

Does Urbanisation Predict Election Outcomes?

A Bayesian's Perspective

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Introduction

- **Research Question:** How does urbanization of a particular district affect result of an election in the US?
- **Variable of Interest:** Winning party in the House of Representatives 2022 General Election (binary)

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Dataset

We wanted to consider different factors in the analysis, with our primary focus being the urbanization of each House district. These factors included:

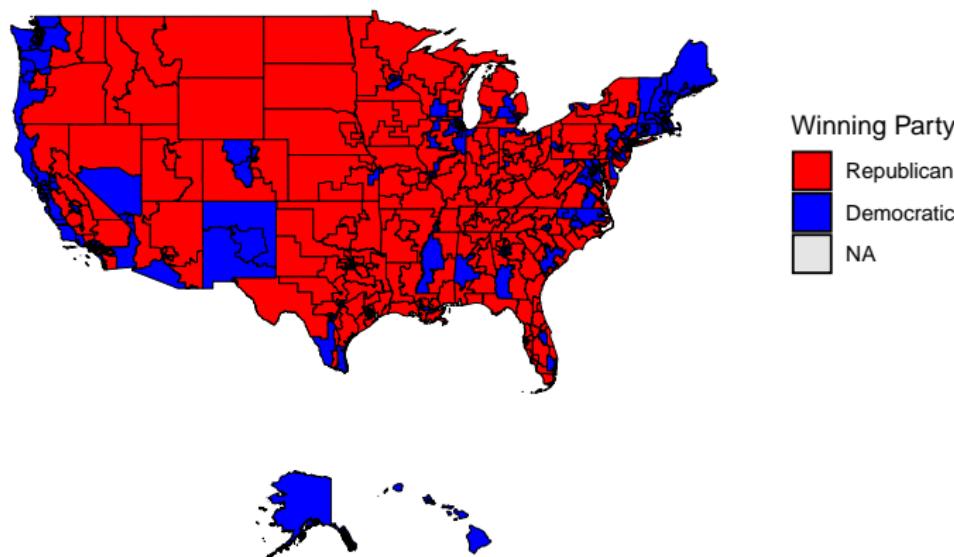
- ① Demographic Data (US Census Bureau)
- ② Urbanization (FiveThirtyEight)
- ③ Regional Information (US Census Bureau)
- ④ Election Results (FiveThirtyEight)

We combined different sources in order to create our data set containing 435 instances of 16 unique covariates.

Winning Party

Our independent variable is Winning party in the 2022 Election.

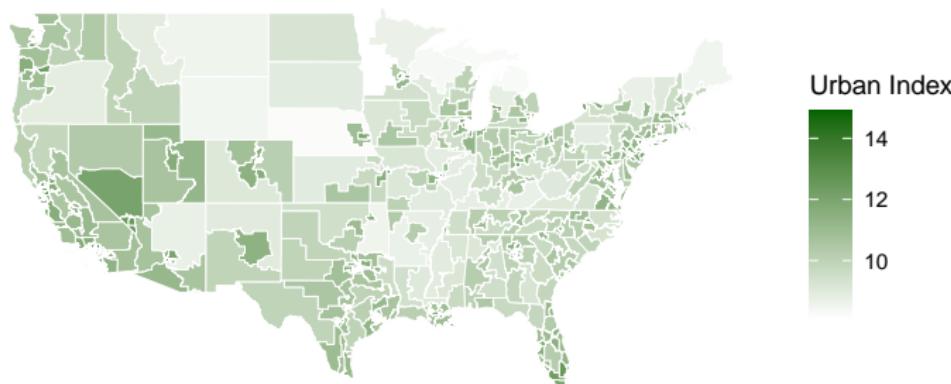
Winning Party by Congressional District



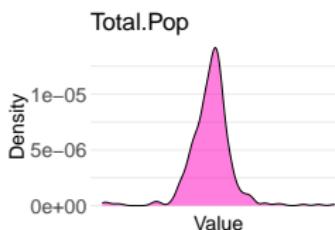
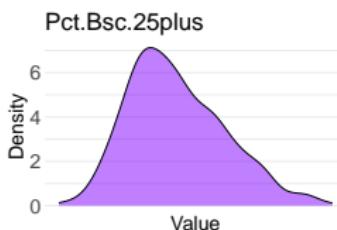
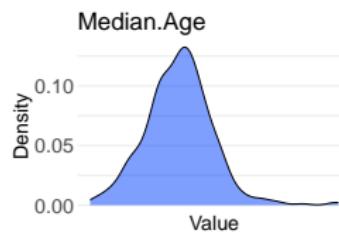
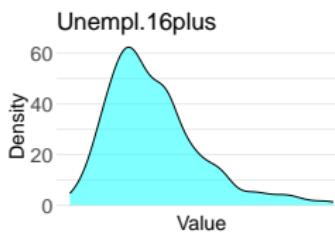
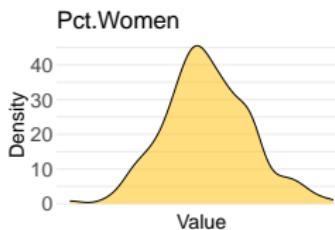
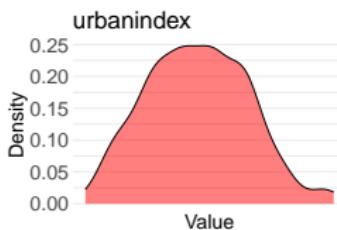
Urban Index

Our dependent variable of interest is the Urban Index from FiveThirtyEight.

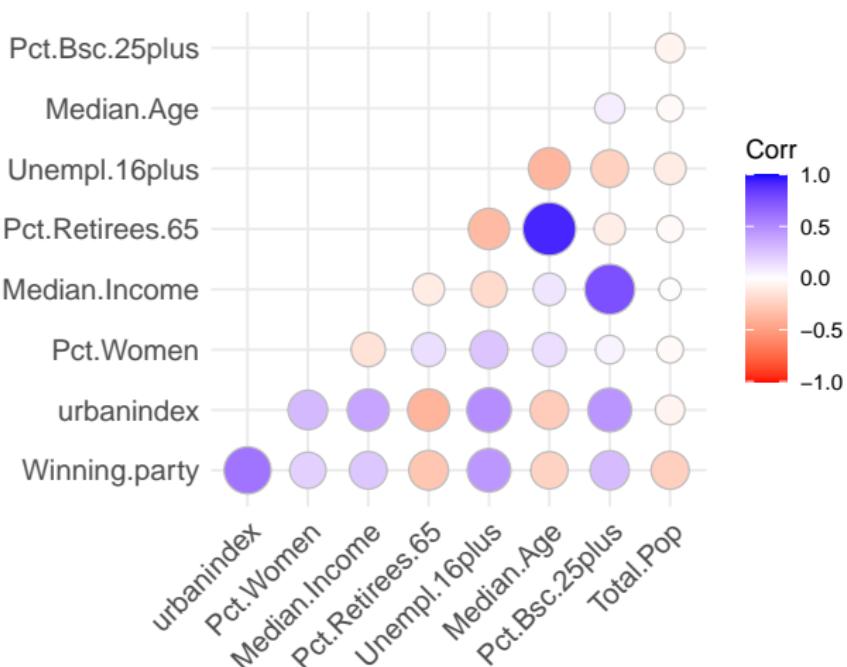
Urban Index by Congressional District



Densities



Correlation Matrix



Motivation for Hierarchical Modelling

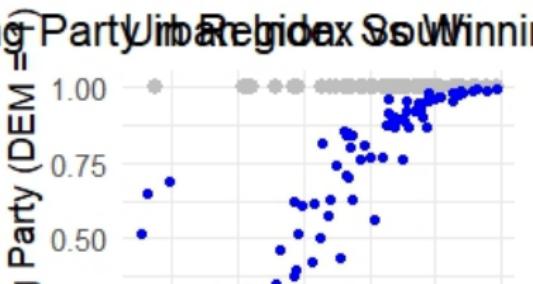
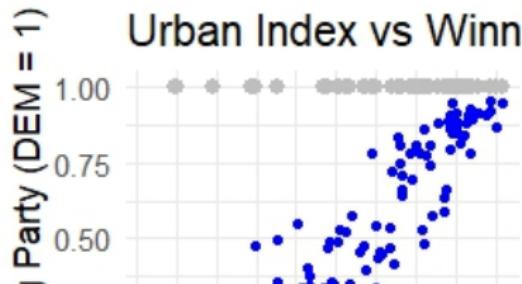
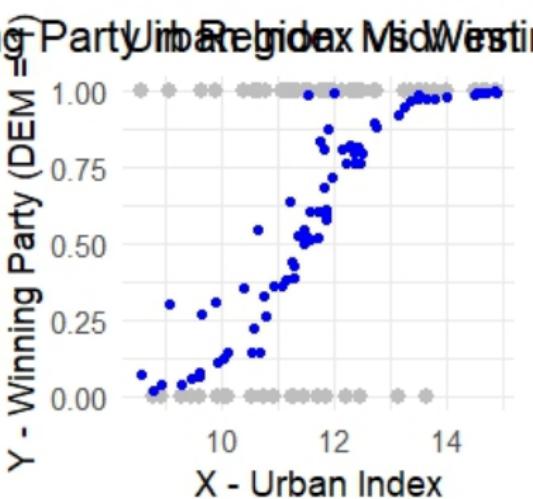
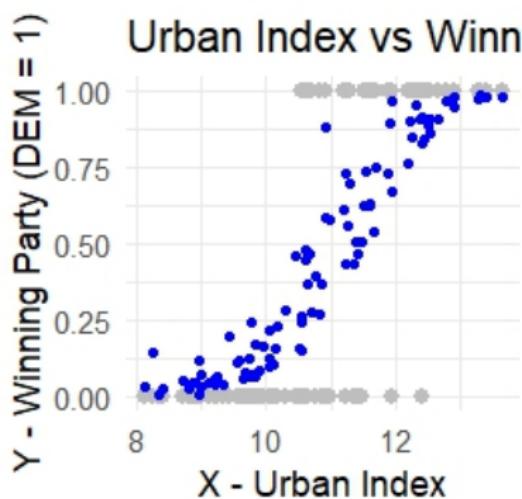


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Model Assumptions

There are many people trying to predict US election outcomes, from the wealth of data available about voters. However we wanted to look at the voters in relation to their geography. In order to do this we assumed

- District voting outcomes can be modeled via logistic regression
- Districts are exchangeable within each state and each state is exchangeable within its region
- ???

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Model 1

Let the response variable 'Winning Party' be y , the predictor of interest 'Urban index' be x , and the other covariates be a 15-dimensional vector z . Let i , j , and k be the indices for the district, region, and state respectively.

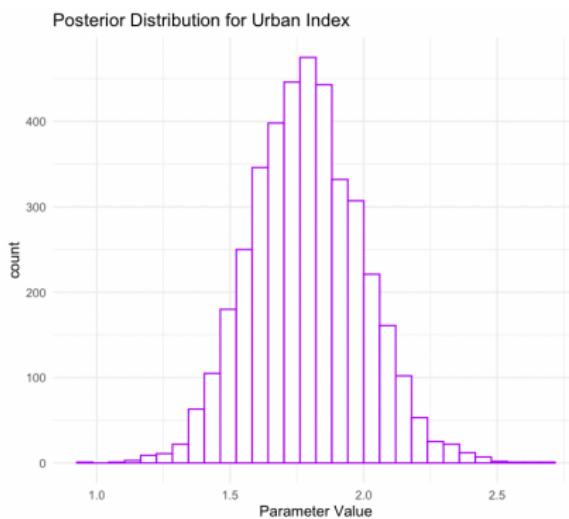
$$y_{i,j} \sim Ber.(logit^{-1}(\theta_j))$$

$$\theta_j := \beta_0, j + x_{i,j} * \beta_{1,j} + z_{i,j}^T * \gamma_{1,j}$$

$$\beta_{1,j} \sim Gam.(1, \tau)$$

$$\tau \sim Normal(0, 1)$$

Model 1: Results



Regression Coefficients:

	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS	
Intercept	-18.00	2.52	-22.94	-13.01	1.00	2713	2434	
urbanindex	1.79	0.21	1.40	2.20	1.00	3427	2864	
Percentage.Women	0.08	1.01	-1.94	2.08	1.00	7100	2504	
pct.bach	0.35	1.67	-2.87	4.51	1.00	3277	1433	
Median.Household.Income	-1.37	0.76	-2.90	0.06	1.00	4236	3037	universität
pct.retirees	-3.84	4.41	-15.57	0.97	1.00	2060	1858	

Model 2

Model 2: Results

Model 3

Model 3: Results

Model 4

Model 4: Results

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Model Comparison: R^2

Model	Estimate	Estimate Error	Q 2.5	Q 97.5
1	0.568	0.0246	0.516	0.612
2	0.534	0.0255	0.479	0.579
3	0.529	0.0255	0.474	0.574

Model Comparison: RMSE

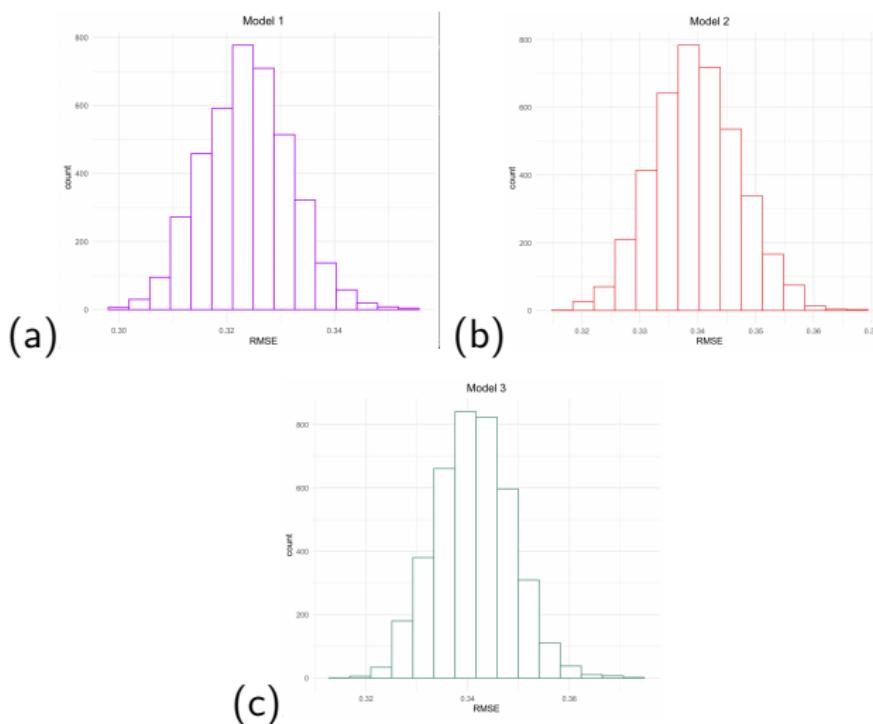


Figure: RMSE Comparison

Model Comparison: Data Log-likelihood

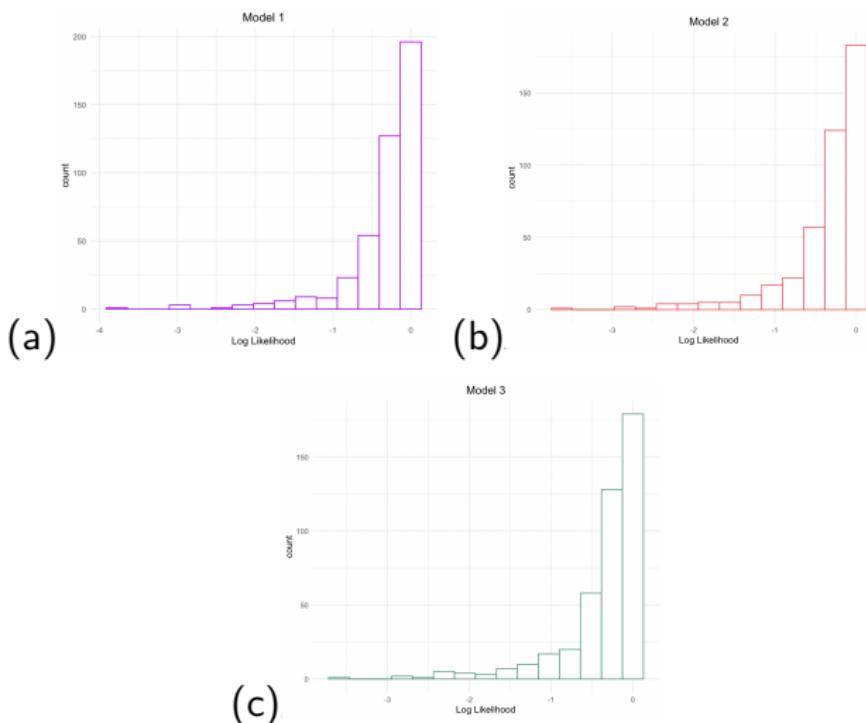


Figure: RMSE Comparison

Model Comparison: Posterior Distribution of Urban Index

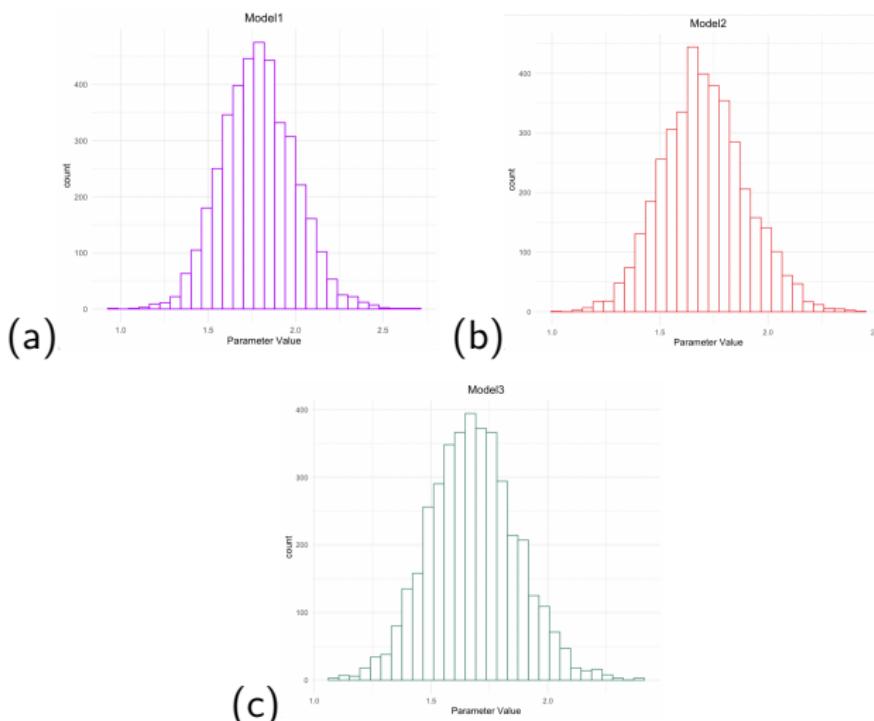


Figure: RMSE Comparison

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Alternative Priors

What's changed

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Raw references

- stargazer
- tidybayes
- brms, stan