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Community-level Correlates of Crime Rates in Rhode Island

Herschel Smith

ABSTRACT

"Community-level Correlates of Crime Rates in Rhode Island"

By

Herschel Wellington Smith IV

3/26/19

The built environment has been associated with community health through numerous studies (Wilcox 2003). Past research into built environments effect on community crime has identified increased green spaces as having a protective effect on property and violent crime rates (Kuo 2001). Kuo and others examine how crime rates are either positively or negatively associated with specified built environment features. The goal of this study is to identify which business types and institutions demonstrate an increased risk or protective effect on community crime rates. It is hypothesized that business types and institutions associated with low social capital crime rates will have a positive correlation with crime rates and outdoor recreation centers/facilities have a protective effect on crime. The data collected includes 2016-2017 Rhode Island average crime rates for general crime, assault, sexual assault, robbery and burglary and 19 built environment characteristics within the 39 Rhode Island county police precincts. Partial least squares regression analysis was performed to model the effects of business types on general crime rates, assault rates, robbery rates, burglary rates, and sex crime rates. The analysis identified a greatest increasing effect on burglary rates with pawn shops and strip clubs, while outdoor recreation centers and fire stations demonstrated the greatest protective effects. An increasing effect on robbery rates was associated with worship centers and pawn shops, while outdoor recreation centers again demonstrated the largest protective effect. The largest increasing effect on sex crime rates was libraries and gun dealers. The predictors that were most positively and negatively associated with violent assault were pawn shop rates and pain treatment center rates, respectively. The study found that outdoor recreation facilities was the only predictor to consistently demonstrated significant protective effects against all 4 specific crime rate types observed. Further research investigating latent factors within Rhode Island communities is necessary.

“Community-level Correlates of Crime Rates in Rhode Island”

by

Herschel Wellington Smith IV

B.S., EMORY UNIVERSITY

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
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MASTER OF PUBLIC HEALTH

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APPROVAL PAGE

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__3/26/2019_____
Date

Acknowledgements:

I’d like to take this moment to thank my family, friends, professors and peers for always encouraging me to set my goals high and pursue them with fervor.

Author's Statement Page

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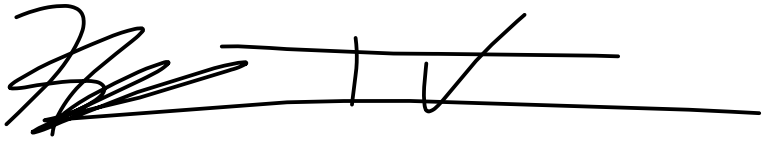

Signature of Author

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Introduction:

One of the integral goals of public health is to ensure and improve community health. As described by Wilcox (2003), a healthy community is one that is in part defined by residents feeling safe from crime and understanding the factors that may impact crime rates and perceived crime risk in the community. Wilcox (2003) cites many studies in the past few decades that highlight built environment and public land use as having a direct effect on risk perception and actual crime, increasing the popularity of studies incorporating built environment into their analysis of community health. The term 'built environment' is defined as "the human-made space in which people live, work, and recreate on a day-to-day basis" (Roof 2008). One of the reasons for greater interest in environmental factors is the dramatic increase in impoverished neighborhoods in the United States since 1970 (Peterson 2000). A chart of increasing impoverished population in U.S. from 1959-2017 available in the appendix (Image 5.1). Many studies investigated vague community characteristics, where business types/community institutions were not directly observed, hindering the relatability of results. Wilcox (2003) followed up a study of built environment and community crime in Chicago neighborhoods with another in 2004 observing Seattle communities' land use and crime (Wilcox 2004). While both studies included neighborhood-level effects like schools, playgrounds, and places of business, they failed to investigate the types of businesses within the community. Both studies identified a direct correlation between the presence of businesses and increased burglary risk in both Seattle and Chicago but failed to delve deeper into what types of businesses with in the studied communities (Wilcox 2003 & 2004).

Several studies, including Peterson (2000) and Pridemore (2013), incorporated additional elements like locally owned businesses, alcohol outlets, and libraries in their analyses of effect on community violent crime, but few recognize a truly diverse list of business types commonly found in the community as key predictors. It is important to recognize rates of businesses associated with lower social capital, such as pawnshops, gun stores, strip clubs, and alcohol distribution outlets, which have been associated with impoverished communities in the United States (Faber 2019, McGrath 2013, Pridemore 2013). Social capital is a complex subject that commonly describes factors of effectively functioning social groups that include interpersonal relationships, a shared sense of identity, a shared understanding, shared values trust, cooperation and reciprocity (Adler 2002). Lorenc (2012) found a direct association between social environment and crime/fear of crime. However, a thorough literature review did not identify any studies incorporating these and other community institutions simultaneously as predictors for crime rates.

Similarly, there have been studies identifying built environment characteristics that have a protective effect on crime rates. Green spaces, playgrounds and outdoor recreation centers, have been identified as environmental features that reduce property and violent crime (Kuo 2001). However, no studies were found that incorporated protective and disruptive factors in community crime rate analyses simultaneously to evaluate and compare effects.

Partial least squares (PLS) regression analysis is a statistical method that can simultaneously analyze numerous predictors we would like to include in our model of

crime rate outcomes. It was designed to deal with multiple regression when data has small sample, missing values, or multicollinearity. Partial least squares has been popularly used in hard sciences, especially chemistry and chemometrics, where it was initially developed by Herman Wold (Wold 2001). PLS is equipped to handle datasets where there are relatively many predictors and few observations, thus making it a necessity for this study's analysis. No past built environment and crime rates studies were identified that utilized partial least squares regression in their research.

The purpose of this study is to identify community business types and institutions that either positively or negatively impact Rhode Island crime rates; specifically: assault rates, sex crime rates, burglary rates, and robbery rates. It is hypothesized that identifying communities with high rates of businesses associated with low social capital (pawn shops, gun stores, alcohol distribution outlets, etc.) will be associated with increased risk of burglary, assault, sexual assault and robbery crime rates. Additionally, it is predicted that outdoor recreation centers will have a protective association across crime rates.

Identifying community-built environment characteristics that influence crime rates can guide policy on where and how to effectively and efficiently reduce crime through the reduction of some built environment features and the promotion of others.

Methods:

Rhode Island precinct crime rate data was collected by the State of Rhode Island Department of Public Safety. For the purposes of this study, only crime records that fell into the desired outcomes were used. Outcomes of interest were burglary, sex crime,

assault, and robbery as distinguished by the Division of Sheriffs whom maintain public records documents under the Access to Public Records Act (APRA). These records include crime data from all 39 Rhode Island county precincts, cumulatively 26086 crime events over November 25, 2015 to May 23, 2016 (6 months). These counts were converted into crime rates per 1000 people based on U.S. Census Bureau county population data estimates via the RI Department of Labor and Training Labor Market Information to control for variance in population.

Predictor data was collected via a 2018 study by the Department of Psychiatry and Human Behavior at Alpert Medical School of Brown University utilizing state-wide business listings and specified databases to verify location for each predictor. Approximately 1713 businesses/institutions were included in the study and divided into the following predictors (19): Outdoor Recreation, Fire Stations, Libraries, Gun Dealers, Alcohol Distribution Centers, Museums, YMCAs, Food Pantries, Transit Stations, Worship Centers, Pain Treatment Centers (PainTx), Homeless Shelters, Boys and Girls Clubs, Grocery Stores, Substance Use Disorder Treatment Centers (SUDTx), Hospitals, Sex Shops, Strip Clubs, and Pawn Shops. Like the criminal outcome data, these counts were converted into rates per 1000 people based on U.S. Census Bureau county population data estimates via the RI Department of Labor and Training Labor Market Information to account for population density.

As some counties reflected a 0.00 rate per 1000 people for some business types, rates were standardized across the 39 precinct jurisdictions to accurately quantify

differences between communities. Differences between rates may have been due to differences in current local policy limiting certain business types in some communities.

Analysis:

Partial least squares regression analysis was selected to analyze the data of this study as it is one of the least restrictive extensions of multiple linear regression modeling (Statsoft 2013). It can model many predictors (19) and several response variables simultaneously with relatively few observations (39 Rhode Island police precincts) (Statsoft 2013). PLS regression is related to principle components regression in that it determines necessary components, or latent variables, that explain the maximum covariance between the outcome and predictor variables. PLS then finds a linear regression model by projecting the predicted outcome to the new latent variables (Wold 2001).

Partial least squares (PLS) regression analyses were performed to model the effects of business types/institutions on burglary, sex crime, assault, and robbery, respectively. Based on the root mean square error of prediction (RMSEP), cross-validation was used to identify the number of components to include in the model. The number of components corresponding to the minimum cross-validation RMSEP is chosen as optimal (Mevik 2018). The Kernel method was used in PLS model fit. This method of pattern analysis identifies the afore mentioned necessary components by assigning weights proportional to the covariance among predictor and outcome variables (Shawe-Taylor 2004). Kernel PLS has been noted to use much fewer, qualitatively different components compared to Ridge regression (Rosipal 2001).

PLS results for each desired outcome were compared to linear regression models to verify results. Bivariate correlations, which indicate the strength of a relationship between two variables, were identified to measure the strength of outstanding predictors' relationships with crime rates. Partial least squares regression analysis, linear regression analysis, and bivariate correlation coefficients were performed via RStudio (Package *pls* version 2.7-0). Charts of RMSEP vs. components are available in the appendix (Image 1.5, 2.5, 3.5, 4.5)

Results:

Using partial least squares regression analysis, 1 component is selected which explained 41.01% of variance in burglary rate. PLS coefficients estimate effect size compared to other predictors modeled. For burglary, pawn shops resulted the largest risk factor coefficient (14.24), while outdoor recreation centers resulted in the largest protective factor coefficient (-9.42). The linear model found pawn shop rates had significance at <0.05 (p-value= 0.0233) on burglary rate. The bivariate linear correlation coefficient between burglary and pawn shops was 0.61, indicating a moderate-strong positive relationship. The correlation coefficient between burglary and outdoor recreation centers was -0.41, indicating a moderate negative linear relationship. These coefficients indicate relationships outside of the incorporation of all 19 predictors. A chart of burglary rate PLS coefficient values has been included in the appendix (Image 1.1).

The PLS robbery rate identified 1 necessary component, which explained 42.55% of variance. Worship centers resulted the largest risk factor coefficient (12.57), while outdoor recreation centers resulted in the largest protective factor coefficient (-

10.45). The robbery linear model did not find significance at <0.10 across predictors, however the worship centers and pawn shops resulted in the lowest p-values at 0.121 and 0.278, respectively. The bivariate linear correlation coefficient between robbery and worship centers was 0.17, identifying a much weaker correlation than initially indicated by partial least squares regression. The correlation coefficient between robbery and pawn shops was 0.55, identifying a strong positive relationship. The correlation coefficient between robbery and outdoor recreation centers was -0.42, emphasizing a moderate negative relationship. A chart of robbery rate PLS coefficient values has been included in the appendix (Image 2.1).

The PLS assault rate identified 1 necessary component, which explained 37.60% of variance. Pawn shops resulted the largest risk factor coefficient (19.24), while pain treatment centers resulted in the largest protective factor coefficient (-15.30). The assault rate linear model found pawn shops had significance at <0.05 (p-value=0.0259) on assault rate. The bivariate correlation coefficients between assault and pawn shops was 0.53, indicating a relatively moderate positive correlation. The correlation coefficients between assault and pain treatment centers was 0.05, resulting in a weak positive relationship. A chart of assault rate PLS coefficient values has been included in the appendix (Image 3.1).

The PLS sex crime identified 2 necessary components which explains 44.34% of variance. Libraries resulted the largest risk factor coefficient (15.59), while outdoor recreation centers resulted in the largest protective factor coefficient (-9.44). The linear model for sex crime rate did not find significance at <0.10 across predictors tested, however, libraries and pawn shops resulted in the lowest p-values at 0.229 and 0.268,

respectively. The bivariate linear correlation coefficients identified were libraries (0.13) and outdoor recreation centers (-0.34). In libraries, this indicates a weak positive relationship, and in outdoor recreation centers, a weak-moderate relationship. A chart of sex crime rate PLS coefficient values has been included in the appendix (Image 4.1).

Bar plots of the top coefficients of risk factors and protective factors from partial least squares models as well as bivariate correlation matrices and RMSEP charts are available in the appendix for burglary, robbery, assault, and sex crime, respectively (Image 1.2-5, 2.2-5, 3.2-5, 4.2-5).

Discussion/Conclusion:

As the explained variance from partial least squares analysis indicates, there are many unmeasured factors that influence Rhode Island crime rates. Though predictors were limited to the built environment, the study succeeded in identifying factors that influence crime rates. Pawn shops consistently were associated with greater risk for burglary and assault. This is in line with past research that areas with high rates of pawn shops (or other nefarious businesses) have increased crime rates (Faber 2019). Outdoor recreation centers resulted in the greatest protective influencer on burglary, robbery and sex crimes. This is consistent with past research indicating lower crime rates and perceived crime rates in areas with green spaces/outdoor recreation facilities (Kuo 2001).

The lower bivariate correlation coefficient identified between robbery and worship centers (0.17) suggests that the inclusion of additional built environment factors is

amplifying our observed effect. Similarly, libraries were found be the largest predictor associated with an increased risk of sex crime but resulted in a weak positive bivariate correlation (0.13). Further research is necessary to better understand these interactions.

Strengths of the study include the utilization of multiple business types/institutions as predictors to model outcomes simultaneously. Many past studies fail to observe a multitude of built environment features. These results will be useful for Rhode Island politicians and community leaders as a guide for how to passively reduce crime rates at the community-level.

While successful in its goal, the study had several limitations. While the predictors assessed are important, additional information on community make up would further improve crime rate analysis. Incorporating additional community-informative complex predictors, like concentrated disadvantage, social capital and demographic make-up, is critical to future studies. The Lasso and Ridge regressions are additional analytical tools that could be better suited for this research question. For information that is sensitive to immediate surroundings, geospatial analysis would be advised, especially as thorough data could incorporate exact locations for crimes and business addresses. The limited timeframe of criminal data collection could result in differing trends over a different window out of the year or over a longer period. These adjustments to future studies could increase the amount of explained variance, further validating findings.

Considering past literature and the study at hand, much is still left to be learned as discoveries here do not infer a causal relationship between pawn shop and increased crime or green spaces and decreased crime rates. There is still a relatively

pubescent understanding of the built environment and its effect on health outcomes, but this is a step in the right direction for a healthier society.

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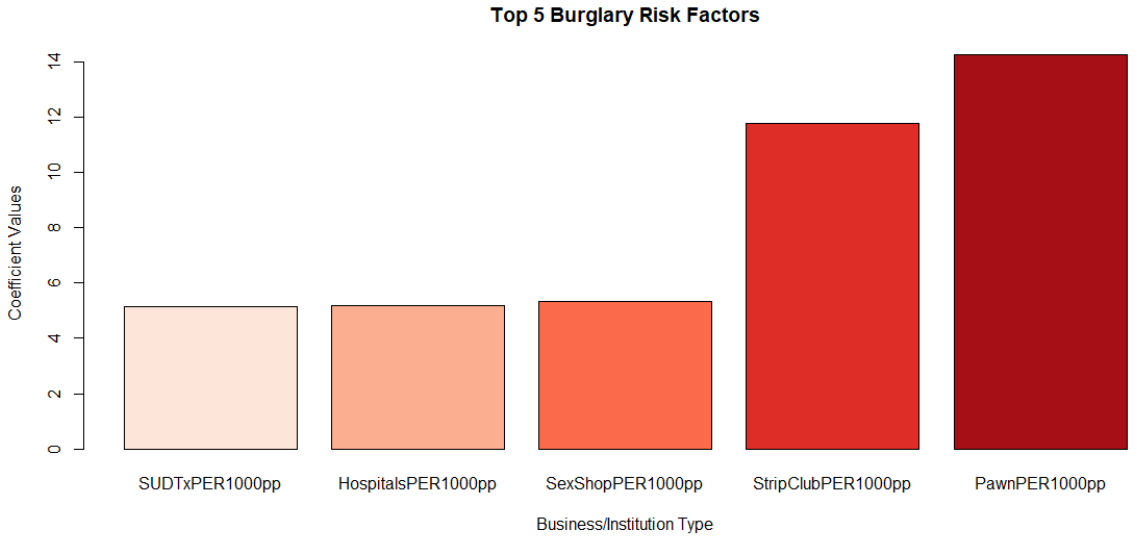
Appendix:

Image 1.1:

```
> Burglary_coefficients
  OutdoorRECPER1000pp FirestationsPER1000pp    LibrariesPER1000pp
            -9.415041              -8.563986              -8.219711
     GunDealPER1000pp             Alc1000ppl      museumsPER1000pp
            -5.361207              -3.948582              -2.775788
        YMCAper1000pp     PantriesPER1000pp      TransitPER1000pp
            -2.379262              -1.600625              -1.377962
     WorshipPER1000pp       painTXPER1000pp     SheltersPER1000pp
             0.844219               2.827892               3.025013
boygirlclubsPER1000pp      GroceryPER1000pp       SUDTxPER1000pp
             3.038686               4.941364               5.136142
   HospitalsPER1000pp      SexShopPER1000pp    StripClubPER1000pp
             5.193900               5.331719              11.776673
         PawnPER1000pp
            14.242226
```

Image 1.2:



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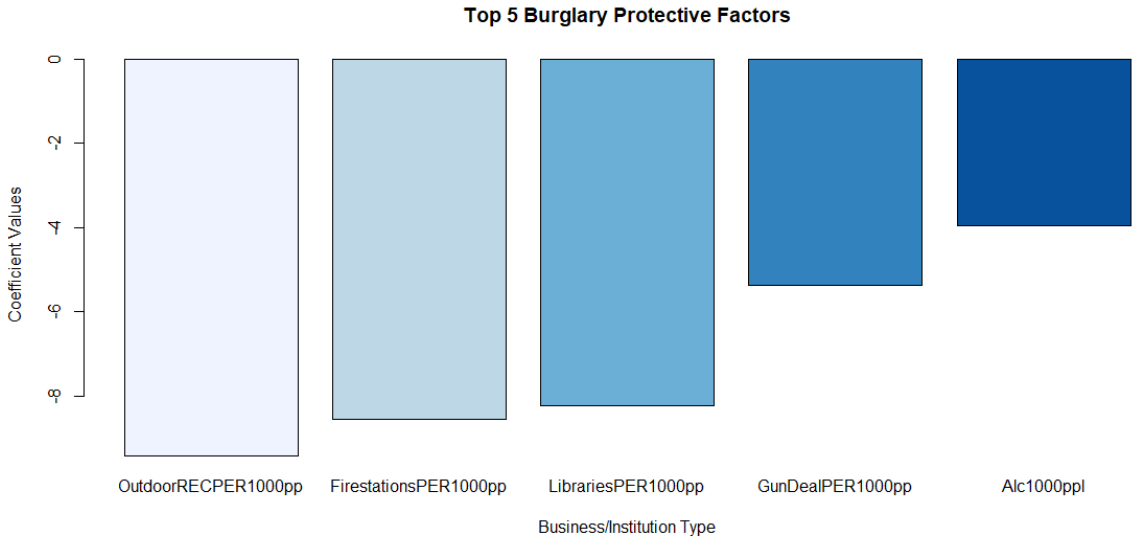
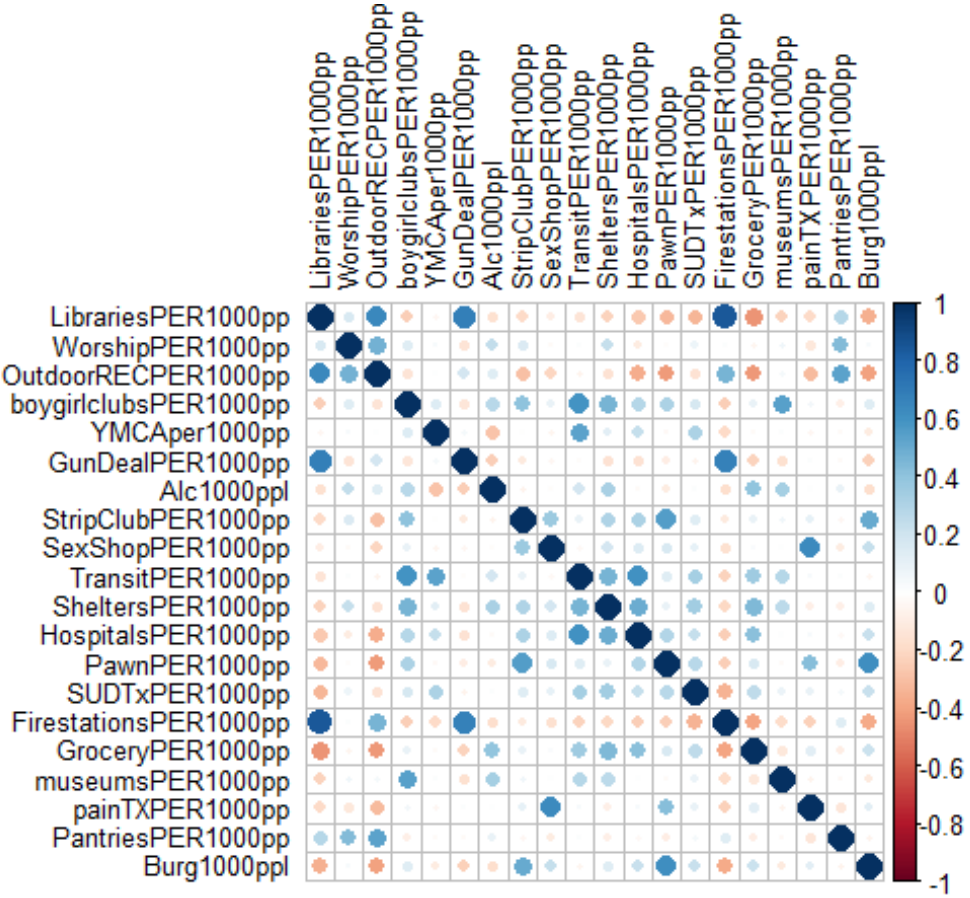


Image 1.4:
Burglary Bivariate Correlation Matrix



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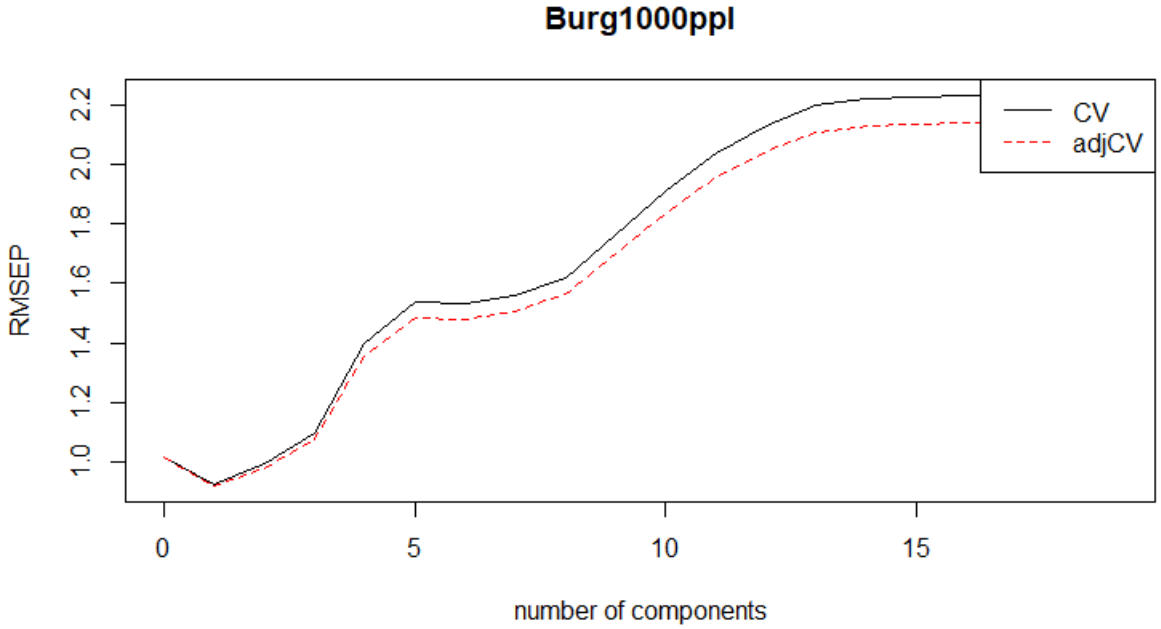

Image 2.1:

```
Robbery_Coefficients
OutdoorRECPER1000pp     SheltersPER1000pp      GunDealPER1000pp
         -10.4517682           -7.6298026            -5.9371582
  PantriesPER1000pp boygirlclubsPER1000pp      museumsPER1000pp
         -5.6342941           -4.2635059            -2.1008172
     painTXPER1000pp         YMCAper1000pp        SUDTxPER1000pp
         -0.7134710           -0.1171947             0.9891474
    SexShopPER1000pp    LibrariesPER1000pp FirestationsPER1000pp
          1.3678316            1.5848969             4.8325516
    GroceryPER1000pp    HospitalsPER1000pp    StripClubPER1000pp
          5.1001747            6.0969271             6.5493218
    TransitPER1000pp           Alc1000ppl          PawnPER1000pp
          6.5549054            6.9871622            10.5176733
    WorshipPER1000pp
         12.5713962
```

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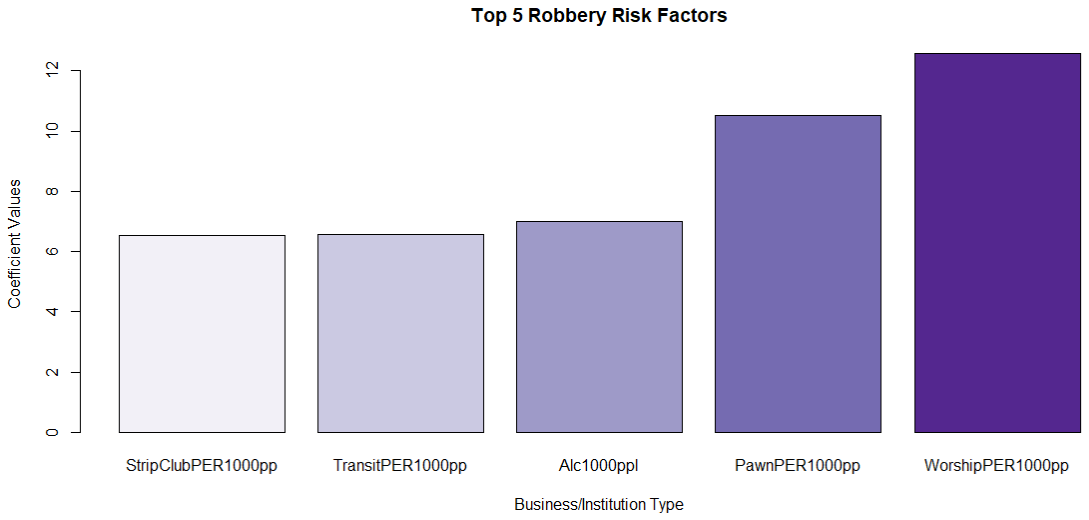

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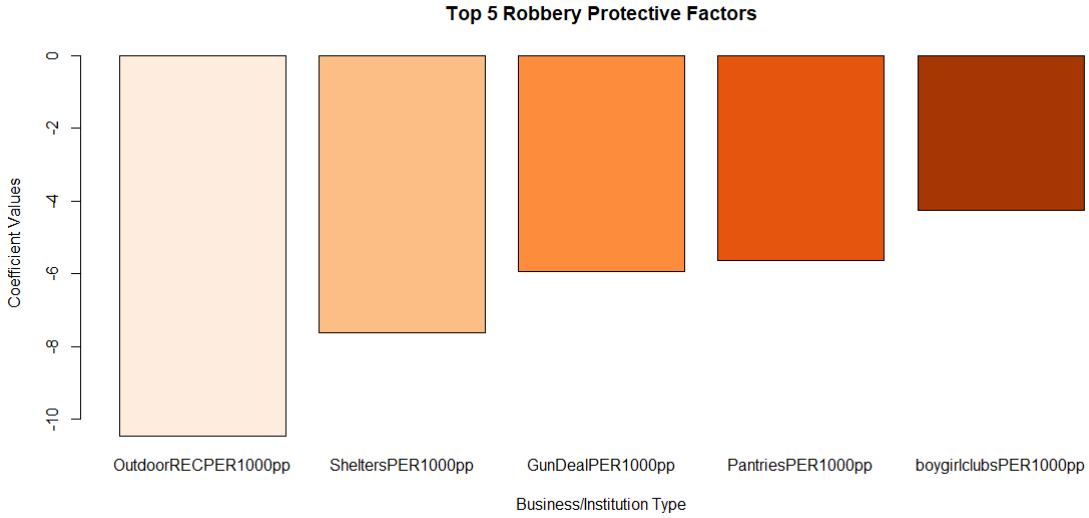
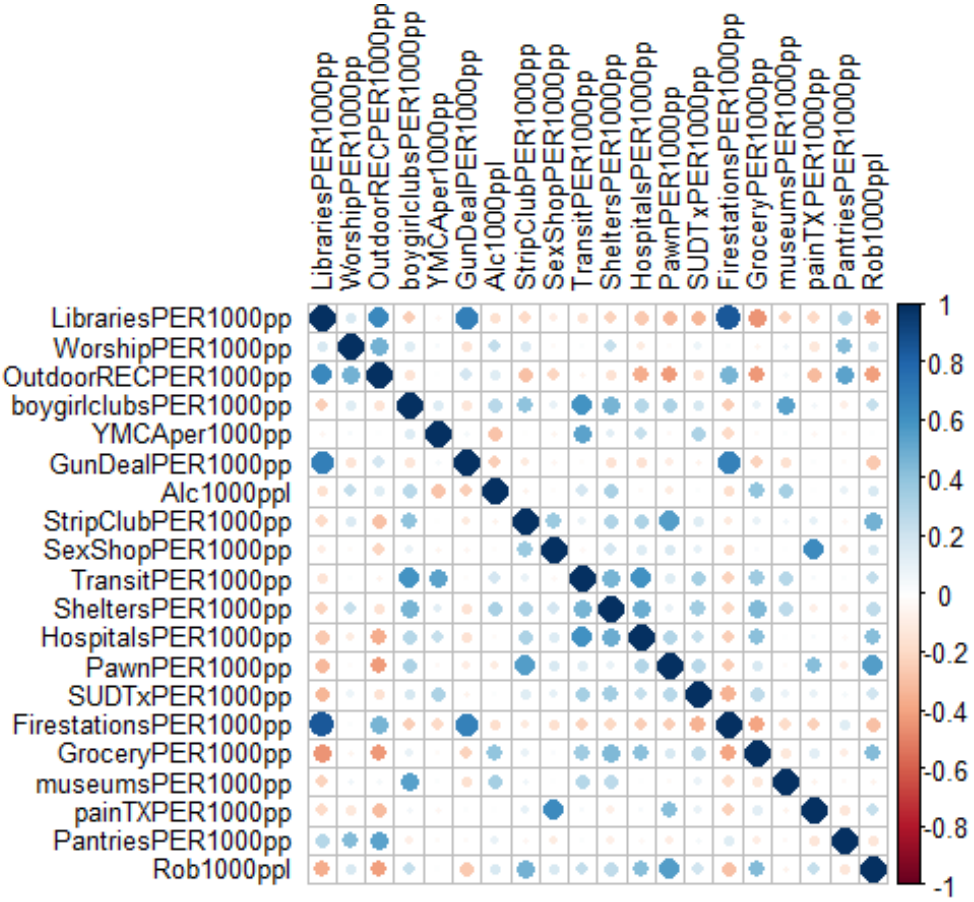


Image 2.4:
Robbery Bivariate Correlation Matrix



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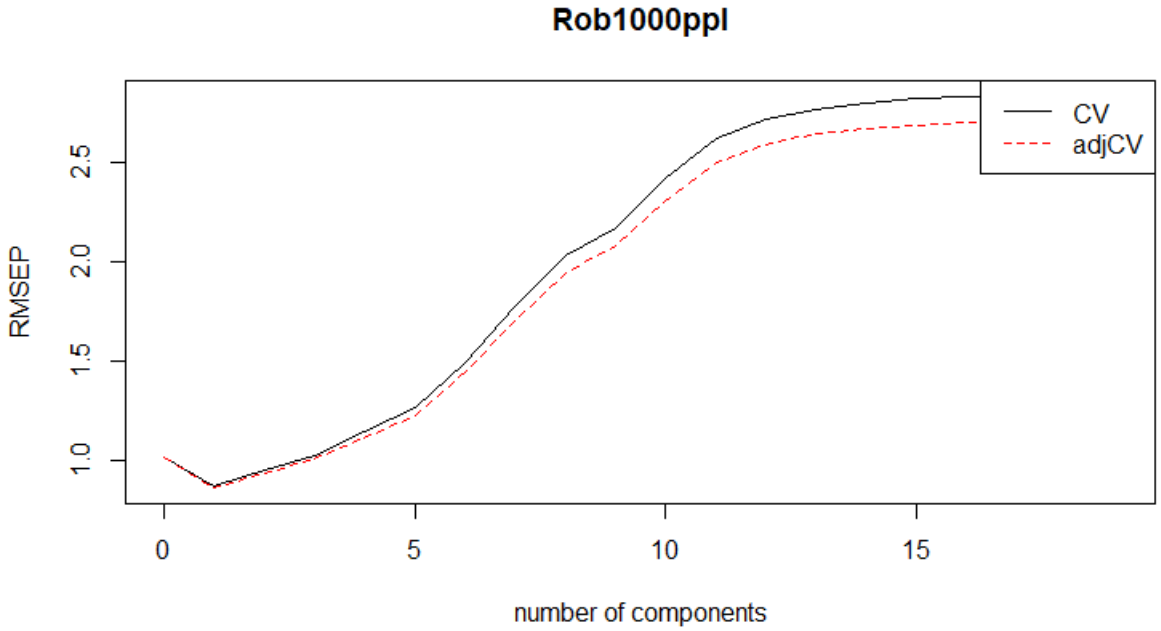

Image 3.1:

```
Assault_Coefficients
     painTXPER1000pp     StripClubPER1000pp    OutdoorRECPER1000pp
         -15.30437447           -9.50476960           -7.52151617
       YMCAper1000pp      PantriesPER1000pp       GunDealPER1000pp
          -3.91531546           -3.78365172           -3.27418210
  HospitalsPER1000pp     SheltersPER1000pp     LibrariesPER1000pp
          -1.74646969           -1.40042372           -0.34400231
      SUDTxPER1000pp            Alc1000ppl       museumsPER1000pp
          -0.20852739            0.09831221            0.65165258
   TransitPER1000pp FirestationsPER1000pp boygirlclubsPER1000pp
           0.71022246            2.30796762            5.14275708
   WorshipPER1000pp       GroceryPER1000pp       SexShopPER1000pp
           6.34254660            8.21420459            9.89688296
       PawnPER1000pp
          19.63222126
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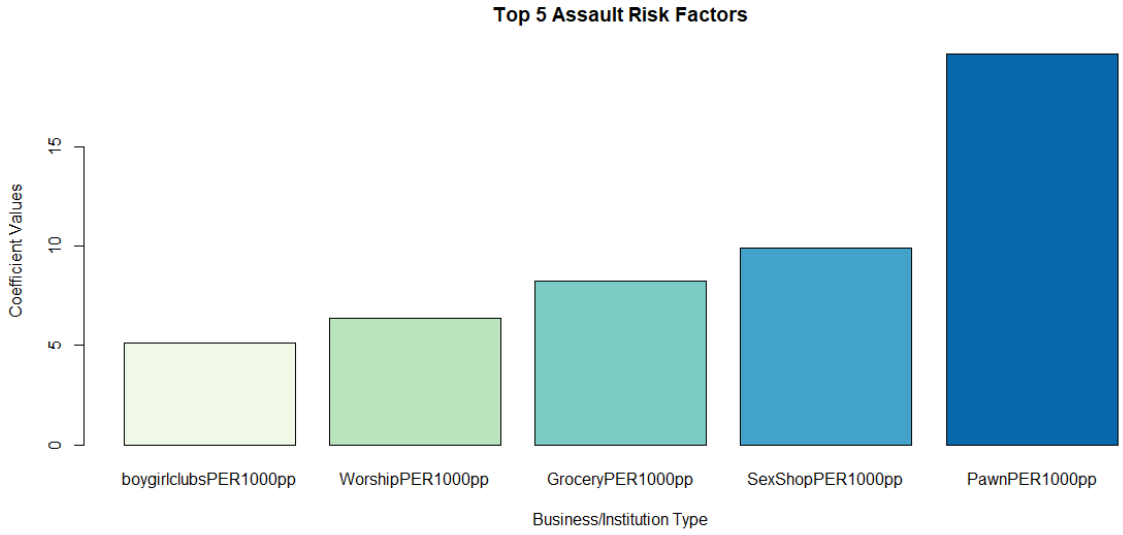

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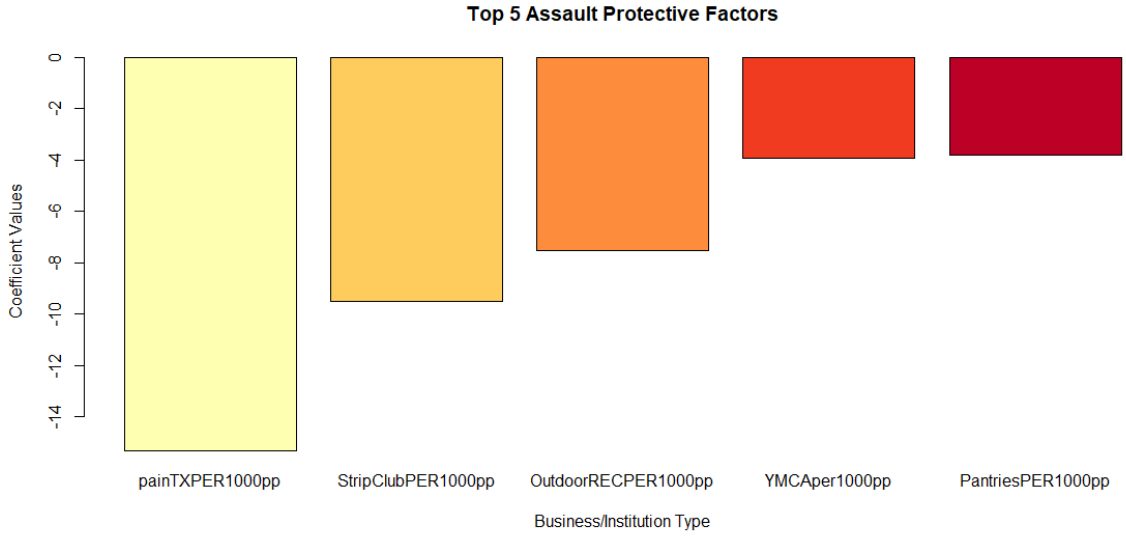
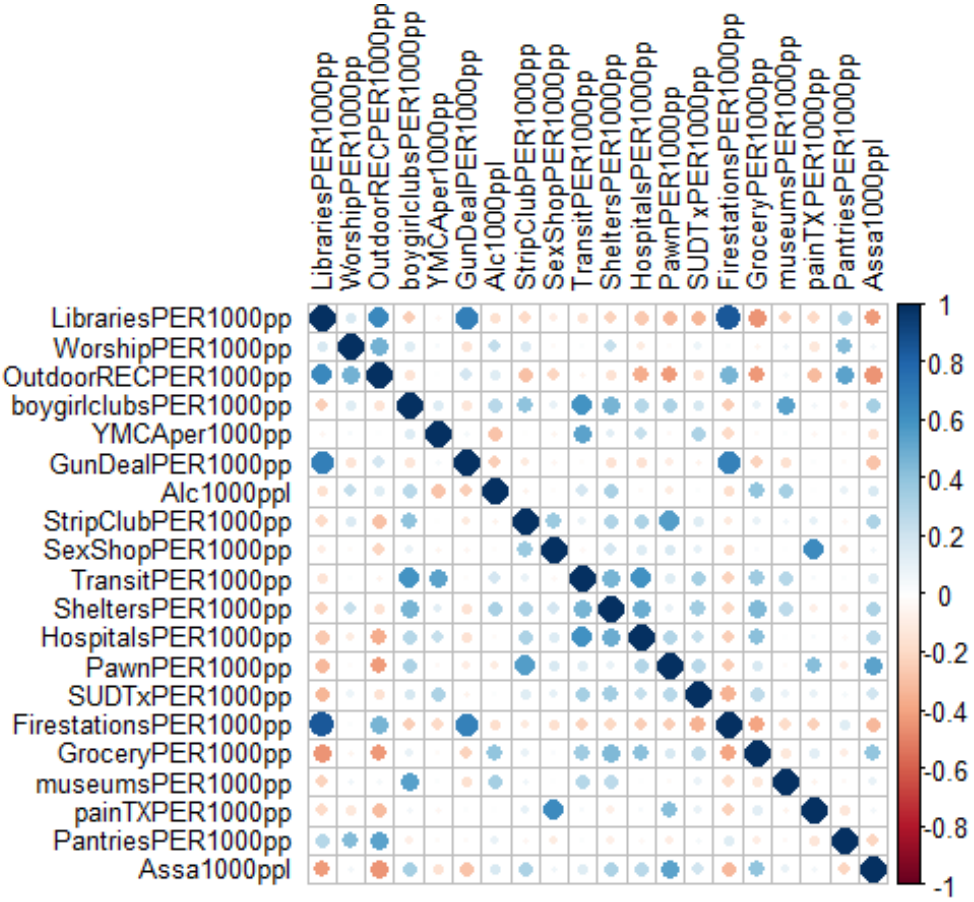


Image 3.4:
Assault Bivariate Correlation Matrix



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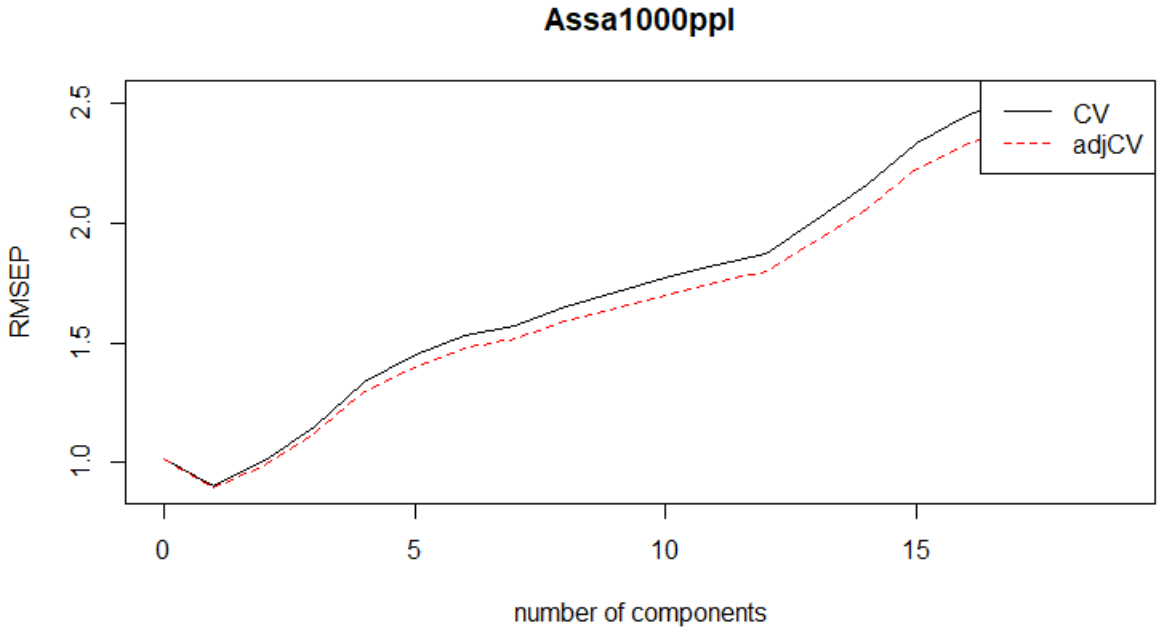

Image 4.1:

```
Sex_Crime_Coefficients
OutdoorRECPER1000pp       painTXPER1000pp FirestationsPER1000pp
         -9.44815668            -9.14735881             -7.88094016
   TransitPER1000pp     PantriesPER1000pp boygirlclubsPER1000pp
         -7.53033687            -4.92546138             -2.17644788
  SheltersPER1000pp         YMCAper1000pp              Alc1000ppl
         -2.11902870            -0.97861324             -0.67788688
    WorshipPER1000pp        SUDTxPER1000pp    StripClubPER1000pp
          0.09892651             1.12034786              1.23920758
 HospitalsPER1000pp      museumsPER1000pp      GroceryPER1000pp
          1.35975795             4.94538859              5.62906276
   SexShopPER1000pp         PawnPER1000pp      GunDealPER1000pp
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LibrariesPER1000pp
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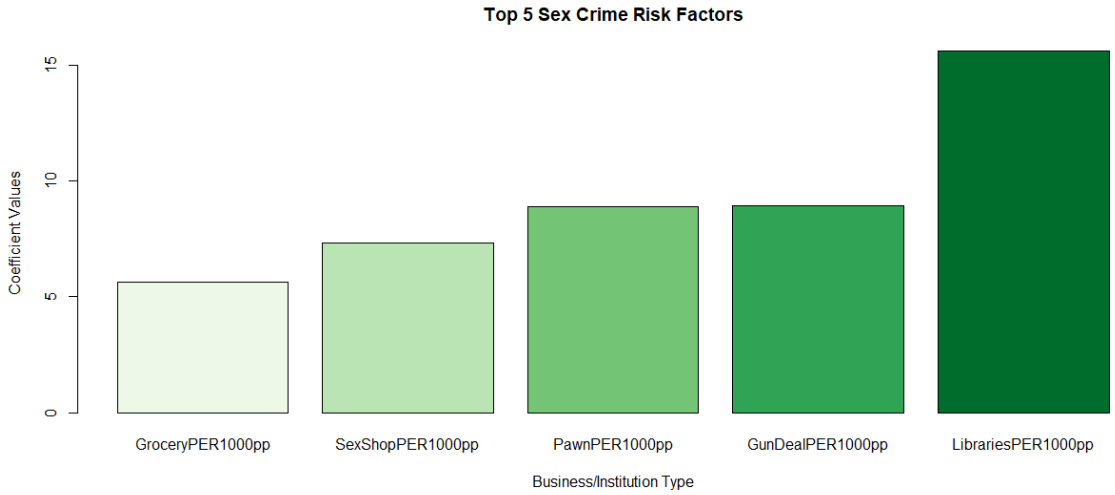
Image 4.2:



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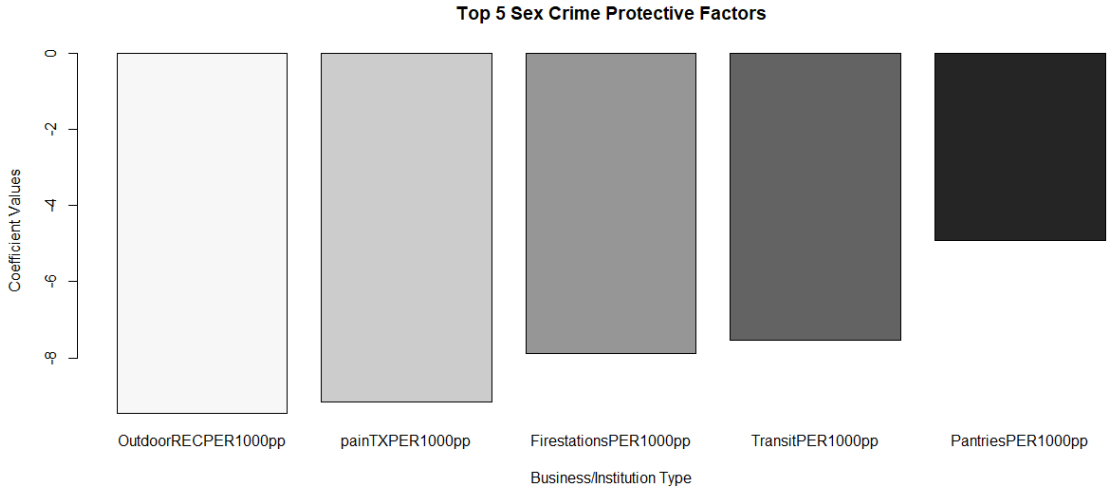
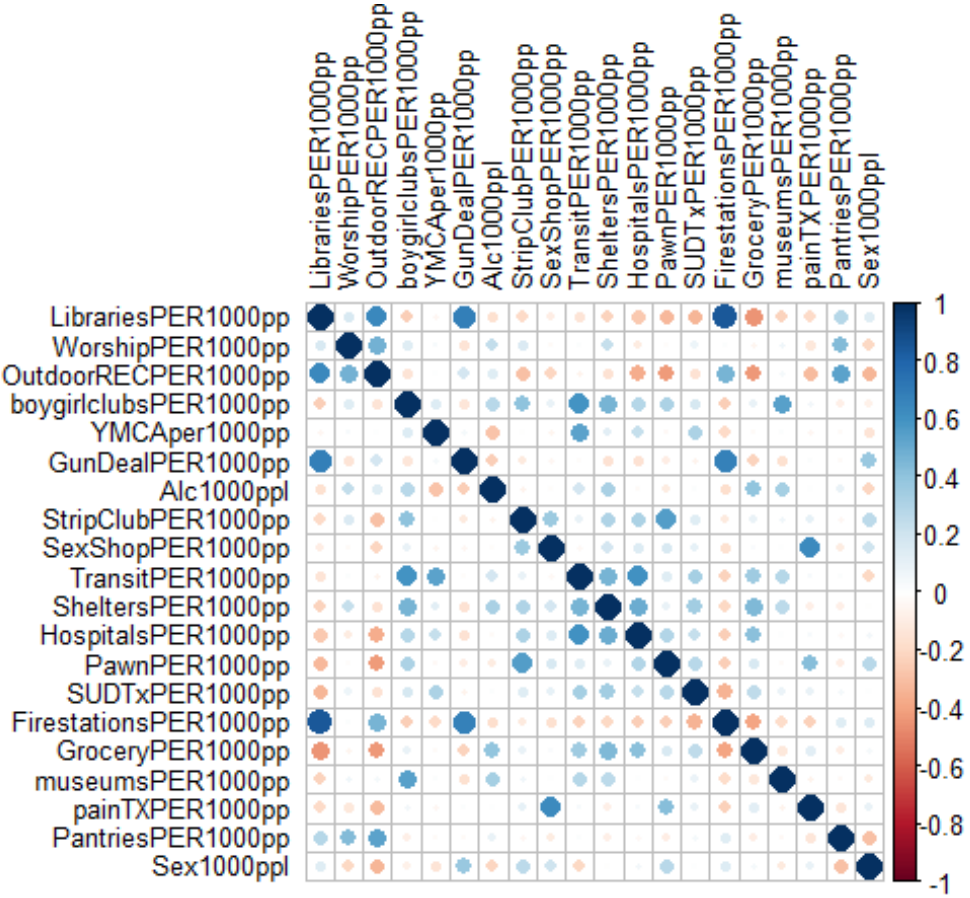


Image 4.4:
Sex Crime Bivariate Correlations



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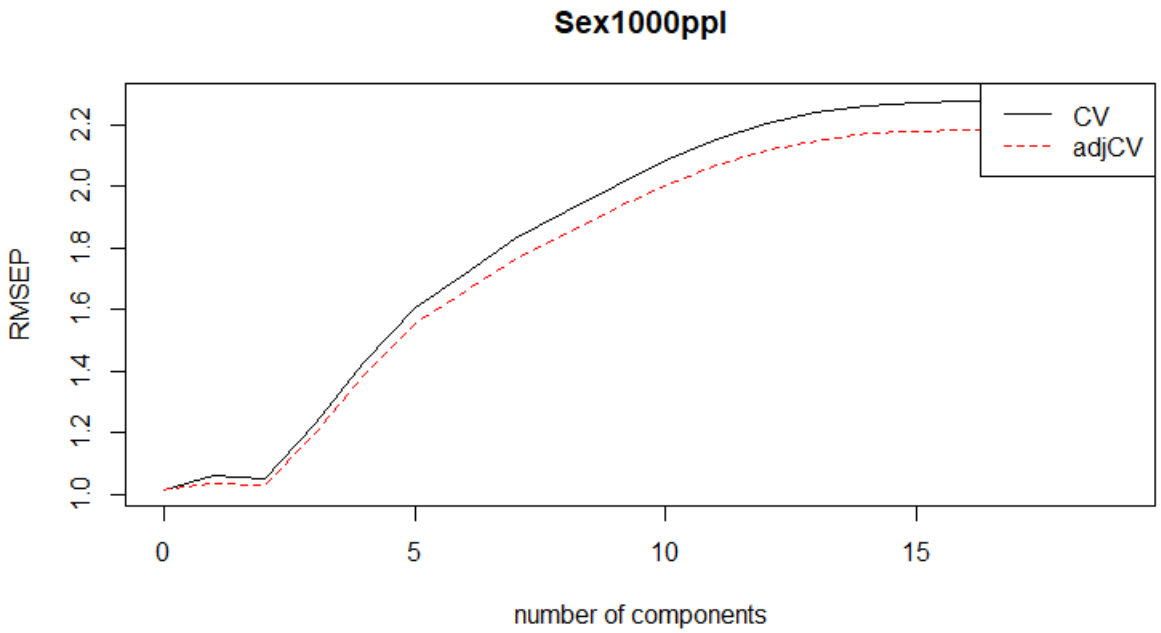
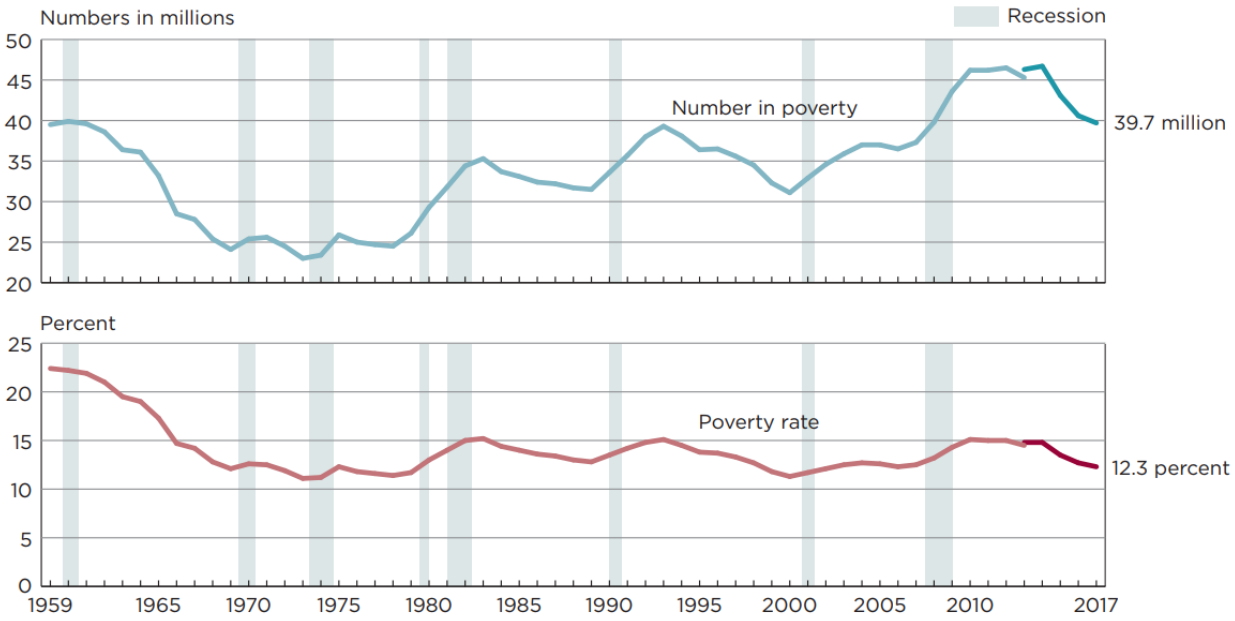


Image 5.1:

Figure 4.

Number in Poverty and Poverty Rate: 1959 to 2017



Note: The data for 2013 and beyond reflect the implementation of the redesigned income questions. The data points are placed at the midpoints of the respective years. For information on recessions, see Appendix A. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see <www2.census.gov/programs-surveys/cps/techdocs/cpsmar18.pdf>.

Source: U.S. Census Bureau, Current Population Survey, 1960 to 2018 Annual Social and Economic Supplements.