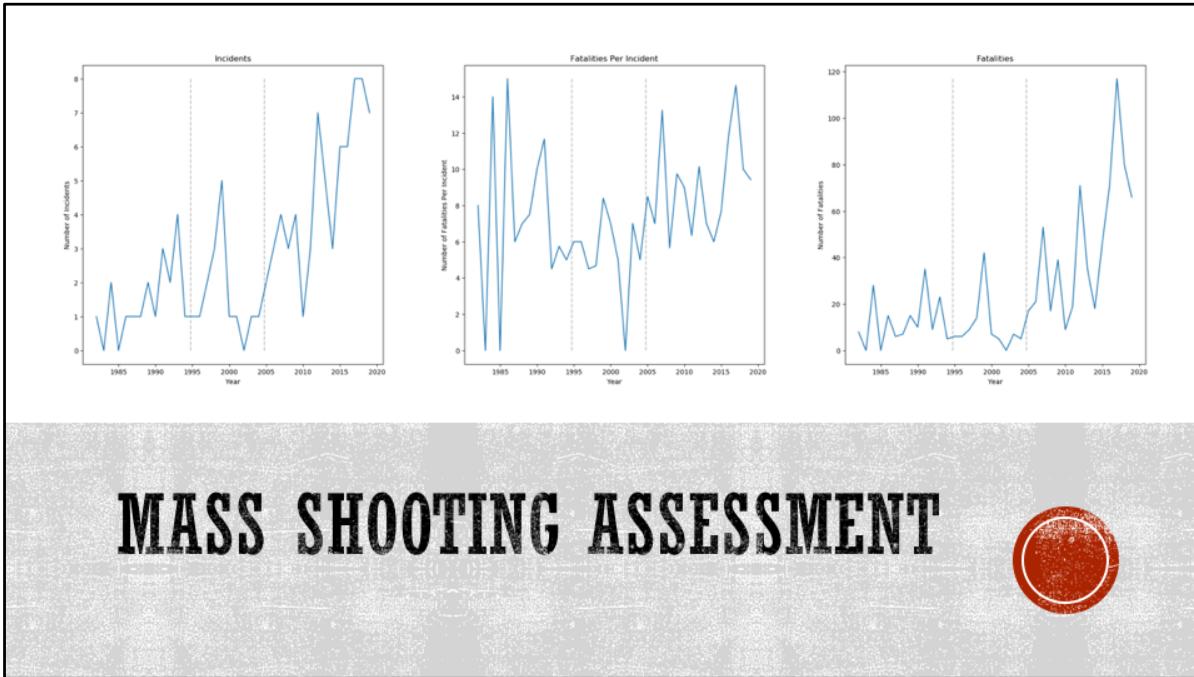
1994 – 2004

Despite best efforts, we were unable to establish a clear link between state gun laws and the occurrence of mass shootings. The initial results were not particularly surprising since these types of events are quite rare, statistically speaking. So, rather than look at state laws, we will look at federal regulation; specifically, the Public Safety and Recreational Firearms Use Protection Act. Otherwise known as the Assault Weapons Ban, this law was in effect from September 1994 through September 2004. What kind of impact, if any, did the ban have on mass shooting rates and fatalities?



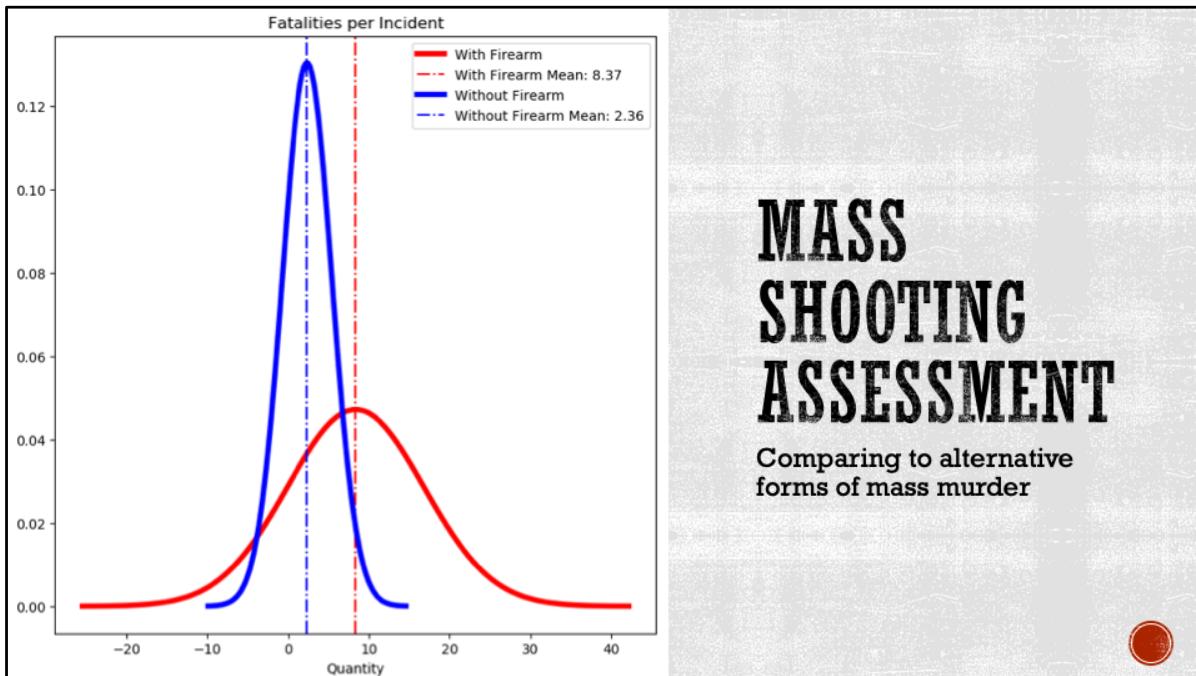
Here, the red curve represents years with the ban in place, and the blue curve represents years without a ban. The dashed, vertical lines represent the respective means of each curve. Since the blue line is further to the right of the red line, this is an indication that the average number of incidents per year was higher without the ban. Specifically, there were 3.1 incidents per year without the ban, but only 1.67 in years with the ban.

When looking at fatalities per incident, we see similar results. With the ban, there were 5.4 fatalities per event, but that number jumps to above eight in years without the ban. Putting these together, we can see that there were 20 fewer fatalities per year when the ban was in place. The results seem to suggest that the assault weapons ban was quite effective at reducing the frequency of and the number of fatalities from mass shootings. But there's one problem.



Have a look at the changes in these results over time. When looking at the frequency and total deaths, we see the numbers are significantly higher in the years after the ban than before the ban. The spike in 1999 due to Columbine and other copycats even seems to be part of a longer trend. Pretend the year is 2004: we are conducting this analysis to determine whether the ban should remain in place. Using the same methodology, all signs of significance disappear.

Fatalities per incident, however, is another story. We see a clear drop around 1994 and a subsequent increase after 2005. The difference in means is significant at the 95% level. So, though the ban may not reduce the frequency of these events, it can improve the survivability of them.



And even if we consider the possibility that would-be shooters will turn to other methods of mass murder, we can see that the difference is even more pronounced. There is an average of 8.4 fatalities per mass shooting and 2.4 with alternative methods.

RECOMMENDATIONS & NEXT STEPS



Start with the
Basics



Family Intervention
/ Red Flag Laws



Collaboration with
Neighboring States



So, with all information, what recommendations can we make with regard to gun laws?

First, and probably most obvious, states need to put in place more restrictions to keep guns out of the hands of domestic abusers and fugitives. However, the lack of such restrictions in so many states really alludes to a broader issue of taking care of the basics. For example, in 21 states, individuals found not guilty of a crime by reason of insanity are not prohibited from having firearms. And in 23 states, individuals found incompetent to stand trial are not prevented from having firearms. There are a host of situations like these that most would think are already covered by state laws, but actually aren't in many cases. And the unfortunate reality is that, while many of these laws are in place at the federal level, the means of enforcement are extremely limited if states don't have analogous laws to do so. So, it is incumbent on citizens in each state to get familiar with these sorts of obvious gaps in their state laws if any progress is to be made.

However, empowering law enforcement to remove guns at their discretion, is likely to be met with significant amounts of resistance on both sides of the aisle. As an alternative, immediate family members might be empowered to petition a court for

such removals when they identify red flags of their own. Otherwise known as “extreme risk protection orders” or “red flag laws,” such an approach could potentially yield similar results without yielding too much power to enforcement agencies. In 2015, only two states had such laws in place, but that number has since grown to 17. Because the laws are so new, it will be a few years before their effectiveness can be measured. Furthermore, the criteria used by courts to make decisions on such petitions still needs to be established.

The third thing I want to draw attention to is firearm training. Though not explored in depth, this requirement was found to be significant when treated as a prerequisite to obtaining concealed carry permits. It would be a good idea to conduct further research in this area to understand if there are specific features of training that need to be emphasized.

Finally, states need to work together. States like California, for example, are likely to see better results if they try to initiate some sort of compromise with Arizona and Nevada in an effort to get them to close the gaps in their laws.