# The Trump Score: Using Bayesian Analysis To Find How Likely the House and Senate Supports Trump

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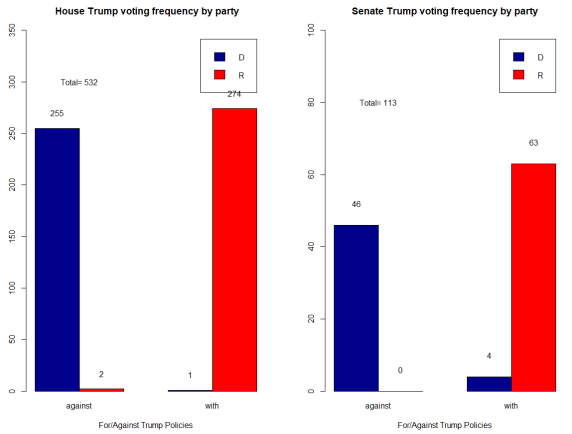
## 1 Introduction

The popular political data website FiverThirtyEight created a metric known as the "Trump Score" which ranked house and senate members by the likelihood that they would represent the same position as Donald Trump in bills and joint resolutions. This value was calculated based on historical data of these political members. It is explained that to calculate the Trump Score, "add the member's 'yes' votes on bills that Trump supported and his or her "no" votes on bills that Trump opposed and then divide that by the total number of bills the member has voted on for which we know Trump's position"[1]. To prepare the data for the model, data was scrapped from Bycoffe and Silver's dataset on the website and split into a dataset for congress and house members. The Trump Score was converted into a dichotomous variable where a score of 50% or higher would result in said member supporting Trump and anything below that threshold being against Trump. A hierarchical model was built on top of both the house and senate dataset split by party affiliation (independents were removed). Using Bayesian analysis, our model should predict the likelihood of a house or senate member supporting Donald Trump's policies and also show the likelihood of them supporting Trump within their own party lines.

## 2 The Data

The data we are using contains party member affiliation and an indicator variable named "Approval" indicating a 0 if a member was likely to support Trump or a 1 if they did not support Trump. Below are two bar plots representing the distribution of votes in house and senate by party affiliation. Each plot shows the frequency of members in each party who agree or are against Trump as well as the total members for each group of house and senate.



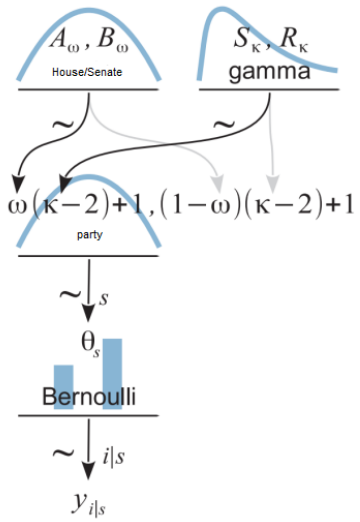

Frequency of members who support Trump's position by party

[1] (Bycoffe 2017)

As we can see, the party affiliation is heavily biased in whether or not a member of congress/house will support Trump. For the house, republicans slightly outnumber democrats and nearly all of them support Trump on most of his policies. Only 1 democrat in the house is likely to support Trump's stances. The distribution of party members in senate is a lot more skewed in the republicans favor. All of republicans and even 4 members of the democratic party in the senate are likely to support Trump's stances. Based on this information, it is clear that both the house and senate are more likely to be in support of Donald Trump. It is also clear that party lines are almost a guaranteed determining factor in whether someone will support Trump.

# 3 The Model

Our model is concerned with finding the overall probability that the house or senate will support Donald Trump on his political stances as well as finding how likely a person within house or senate will support Trump based on their party affiliation. We are using a software package known as JAGS (Just Another Gibbs Sampler) to build our model. Below is a diagram representing the model that is passed to JAGS.




Bayesian hierarchical model for building distribution over house/senate by party

Our model first samples from a beta distribution with the parameter $\omega$ representing the overall chance a house/senate member will support Trump and a $\kappa$ parameter representing the variance within the parties (it will be very small due to party differences). From those two parameters, we build a beta distribution on party affiliation which will predict the likelihood of a party member supporting Trump.

## 3.1 Prior distribution parameters

We have two separate prior distributions representing both house and senate. For our $\omega$ prior, it is defined as a beta distribution with parameters $a$ and $b$ representing democrats and republicans respectively for both of our house and senate models. For example, there are 256 democrats and 276 republicans in house, thus the prior for our house $\omega$ is defined as **dbeta**(256,276). For our $\kappa$ prior, it is set to an arbitrarily small number close to 1. This is because we can see a clear difference between the two party affiliations.

# 4 The Posterior

## 4.1 MCMC Diagnostics

We can ensure the accuracy of our posterior distributions due to our MCMC diagnostics. Each of our chains' metrics satisfy the assumptions which provide evidence showing that the chains converged correctly.

The chains' all showed random behavior during the run period. All of our chains' auto-correlation and shrink factors converge towards 1 and 0 respectively and our density plots show tightly clustered distributions. If you would like see the diagnostic maps, please refer to the code.

## 4.2 Establishing ROPE parameters

Considering we are predicting whether a random member in house or senate will support Trump's political stance on a topic, the difference between a 50% chance and a 49% chance is significantly different. Based on our scale, anything above a 50% chance means a member will not support Trump's stance. Because both house and senate are dominated by republicans, we assume that members are more likely to support trump. Therefore, it is reasonable to set a rope value at the 49% value mark and the bounds extend 0.9% to the left. When comparing the two parties, we set a ROPE value of -1 since members who support/are against Trump are for the most part exclusively republican or democrat respectively. The bounds of the ROPE are set to 0.1 in either direction of the ROPE value.

## 4.3 Simulation results

After running the simulation, we obtained a posterior distribution representing the likelihood of house and senate members have in supporting Donald Trump's political stance. We have also obtained he likelihood of someone supporting Trump based on their party affiliation within house and senate. Below is the resulting posterior distributions of our top level model and party affiliation within house/senate:

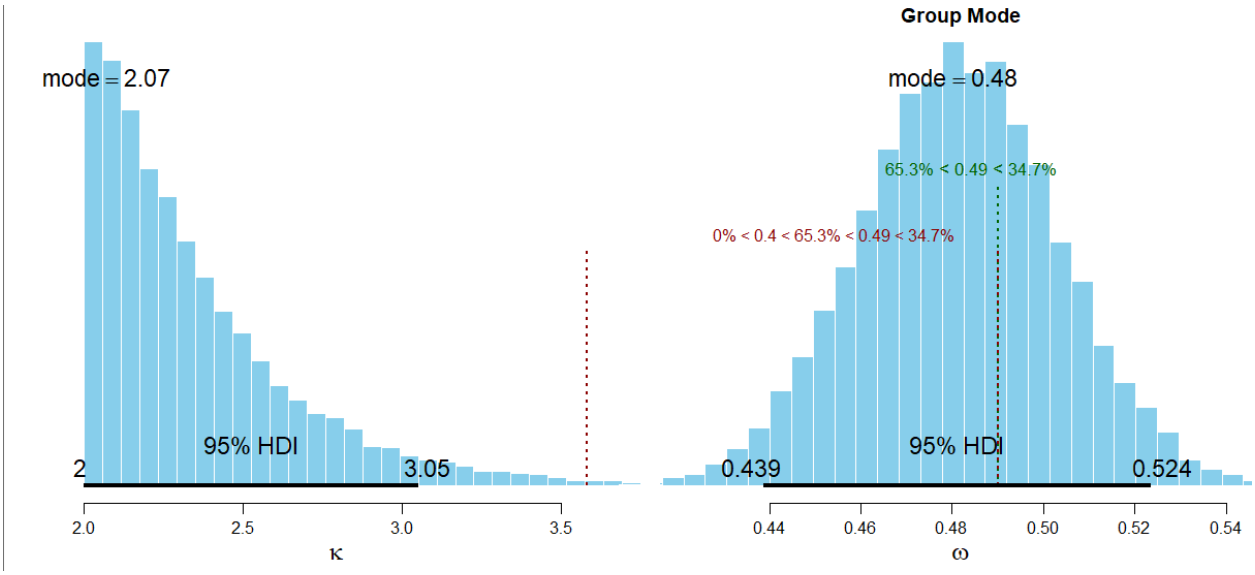



Figure 1: Likelihood of house to vote against Trump

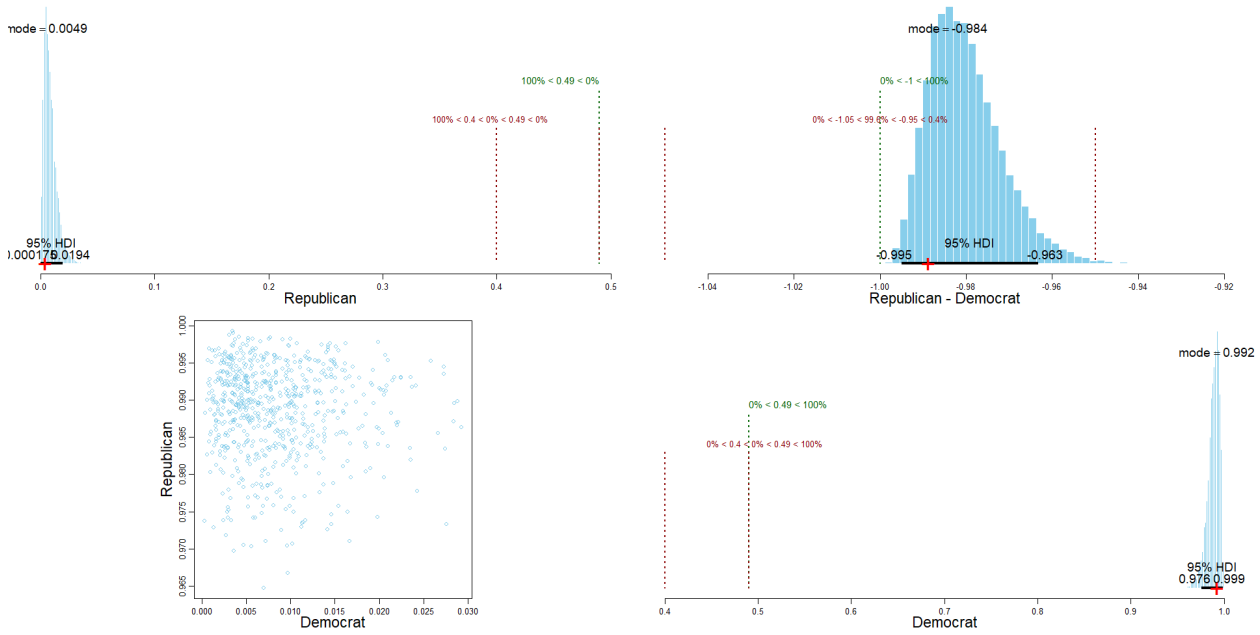



Figure 2: Posterior of house by party

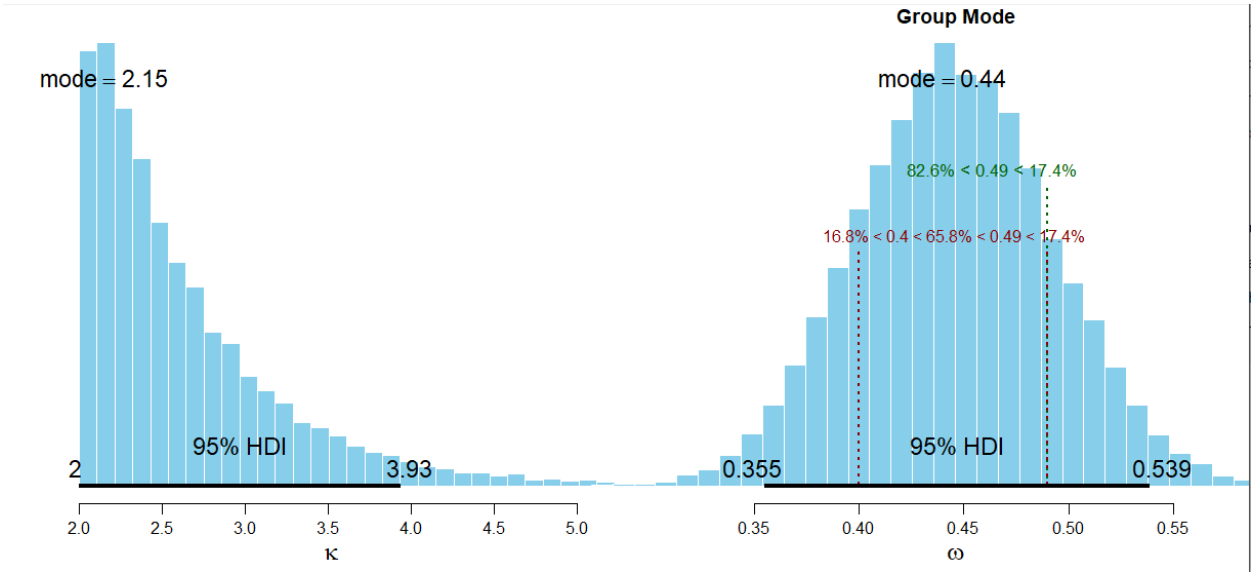



Figure 3: Likelihood of senate to vote against Trump

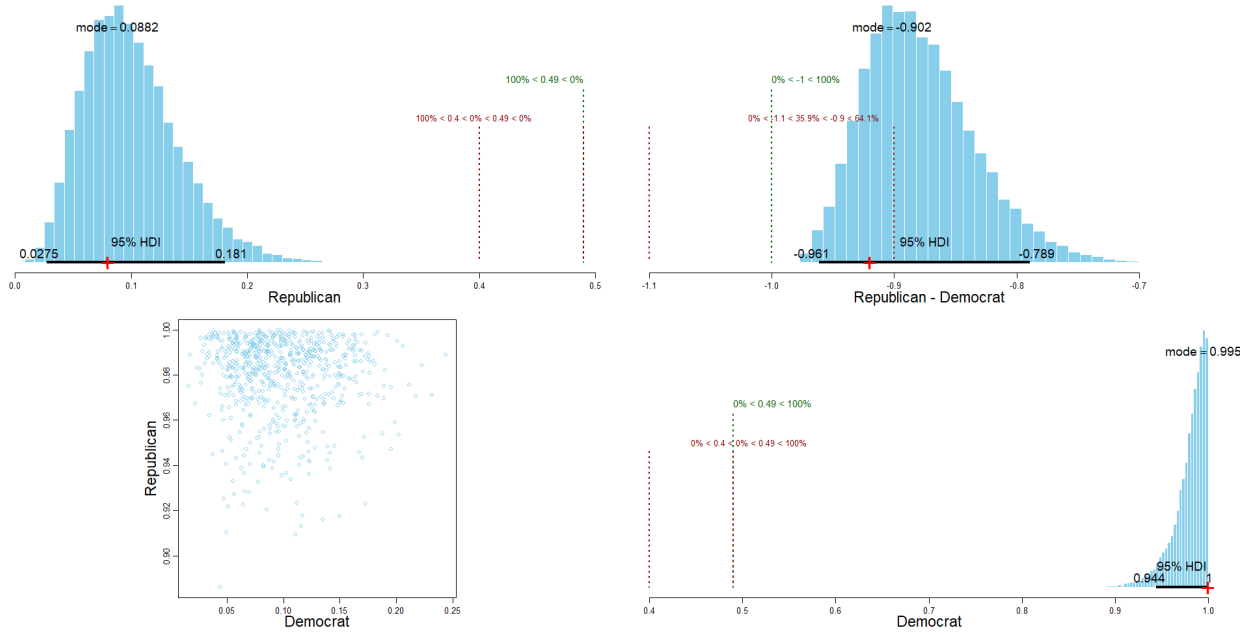



Figure 4: Posterior of senate by party

### 4.3.1 House results

Based on our prior distribution of our $\omega$ parameter, it is most likely that there is a 48% chance that any random house member will vote against trump. The HDI ranges from 0.524 to 0.439, meaning that it is still credible to think that the house majority could vote against Trump. Our established ROPE bounds fall within the HDI, confirming that our hypothesis that the house is likely to support Trump cannot be rejected. Our $\kappa$ parameter is small with the mode being 2.07. This confirms the fact that the variance between the two parties is large.

While analysing the posterior distributions of the two parties within the house, we can see that Republicans have a 4.9% chance to not support Trump (or a 99.5% chance to support him). The 95% HDI spans from a range of 0.0194-0.00175 (a range of 0.01765) which is an extremely small margin. On the other hand, Democrats are most likely to have a 99.2% to vote against Trump with a 95% HDI ranging from 0.976-0.999. This HDI range is slightly larger than the republicans and suggests that the Democrats have a higher chance to flip sides. The plot in the upper left corner shows that there is nearly a 100% difference between the Republicans and Democrats in their support for Trump. It is not exactly 100% since our 95% HDI does not include -1 in its range. It does however, fall within our ROPE bounds.

### 4.3.2 Senate results

Based on our prior distribution of our $\omega$ parameter, it is most likely that there is a 44% chance that any random senate member will vote against trump. The HDI ranges from 0.355 to 0.539, meaning that it is still credible to think that the senate majority could vote against Trump. Although it would seem that based on the data for senate, the HDI for our $\omega$ should be tighter than the house given that the party lines were basically the same as whether or not a member supported Trump, we had a smaller sample size for our distribution to sample from. Our established ROPE bounds fall within the HDI, confirming that our hypothesis that the house is likely to support Trump cannot be rejected. Our $\kappa$ parameter is small with the mode being 2.15. This confirms the fact that the variance between the two parties is large.

While analysing the posterior distributions of the two parties within the senate, we can see that Republicans have a 8.82% chance to not support Trump (or a 91.18% chance to support him). We would expect this value to be higher since all republicans in the senate are were in support of Trump, but this too is also caused by the smaller sample size and shrinkage of the model. The 95% HDI spans from a range of

0.0275-0.181 (a range of 0.1535) which is a slightly larger margin than what we had for house republicans. On the other hand, Democrats are most likely to have a 99.5% to vote against Trump with a 95% HDI ranging from 0.944-1 which is a tighter range than the republicans. This HDI range suggests that there is a chance that democrats in the senate will only vote against Trump. The plot in the upper left corner shows that there is nearly a 100% difference between the Republicans and Democrats in their support for Trump. It is not exactly 100% since our 95% HDI does not include -1 in its range. It does however, fall within our ROPE bounds

# 5 Conclusion

It is clear that support for Donald Trump is completely split by bi-partisan lines. The fact that republicans dominate the majority of the house and the senate shows that both institutions are likely to support Trump. It is clear that our results may not be completely accurate. This is evident in our posterior for senate republicans considering that all republicans in the senate were likely to support Trump. We can attribute inconsistencies in our model due to shrinkage from the hierarchical model and small sample sizes however, our $\kappa$ parameter for both models are quite small. To conclude, party affiliation is practically a determining factor in whether or not a member of house or senate will support Trump.

# References


[1] Bycoffe, Aaron. "Introducing The Trump Score." FiveThirtyEight, FiveThirtyEight, 30 Jan. 2017, fivethirtyeight.com/features/introducing-the-trump-score/.

[2] Bycoffe, Aaron, and Nate Silver. "Tracking Congress In The Age Of Trump." FiveThirtyEight, 26 Mar. 2020, projects.fivethirtyeight.com/congress-trump-score/?ex$_c id = irpromo$.