**State Gun Laws and the Incidence of Mass Shootings in 2022**

Andra Kennedy

Western Governor’s University

D195: Data Management/Analytics Undergraduate Capstone

**Table of Contents**

Project Overview ........................................................................................................................... 3

Project Summary ........................................................................................................................... 3 Project Plan .................................................................................................................................... 3

Project Planning Methodology ...................................................................................................... 4

Project Timeline & Milestones ………………………………………………………………….. 5

Data Selection and Methodology ................................................................................................... 5 Data Set Advantages and Limitations …........................................................................................ 5 Data Extraction/Preparation Processes …………………………………….................................. 6

Data Analysis Process .................................................................................................................... 6

Analysis Tools/Techniques - Advantages and Limitations ............................................................ 7

Application of Analysis Methods ….............................................................................................. 8 Results ............................................................................................................................................ 9

Statistical Significance …............................................................................................................... 9 Practical Significance …................................................................................................................. 9

Overall Success ……………………............................................................................................ 13

Key Takeaways ............................................................................................................................ 13

Conclusions .................................................................................................................................. 13

Effective Storytelling ................................................................................................................... 13 Findings-based Recommendations .............................................................................................. 14

Panopto Video Link ..................................................................................................................... 15

Appendices ................................................................................................................................... 15

Sources ......................................................................................................................................... 16

**Project Overview**

1. **Project Highlights**

**Research question:**

This project analyzed the most recent data regarding mass shootings occurring in the United States in 2022 and the state gun control measures implemented by each state. Specifically, this project aimed to determine if state gun control measures implemented in 2021 had an impact on the incidence of mass shootings occurring in 2022, and if there was a difference in mass shooting events occurring in states with strict gun laws versus weak gun laws using statistical analyses.

**Project Scope:**

The scope of this research project was to determine if current state laws regarding gun control had an impact on the incidence of mass shootings in the year following legislative implementation. A dataset containing a record of each mass shooting occurring in the United States in 2022 was compared to State Gun Laws as assessed and graded by the Giffords Law Center. Using the Giffords Law Center grades, states were categorized into five groups related to gun control legislation from strict to weak gun laws. Further analyses were conducted to extract descriptive and statistical findings from the dataset.

**Solution Overview - Tools and Methodologies:**

A .csv file downloaded from the Gun Violence Archive was obtained as the basis for analyses for this project. Once downloaded, the datafile was uploaded to a Jupyter Notebook where it was read into a coding environment via Python. These tools were chosen for their ability to load and analyze datasets quickly and easily while creating meaningful outputs. State Gun Law Grades were obtained via the Giffords Law Center and manually added to the coding environment. After obtaining the data needed for analysis, data cleaning and transformation methods were conducted to prepare the data for analysis. Exploratory Data Analysis, descriptive analyses, and statistical analyses were conducted. Additional information regarding each method will be detailed below.

**Project Plan**

1. **Project Execution**

**Project Plan**

The project plan for this project was completed as expected. All goals, objectives, and deliverables listed below were completed exactly as described in task 2. There were no differences noted between the project plan as proposed and as implemented.

The goal of this project was to determine if state gun laws enacted in 2021 had an impact on the incidence of mass shootings occurring in 2022.

The objectives for this goal were:

* To utilize descriptive analyses to find trend statistics by state.
* To utilize descriptive analyses to find trend statistics between states.
* To utilize descriptive analyses to find trend statistics between gun law grades of states, from states with strictest gun laws to states with least restrictive gun laws.
* To determine statistical significance between the incidence of mass shooting events as compared to states with strictest to least restrictive gun laws.

The deliverable for the above objectives is a report with graphs, tables, and final statistical analyses to add to the current research base.

**Project Planning Methodology**

The project planning methodology chosen for this project was the Agile method for its iterative qualities that allow for adjustments as the project progresses. This was advantageous as once the data cleaning and analyses began, certain changes regarding the analytical methods chosen were made. The details regarding how this project implemented the five steps of the Agile method are discussed below:

* Define: This step centered on gathering research and background information regarding the proposed research question. Several sources were evaluated and categorized as being relevant or irrelevant to the research question. Some sources led to additional sources, and some studies used as background information provided insight in the development of this project. As the definition of the research project narrowed, and as the project progressed, there were times that further research was needed to aid in the development of this project. Additional research was also required in the implementation of the coding and testing environment.
* Design: This step outlines how the project progressed through the stages required at each step. The design of this project did not deviate from the stages required at each step as identified in Task 2.
* Build: This step began the real work of the project. Once the dataset was uploaded into the coding environment, exploratory data analysis helped drive the project overall. At times additional datasets were considered but ultimately were deemed unnecessary and out of scope for this project. Various Python coding tools were researched and assessed for the development of this project, with some proving advantageous and others unnecessary once implemented in the coding environment.
* Test: The fourth step of the Agile method involves testing the dataset according to the research problem and making corrections as needed based on results. This stage resulted in the most deviation from the original plan. The original planned statistical model identified in Task 2 was deemed inappropriate for this research project, so alternative statistical models were researched and implemented. Additional information regarding the statistical models utilized in this project will be explained below.
* Release: The final step of the Agile method is the end result of the research project. The final deliverable for this project is a report detailing the results of the research question using graphs and tables discussing the final analysis results. This did not deviate from the original plan identified in Task 2.

The changes to the analytical models utilized for this project will be discussed below in more detail, however, the iterative nature of the Agile methodology allowed for changes to be made to this project as needed.

**Project Timeline and milestones**

The project timeline and milestones were not completed as anticipated. Some milestones were completed ahead of schedule while others took longer to complete. As this project was completed with an iterative Agile approach, each step of the Agile method was revisited as necessary, resulting in varied timelines than originally anticipated. Actual timeline of this project is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Project Milestones** | **Actual Start Date** | **Actual End Date** | **Duration** |
| Background & Research | 1/23/2023 | 1/27/2023 | 5 days |
| Dataset Wrangling | 1/30/2023 | 2/1/2023 | 3 days |
| Statistical Analyses | 2/2/2023 | 2/7/2023 | 4 days |
| Final Report Writing | 2/8/2023 | 2/16/2023 | 7 days |
| Editing and Corrections | 2/17/2023 | 2/18/2023 | 2 days |

**Methodology**

**Data Collection Process:**

The Gun Violence Archive tracks and collects gun-related events across the country. They store and maintain several .csv files that are made publicly available. These files are easily downloaded and evaluated, and no obstacles were encountered in obtaining the data. Since these datasets are gathered and maintained by a separate entity for the purposes of public distribution and transparency, concerns related to data governance were not present. This dataset did not contain any personally identifiable information or sensitive information requiring additional security measures, and all legal and ethical issues were resolved prior to download. The dataset was uploaded locally to a Jupyter Notebook environment to allow for additional manipulation and analyses. No obstacles were noted during the data collection process, and it did not deviate from the original data collection plan identified in Task 2.

**Advantages and Disadvantages of Dataset**

The dataset from the Gun Violence Archive was chosen because it is the most complete and reputable source for this data. This dataset lists all incidents of mass shootings occurring in 2022 by date, state, address, and number of people killed/injured. It contained all the information needed for the purpose of this project.

Upon upload of the dataset and initial analyses, it was found this dataset was not as extensive as originally anticipated. Although it is complete, there were only 648 mass shooting events that occurred in 2022. Considerations were made to combine this dataset with other datasets to include other incidents of gun violence, such as individuals killed or injured by gun-related events outside of mass shootings events, children and teens that were victims of gun violence, and accidental or suicidal incidents involving guns. It was also considered to include data of mass shooting events from previous years. However, both of these considerations would be out of scope for this project. Therefore, the decision was made to analyze only the 2022 data as aligned with the original scope of this project. Considerations were also made to include data regarding the United States census for the year 2022 but after analyzing this dataset, it was determined this information did not notably contribute to the scope of this project, and analyses could be made without the addition of this information. After careful consideration, it was determined the one dataset regarding mass shooting events in 2022 was sufficient for the purposes of this project.

**Data Extraction and Preparation Processes**

The dataset was downloaded directly from the source in a .csv file. After downloading, the file was first opened in excel to superficially view the dataset prior to uploading to Jupyter Notebook. Viewing the dataset in Excel was necessary to determine what measures may have been needed to load the datafile in the Jupyter Notebook coding environment. Jupyter Notebook is a web-based coding environment that allows for simple workflow and performs analyses quickly with easy-to-read outputs. Following the upload to the coding environment, the datafile was read using Python coding language. The Python Coding Language is an object-oriented programming language that is easy to use and comes with a library of tools and resources to assist in performing data analysis.

Python coding techniques were used to visually assess the dataset regarding length, datatypes, and simple exploratory data analysis. From this analysis, it was found the ‘Incident Date’ column was in a string datatype and required conversion to datetime datatype for future analysis. Other columns were viewed and deemed unnecessary for this project and were subsequently removed. Null values were also discovered and resolved without affecting the data integrity.

In order to compare the mass shooting incidents to state grading groups identified by Giffords Law Center, the state grades were obtained manually from the source and placed into a dictionary within the coding environment. A new column was added to the dataset to list gun law grade levels based on the state using this dictionary. After adding the state grade levels, it was discovered 9 mass shooting incidents occurred in Washington, District of Columbia (D.C.). Since this is categorized as a district and not a state, no grade level regarding gun control legislation was available. These 9 incidents were therefore removed from this dataset, resulting in 639 remaining mass shooting incidents for analysis.

Other columns were also added to the dataset to list total mass shooting incidents, total number of people killed, and total number of people injured as a result of each mass shooting event by state. These columns provided further information for exploratory data analysis and creating visualizations. Once these columns were added and the dataset was cleaned and transformed into a format suitable for analyses, progress was made regarding exploratory data analysis and statistical analyses. Performing this analysis within the Jupyter Notebook environment using Python programming language provided an easy to use platform that aided in the completion of this project

**Data Analysis Process**

**Data Analysis Methods**

Descriptive analytics was the first method used during exploratory data analysis of this project. Using this method, simple observations and inferences were made, such as identifying states with the most mass shootings incidents, states with the most people killed and/or injured within each state, and a timeline of mass shooting events occurring over the year. Using Descriptive analytics helps to identify trends and guide the project in further analyses to gain additional insights.

Statistical analyses were utilized to determine significance between state grade groups and mass shooting events. Statistical analysis is necessary to determine if differences observed between sample groups is meaningful or due to chance. For this project, 3 statistical models were applied and considered. Further discussion of the statistical models considered is detailed below.

**Advantages and Limitations of Tools/Techniques**

The first statistical analysis considered for this project was a One-Way Analysis of Variance (ANOVA). A One-Way ANOVA compares groups within a single independent variable to a continuous dependent variable. It assumes a normal sample distribution, independence of sample groups, and an equal amount of variance among sample groups. This was originally determined to be a good fit in Task 2 as this method compares the mean variance among groups within a single variable as it compares to a dependent variable. However, following ANOVA analysis on this dataset, considerable variance was noted among some of the groups, and it was determined this method was not the best fit for this project.

Kruskal-Wallis was then utilized to analyze the data as this method measures the variance among the five groups using the median of each group. The Kruskal-Wallis is considered the non-parametric equivalent to the One-Way ANOVA and was therefore considered a suitable model to replace the ANOVA. It does not have the same assumption requirements of a normal distribution and equal variance among sample groups the way ANOVA requires. It proved to be a good measure for the original problem, but further analysis of the dataset suggested otherwise.

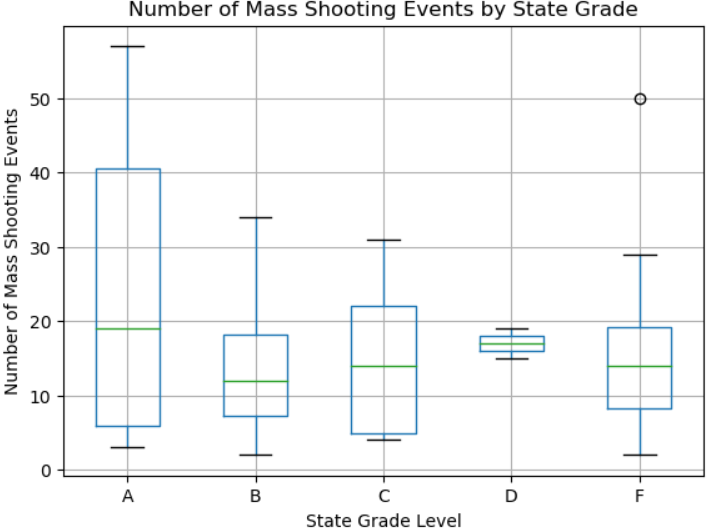
Although the dataset consisted of 639 mass shooting events in 2022, these events occurred in 37 out of 50 states. Dividing these 37 states into five groups based on state gun law grading groups resulted in some groups being relatively small and not a good representative sample to conduct statistical analyses. Below is a table listing each state by grade and whether or not a mass shooting event occurred in that state in 2022.

|  |  |  |
| --- | --- | --- |
| **Grade** | **States with Mass Shooting Events in 2022** | **States with No Mass Shooting Events in 2022** |
| A | California, New Jersey, Connecticut, Illinois, Maryland, Massachusetts, New York | Hawaii |
| B | Colorado, Delaware, Virginia, Washington, Oregon, Pennsylvania | Rhode Island |
| C | Michigan, Nevada, Minnesota, New Mexico, Florida, Nebraska, North Carolina, Wisconsin | Vermont |
| D | Ohio, Indiana |  |
| F | Alabama, Arkansas, Arizona, Georgia, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Oklahoma, South Carolina, Tennessee, Texas | Alaska, Idaho, Maine, Montana, New Hampshire, North Dakota, South Dakota, Utah, West Virginia, Wyoming |

In order to get a more representative sample, a third statistical analysis was conducted by splitting the dataset into two groups and conducting a two sample T-test. The two sample T-test has five assumptions. The first assumption requires the measurement be a continuous variable. The second assumption is that the sample data is random and representative of the general population. The third assumption requires the data sample to be normally distributed. And the fourth and fifth assumptions require the data to be of large sample size and to have equal variances. When comparing these assumptions to this research project, this analytical model appeared to be the best fit overall. This test compares the means of two independent groups to determine significance, and considering the size of the dataset, was determined to be a better model to determine statistical significance for this project.

**Application of Analytical Methods**

When implementing the One-Way ANOVA method, the first step was using a boxplot to visualize the dataset. This visual was the first indication that the variance among groups was very large and this method may not be the best fit for the dataset. The below figure depicts the boxplot of the five state grade groups.



Statistical analysis for a One-Way ANOVA was run using pingouin, a statistical package in Python. This package is able to determine the statistical differences in variance between and within groups, but does not indicate which groups may or may not be significantly different. Further post-hoc tests, such as Tukey, determines pairwise comparisons among sample groups and is needed to determine which groups are significantly different. These analyses were conducted by this analyst solely for educational purposes but were not the main analysis, since this project is not a good fit for ANOVA.

The Kruskal-Wallis was conducted to determine significance among the groups since it is a non-parametric version of the One-Way ANOVA. To complete this analysis, each state grade level group was first converted into an array, and then run through the scipy stats Kruskal-Wallis package. It was a better fit for the project, however some of the sample sizes were still small, suggesting it may not be the best method for this project. To create a more complete picture of the dataset, a third statistical analysis was performed.

The two sample T-test was deemed to be a better fit for this project as splitting the dataset into two groups would allow for larger sample sizes and more even sample group comparisons. The dataset consisted of 639 mass shooting events occurring in 37 states, with those states graded from ‘A’ (strictest) to ‘F’ (weakest). In order to split this dataset into two relatively equal sample groups, states with grades ‘A’, ‘B’, ‘C+’, and ‘C’ were placed into the “Strict” state group while states with grades ‘C-‘, ‘D’, and ‘F’ were placed into the “Weak” state group. Once divided, the Strict group contained 304 mass shooting events occurring in 17 states with a mean of 17.88. The Weak group contained 335 mass shooting events occurring in 20 states with a mean of 16.75. The variance of these two groups was evaluated and determined not to be significant. The sampling distribution of both groups was compared and determined nonsignificant. Splitting the dataset into two groups in this way was a better fit for the dataset and satisfied all assumptions for the T-test.

**Results**

**F. Project Success**

**Statistical Significance**

The first statistical analysis that was run on this dataset was a One-Way ANOVA to determine if statistical differences exist between the five state grade levels. The F-value obtained was 0.60 with a p-value of 0.66, which is greater than the pre-determined alpha of 0.05. This result indicates there is no significant difference between the five groups using a One-Way ANOVA. However, since the assumption of equal variances did not exist, it was determined the ANOVA was not a good fit for this dataset.

The non-parametric equivalent, Kruskal-Wallis, model was then used. An F-value of 0.78 and a p-value of 0.94 was obtained which is again greater than the alpha of 0.05, further supporting the ANOVA finding that no statistical difference exists between the state grade levels and the incidence of mass shootings. However, the state grade level groups did not have equal or similar sample sizes which may skew results, so the Kruskal-Wallis was determined not to be the best fit for this dataset.

The third statistical analysis used for this dataset was a two sample T-test after dividing the dataset into two groups with similar sample sizes, means, and variances. The statistical F-value obtained was 0.24 and the p-value was 0.81. As this value was greater than the alpha of 0.05, it was determined no statistical difference was observed between the two groups. Therefore, the decision was made to Fail to Reject the Null Hypothesis and accept that there is no difference between state gun law levels and the incidence of mass shooting events.

**Practical Significance**

Although no statistical significance was observed between states with strict gun laws and states with weak gun laws, other insights were observed when analyzing the dataset.When analyzing the number of mass shooting events occurring by month, a steady incline in mass shooting events is noted to occur from January to May, peaking in July with a total of 88 mass shootings occurring that month. Subsequently, a steady decline in mass shooting events is observed the second half of the year. This finding is depicted in the graph below.

Chart, line chart

Description automatically generated

When analyzing the number of mass shooting events occurring by state grade level, the highest number of mass shootings occurred in states with the weakest gun control laws, with 228 total mass shootings in states with an ‘F’ rating. The second highest number of mass shooting events occurred in states with the strictest gun laws, with 172 mass shootings in states with an ‘A’ rating. States with ‘B’ and ‘C’ ratings had 86 and 119 mass shooting events, respectively. States with a ‘D’ rating had the lowest number of mass shooting events, with 34 occurring in 2022. It should also be noted that this was the smallest group of all grade levels, containing only 2 states. The proportion of mass shooting events occurring in each state grade level are as follows: Grade ‘A’ (26.9%), Grade ‘B’ (13.5%), Grade ‘C’ (18.6%), Grade ‘D’ (5.3%), and Grade ‘F’ (35.7%). See the figures below comparing the number of mass shooting events occurring by state grade level.

Chart

Description automatically generated*Chart, pie chart

Description automatically generated*

When analyzing which states had the most mass shooting incidents in 2022, Illinois topped the list with 57 total mass shooting events. California and Texas tied for second place, with 50 total mass shooting events in 2022 in each state. Iowa and Delaware were identified as having the least number of mass shooting events. The following figure depicts each state’s number of mass shooting events in descending order.

Chart, histogram

Description automatically generated

When comparing the states with the most mass shooting events to their state gun law grade level, it is interesting to note that out of the top ten states with the most mass shootings, 3 are among the states with the strictest gun laws, 3 are among states with moderate gun laws, and 3 are among states with the weakest gun laws. Of the states with the least number of mass shooting events, 3 were among the states with moderate gun laws and 3 were among the states with the weakest gun laws. A detailed table listing each state by grade level with the number of mass shooting events, total number of people killed, and total number of people injured during each mass shooting event can be found below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Grade A** | | | |
| **State** | **Number of Mass Shooting Events** | **Total Killed** | **Total Injured** |
| California | 50 | 62 | 192 |
| Connecticut | 3 | 1 | 11 |
| Illinois | 57 | 51 | 254 |
| Maryland | 19 | 31 | 53 |
| Massachusetts | 3 | 0 | 14 |
| New Jersey | 9 | 3 | 40 |
| New York | 31 | 23 | 129 |
| **Grade B** | | | |
| Colorado | 13 | 23 | 57 |
| Delaware | 2 | 0 | 8 |
| Oregon | 6 | 6 | 24 |
| Pennsylvania | 34 | 23 | 146 |
| Virginia | 20 | 37 | 75 |
| Washington | 11 | 4 | 49 |
| **Grade C** | | | |
| Florida | 31 | 23 | 129 |
| Michigan | 25 | 19 | 100 |
| Minnesota | 12 | 11 | 43 |
| Nebraska | 5 | 6 | 18 |
| Nevada | 5 | 2 | 36 |
| New Mexico | 4 | 2 | 17 |
| North Carolina | 21 | 17 | 88 |
| Wisconsin | 16 | 20 | 68 |
| **Grade D** | | | |
| Indiana | 15 | 19 | 58 |
| Ohio | 19 | 19 | 76 |
| **Grade F** | | | |
| Alabama | 16 | 11 | 69 |
| Arizona | 13 | 8 | 67 |
| Arkansas | 5 | 8 | 36 |
| Georgia | 29 | 32 | 109 |
| Iowa | 2 | 3 | 13 |
| Kansas | 3 | 3 | 12 |
| Kentucky | 9 | 7 | 39 |
| Louisiana | 28 | 14 | 138 |
| Missouri | 14 | 14 | 60 |
| Mississippi | 14 | 16 | 57 |
| Oklahoma | 8 | 23 | 19 |
| South Carolina | 20 | 15 | 93 |
| Tennessee | 17 | 14 | 72 |
| Texas | 50 | 90 | 200 |

**Overall Success**

The goal of this project was to determine if there was a significant difference in the number of mass shooting events occurring in states with strict versus weak gun laws. Three statistical analytical models were used with consistent results among all three, further validating the finding that there is no significant difference in the number of mass shooting events as they relate to state gun laws. Since these three methods all resulted in similar findings, this analyst interprets these findings and this project as a success. Other goals related to this project were to determine trends among the data and identify states with the highest incidents of mass shootings as they relate to state gun laws. Several interesting insights were revealed while analyzing this data. The information gleamed from analyzing this dataset and the ability to contribute to the existing research base regarding state gun laws and gun-related violence is interpreted by this analyst as a success. This project succeeded in answering all questions originally proposed for this research project, and those findings resulted in additional questions being raised. The need for additional research in this field is evident.

**Key Takeaways**

**Summary of Conclusions**

After completing multiple statistical analyses, this project found no significant difference in the number of mass shooting events occurring within each state and the restrictive nature of those state’s gun laws. This project found states with the strictest gun laws are just as likely to have a mass shooting incident occur as are states with the weakest gun laws. When viewing the top ten states with mass shooting incidents, three were states with strict gun laws, three were states with moderate gun laws, and three were states with weak gun laws. Similarly, of the ten states with the fewest mass shooting events in 2022, three were states with moderate gun laws and three were states with weak gun laws. In 2022, mass shooting events occurred in 37 states. Of the remaining 13 states that did not experience a mass shooting event, ten of those states are identified as having the weakest gun laws. During each comparison of groups comprised of states with the strictest gun laws versus states with the weakest gun laws, the incidence of mass shooting events were comparable. These findings appear consistent with previous research studies that suggest state gun control legislation does not decrease the prevalence of gun violence in America.

**Effective Storytelling**

The visual depictions used to summarize this project’s results included tables, a line graph, bar charts, and a pie chart. The tables were presented in a way so that the audience could quickly scan and interpret the information, as well as seek out immediate findings regarding specific states. Tables quickly and efficiently informed the viewer which states had mass shooting events in 2022 and which states did not, as well as which states fell into each grade level grouping, and the number of mass shooting events, total people killed, and total people injured during those mass shooting events. These tables were utilized to communicate and summarize these findings quickly and easily for the viewer.

A timeline graph depicting the number of mass shooting events occurring by month was used to analyze the mass shooting trend over the entire year. It is interesting to note how the number of mass shooting events continues to rise during the spring, peaks during the summer, and then declines during the fall. This information is most clearly depicted with this line graph.

Bar charts are utilized as an effective way to visualize the differences among groups and states. The bar chart depicting how the number of mass shooting incidents vary among the five state grade level groups is a quick and efficient way to see which states have the most and least mass shooting events, as well as how they relate to each other. Using these bar charts, the audience can visualize which grade level groups are comparable, and which grade level groups vary from each other significantly. Using a bar chart to compare all states together gives the audience a quick and easy visual displaying the number of mass shooting incidents by state. The viewer can easily pick out states he/she may wish to compare to other states. Similarly, the pie chart offers a simple and easy way to see the proportion of mass shooting events occurring within each grade level as a whole.

The use of these graphs and visual aids provides a succinct and comprehensive understanding of the research findings as they relate to this project. With use of these tables, graphs, and figures, one is able to quickly and efficiently understand the project conclusions and key takeaways without reading the full study. Should the viewer become confused regarding the verbiage of this analysis, the visual depiction of findings provide a succinct and easily understandable presentation of findings.

**Findings-based Recommendations**

This analysis revealed several insights that warrant further investigation. While viewing the timeline of the number of mass shooting events that occurred over the course of 2022, it was noted that mass shooting events steadily increased over the spring, peaked in July, and decreased over the fall. It would be interesting to see if similar trends occurred in previous years. Perhaps viewing the trends of mass shootings by year over the last decade can lead to further insights. It would also be interesting to compare the timeline trends of mass shooting events as they relate to other sociological movements or events that took place in America during or prior to those years.

Although this project did not find a statistical difference between the incidence of mass shooting events and state gun laws, it would be interesting to expand this analysis. This dataset was limited to only mass shooting events occurring in 2022. It would be interesting to see if the findings of this research project remain the same when comparing ALL incidents of gun violence that occurred in the year 2022. It would also be interesting, as found in other studies, if the specific type of gun control legislation leads to a significant decrease on the prevalence of gun violence. Instead of comparing state gun legislation by overall grade, a deeper analysis could be conducted regarding the type of gun control legislation, such as large capacity weapons bans or gun permit licenses conducted by local police departments with fingerprint background checks. Perhaps significant differences exist when the type of gun control legislation is compared rather than an overall state grade.

Additional research on this topic is required and should be pursued. The threat of gun violence continues to plague America every day with no end in sight. If stricter gun laws do not decrease gun violence, as found during this project and other research studies, what is the answer to quell gun violence in America? How do we keep our children and loved ones safe? Perhaps a more detailed analysis of the perpetrators of gun violence is in order to see if trends or patterns exist within these individuals. Or perhaps evaluating the topic of mental health in America and how it relates to gun violence could offer additional insights. One thing is very clear, further research is needed on this topic to find the solution to decreasing gun violence in America.

**Panopto Presentation**

**Panopto Presentation Link**

[**AK Capstone Panopto Video Presentation**](https://wgu.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=4a74f4ea-b915-4910-98ac-afac01364051&query=ath1308%40wgu.edu)

**Appendices**

**Evidence of Completion**

Jupyter Notebook with Python Code for this project: [**AK Capstone Jupyter Notebook**](../Downloads/Mass_Shootings_2022_Capstone.ipynb)

Jupyter Notebook with Python Code in .html: [**AK Capstone.html**](../Downloads/Mass_Shootings_2022_Capstone.html)

Dataset from Gun Violence Archive for Mass Shootings in 2022

(<https://gunviolencearchive.org/reports>): [**gva\_mass\_shooting\_2022.csv**](../Downloads/gva_mass_shooting_2022.csv)

Gun Laws By State 2021: (<https://giffords.org/lawcenter/resources/scorecard/>)

**Sources**

*ANOVA (analysis of variance)*. Statistics Solutions. (2022, June 27). Retrieved February 16, 2023, from https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/anova/

Bedre, R. (2022, March 6). *ANOVA using python (with examples)*. Data science blog. Retrieved February 16, 2023, from https://www.reneshbedre.com/blog/anova.html

Das, A. (2022, November 7). *Kruskal Wallis test for Beginners*. Medium. Retrieved February 16, 2023, from https://towardsdatascience.com/kruskal-wallis-test-for-beginners-4fe9b0333b31#:~:text=Kruskal%20Wallis%20is%20a%20non,of%20the%20Kruskal%2DWallis%20test.

Datatab Team. (n.d.). *Kruskal-Wallis-Test*. Datatab. Retrieved February 16, 2023, from https://datatab.net/tutorial/kruskal-wallis-test

GeeksforGeeks. (2022, October 17). *How to conduct a two sample t-test in Python*. GeeksforGeeks. Retrieved February 16, 2023, from https://www.geeksforgeeks.org/how-to-conduct-a-two-sample-t-test-in-python/

Marsja, E. (2020, November 19). *Four ways to conduct one-way anova with python*. Erik Marsja. Retrieved February 16, 2023, from https://www.marsja.se/four-ways-to-conduct-one-way-anovas-using-python/

Maverick, J. B. (2022, July 13). *What assumptions are made when conducting a T-test?* Investopedia. Retrieved February 16, 2023, from https://www.investopedia.com/ask/answers/073115/what-assumptions-are-made-when-conducting-ttest.asp

*Independent T-test*. Python for Data Science. (n.d.). Retrieved February 17, 2023, from https://www.pythonfordatascience.org/independent-samples-t-test-python/

*One-way ANOVA with Python.* Python for data science. (n.d.). Retrieved February 16, 2023, from https://www.pythonfordatascience.org/anova-python/

The following were referenced to assist in coding this project:

<https://www.geeksforgeeks.org/bar-plot-in-matplotlib/>

<https://stackoverflow.com/questions/26358200/xticks-by-pandas-plot-rename-with-the-string>

<https://stackoverflow.com/questions/25447700/annotate-bars-with-values-on-pandas-bar-plots>

<https://matplotlib.org/stable/gallery/lines_bars_and_markers/bar_label_demo.html>

<https://stackoverflow.com/questions/14270391/python-matplotlib-multiple-bars>