Data Bootcamp Final Project: State Gun Regulations and Violent Crimes

Author: Daniel Herrera

Email: dh2412@nyu.edu (dh2412@nyu.edu)

The current national climate on guns and gun regulations has inspired me to look into the real effects of guns on safety. In this project I will show how lax gun regulations have a negative impact on personal safety. To do this I will specifically look at homicide and rape in states with poor gun control regulations versus states with more effective gun control regulations.

This project will be organized in several steps:

1. Desription of the data
2. Discussion of the packages I use to perform the analysis
3. A map that shows the efficiency of gun regualtions accross states
4. Organization and presentation of the Data

Data Report

There are two key sources of data for this project. The key data component to this project is the ratings of states' gun control regulation done by the Giffords Law Center to Prevent Gun Violence (http://lawcenter.giffords.org). The Giffords Center provided the data under the condition that it not be published. For this reason and for the purpose of this report the data will be read in locally from my computer.

This project will also take data from the FBI Crime Data API (https://crime-data-explorer.fr.cloud.gov/api) where as many as 18,000 law enforcement agencies in the US cooperate to provide these data and promote transparency in the judicial system(FBI Crime Data Explorer (https://crime-data-explorer.fr.cloud.gov)).

Packages

I will use the following packages to help me import and analyze my data:

- `pandas` is the key tool to import and manipulate the data
- `requests` and `json` are needed to import data from the FBI's API
- `matplotlib` enables me to plot charts and graphs
- `os` needed to import the map shapefile
- `fiona` is required
- `geopandas` creates a dataframe with shapes to make maps
- `shapely` creates and displays the shapes

In [1]:
```
import pandas as pd
import requests
import json
import matplotlib.pyplot as plt

import os
import fiona
import geopandas as gpd
from shapely.geometry import Point, Polygon
```

Importing and Organizing the Data

Below I import both daatasets; the FBI API from the web, and the Giffords Center data I will read in from my computer due to the restrictions placed on the data. Here is a brief description of the data importing process:

- The FBI data has to be imported state by state, so I created a list of all the states using their 2 digit codes so that I may automate this process with a for loop. I also had to create an empty dataframe so that I could later append each state as it was being imported by the loop. Finally, I created a data frame with only the year and columns I was interested in called `crime2016`. To this dataframe I added two columns (`rapebypop` and `homicidebypop`). These are instances of each crime for every 100,000 people in the state. This is the dataframe I will use for my analysis.
- The Giffords Center data is read in from an excel file on my computer titled "yr2016". I only imported the columns and rows that were relevant to my analysis. Then I renamed a few of the columns and set the `Rank` column as the index for the dataframe.

In [2]:
```
state_list = ["AL","AK","AZ","AR","CA","CO","CT","DE","FL","GA","HI","
ID","IL","IN","IA","KS","KY","LA","ME","MD",
              "MA","MI","MN","MS","MO","MT","NE","NV","NH","NJ","NM","
NY","NC","ND","OH","OK","OR","PA","RI","SC",
              "SD","TN","TX","UT","VT","VA","WA","WV","WI","WY"]
```

In [3]:
```
df = pd.DataFrame(columns=['aggravated_assault', 'burglary', 'caveats'
, 'homicide', 'larceny',
       'motor_vehicle_theft', 'population', 'property_crime', 'rape_le
gacy',
       'rape_revised', 'robbery', 'state_abbr', 'violent_crime', 'year
'])


df.shape # empty dataframe
```

Out[3]:
```
(0, 14)
```

In [4]:
```
# If for some reason this doesn't work, you may need to
# go to the FBI API and get a new key
url1 = "https://api.usa.gov/crime/fbi/ucr/estimates/states/"
url2 = "?page=1&per_page=100&output=json&api_key="
key = "W4oJrpnslHJg0zJPFg8l1JK5udAqayXELjFyi2x0"

for state in state_list:
    url = url1 + state + url2 + key                # assembles the url
    response = requests.get(url)                   # calls the url
    crime = json.loads(response.content)           # loads the data in
to a dictionary
    df = df.append(pd.DataFrame(crime["results"])) # appends all the d
ata into the empty df
df.shape
```

Out[4]:
```
(1100, 14)
```

In [5]:
```
# Pulling out year 2016 and dropping unnecessary columns
crime2016 = df.loc[21].drop(columns=['aggravated_assault', 'burglary',
'caveats', 'larceny','motor_vehicle_theft',
               'property_crime', 'rape_legacy', 'robbery', 'violent_cri
me', 'year'])

# Adding the rape/homicide per 100,000 population columns
crime2016['rapebypop'] = (crime2016.rape_revised / crime2016.populatio
n)*100000
crime2016['homicidebypop'] = (crime2016.homicide / crime2016.populatio
n)*100000
crime2016.head()
```

Out[5]:

	homicide	population	rape_revised	state_abbr	rapebypop	homicidebypop
21	407	4863300	1385.0	AL	28.4786	8.3688
21	52	741894	757.0	AK	102.036	7.00909
21	380	6931071	2452.0	AZ	35.3769	5.48256
21	216	2988248	1545.0	AR	51.7025	7.22832
21	1930	39250017	10149.0	CA	25.8573	4.9172

In [6]:
```
# Reading in and organizing Giffords center data
yr2016 = pd.read_excel("2016_Chart.xlsx", skip_footer = 2, usecols = "
A:B,AW")
yr2016 = yr2016.rename(columns={"Unnamed: 1":"NAME","Raw Score 2016":"
Score"}).set_index("Rank")
yr2016.head()
```

Out[6]:

	NAME	Score
Rank		
1	California	100.5
2	Connecticut	77.5
3	New Jersey	76.0
4	Massachusetts	71.5
5	Maryland	71.0

Creating a Map: Showing which states have the strongest gun regulations

To create the map, I first read in a shapefile from my computer. Then I drop the territories and states not part of the continental United States. This is to make the map look nicer. Next, I merge the information about gun regulations scores which will help me color the map. Finally I create the map and add a legend.

In [7]:
```
cwd = os.getcwd()                                                    # Getting m
y cwd
states_shape = cwd + "/shape_file/cb_2017_us_state_5m.shx" # Creating
the path to the shapefile
us_map = gpd.read_file(states_shape)                                 # Creating
the geopandas dataframe
us_map.head()
```

Out[7]:

	STATEFP	STATENS	AFFGEOID	GEOID	STUSPS	NAME	LSAD	ALANI
0	01	01779775	0400000US01	01	AL	Alabama	00	131174431216
1	02	01785533	0400000US02	02	AK	Alaska	00	147858823156
2	04	01779777	0400000US04	04	AZ	Arizona	00	294198661567
3	08	01779779	0400000US08	08	CO	Colorado	00	268425964573
4	12	00294478	0400000US12	12	FL	Florida	00	138911437206

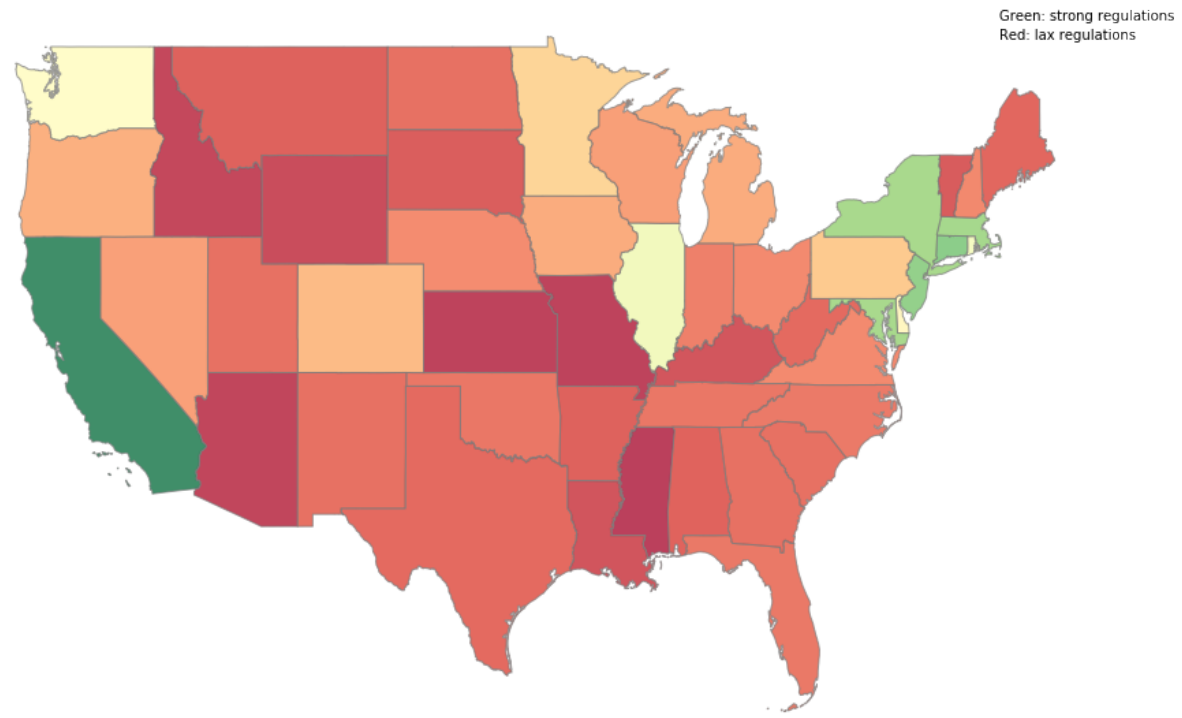
In [8]:
```
# Dropping the states and territories that are out of the continental
US
us_map = us_map.set_index("STUSPS").drop(["AK","HI","VI","PR","MP","AS
","GU"])
```

In [9]:
```
# Merging with the gun regulation data
final_us_map = pd.merge(us_map, yr2016,on='NAME',how='right',indicator
=True)
final_us_map.head()
```

Out[9]:

	STATEFP	STATENS	AFFGEOID	GEOID	NAME	LSAD	ALAND	AWA
0	01	01779775	0400000US01	01	Alabama	00	1.311744e+11	4.592945
1	04	01779777	0400000US04	04	Arizona	00	2.941987e+11	1.027245
2	08	01779779	0400000US08	08	Colorado	00	2.684260e+11	1.178496
3	12	00294478	0400000US12	12	Florida	00	1.389114e+11	3.139880
4	13	01705317	0400000US13	13	Georgia	00	1.491775e+11	4.733386

In [10]:
```
fig, ax = plt.subplots(figsize = (15,10))

# Creates the map and colors it according to regulation strength
final_us_map.plot(ax = ax, edgecolor='tab:grey',
             column='Score',
             cmap='RdYlGn',
             alpha = 0.75)

# Gets rid of the axes and spines
ax.spines["right"].set_visible(False)
ax.spines["top"].set_visible(False)
ax.spines["left"].set_visible(False)
ax.spines["bottom"].set_visible(False)
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)

# Adds a legend
message1 = "Green: strong regulations"
message2 = "Red: lax regulations"
ax.text(-70,50,message1 )
ax.text(-70,49.3,message2)

# Chart Title
fig.suptitle("Gun Safety Score by State",
             fontsize = 16, fontweight = "bold")
plt.show()
```



Visualizing the Relationship Between Gun Regulation and Crime

In this section I will create two graphs to show the relationship between gun regulations and crime.

- The first graph will show how some of the deadliest states have the more lax gun regulations while states with stronger gun regulations have lower homicide rates.
- The second graph will show that states with higher gun safety scores experience less cases of rape than those with lower gun safety scores.

The procedure for making these graphs is similar. I will create lists to pull out of each dataframe (FBI and Giffords Center) the appropriate states for each graph and creae a new dataframe by merging the slices of each of the original dataframes. Then I will create two bar graphs that share a y-axis to show the relationship.

In [11]:
```
# Creating lists with the States I will use and their codes
homicide_statecodes = ["RI", "HI", "MN", "MA", "CT","NV", "MS", "AL",
"MO", "LA"]
states = ["Rhode Island","Hawaii","Minnesota","Massachusetts","Connect
icut","Nevada",
          "Mississippi","Alabama","Missouri","Louisiana"]
state_abbr = {"Rhode Island":"RI", "Hawaii":"HI" , "Minnesota":"MN", "
Massachusetts":"MA",
                       "Connecticut":"CT","Nevada":"NV", "Mississippi":
"MS", "Alabama":"AL",
                       "Missouri":"MO", "Louisiana":"LA"}
```

In [12]:
```
# Pulling out the states I want from the FBI dataframe
hom_cases = crime2016[crime2016.state_abbr.isin(homicide_statecodes)]
# Pulling out the same states from the Giffords dataframe
hom_gunreg = yr2016[yr2016.NAME.isin(states)]
# Adding the state codes to the Giffords dataframe
hom_gunreg["state_abbr"] = hom_gunreg['NAME'].map(state_abbr)
```

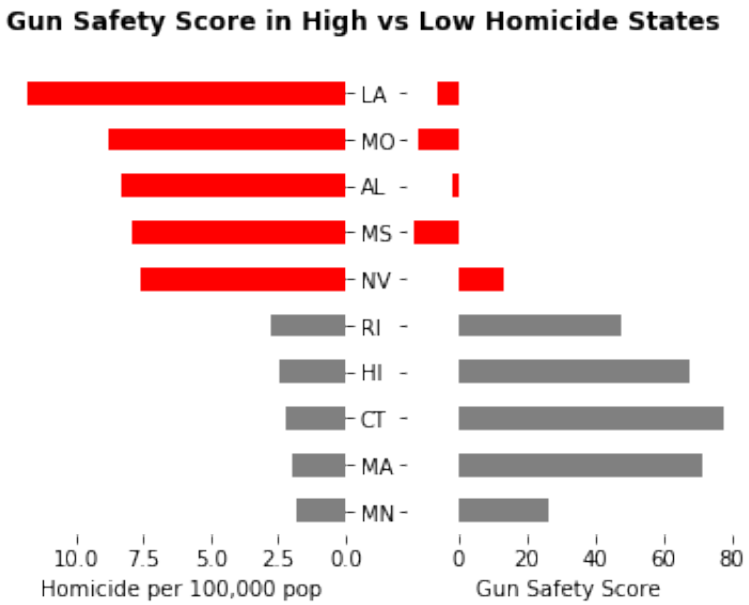
```
/Users/danielherrera/anaconda3/lib/python3.6/site-packages/ipykernel
_launcher.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
```

In [13]:
```
# Merging and Sorting the two dataframes
hom2016 = pd.merge(hom_cases, hom_gunreg, on='state_abbr',how='right',
indicator=True)
hom2016.sort_values("homicidebypop", ascending = True, inplace = True)
hom2016.head()
```

Out[13]:

	homicide	population	rape_revised	state_abbr	rapebypop	homicidebypop	
5	101	5519952	1731.0	MN	31.359	1.82973	Minnes
4	134	6811779	1592.0	MA	23.3713	1.96718	Massac
1	78	3576452	561.0	CT	15.6859	2.18093	Connec
2	35	1428557	447.0	HI	31.2903	2.45002	Hawaii
9	29	1056426	328.0	RI	31.0481	2.7451	Rhode

In [14]:
```
fig, axes = plt.subplots(ncols=2, sharey=True)

y = hom2016.state_abbr                              # Setting the y-axis

colors = ['gray','gray','gray','gray',              # Setting the colors
          'gray','r','r','r','r','r']

hom2016.homicidebypop.plot (kind="barh",            # Creating the left ba
r chart
                            ax=axes[0],
                            color=colors)

hom2016.Score.plot (kind="barh",ax=axes[1],         # Creating the right b
ar chart
                    color=colors)

axes[0].set_xlabel('Homicide per 100,000 pop')   #Setting the X-Lables
axes[1].set_xlabel('Gun Safety Score')

axes[0].invert_xaxis()                              # Organizing the left
bar chart
axes[0].set(yticklabels = hom2016.state_abbr)
axes[0].yaxis.tick_right()

for ax in axes.flat:                                # Setting the margins/
removing spines
    ax.margins(0.03)
    ax.spines["right"].set_visible(False)
    ax.spines["top"].set_visible(False)
    ax.spines["left"].set_visible(False)
    ax.spines["bottom"].set_visible(False)

                                                    # Chart Title
fig.suptitle("Gun Safety Score in High vs Low Homicide States",
             fontsize = 12, fontweight = "bold")

fig.subplots_adjust(wspace=0.18)                    # Setting the spacing
plt.show()
```



In [15]:
```
best_worst_gunreg = ["California", "Connecticut", "New Jersey","Massac
husetts","Maryland", "New York",
                "Idaho", "Arizona", "Kansas","Missouri", "Mississippi"]
state_abbr = {"California":"CA", "Connecticut":"CT", "New Jersey":"NJ"
, "Massachusetts":"MA", "Maryland":"MD",
                "New York":"NY","Idaho":"ID", "Arizona":"AZ", "Kansas":"
KS","Missouri":"MO", "Mississippi":"MS"}
rape_statecodes = ["CA", "CT", "NJ", "MA", "MD","NY","ID", "AZ", "KS",
"MO","MS"]
```

In [16]:
```
# Adding the state codes to the Giffords dataframe
rape_gunreg = yr2016[yr2016.NAME.isin(best_worst_gunreg)]
# Pulling out the same states from the Giffords dataframe
rape_gunreg["state_abbr"] = rape_gunreg['NAME'].map(state_abbr)
# Pulling out the states I want from the FBI dataframe
rape_cases = crime2016.loc[crime2016.state_abbr.isin(rape_statecodes)]
```

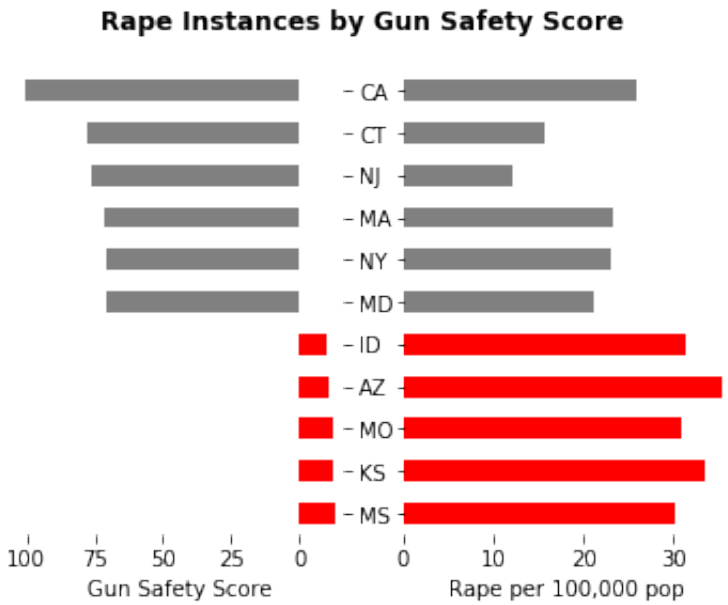
```
/Users/danielherrera/anaconda3/lib/python3.6/site-packages/ipykernel
_launcher.py:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  after removing the cwd from sys.path.
```

In [17]:
```
# Merging and Sorting the two dataframes
rape2016 = pd.merge(rape_gunreg, rape_cases, on='state_abbr',how='righ
t',indicator=True)
rape2016.sort_values("Score", ascending = True, inplace = True)
rape2016.head()
```

Out[17]:

	NAME	Score	state_abbr	homicide	population	rape_revised	rapebypop	hon
10	Mississippi	-13.0	MS	238	2988726	905.0	30.2805	7.96
8	Kansas	-12.0	KS	111	2907289	971.0	33.3988	3.81
9	Missouri	-12.0	MO	537	6093000	1884.0	30.9207	8.81
7	Arizona	-11.0	AZ	380	6931071	2452.0	35.3769	5.48
6	Idaho	-10.0	ID	49	1683140	529.0	31.4294	2.91

In [18]:
```
fig, axes = plt.subplots(ncols=2, sharey=True)

y = rape2016.state_abbr                                  # Setting the y-axis

colors = ['r','r','r','r','r','gray',                    # Setting the colors
          'gray','gray','gray','gray','gray']

rape2016.Score.plot (kind="barh", ax=axes[0],     # Creating the left
bar chart
                     color=colors)
rape2016.rapebypop.plot (kind="barh", ax=axes[1], # Creating the right
bar chart
                         color=colors)

axes[0].set_xlabel('Gun Safety Score')                   #Setting the x label
s
axes[1].set_xlabel('Rape per 100,000 pop')

axes[0].invert_xaxis()                                   # Organizing the lef
t bar chart
axes[0].set(yticklabels = rape2016.state_abbr)
axes[0].yaxis.tick_right()

for ax in axes.flat:                                     # Setting the margin
s/removing spines
    ax.margins(0.03)
    ax.spines["right"].set_visible(False)
    ax.spines["top"].set_visible(False)
    ax.spines["left"].set_visible(False)
    ax.spines["bottom"].set_visible(False)

                                                         # Chart Title
fig.suptitle("Rape Instances by Gun Safety Score",
             fontsize = 12, fontweight = "bold")

fig.subplots_adjust(wspace=0.18)                         # Setting the spacin
g
plt.show()
```



Summary:

Based on this data it is fairly clear that there is still a long road ahead for the country with regards to effective gun regulation. However we can see the benefits of these efforts, the data show a relationship between strong gun regulations and a lower incidence of crime. While these relationships are not incredibly stong, I belive that with more future regulations the trend will continue in this direction and states with stronger regulations will experience less violent crimes.