Institute of Technology Tallaght, Dublin
Department of Computing

Bachelor of Science in I.T. Management

Subject: **Interactive Media Design & Data Visualisation**

Year: 4 (Full Time)

Assignment Title: CA1

Format: Individual

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Date Due: 6th November 2017

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Interactive Media Design CA1

CA Summary

This CA will be comprised of a detailed report based on the area I have chosen to investigate, along with an interactive dashboard to help me display data relating to this area. During the course of this continuous assessment, I hope to have several visualisations created in Tableau illustrating all the mass shootings that have taken place in the United States of America between the years 1966 and 2016. I would like to gain a better understanding of these tragic events and hopefully uncover details and find any links or patterns which may exist between different tragedies such:

- If some certain types of guns are favoured and have been used multiple times to commit these horrible crimes.
- If one ethnic group has been targeted more than another.
- If one venue, i.e. school or workplace, has been the scene of these cruel events more than another.
- If the shooter had any relationship to the incident location.

By the conclusion of this report, I hope to have a dashboard which can demonstrate these possibilities, along with any other notable information I find through my analysis of the dataset.

Background

I spent multiple days trying to find the right dataset to base my project on. I had to change

my mind more than once about what area I wanted to investigate. Some datasets were locked behind paywalls. It took some time and a lot of consideration but eventually I decided on a dataset. I wanted to choose an area that I was familiar with and had a personal opinion on. On October 1st, 2017, the Route 91 Harvest music festival was being held on the Las Vegas strip in Nevada. During this festival, from a vantage point on the 32nd floor of an adjacent hotel, a gunman opened fire on the crowd killing 58 people and leaving 546 injured. It took on 10 minutes to cause such carnage. Mass shootings in America happen far too often. From outside of the United States of America looking in, it is mindboggling to think that stricter gun laws have not been set in place yet by the American government. The fact that there is a possibility for someone to lose their life while attending a music festival, or even for just attending college or school, is ludicrous. There is always heavy debate in America over this issue, however necessary action is never taken. I strongly disagree with the standpoint of many Americans in that it is more important to protect people's right to bear arms than it is to protect people's lives and ensure people aren't needlessly killed through gun violence. I hope, by the end of this project, that through collection, analysis and visualisation of the data set I have chosen, I will have several visualisations which will shed a light on the frequency and seriousness of mass shootings in America and why as a result, stricter laws around the purchase and distribution of guns need to be implemented to tackle the issue. Data analysis on mass shootings in America has been carried out before by well-respected sites such as Every Town Research and the Washington Post, however, I struggled to find many visualisations which have been made from the data.

Dataset

I took my time trying to find a dataset with enough detail to use for this project. Eventually, I came across one on the website Kaggle. The Stanford MSA (Mass Shootings in America) project is a database which contains a list of all mass shootings in America beginning in the year 1966. It is the most well-respected and detailed dataset in this area. Stanford updates this database on a yearly basis which means at this point in time, it only reaches the year 2016. Although the dataset which can be obtained from this research is not perfect, it contains all the important and necessary details including:

- Location the shootings took place in.
- Number of fatalities.
- Number of injuries.
- Date which the incidents took place.
- Average age of the shooter(s), which is helpful because of the fact that in some cases there was more than one person committing the unforgivable crime.
- The race of the shooter.
- The general type of gun used, i.e. handgun, rifle, multiple guns.
- A breakdown of the number of each type of gun that was used in the shooting
- If there was a history of mental illness for the shooter or not.

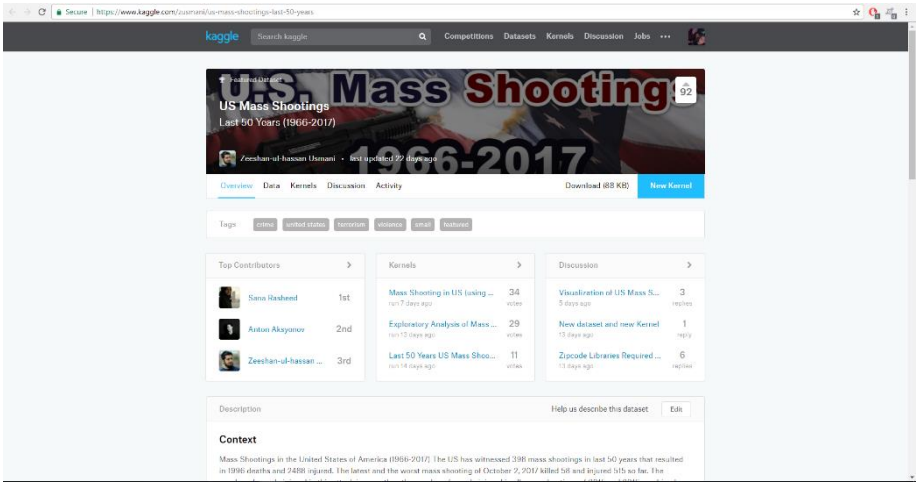
The dataset is extremely detailed. There are 48 columns and 308 rows of information in it. However, because it is so detailed, there is also a lot of data which I will not need for my visualisations. I will need to filter a lot of data until I am left with a dataset that only contains the relevant and necessary information

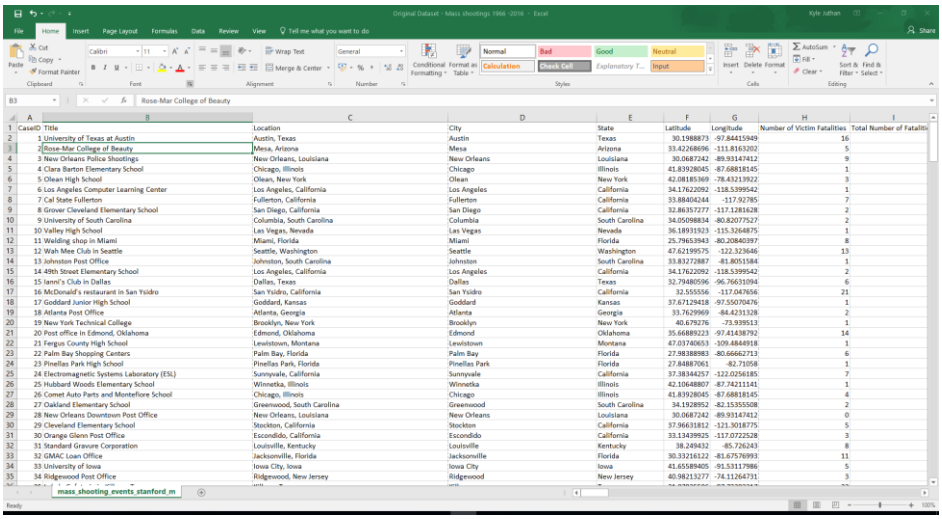
Seven Step Process

To help me complete my objective for this CA of several visualisations representing mass shootings in America, I used Ben Fry's Seven Step Process.

Step 1: Acquire

Firstly, I had to a find a suitable dataset. I searched across multiple sites until I found one with the information I needed. I downloaded the dataset which was titled 'US Mass Shootings – Last 50 Years (1966 – 2017)'.

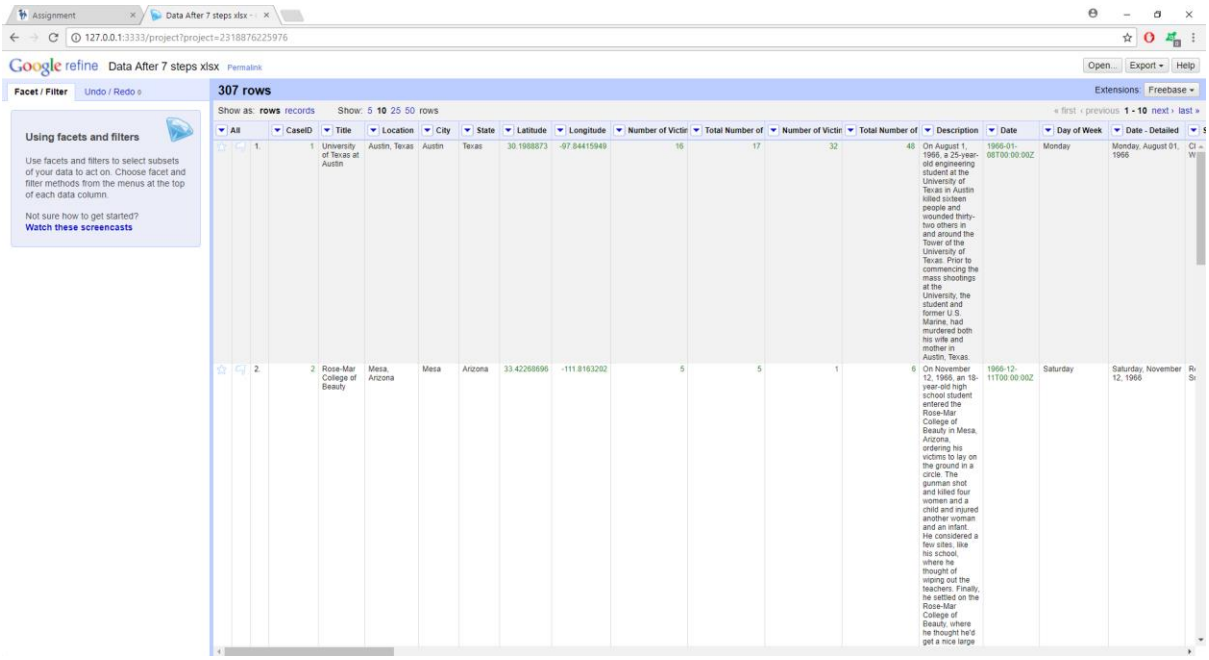




This dataset can be found at: Kaggle – Mass Shootings in America Dataset.

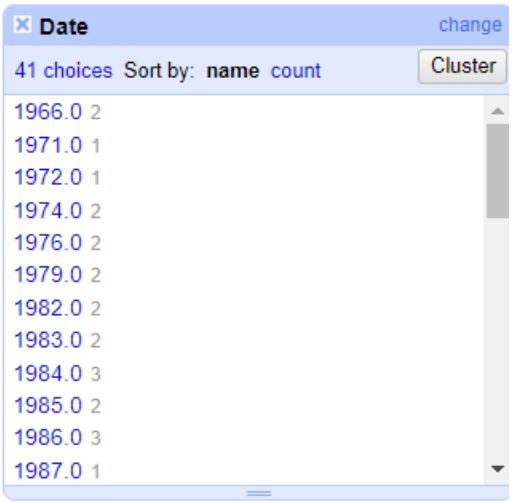
Step 2: Parse

In this step, I had to clean the data. I downloaded and used Google Refine throughout this step which was very helpful in parsing data.



One issue with this dataset was that there were entries which could have been simplified into one to make it easier to analyse the data. For example, under the race of the shooter column, there where entries such as ‘White’, ‘White American’ and ‘White European’. To simplify the data, I changed these entries to simply ‘White’ and carried out the same edits changing entries of ‘Black American’, ‘African American’, ‘Black European’ and ‘Black’ to simply just black, and so on in order to make it easier to visualise the data.

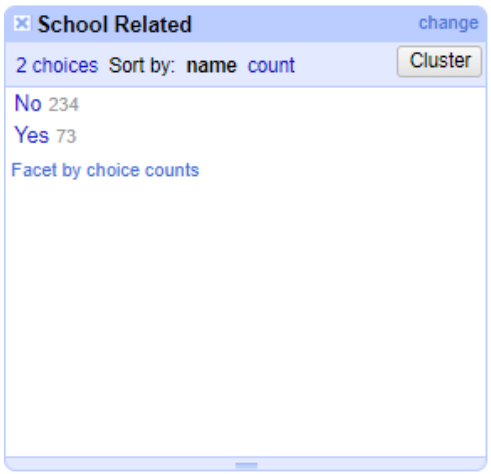
Dates of the shooting had different formats. Some were in the form of dd-mm-yyyy, while others were mm-dd-yyyy or even dd/mm/yyyy. In order to clean this column, I decided it would be best to only include the year in which the shooting took place as that is all that I require.



Next, I cleaned up the 'Type of Gun' column. Similar to the 'Shoorter Race' column, there were multiple entries which could have been grouped into one. Some were due to spelling mistakes, while others where the result of different wording.

I cleaned up both the 'School Related' and 'Place Type' columns also. I rectified unknowns in the school related column by using the description column to help me decide if an incident was related to schooling or not. I then cleaned up the place type column as there were far too many different entries. I group parks and public streets into one entry called 'Public

Location', grouped any entries which took place in a resendential area into one entry called 'Resedential Neighborhood, corrected spelling mistakes that were present and morphed restaurants and cafes into one entry called 'Restaurant'. In the end, the number of different choices for 'Place Type' was reduced to only fourteen.



The dataset from Stanford contains a 'Class' column. The entries in this class column were merely acronyms so at first I did not understand what this column was to represent. Thankfully, the Stanford dataset also contained a manual with the download. I discovered that this dataset also breaks shootings into different categories. I found that 'FMS' meant that it was a family murder-suicide killing, 'SPK' was a spree killing, 'GD' was gang or drug related killing and 'MS' represented the standard mass shooting. I used google refine to help clean these up by changing their names to allow for a better understadning of what each represents.

After this, I noticed that data such as Number of guns used were of type string and not a number. This was because some entries were 'Unknown'. For the sake of creating visualisations I changed any unknown entry in this column to a 0 and converted it to a number type. This will allow me to easily visual these figures when the time comes.

Once I finished cleaning the data, I began to order the columns by which columns I felt were most important to help me create visualisations. I also gave certain columns shorter names as I felt some, such as 'Number of Victim Fatalities' were unecessarily long so I changed it to 'Victim Fatalities'. I did this for several other columns also.

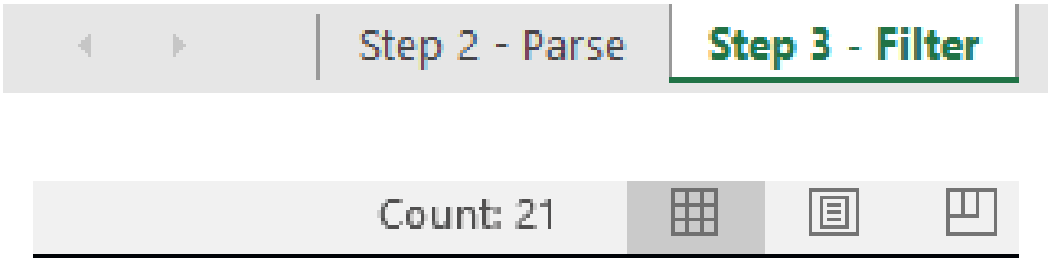
	A	B	C	D	E	F	G	H	
1	**State**	**City**	**Date**	**Class**	**Victim Fatalities**	**Victims Injured**	**Total Victims**	**Place Type**	**Typ**
2	Alabama	Geneva	2009	Spree Killing	10	6	16	Residential Neighborhood	Mul
3	Alabama	Huntsville	2010	Mass Shooting	3	3	6	College	Har
4	Alabama	Opelika	2011	Mass Shooting	1	3	4	College	Har
5	Alabama	Auburn	2012	Mass Shooting	3	3	6	Residential Neighborhood	Har
6	Alabama	Montgome	2013	Mass Shooting	3	5	8	Entertainment Venue	Har
7	Alabama	Birminghar	2012	Mass Shooting	5	0	5	Residential Neighborhood	Har
8	Alabama	Birminghar	2015	Mass Shooting	1	2	3	Public Location	Har
9	Alabama	Cottonwoo	2015	Mass Shooting	2	1	3	Residential Neighborhood	Rifl
10	Alabama	Wetumpka	2016	Mass Shooting	2	2	4	Public Location	Har
11	Alabama	Greenhill	2016	Family Murder Suicide	1	2	3	Residential Neighborhood	Unk
12	Alabama	Brooksville	2016	Mass Shooting	0	4	4	Public Location	Mul
13	Alaska	Bethel	1997	Mass Shooting	2	2	4	Secondary School	Sho
14	Arizona	Mesa	1966	Mass Shooting	5	1	6	College	Har
15	Arizona	Tucson	2002	Mass Shooting	3	0	3	College	Har
16	Arizona	Phoenix	2008	Mass Shooting	0	3	3	College	Har
17	Arizona	Tucson	2011	Mass Shooting	6	13	19	Shop/Shopping Centre	Har
18	Arizona	Phoenix	2013	Mass Shooting	2	1	3	Workplace	Mul
19	Arizona	Phoenix	1991	Mass Shooting	9	0	9	Place of worship	Mul
20	Arizona	Mesa	2015	Gang/Drug Related	1	5	6	Residential Neighborhood	Unk

Step 3: Filter

After the parsing is complete, it is time to filter the data. Here, I had to try and figure out which data is relevant to help create the visualisations I need, and which data excess and therefore not required. Before the filtering, there were 48 columns in this dataset. It was a challenging task trying to decide which data to keep and which to dispose of. After some deliberation, I managed to reduce my columns to only 21. I copied these columns into a new sheet in the same file and called this sheet 'Step 2- Filter'. I felt that these 21 columns would

be what I needed to help me create multiple visualisations, representing different aspects of these shootings. Some of the columns I decided were not needed included:

- Sources containing links to news articles about each shooting.
- Fate of shooter.
- Case ID.
- Description of events.
- Name of shooter.
- Possible motives.



I was now ready to move on to the data mining step.

Step 4: Mine

This stage is all to do with statistics. I used data mining to discover that the average age of all shooters is roughly 32. I also calculated that in total, between 1966 – 2016, the total number of fatalities was 1103, the total number injured was 1292 leading to the total number of victims for these tragic incidents being 2395. The maximum and minimum latitude were 60.79053882 and 21.309106 respectively. The maximum longitude was -69.70782299, with the minimum longitude being -161.7927517. I also used data mining to uncover the figures regarding the known number of different types of guns used to commit

all mass shootings. These Included:

- The known number of shotguns used was 48.
- The known number of rifles used was 86.
- The known number of handguns used was 274.
- The known number automatic guns used was 6.
- The known number of semi-automatic guns uses was 210.

This lead to a total number of 624 known guns being used to commit these crimes. It is important to note that these figures are only the known number of weapons used, as reported by the authorities across America. In some cases, the police were not able to identify which weapons were used.

Step 5: Represent

This step needed to be carried out using Tableau. I needed to decide what type of visualisations to use. Based on the type of data I want to visualise, I thought visualisation types that would suit best would be map visualisations, tables, bar charts and graphs.

Step 6: Refine

The first visualisation I wanted to create was a map which illustrated the number of shootings in each state. To make the visual clear, I added a heading of 'Total Number of Shootings in each State'. Next, I added labels of font size 8 and set it to bold in order to illustrate each state on the map. However, when I did this I felt that the map looked too clustered with the names of states. To make it look tidier and more appeasing, I set the labels to only appear when a state was selected to avoid the overcrowded appearance. After this, I used a red colour scheme to help indicate states with the lowest to highest total

number of shootings between 1966 and 2016. The darker the shade of red a state is, the more number of shootings that have taken place within it. I also added headings and labels where necessary to all other visualisations that I created which included:

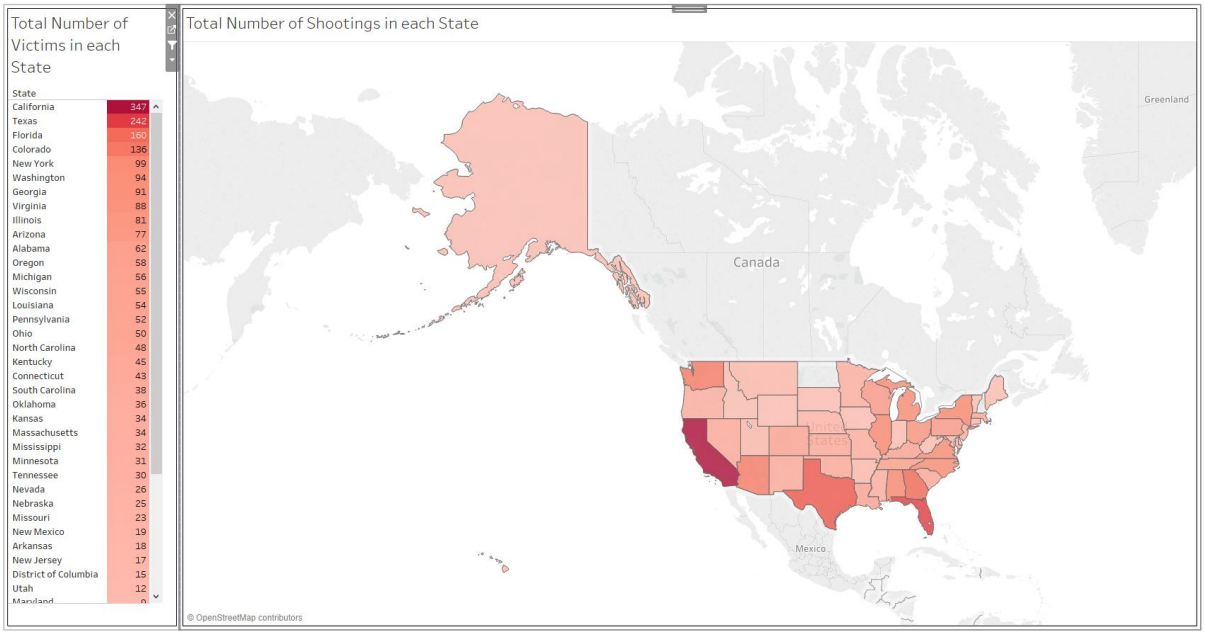
- A highlight table to illustrate the number of victims in each state.
- A line graph to show the trend in the number of shootings which occurred each year from 1966 to 2016.
- A purple colour schemed map which used a date filter to show the number of shootings that took place in different states each year.
- A second highlight table to show the number of victims for each year between 1966 and 2016.
- A map visualisation to help demonstrate what states had the highest number of a certain type of shooting, i.e. mass shooting, spree killing, gang or drug related shooting or family murder-suicide.
- A stacked bar chart indicating in how many cases it was confirmed whether the shooter had a history of mental illness for each type of shooting.
- A bar chart based on a custom calculation which splits known shooters into 2 different groups: Under 21 and Over 21. This bar chart specifies the type of location which a shooting occurred.
- A treemap visual which weighs the shooter ages against the number of shootings that have taken place.
- A bar chart showing how many shooters were over 21 and how many were under 21.
- A highlight table pitting the shooter age against the total number of victims for each age.

- A highlight table indicating the number of victims of each age group that I created in Tableau, i.e. over or under 21.

Step 7: Interact

In this step, I used my visualisations to create interactive dashboards. In total, based on the mass shooting data, I created 13 visualisations. I then used these visualisations to create a total of 4 dashboards.

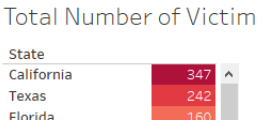
Dashboard 1 - Total Victims from Shootings in each State Dashboard



This dashboard illustrates the number of victims from each state, along with how many shootings took place in each state between 1966 and 2016. I used a red colour scheme throughout to keep a consistent theme throughout and emphasise that the visualisations that make up this dash board are linked. In this dashboard, I used 2 visualisations. The first was an interactive map visual. I used a colour scheme to demonstrate the severity of the number of shootings in each state. I added used the state dimension to help label the map. However, I noticed that it looked too overcrowded when all the names were showing at

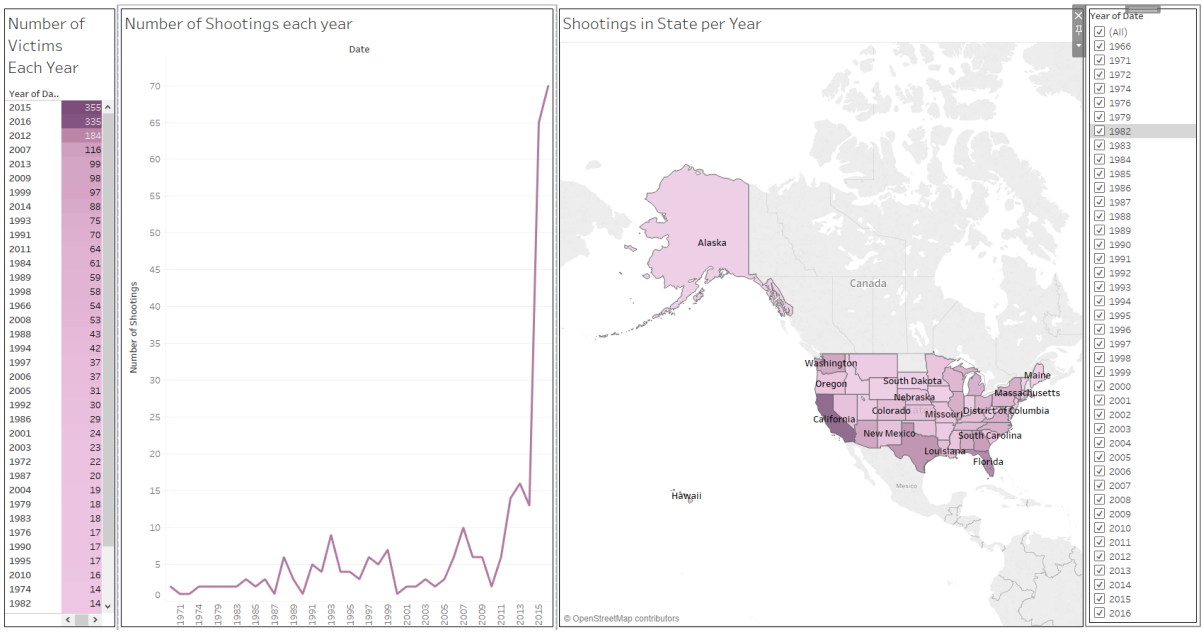
once so I changed the setting to display the label only when a state was selected. The state name will still appear in the popup when you hover over a state, however the label will only be present on a state when it is clicked.

The second visualisation which helped create this dashboard was a highlighted table which gave information about the total number of victims in each state between 1966 and 2016. Similar to the map, the darker the shade of red, the higher the victim count.



I used the map visualisation as a filter in this dashboard. This means by clicking on a state on the map, it will filter the table and only display the victim count for that particular state.

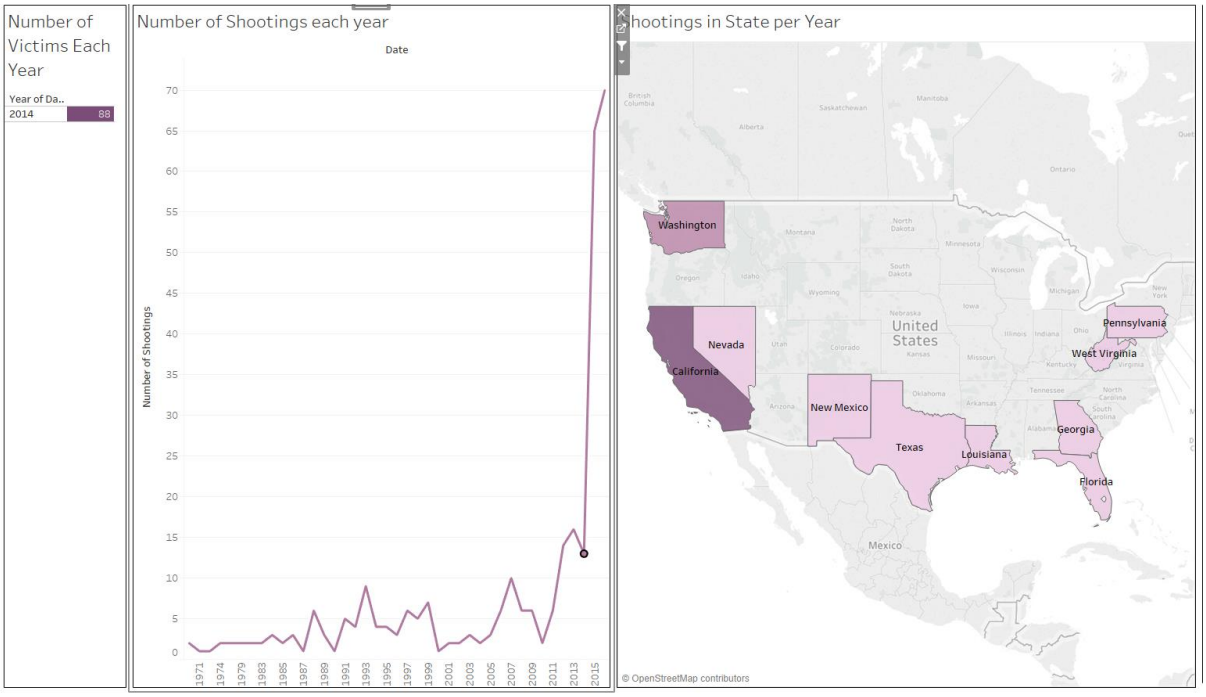
Dashboard 2: Victims from each State for every Year Dashboard



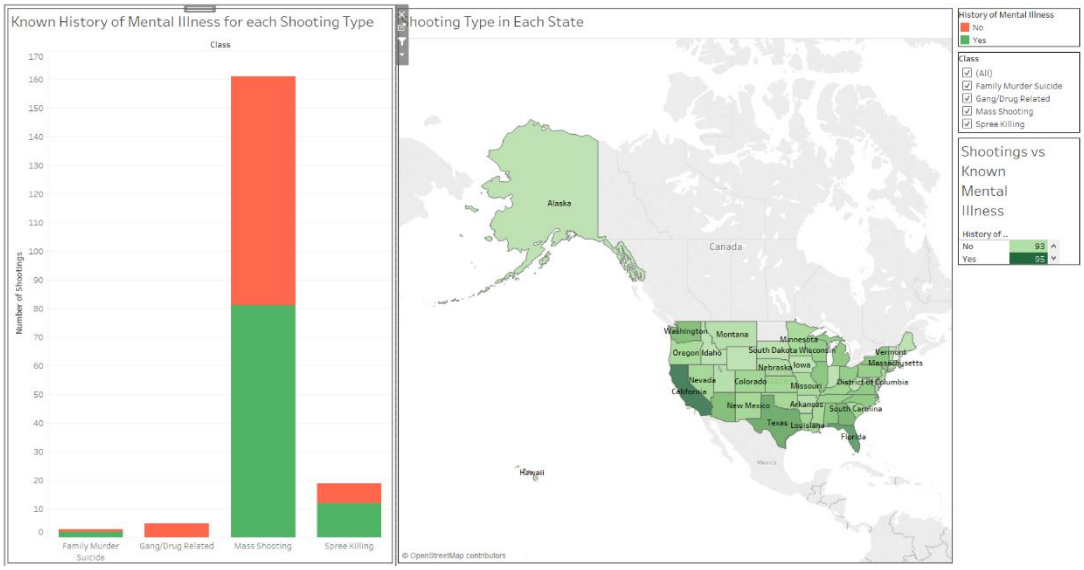
This dashboard is comprised of 3 virtualisations and helps to demonstrate the number of victims of shootings for every year from 1966 to 2016. First, I created a line graph visualisation to indicate the trend regarding mass shootings as years progress. Then I created another map visualisation. However, this time I used the date as a filter, allowing a user to check which year or years they would like to see the number of shootings per state for. The last visualisation used to create this dashboard was a highlighted table which provided information on how many victims of shootings there was in each year from 1966 to 2016.

For this dashboard, I used the line graph visualisation regarding the number of shootings every year as a filter. By clicking a year on this graph, the number of victims each year table and the map would update to illustrated both, the number of victims for that year, and also in what states mass shootings occurred in that year. I decided to leave the date filter tab for the map visualisation in to allow the user to select multiple years to examine as using the

line graph as a filter only shows information for whichever 1 year is selected. Due to the fact that in this dashboard the map is not a filter, I decided to leave the labels on permanently so that they would show when a year was selected on the line graph.

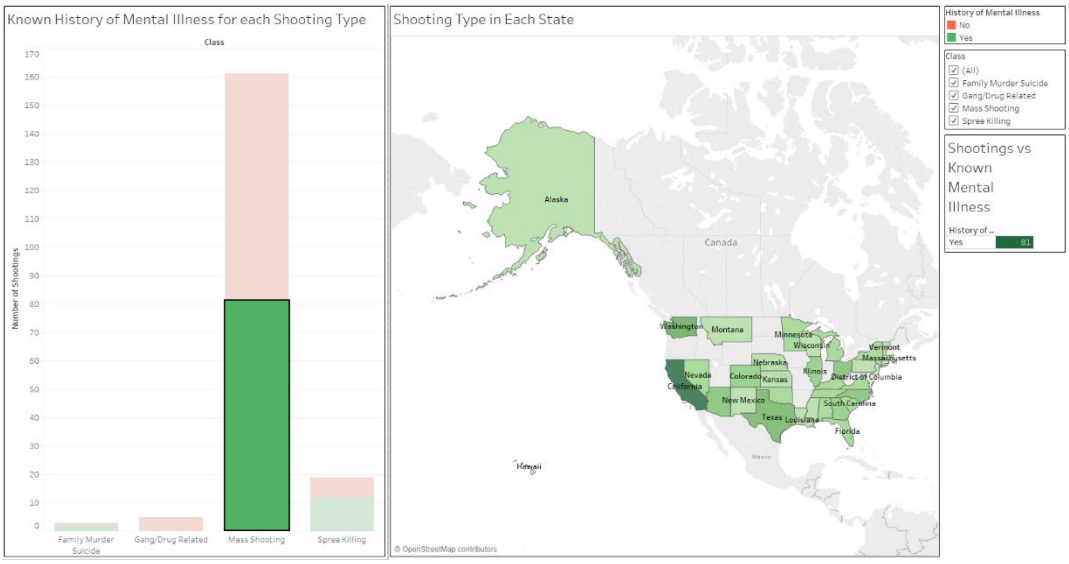


Dashboard 3: Mental Illness and Shooting Type Dashboard

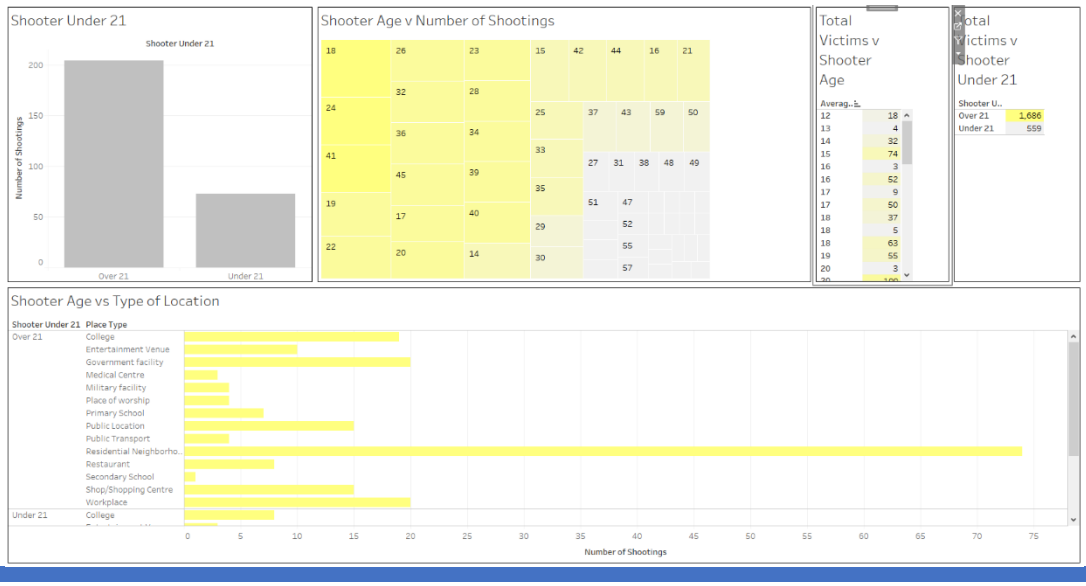


This interactive dashboard helps illustrate whether a shooter had a mental illness along with what type of shooting it was. I used three visualisations to design this dashboard. The first

visualisation I created was a stacked barchart which displayed, for known cases only, if the shooter had a mental illness or not and what type of shooting took place. The second was a map visual with a filter regarding the shooting 'class' as the column is named in the data. Lastly I created a highlighted table to illustrate the total number of shootings which have been confirmed as mental illness either present or not present. I used the stacked bar chart as the filter in this dashboard. This allows the user to navigate to a type of shooting, e.g. mass shooting, and click whether they want to view instances where it was known that the shooter had a mental illness or not.



Dashboard 4: Known Shooter Age Dashboard



This dashboard is the largest and most complex dashboard that I created as it contained 5 visualisations. I started by creating a custom calculation called ‘Shooter Under 21’ which separated shooters into two different age groups: Under 21 and Over 21.

I then used this new measure to help create a bar chart visualisation showing the number of shootings which were carried out by shooters under and over 21 years of age. This visualisation was going to be the filter for the dashboard. I then created a treemap showing shooter age versus the number of shootings to help show at what age shooters carried out the most shootings. The darker the shade of yellow, and the bigger the box on this treemap, the higher number of shootings that were carried out by shooters of that particular age. Once the treemap was created, I created a horizontal bar chart using my custom ‘Shooter Under 21’ value , place type, and number of shootings data which showed what were the most poupular places that shootings were carried out for each age group. Next, I created a highlighted table visualisation which showed the number of victims for each age of a shooter. Lastly, I wanted to have a small highlighted table to illustrate the total number of victims for each age group. The under of over 21 years og age bar chart was the filter for this dashboard so by clicking on either group, all other visualisations would update accordingly

in order to represent the data for that age group.

Problems and Solutions

While I reached my goal of creating visualisations and dashboards in the end, there were several challenges and problems which I encountered along the way.

Before I began making visualisations, I had planned out several which I wanted to accomplish. One of these revolved around the data relating to the number of each type of gun that was used for these shootings and also the total number of guns used. However, when I attempted to create some visualisations with that data I noticed an issue. Due to the fact that authorities cannot often find or document every type of weapon that was used in a mass shooting, there was a lot of ‘Unknowns’ among these data columns. For the sake of creating the virtualisations, I changed any entry of ‘Unknown’ to 0. However, when I created virtualisations pitting the types of guns against the number of shootings, there were too many 0s in the data. I felt that a virtualisation using this data would not be even close to

accurate and I did not want to use and draw conclusions from data that I felt was inaccurate and did not provide an honest representation of events that occured. Therefore I decided to remove these virtualisations and avoid any data relating to them which I deemed inaccurate.

One other problem I encountered was when I first booted up Tableau and imported the data was to do with the map locations. Tableau could not find any of the locations specified in my data. To solve this issue I had to navigate to the edit locations settings of the map and change the country from Ireland to United States, and change county to state. Once I completed these actions Tableau recognised the locations in my data and I wa able to create my map visualisations.

Another issue I had to tackle was during the creating of the known history of mental illness versus shooting classes or types virtualisation. Originally I had a regular bar chart to illustrate this data. However, I felt that chart did not look too appeasing with 2 sets of bars for each answer to the question of did the shooter have a mental illness. Therefore, I made the decision in the end to change it to a stacked bar chart. I felt this was the best choice as it kept the virtualisation clean and compact and worked well due to the fact there were only 2 possibilities, yes or no, to the mental illness question.

Conclusion

There are several conclusions and important points that can be drawn from the 4 dashboards I have created.

Firstly, if we examine dashboard 1 which is about the total number of victims from each state, and how many shootings occurred to reach this tally of victims. What is surprising about the information this dashboard provides is the stark contrast between California, the state with the highest number of mass shootings and the highest victim count, and Alaska, who are tied lowest in number of mass shootings with 1 and have a victim count of 4. What surprised me about this data is in relation to the gun laws of each state. The gun laws in California are currently some of the most restrictive in the United States. These gun laws strongly regulate the possession, sale and use of both ammunition and fire arms. To purchase a gun in California you need a state permit, firearm registration, a carry permit and to pass several background checks. Open carry of fire arms is only permitted in areas where a firearm discharge is not prohibited by local decree. However, despite all these restrictions and checks, by the close of 2016, California still had the highest number of mass shooting victims with the highest number of mass shootings also occurring in this state. It has experienced 34 mass shootings which has produced 347 victims between 1966 and 2016.

Since 1966 however, Alaska has only experienced 1 mass shooting with only 4 victims being affected even though Alaskan gun laws are very lenient. There are very few regulations in place in Alaska for the sale, possession and use of firearms and ammunition. Unlike California, no state permit, firearm registration or owner license is required. Open carry is also allowed without restrictions and even without the possession of a permit or license.

Even with all the permission laws around guns in Alaska, it has experienced 33 less mass shootings and has a victim count of 346 less than California. I found this a very interesting statistic and comparison and I feel as if I wouldn't have noticed through the raw data with no visualisation.

The second dashboard I created which illustrates the trend of mass shootings occurring between 1966 and 2016 and the number of victims each year, is very important. By using this dashboard, we can see how serious and frequent mass shootings have been occurring in the past couple of years. Up until 2014, the highest number of mass shootings to occur in a single year since 1966 was 16 in 2013. This number dropped to 13 in 2014. 16 and 13 are still unnecessarily and extremely high numbers regarding the occurrence of mass shootings. However, from 2014 to 2015, there is an enormous increase in mass shootings. The number rises from 13 in 2014, to 65 in 2015. 355 people fell victim to a mass shooting in 2015. As of the close of 2016, this was the highest number of victims in any year. Although the number of victims did drop in 2016, the number of mass shootings increased. The number of mass shootings rose from 65 to 70 in 2016 leaving 335 victims in their wake. This shows that things are only going to continue to get worse in America regarding mass shootings. Both the number of victims and the number of mass shootings will continue to rise based on these visualisations and data. As Stanford only update their database at the end of each year, there are no figures for 2017 yet. However, I believe that by what we have already seen this year, it is already clear that things have gotten worse in 2017 and will presumably continue to do so in 2018. I feel that this dashboard provides a great insight into why America needs to review its gun laws and enforce more restrictions regarding the sale and possession of guns, and do so promptly.

The third dashboard I created revolved around an area I was very interested in examining. Often, whenever I hear of a horrific mass shooting occurring in America, I turn on one of the American news channels. One of the first topics always raised by the news anchors on screen is whether or not the shooter had any history of mental illness. I wanted to uncover whether mental illness was a prevalent factor in shootings between 1966 and 2016. I decided to test it against each type, or class, of mass shooting which are family murder-suicide, gang or drug related, standard mass shooting, and a spree killing. Out of 307 mass shootings that occurred between 1966 and 2016, only 188 have a definitive answer as to whether the shooter had a mental illness or not so I based my visualisations for this dashboard solely on these 188 cases. The most common type of shooting is a standard mass shooting which accounts for 161 of these 188 cases. This is the largest bar in the chart. By examining it we can see that out of the 161 cases, 81 shooters had a mental illness and 80 did not. Only 1 more case involved a shooter with a mental illness that those which didn't. I feel that this is important as it is nearly a 50:50 split which shows that it is not only people with mental illnesses that carry out these heinous acts. Even if the other types of shootings are examined the split is relatively close. Out of 19 spree killings, 12 shooters had a mental illness while 7 did not. Regarding gang or drug related shootings, 0 shooters out of 5 had a mental illness. Finally, in the case of a family murder-suicide, 2 shooters had a mental illness while 1 did not. These stats, I believe, support the view that the mental condition of the shooter should not always be the prime focus when a shooting occurs, but that sometimes all of the attention should be directed towards lenient gun laws.

While all 3 previous dashboards are important and provide interesting results and conclusions, I believe that the forth dashboard I created is the most important out of them

all. For this dashboard, I created a custom calculated field to help me split the shooters into two different age groups. I wanted to have shooters who are over the age of 21 and shooters who are 21 and younger in different groups. In America, to legally purchase and drink alcohol, you must be at least 21 years of age. However, in over 30 states in America, it is possible for a child, in some circumstances as you as 12, to legally purchase and possess a firearm.

In 277 of the 307 mass shootings between 1966 and 2016, the ages of shooters were confirmed. In 73 of these case, the shooter was under the age of 21. 559 victims were killed or injured by someone who is still not legally allowed to drink alcohol, but can legally possess a firearm. The data helps illustrated the fact that 2 mass shootings have been carried out by children that are only 12 years of age. These 2 shootings left 18 victims. The second highest age under 21 regarding the number of victims that were injured or killed is 15 years of age with 74 victims. If we look at the shooter age vs type of location bar chart, we can see that educational institutes are the location of these shootings the most. 21 primary schools, 21 secondary schools and 8 colleges have all been the scene of a mass shooting at the hands of someone under the age of 21. The results of this dashboard shocks me the most. While this dashboard does show that 240 shootings which injured or killed 1686 victims were carried out by people over 21, the fact still remains that in a country as advanced as America it is illegal to buy or drink alcohol until you are 21, but in the majority of states it is perfectly fine for a child as young as 12 to legally purchase and carry a gun. I believe that all the information my four dashboards provide indicate reasons why gun law reform is essential in America to stop pointless killings. People should be able to go to a cinema or to school or a nightclub and not have a fear of becoming just another statistic

in another mass shooting.

I believe, that if more data was available such as a gun to person ratio for each state, or if I was to update my dashboards and virtualisations when Stanford update their database with the 2017 mass shooting figures, I will be able to further drive home the point of a need for stricter laws around firearms in America. My research and findings from this continuous assessment have solidified my belief even further that America needs to change, and soon.

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