

# The Association of Crime Occurrence on Rates of Suspensions and Expulsions in Chicago Public Schools Using Poisson Regression

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## Motivation

- **Goal:**
  - ▷ To gain a better understanding of factors that may influence student expulsion
- **Steps:**
  - ▷ Investigate potential factors leading to student expulsion
  - ▷ Analyze the effects of the amount of violent crime in a school attendance boundary
  - ▷ Examine spatial effects of school attendance boundaries

## Model

### Count Data Modelled Using a Poisson Distribution

$$y_i \sim \text{Poisson}(\lambda) \quad (1)$$

### Priors for Beta and Alpha Parameters

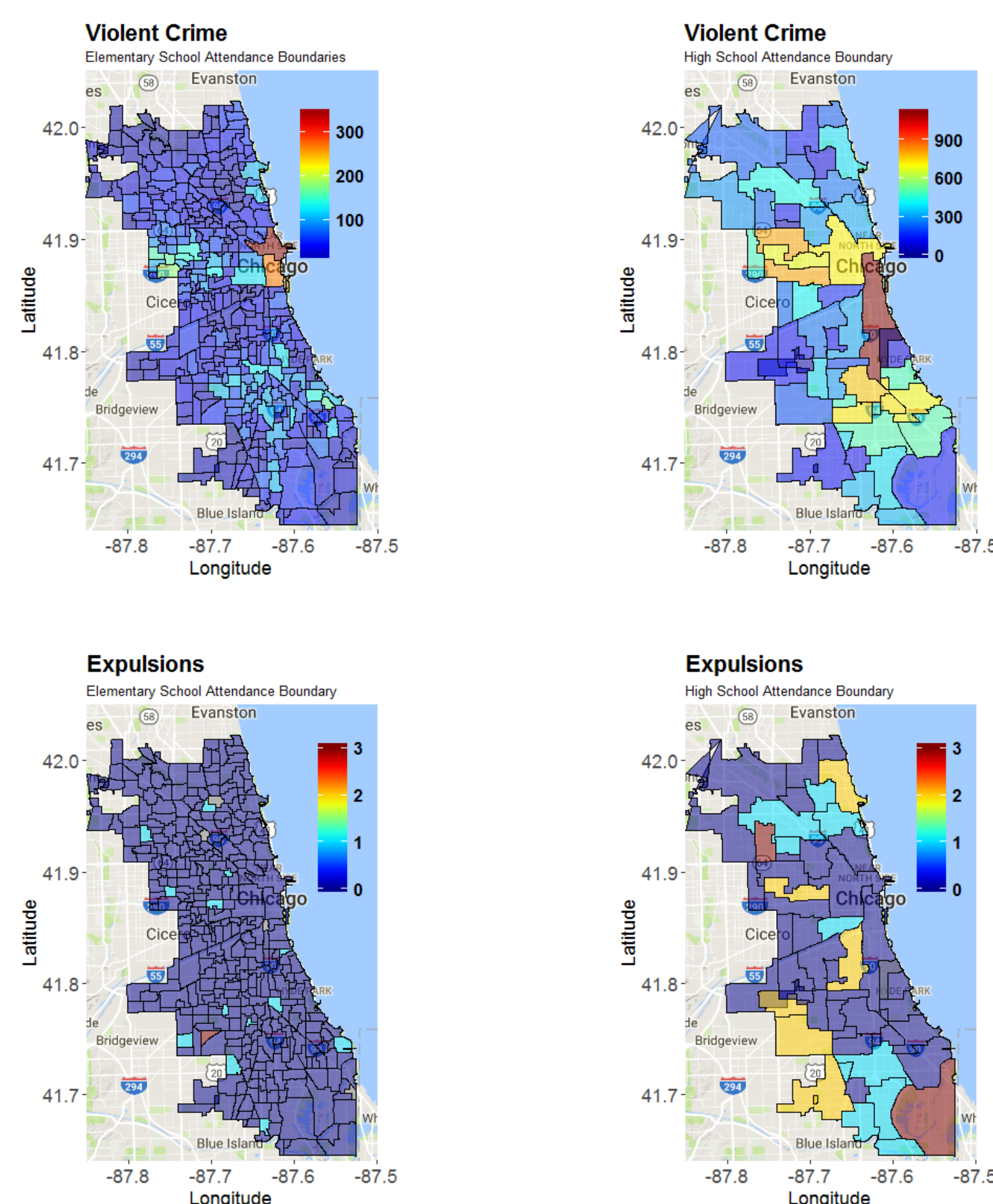
$$\begin{aligned} \beta_j &\sim \text{Normal}(0, 100) \\ \alpha_i &\sim \text{Normal}(0, 1000) \end{aligned} \quad (2)$$

### Negative Binomial and Generalized Pareto Distribution Double Hurdles Models

$$\begin{aligned} \log(\mu_i) &= \log(n_i) + \alpha_i + \mathbf{X}\beta \\ \mathbf{X}\beta &= \beta_0 + X_1\beta_1 + \dots + X_n\beta_j \end{aligned} \quad (3)$$

## Data

- Chicago Data Portal
  - ▷ Chicago Crime Records for the year 2015
  - ▷ Shapefiles for CPS attendance boundaries
- Chicago Public School Data from the CPS Website
  - ▷ Attendance records
  - ▷ Education quality scores
  - ▷ Standardized test scores
  - ▷ Suspension, expulsion, and misconduct information



## Model Variables and Results

### Response data:

Expulsions → Expulsions counts for each Chicago Public School

### Model Covariates covariates:

- Common Covariates
  - $\mathbf{x}_1 - \mathbf{x}_3$  = Ethnicity counts for schools; White, African American, Hispanic respectively
  - $\mathbf{x}_4$  = Number of misconducts per school
- Unique Elementary School Covariates
  - $\mathbf{x}_5$  = School quality score
  - $\mathbf{x}_6$  = PARCC average math score
  - $\mathbf{x}_7$  = PARCC English Language Arts average score
  - $\mathbf{x}_8$  = Crime counts based on school attendance boundary
- Unique High School Covariates
  - $\mathbf{x}_5$  = Average ACT composite score per school
  - $\mathbf{x}_6$  = Crime counts based on school attendance boundary
  - $\mathbf{x}_7$  = School quality score
- Spatial Random Effects are included for each model

### Elementary School and Crime Frequencies

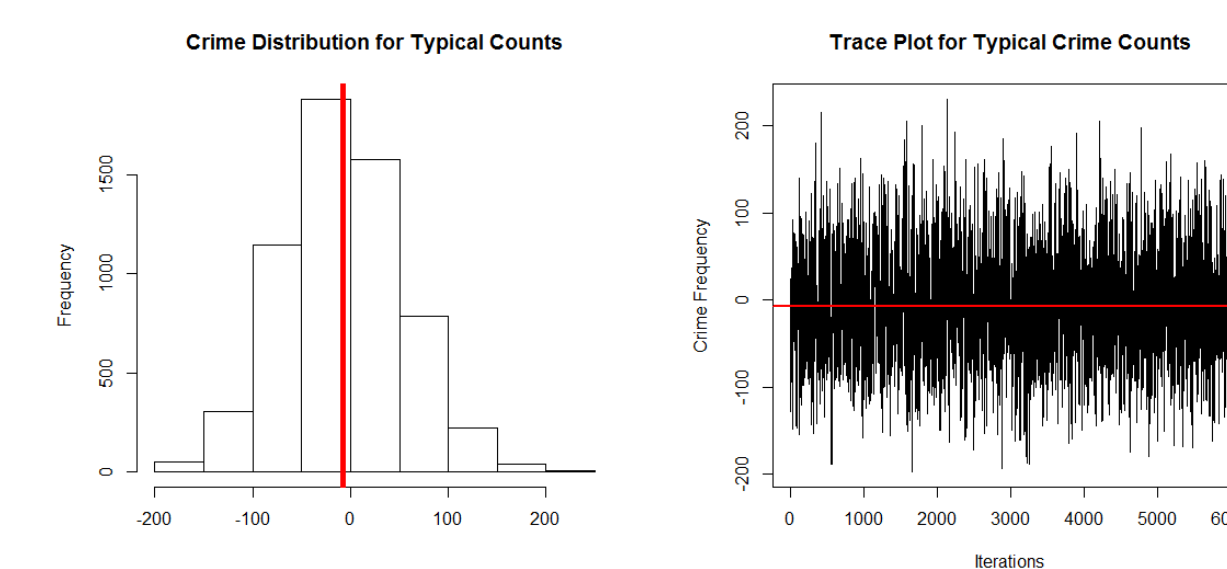


Figure: Expulsion Models for Elementary Schools

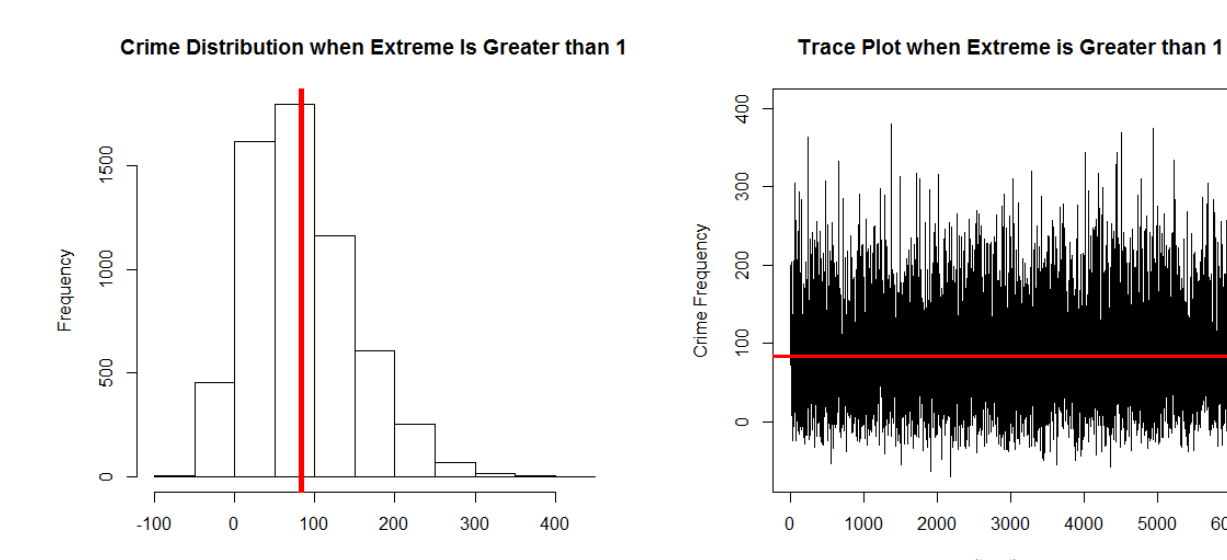


Figure: Suspension Models for Elementary Schools

### High School and Crime Frequencies

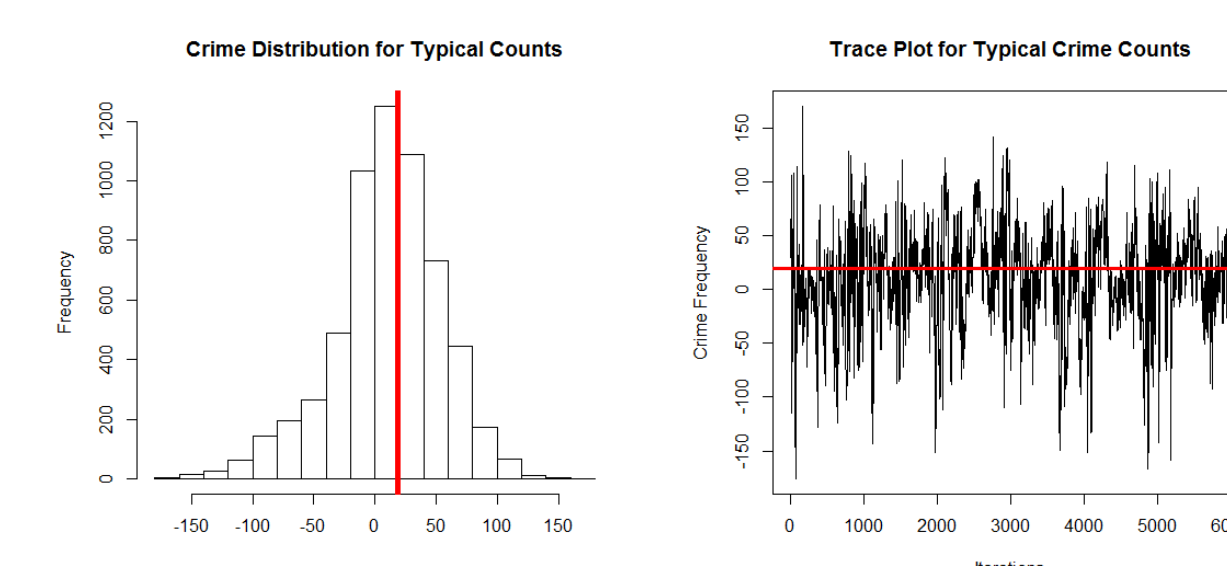


Figure: Expulsion Models for High Schools

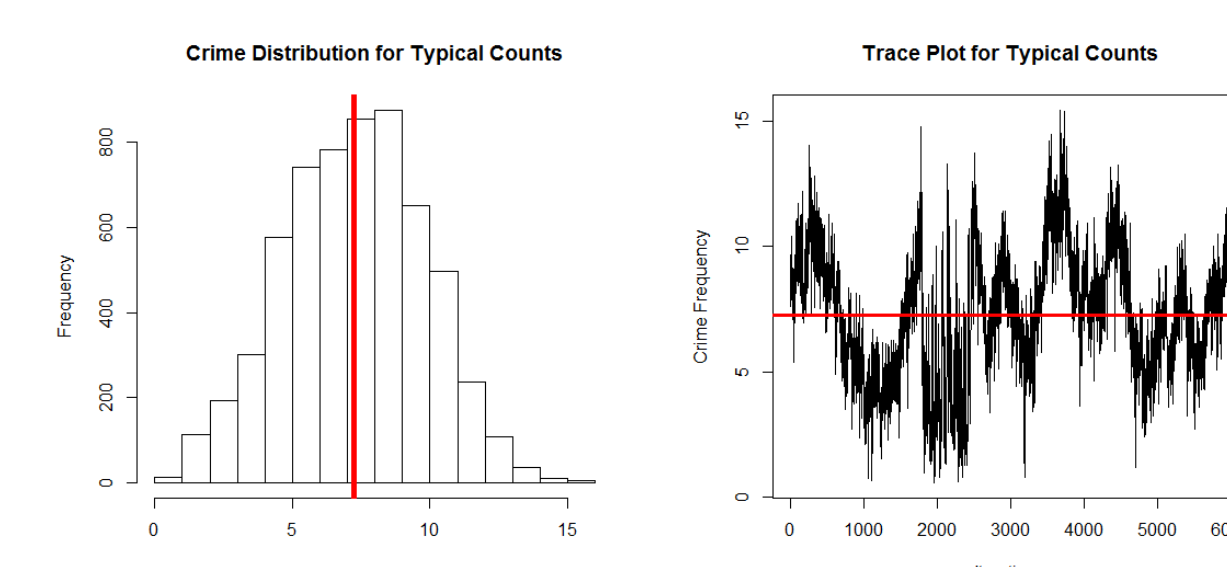


Figure: Suspension Models for High Schools

## Model Diagnostics

Model	DiC	CPO	PPO
1	189.0624	0.906428	0.910272
95	186.6292	0.906297	0.909889
Extreme	187.1526	0.90624	0.910572

Model	DiC	CPO	PPO
1	3891.406	0.009427	0.009448
95	3901.314	0.008998	0.009682
Extreme	3891.117	0.009428	0.009446

Figure: Elementary School Expulsion Diagnostic (left) and Suspension Diagnostics (right)

Model	DiC	CPO	PPO
1	399.6648	0.425075	0.445602
95	370.6124	0.422647	0.449454
Extreme	371.3801	0.430773	0.455491

Model	DiC	CPO	PPO
1	1140.971	0.010367	0.010546
95	1045.549	0.045831	0.060184
Extreme	1135.263	0.015739	0.01652

Figure: High School Expulsion Diagnostic (left) and Suspension Diagnostics (right)

## Discussion of Results

- Demographics
  - ▷ These factors were mostly insignificant
  - ▷ A couple were barely significant in a couple models, however overall not very important
- Test Scores
  - ▷ Test scores were used to look at student performance and were used as a proxy for student motivation
  - ▷ Most significant when modelling the mean number of non-zero expulsion counts
- Misconducts
  - ▷ The number of misconducts was significant in the majority of the models run. This is expected, as with the more misconducts we expect more suspensions and expulsions
- Quality Scores
  - ▷ A quality score provided by CPS for each school
  - ▷ Found to be insignificant in the majority of the models
- Violent Crime Frequency
  - ▷ Crime frequency was found to be significant for both suspensions and expulsions for most of the models
  - ▷ For most cases, it was found to be a positive relationship between the amount violent crime and the number of suspension and expulsions
- Spatial Random Effects
  - ▷ This variable examined whether the occurrence of a crime in one school boundary influenced crime in a neighboring school boundary
  - ▷ Found to be almost completely insignificant, implying there are not spatial influences between schools

## Future Considerations

- Consider temporal factors as potentially affecting suspensions and expulsions
- Consider more types of crime than just violent crime
- Consider physical distances of crimes to a school

## Acknowledgements

- Software Used: . (www.r-project.org)
- Data obtained from the Chicago Data Portal and Chicago Public Schools Data Page
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