

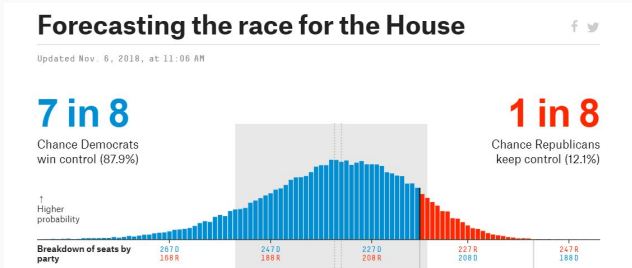
Multivariate Temporally Correlated Data Analysis

Analyzing the evolution of election race predictions

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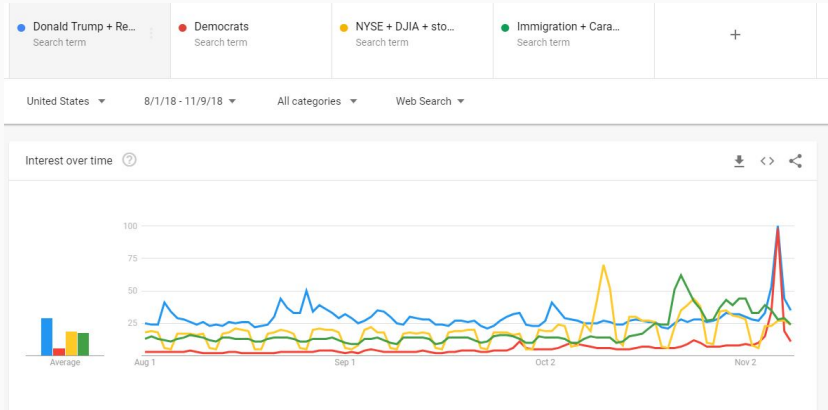
Stat 666 Project

Introduction



- Using polling and historical data, Fivethirtyeight.com provides a predicted vote share and probability of winning for every congressional race
- Releases new predictions each day, incorporating the latest polls

Introduction



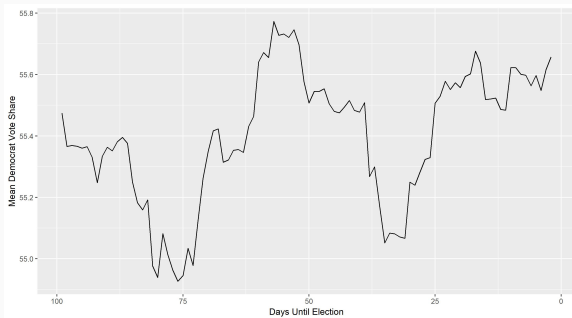
- Google trends allows you to track search frequency over time
- Measure relative interest in topics over time

Can we measure how trending topics in the news effect the forecast?

- Specifically, do trends in four main topics (Trump, immigration, the economy, and Democrats) explain variation in the predictions with regards to:
 - Average predicted vote share for a Democratic candidate?
 - Overall mean squared error between the predictions and actual results?
 - Overall calibration of probabilities of winning vs. who actually won?

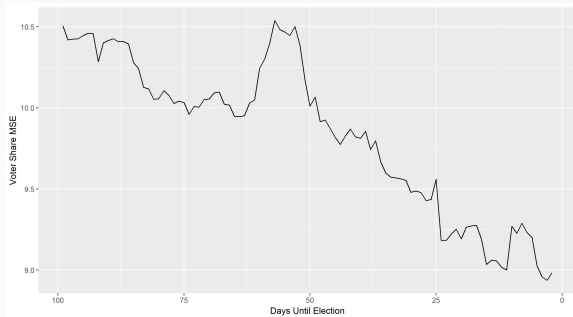
Average predicted vote share

As stories about Trump of "the caravan" spike, does that increase or decrease the predicted vote share for Democrats?



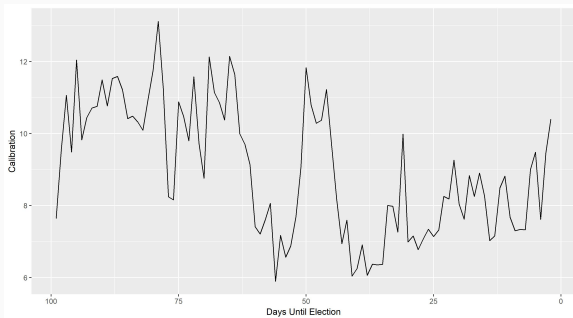
Prediction Accuracy

As stories about the stock market increase, does the accuracy of the forecast (as measured by MSE) increase or decrease?



Calibration Accuracy

Calibration is the idea that if you give 20 candidates a 10% chance of winning, close to two of them should win. I wrote a function that calculates the χ^2 goodness-of-fit statistic on binned probability intervals



Research Question

Given 98 days of these three different metrics leading up to the election, can we establish any relationship between the Google Trends data and the model's predictions during this window?

We will use a multivariate AR(1) to account for correlation in the response:

$$y_t = X_t\beta + \epsilon_t$$

$$\epsilon_t = \Phi\epsilon_{t-1} + \omega_t$$

$$\omega_t \sim MVN(\mathbf{0}, \Sigma)$$

Σ is a diagonal covariance matrix with unique variances on the diagonal.

X_t will include our three covariates, an intercept, and a linear time trend.

It seems reasonable that the Google Trends will have a delayed effect on the predictions. However, selecting lag time using AIC leads us to choose no lag.

Trend Lag	AIC
0	-101.3
1	-89.0
2	-83.8
5	-90.9

Fitting this model in R is a pain! Most packages fit:

$$y_t = \Phi y_{t-1} + X_t \beta + \epsilon_t \quad (1)$$

The MARSS package fits the model we specified, but is extremely finicky....

Term	$\hat{\beta}_{MLE}$	95% CI	
(DemShare,Intercept)	55.543	(55.369, 55.717)	*
(calibration,Intercept)	9.094	(7.016, 11.171)	*
(MSE,Intercept)	10.709	(10.511, 10.906)	*
(DemShare,Time)	-0.010	(-0.044, 0.024)	
(calibration,Time)	-0.039	(-0.093, 0.014)	
(MSE,Time)	-0.015	(-0.022, -0.007)	*
(DemShare,Stocks)	0.001	(-0.001, 0.002)	
(calibration,Stocks)	-0.012	(-0.041, 0. 017)	
(MSE,Stocks)	-0.002	(-0.004, -0.0002)	*
(DemShare,Democrats)	0.000	(-0.002, 0.003)	
(calibration,Democrats)	-0.015	(-0.060, 0.031)	
(MSE,Democrats)	0.001	(-0.002, 0.005)	
(DemShare,Immigration)	-0.001	(-0.003, 0.001)	
(calibration,Immigration)	0.018	(-0.012, 0.048)	
(MSE,Immigration)	-0.002	(-0.004, 0.001)	
(DemShare,Trump)	-0.001	(-0.003, 0.001)	
(calibration,Trump)	0.038	(-0.002, 0.078)	
(MSE,Trump)	0.002	(-0.001, 0.005)	

Parameter Estimates

	DemShare	Calibration	MSE
DemShare	1.02	0.00	-0.08
Calibration	0.24	0.55	-1.26
MSE	0.00	-0.01	0.89

Table 1: Loading Matrix for the autoregressive errors (Φ_{MLE})

	DemShare	Calibration	MSE
DemShare	0.0049	0.00	0.00
Calibration	0.00	1.2153	0.00
MSE	0.00	0.00	0.0065

Table 2: Covariance matrix for the ω errors (Σ_{MLE})

From the simulation study (see paper) we can make a few conclusions:

- Error estimates are biased extremely low
- Coverage of confidence intervals is bad EXCEPT
- Coverage of covariate parameters met expectations

Conclusion

- News trends do not have a clear relationship with 538's forecast
- MARSS is a really flexible but difficult to use package
- More common models might give you easier ways to make inference