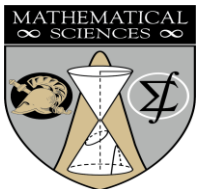




UNITED STATES MILITARY ACADEMY
WEST POINT

Project Proposal

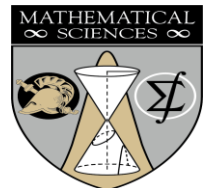
Tobias Hild
Jacob Hyatt





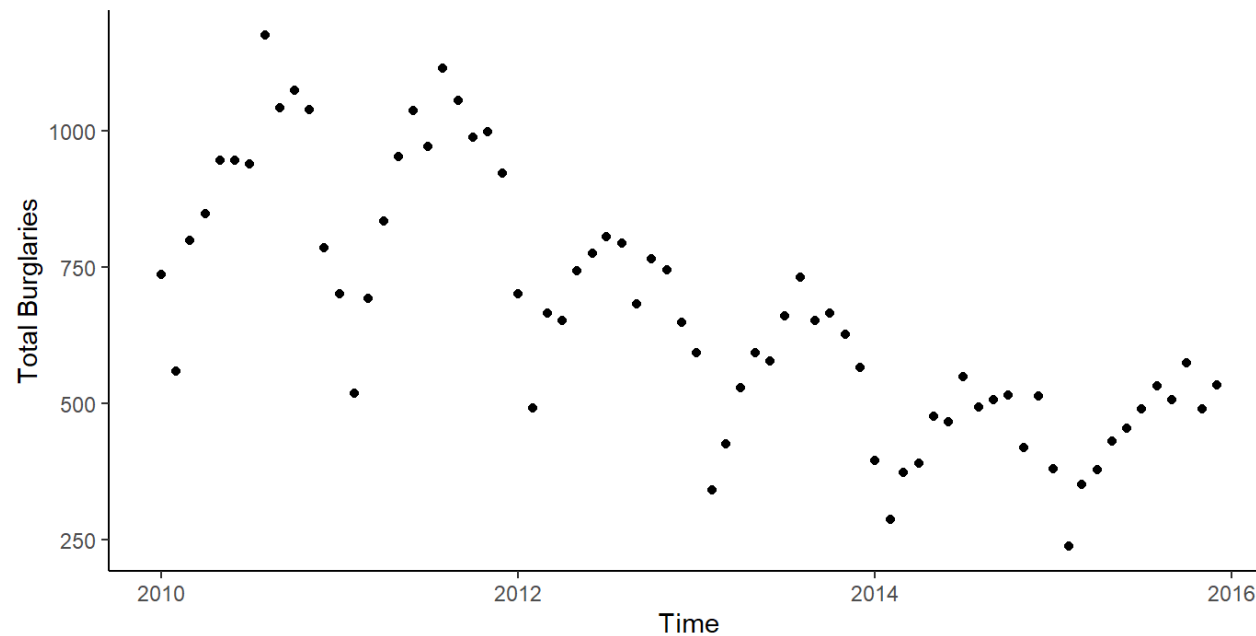
Study the impact of unemployment, wealth, number of young males, and time on the number of burglaries in census blocks across Chicago from 2010-2015.

Sources of Variation Diagram		
Observational Units	Sources of Explained Variation	Sources of Unexplained Variation
Census Blocks within Chicago for each month from 2010-2015	Census Block location Time of year Young Male Proportion Time since Jan 2010 Wealth Unemployment	Other demographic effects Geographic variation in police Variation in Laws Willingness to Report Housing types Security technology and access

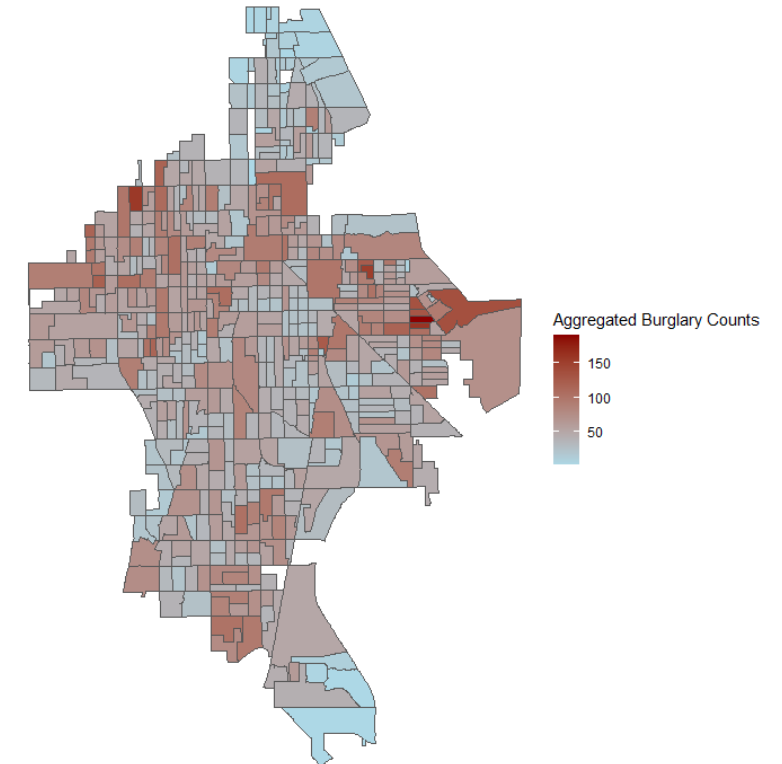


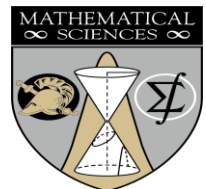
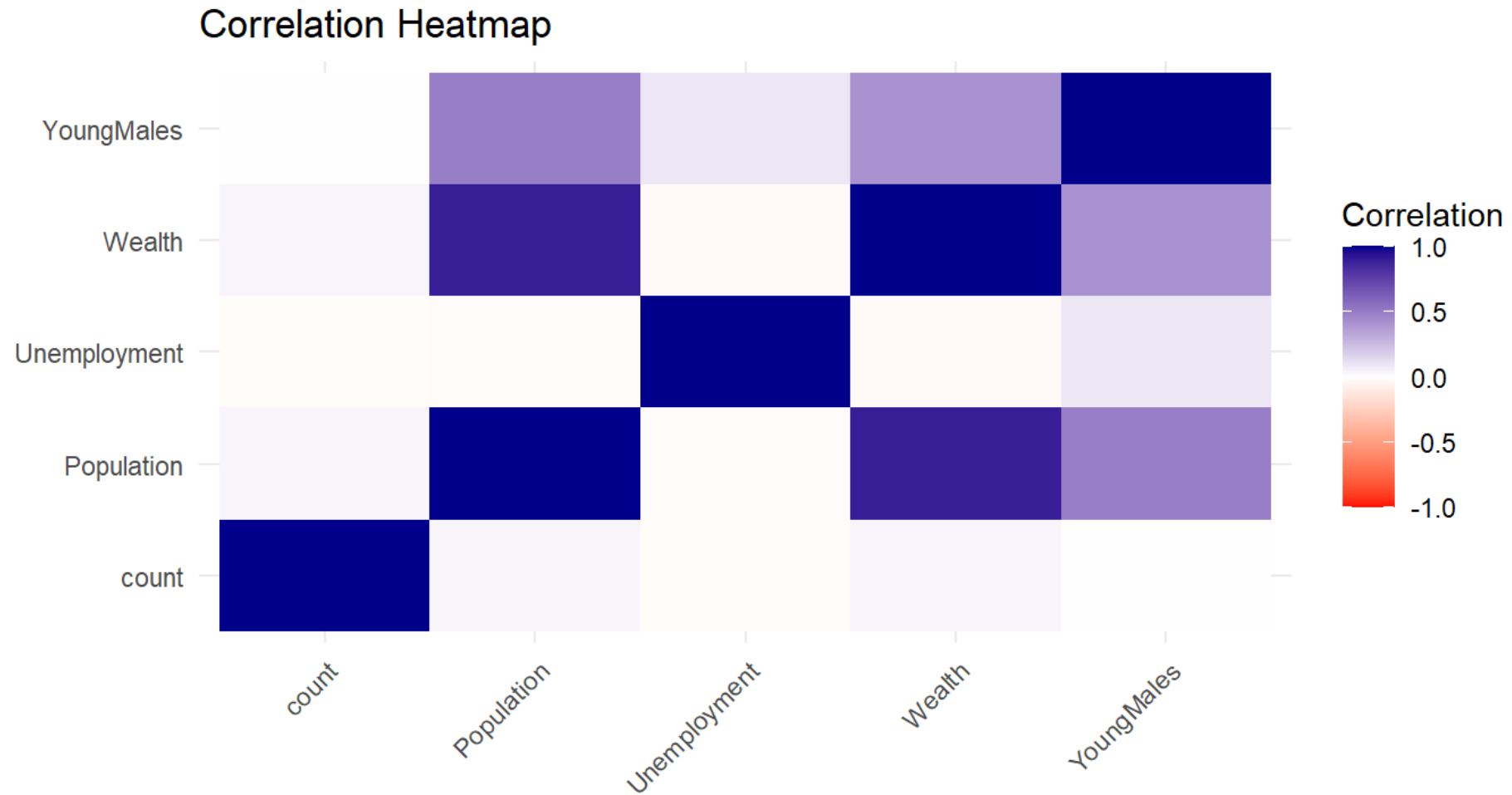


Total Burglaries Over Time in Chicago



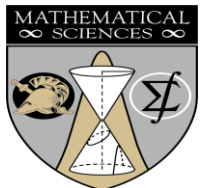
Burglary Counts by Census Block







- Time as a quantitative variable
 - By month
 - By year
 - With season represented by temperature
 - Represented by temperature
- Time as a random variable
 - AR1 correlation structure
 - Grouped by month
 - With year as a quantitative variable
- Location as a random variable
 - BYM model (block and county)
 - Uncorrelated error structure (block and county)
- Feature Extraction
 - Young male percentage
 - Number of unemployed
- Offsets for population
 - Offset for young male population
 - Offset for unemployed population





$$y_{ij} \sim \text{Po}(\lambda_{ij})$$

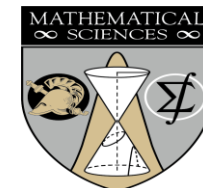
$$\log(\lambda_{ij}) = \eta_{ij}$$

$$\eta_{ij} = \log(\text{Pop}_j) + \beta X + u_i$$

$$X = \begin{bmatrix} \text{Unemployment Proportion}_j \\ \text{Wealth}_j \\ \text{Young Male Proportion}_j \\ \text{Months since Jan 2010}_i \end{bmatrix}$$

$u_i \sim N(0, \sigma_u^2)$ is a random component for Census Block

Model 1: Random Effect by Location, quantitative variable for time, Offset for population. Covariates for wealth, unemployment, young male percentage





$$y_{ij} \sim \text{Po}(\lambda_{ij})$$

$$\log(\lambda_{ij}) = \eta_{ij}$$

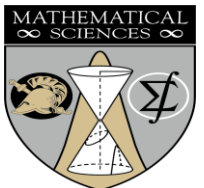
$$\eta_{ij} = \log(\text{Pop}_j) + \beta X + \gamma_j + u_t$$

$$X = \begin{bmatrix} \text{Unemployment Proportion}_j \\ \text{Wealth}_j \\ \text{Young Male Proportion}_j \\ \text{Months since Jan 2010}_i \end{bmatrix}$$

γ_j is the BYM Model

$$u_t = \Phi u_{t-1} + v_t$$

Model 2: Random Effect by Location with neighbors correlated (BYM?), offset for population, Covariates for wealth, unemployment, young males percentage, AR1 for time





$$y_{ij} \sim \text{Po}(\lambda_{ij})$$

$$\log(\lambda_{ij}) = \eta_{ij}$$

$$\eta_{ij} = \log(\text{Young Male Proportion}_j) + \beta X + u_t + \kappa_i$$

$$X = \begin{bmatrix} \text{Unemployment Proportion}_j \\ \text{Wealth}_j \\ \text{Pop}_j \\ \text{Months since Jan 2010}_i \end{bmatrix}$$

$\kappa_i \sim N(0, \sigma_u^2)$ is a random component for Census Block

$$u_t = \Phi u_{t-1} + v_t$$

Model 3: Random Effect by Location, offset for young male proportion, Covariates for cyclic time (monthly temperature), AR1 for time

