**An Analysis of Firearm Related Mortality in the U.S.**

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**Background**

In recent memory the number of mass shootings and large number of fatal incidents with firearms has been a hot button issue in the United States. Both sides of the political spectrum claim to have resolutions to this issue and have, in turn, implemented their idea of fixes to solve this growing problem. The goal of this analysis is to take a look at the data provided by the CDC to attempt to predict the trends of firearm related mortality in the US as a whole and in a few key states. The states we will be pulling data from will be New York, California, Texas, and Florida. Each one of these states has had a polarizing view of firearms and how to regulate them. It is my belief that these states will provide the best contrasting view of how the legislation put in place is affecting the rate of firearm related death.

Business Problem/Research Questions

As stated previously the goal of this analysis is to attempt to predict the future trends of gun related mortality at a national level. This information is important to understand where we are progressing and to see if current laws are having an effect (positive or negative) on the rates at which these incidents are occurring. In addition the secondary aim of this analysis is to determine which methodologies for law, provided by the states, is lowering the number of incidents.

**Analysis**

Data Preparation/Source

The data for this analysis comes directly from the CDC and spans the years 2014-2021. The CDC seemed like the most reliable source for this type of data. Many similar sources of comparable size (of the data) have very arbitrary restrictions for reporting and seem to push an agenda one way or the other. This made the CDC seem like the best choice for a more standardized method of data collection with minimal bias. The dataset also includes data for the year 2005, this was removed from the analysis to keep consistency with the unbroken 2014-2021 data. We will be looking specifically at the rate of mortality, while the dataset also provides information on the total number of deaths this is better represented by the rate per 100k population.

Methodology

The model chosen to evaluate the dataset was a combination of the ARIMA and GARCH models. Originally I wanted to approach this data with just the GARCH method, but was having some issues with the predictions. The combination of both the ARIMA model, which models future returns quite well, and the GARCH model which models conditional variance allows for a more well rounded approach to predicting future results (Dierckx, 2020). In particular the use of the pmdarima package allow for the automatic calculation of the best PDQR values for the ARIMA side of the model. This saves a ton of time and effort which otherwise would be needed to run continuous testing to determine the most correct values. The combination of both the pmdarima and arch packages allows for a near seamless transition and combination of both model types.

Analysis

Based on our combined ARIMA GARCH modeling there are a couple key trends to note. In particular the average national rate of firearm mortality shows a slight increase between the Chart, line chart

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Description automatically generatedyears 2022-2023 and then an eventual downslope over the next 3 years. State-wise there Chart, line chart

Description automatically generatedare sone similar trends to observe. In particular the states of Texas and Florida show Chart, line chart

Description automatically generatedgraphs similar in nature (shape) with Texas displaying a much larger period of growth before the eventual downturn. In the case of New York and California there looks to be an immediate decline in growth with the rate leveling out around 2022 onward. This could be due to the model Chart, line chart

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**Conclusions**

Conclusions

It is interesting to see that the overall trend predicted seems to be moving towards a decrease in overall gun mortalities across the country. In particular it seems that states who have more restrictive gun legislation in place find themselves decreasing even faster than the baseline national average and especially in comparison to states with much looser restrictions. But much of this conclusion hinges on the model itself, depending on how you may interpret the results it could be that previous years were not taken well into consideration when the model weighed out seasons. This could have negatively affected the visualization and understanding of the states of New York and California and could have overvalued previous iterations for Texas and Florida. I don’t believe that this is the case but it is something to consider when evaluating this analysis.

Assumptions

Going into this analysis, my assumption was that states with a lower amount of firearms or heavier restrictions were likely to have lowered or decreasing rates of gun mortality. It seemed to make sense that just lowering the overall number of firearms would decrease the access to their use and this idea seems to be confirmed by previous data and future models presented in this analysis. While there are definitely some outlier states that present a slightly different perception of the topic (New Mexico, Nebraska, ect) I believed that it was important to look at some the highest population states to get a better understanding of the effects of legislation over a much broader range of demographics and overall population.

Limitations

As previously mentioned the data for this type of project was surprising limited given how prevalent it has become in both the news cycle and American consciousness in the last few years. Even with the data sources available many of them we heavily funded or entirely provided by groups involved with one side of the political spectrum trying to push their agenda toward legislation. This made the quality of the data seem disingenuous for the information I wanted to study with this project. This is why the CDC seemed like the most reasonable of the sources available.

Challenges

Due to the limited or biased data previously mentioned in the limitations section, the number of data points available for study was not quite where I wanted it to be. Provided in the CDC dataset there were only two variables, rate of mortality per 100k population and total number of deaths, which limits the amount of reach I had initially anticipated for this study. In addition, I initially wanted to use the GARCH model by itself, but it proved to be a bit unwieldy with the dataset. Without the combination of the ARIMA model the GARCH model had a difficult time fitting with the data, providing very skewed predictions.

**Recommendations**

Recommendations

Based on the findings from this dataset, I think that the models show that increased restrictions on firearms greatly reduce the rate of mortality. While there are many schools of thought on how these issues should be solved, this seems like the best place to start. It does not appear that states with looser restrictions are having a large enough effect to reconcile with the harm these laws appear to be causing. While there are definitely aspects to criticize within the frameworks of the gun legislations in more restrictive states, it is hard to argue with the results they are able to show here.

Future Use/Additional Applications

I think that this analysis provides a solid ground for future study of this issue. There is quite a bit of debate around solving the issue of firearm mortality nationally, this itself warrants further study into current methods and approaches. I think, in the same vein, this study could be applied to similar issues that are debated between the different sides of the political spectrum. Something like environmentally restrictive laws against areas with looser guidelines would be an interesting topic of similar scale.

Ethical Considerations

This is obviously an issue that has caused a considerable amount of harm to American citizens, especially over the last few decades. This alone is cause for a pause when considering working with this type of data. I think that the findings from studies like this or of similar approach could very likely have some heavy ethical implications for law makers and the current ways of thinking. One thing that is clear is that the number of outliers in previous iteration seems to be growing, some action will likely need to be taken in the near future either way.

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Appendix A

A pair of charts displaying graphs using the ARIMA-GARCH model for the states of Nebraska and New Mexico

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10 Reader Questions

1. Are there any differences in restrictions between the selected states that heavily affect their mortality rate over their partner state?
2. Why do you think the GARCH model would be effective with this dataset?
3. What additional data would you have liked to use if it was available
4. With states like Washington or Oregon that have more restrictive gun laws bordering states like Idaho who have less regulation have a major impact on the rate of firearm mortality due to the interstate commerce of purchasing firearms?
5. Are there any other data models that could work better with this dataset.
6. Why are their so many sources that arbitrarily track mortality cases based on their own agendas
7. What do you think you could have done differently if given more time to work with this project
8. Are there any examples of gun restrictions on a national level lowering mortality rates previously
9. What do you think contributes to legislation in these states going one way or the other
10. Why do you think the data from the CDC is a more trusted source compared to other potential datasets.