

Spatial Analysis of Supporting Rate for Donald Trump in Wisconsin

Summary

This study investigates the factors and spatial pattern of the supporting rate for Donald Trump during the American Election of 2016 in Wisconsin. Based on our findings, indigenous and people live in urban area tend to dislike Trump. People who are white and living in rural areas have the highest proportion of voting for Trump.

Introduction

Donald Trump was elected be the new president of America in 2017, we are interested in whether there were spatial patterns of certain properties like race or population density for Trump's supporters in Wisconsin. Data is provided by Harvard Dataverse which contains precinct-level election results of 2016 and we selected the data of the state of Wisconsin for our study.

Method

Since we are doing analysis on a spatial dataset on the supporting rate for Trump in Wisconsin, then we implement a geostatistical analysis:

$$Y_i \sim \text{Binomial}(N_i, \rho_i)$$

$$\log[\rho_i/(1 - \rho_i)] = \mu + X_i\beta + U_i$$

$$U_i \sim \text{BYM}(\sigma^2, \tau^2)$$

$$\theta_1 = \sqrt{\sigma^2 + \tau^2}$$

$$\theta_2 = \frac{\sigma}{\sqrt{\sigma^2 + \tau^2}}$$

Y_i is the total number of Trump voters in county i , N_i is the number of voters in the Republican primary in county i . As voters have two choices either to vote for Trump or not, the outcome is binary from a finite number of sample. Then Y_i follows binomial distribution. ρ_i is the probability of voting for Trump in county i , and $\rho_i/(1 - \rho_i)$ is the odds voting for Trump. μ is the intercept term, and X_i is the covariates of all fixed effects that includes the log ratio of total population over surface area in square km for each county, proportion of each county who are white and the proportion of each county who are indigenous. β is vector of parameters corresponding to all fixed effects, and we use the default prior for β_0 with normal distribution of mean 0 and standard deviation ∞ , and $\beta_1, \beta_2, \beta_3$ with normal distribution of mean 0 and standard deviation 1000:

$$\beta_0 \sim N(0, \infty)$$

$$\beta_1, \beta_2, \beta_3 \sim N(0, 1000)$$

U_i is a spatial random effect of Besag, York and Mollie model, with a spatially structured variance parameter σ^2 and a spatially independent variance τ^2 . θ_1 is the marginal standard deviation with the prior distribution having a prior median with approximately exponential of $\log(2.5)$. θ_2 is the spatial proportion with the prior distribution having a prior median of 0.5 :

$$\text{Prob}(\theta_1 > \log(2.5)) = 0.5$$

$$\text{Prob}(\theta_2 > 0.5) = 0.5$$

Result and Analysis

Figure 1 displays the proportion of votes for Trump of each county in Wisconsin. The redder the colour is, the higher proportion of people in that county are in favor of Trump; the bluer the colour is, the lower proportion of people in that county vote for Trump. The white colour indicate the log ratios of the voters for Trump and his opponents are even. It can be tell that the majority people vote for Trump in Wisconsin, as the area covered by colours range from white to red significantly exceeds the area covered by colours range from white to blue. In addition, his non-voters are mainly located in top-left corner, bottom-right corner and south county under Madison City where coloured by dark blue. There is also a relatively small supportive rate for Trump in top-right county around Green Bay.

Similar interpretations for the grid colours can apply to Figures 2, 3, 4, 5, and 6. Figure 2 presents the population density, the corresponding bottom-right corner, and south county are colored by red, showing a heavily dense population. It may imply that people in densely-populated county tend to dislike Trump.

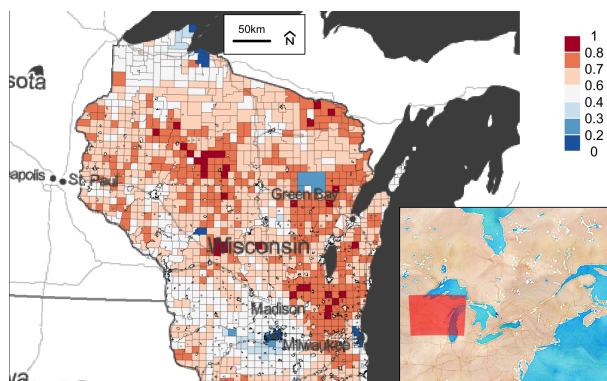


Figure 1: Votes Spatial Distribution

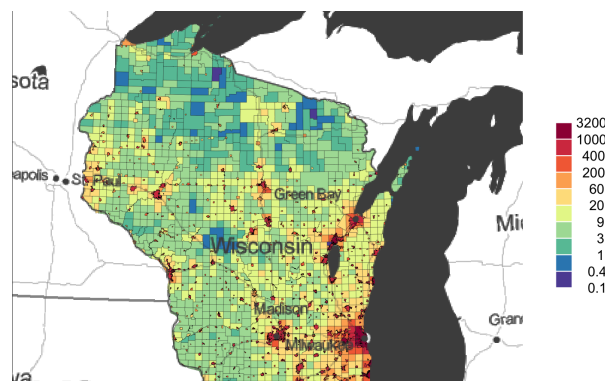


Figure 2: Population Density

The proportion of indigenous and white people spatial distribution can be seen from Figure 3 and 4. In Figure 3, the corresponding spaces of top-left corner and south county under Madison City

are colored by red, indicating that the proportion of indigenous people are high. It implies that indigenous people do not favor Trump. Conversely, the same areas plus bottom-right corner shown in Figure 4 are coloured by blue, meaning that the proportion of white people is relatively low in that county. It implies that Trump has more supporters around white people.

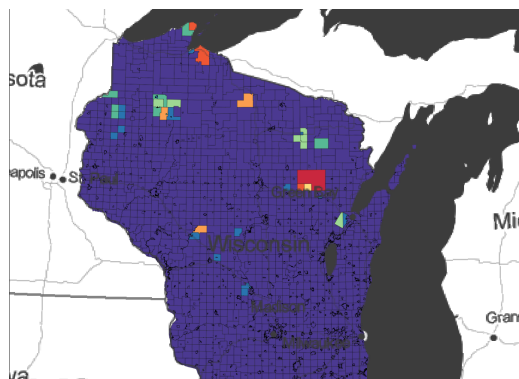


Figure 3: Proportion of Indigenous Spatial Map

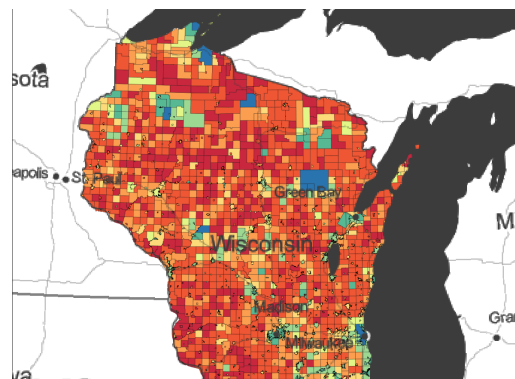


Figure 4: Proportion of White Spatial Map

Figure 5 and 6 below display the proportion of voting for Trump on the expected random effects $E(U|Y)$ and the expected fitted values $E(\lambda|Y)$ respectively. Generally, the random effects of Figure 5 show a higher proportion of voting for Trump than our model of Figure 6 predicts, as the overall color of Figure 5 is redder than Figure 6. Then it might be some other factors that effect people to vote for Trump that are not included in our random effect, and spatial patterns exist.

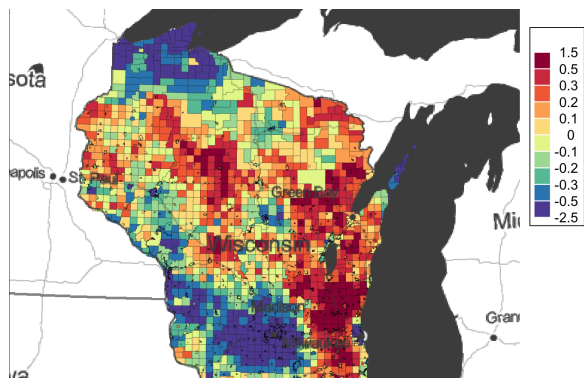


Figure 5: Proportion of Random Effect

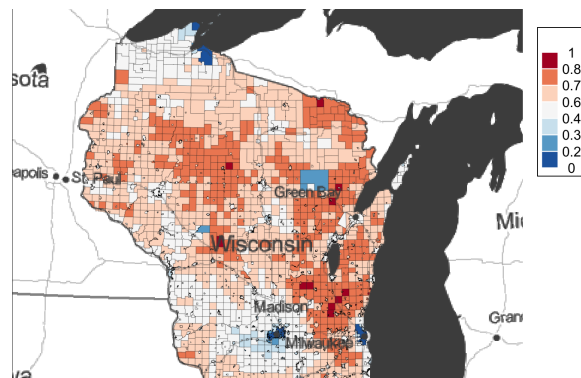


Figure 6: Proportion of Fitted Values

Table 1 gives means and quantiles of the odds ratios on the natural scale after taking the exponential. As the 95% for all parameter plus standard deviation of random effect and spatial dependence do not contain 1, all fixed and random effects are statistically significant. One standard deviation increases, the odds increases by 1.4 times before. When everything else stays the same, one unit increase in population density and indigenous will likely result to a 8% and 54.6% decrease separately of proportion of voting for Trump. One percent increase in white people, the odds of voting for Trump become 4.13 times before.

Table 1: Summary of Posterior Means and 95% Credible Intervals of Odds Ratios for Voting for Trump

	0.5quant	0.025quant	0.975 quant
(Intercept)	0.570	0.437	0.743
Population Density	0.922	0.914	0.930
Proportion of White	4.132	3.166	5.382
Proportion of Indigenous	0.454	0.322	0.640
SD of Random Effect	1.375	1.356	1.397
Spatial Dependence	2.612	2.502	2.680

In conclusion, Indigenous people tend to dislike Trump, and white people living in rural area will most likely favor Trump in the state of Wisconsin.