Firearm Mortality Rates by Homicide Rates and Year

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Statistics + Data Sciences

Introduction

Objectives:

    Firearms and firearm control have been thrust into the national conversation with increasing frequencies of mass shootings. Is there a significant increase between time, firearm mortality rates, homicide rates and how they are related? With firearm control frequently being covered in the media, I expect to see a positive relationship between firearm mortality rates, homicide rates, and year.[1, 2]

Research Questions:

RQ1: Do firearm mortality rates change by year?
RQ2: Is there a relationship between homicide rates and firearm mortality rates?

Methods

Data Collection: Sample subjects are the 50 US states over three years (n = 150). With data compiled from CDC NCHS's (WONDER) Database.

Measures: Firearm (continuous, numeric response) and Homicide (continuous, numeric explanatory) Mortality Rate Units = (individual deaths / US Population) * 100,000. Time (categorical, ordinal explanatory) unit is years.

Analysis Method: R Studio Version 1.1.414 was used to generate a GLM with interaction for Homicide Rates and Years for this data.

```
int_model <- lm(Firearm.Mortality.Rate ~ Log.Transform.Homicide.Mortality.Rate *Year, data =
prelim) #GLM w/interaction
summary(int_model) ) #outputs summary data of GLM with Log Transformed Homicide Rate * Year
```

Descriptives

Response Variable: Table 1 – Descriptive Statistics (n=150)[3]

Response Variable	Center	Spread
Firearm Mortality Rate	Mean = 12.050	SD = 4.630

Explanatory Variables: Table 2 – Descriptive Statistics (n=150)[4]

Explanatory #1	Center	Spread
Homicide Rate	Median = 5.000	IQR = 2.000

Table 3: – Descriptive Statistics, Explanatory # 2 (n=150)[3,4]

Year	Frequency
2014	50
2015	50
2016	50

Results

Table 4 – GLM with Interaction Results (2016 as Reference)

Variable	Estimate	Test Statistic*	P-value
Intercept	12.8159	18.765	<2e-16***
HR_Centered	0.7825	3.842	2.220e-4***
Year 2014	-0.9404	0.957	0.341
Year 2015	-0.3353	-0.331	0.742
HR_Centered*Year 2014	0.2242	0.635	0.527
HR_Centered*Year 2015	0.0580	0.175	0.862

R^2 = 0.2563; approximately 25.63% of the variation in Firearm mortality rates is explained by HR_Centered and year.

Firearm Mortality Rate= 12.816 + 0.783(HR_Centered) – 0.940(Year 2014) – 0.335(Year 2015) + 0.224(HR_Centered*Year 2014) + 0.0580(HR_Centered*Year 2015)

Firearm Mortality Rate by
Log Transformed Homicide Mortality Rate and Year
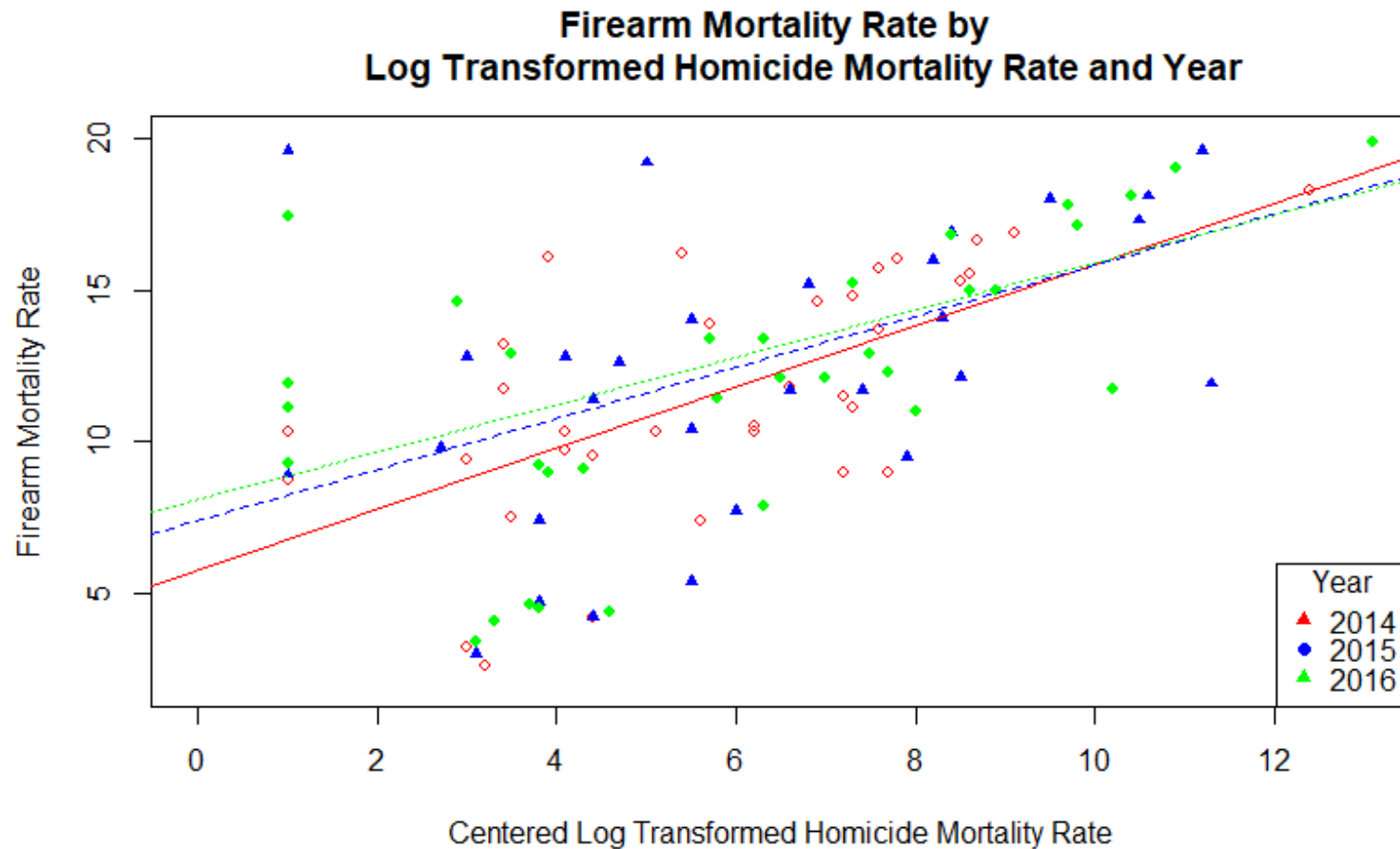
It appears that there is a main effect and interaction between year (2014, 2015, and 2016) and centered log transformed homicide rates. However the GLM suggests that the interactions between each main effect (year & Homicide rate) are not significant (HR_Centered*2014 p-value = 0.527; HR_Centered*2015 p-value = 0.862).

Assumptions

GLM Assumptions:

1. Random Sample; **2.** Independent Observations; **3.** Every numeric X (homicide rates) value is linearly related to Y (Firearm mortality rates); **4.** Residuals are normally distributed; **5.** Residuals have equal variance across range of fitted values

Assumption Checks:

#1 100 random samples were chosen from dataset using data.table package; **#2** observations were made via state issued death certificates; **#3** checked with a scatter-plot; **#4** checked with a QQ-Plot; **#5** checked w/ a residual plot. Normality of firearm mortality checked with a histogram, and boxplots for outlier check.

P-values for GLM:

HR_Centered: 2.22e-4; Year 2014: 0.341; Year 2015: 0.742; HR_Centered*2014: 0.527; HR_Centered*2015: 0.862; alpha = 0.05

Discussion

Interpretation: When controlling for the Year, average Log Transformed Homicide rates explain variation in firearm mortality rates, for every 1 increase in log-transformed homicide rates, firearm mortality rates increase by 0.7825 (*p = 2.22e-04, df = 94, t = 3.842*). When controlling for Homicide Rates, year 2014 does not explain variation in firearm mortality rates (*p = 0.341, df = 94, t = -0.957*). When controlling for Homicide Rates, year 2015 does not explain variation in firearm mortality rates (*p = 0.742, df = 94, t = -0.331*). There is no significant interaction between homicide rates and year 2014 on firearm mortality rates (*p = 0.527, df = 94, t = 0.635*). There is no significant interaction between homicide rates and year 2015 on firearm mortality rates (*p = 0.862, df = 94, t = 0.175*).

The GLM produced tells us that homicide rates are significantly linearly related to firearm mortality rates (RQ1), and that year does not significantly affect firearm mortality rates (RQ2).

Limitations:

- Selection bias possible because data is from recent timeframe and is not historic due to limitations of dataset provided by source. A random sample was taken from the dataset to get a more representative sample.
- Homicide Residuals are positively skewed, several zero value data points; 1 added to all values then log transformation was performed.
- Social factors such as education, nutrition, and income are possible confounding variables that may affect firearm mortality rates.

Implications and Future Research: As the GLM suggests, in the US as homicide rates increase, firearm mortality rates also increase. To expand this research, cities across the US over time can be sampled. In future studies, sample size can be increased for higher power testing.

References:

1. Hauser, C. (2017, November 4). "Gun Death Rate Rose Again in 2016, C.D.C. Says". Retrieved March 6, 2018, from https://www.nytimes.com/2017/11/04/us/gun-death-rates.html (News Article)
2. Roe, D. (2018, March 5). States with Stricter Gun Laws Have Fewer Homicides and Suicides. Retrieved March 7, 2018, from https://tonic.vice.com/en_us/article/59kavd/states-with-strictergun-laws-have-fewer-homicides-and-suicides (News Article)
3. CDC. Firearm Mortality by State. (2018, January 10). Retrieved March 7, 2018, from https://www.cdc.gov/nchs/pressroom/sosmap/firearm_mortality/firearm.htm (Database)
4. CDC. Homicide Mortality by State. (2018, January 11). Retrieved March 7, 2018, from https://www.cdc.gov/nchs/pressroom/sosmap/homicide_mortality/homicide.htm (Database)