Universitat Rovira i Virgili

Master in Artificial Intelligence

Complex Networks

# A5. Project
## The Affinity of Votes per Party/State

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# Contents

# 1 Introduction

In Brazil, the Legislative Power is constituted of two chambers: the Deputies and the Federal Senate. Together, the two Houses make up the National Congress and have specific functions defined in the Federal Constitution. The main one is the elaboration, the debate, and the approval of laws.

The number of seats of deputies per State is distributed according to the number of inhabitants per State, according to the official measurement made by the IBGE[1], through the Census.

Unlike the USA, in which the deputies vote independent from the party, in Brazil, the deputies rarely vote against the party's direction. In this way, the goal here is to show the ideological relationship by party and State, not by deputy.

Two networks were created: one with pairs of votes per party and another network with the pairs of votes from states represented by deputies.

[1]Brazilian Institute of Geography and Statistics

# 2 Networks

## 2.1 Data Fetching

Like most problems with network analysis, getting the data is one of the most challenging steps. Fortunately, the data from the government is being made more accessible to the citizen through transparency laws. According to the Open Data Barometer[1], Brazil has jumped 15 positions (since the first edition) in the ranking that measures how governments are publishing and using the data for social impact, accountability, and innovation.

| Country | Score OUT OF 100 | Score Change SINCE FIRST EDITION | Score Trend OVER PAST EDITIONS | Readiness OUT OF 100 | Implementation OUT OF 100 | Emerging Impact OUT OF 100 |
|---|---|---|---|---|---|---|
| Canada See details | 76 | 18 ▲ | | 86 | 87 | 55 |
| United Kingdom See details | 76 | -4 ▼ | | 83 | 89 | 57 |
| Australia See details | 75 | 17 ▲ | | 79 | 84 | 62 |
| France See details | 72 | 17 ▲ | | 84 | 77 | 55 |
| Korea See details | 72 | 25 ▲ | | 82 | 67 | 67 |
| Mexico See details | 69 | 33 ▲ | | 79 | 67 | 62 |
| Japan See details | 68 | 24 ▲ | | 78 | 68 | 58 |
| New Zealand See details | 68 | 5 ▲ | | 79 | 72 | 52 |
| United States of America See details | 64 | -11 ▼ | | 79 | 76 | 37 |
| Germany See details | 58 | 2 ▲ | | 76 | 72 | 27 |
| Uruguay See details | 56 | 23 ▲ | | 71 | 70 | 28 |
| Colombia See details | 52 | 25 ▲ | | 69 | 60 | 28 |
| Russia See details | 51 | 10 ▲ | | 62 | 59 | 32 |
| Brazil See details | 50 | 15 ▲ | | 63 | 56 | 30 |
| Italy See details | 50 | 8 ▲ | | 61 | 61 | 27 |
| India See details | 48 | 16 ▲ | | 64 | 49 | 32 |

Figure 1: Brazil data openness increased since first edition.

To get the data of the parties, deputies, and votes, the APIs of the government website *dados abertos* footnote`www2.camara.leg.br/transparencia/dados-abertos/dados-abertos-legislativo` were used. Unfortunately,

there is not a single API that can be called in batch to decrease the number of calls. The APIS (url base https://www.camara.leg.br/SitCamaraWS/) used were:

- All political parties available and their ids and details: Deputados.asmx/ObterPartidosCD
- All law propositions, given a year: Proposicoes.asmx/ListarProposicoesVotadasEmPlenario
- The votes for each proposition's sessions: Proposicoes.asmx/ObterProposicaoPorID
- Details for each deputy: Deputados.asmx/ObterDetalhesDeputado

For this experiment, the range of years that the votes were fetched was between 1991 and 2019.

The number of political parties retrieved was 56, including the ones that are not active anymore.

There were retrieved 1350 law propositions, with 3519 voting sessions and more than one million and seven hundred thousand individual votes.

There were also fetched 2593 deputies with all details.

This fetching procedure time is prolonged when fetching the individual votes for each session, and it took almost 8 hours of processing.

### 2.1.1 Pickle Files

In order to save all this information that was retrieved from the web APIs, the data was serialized and saved in a pickle[2] format. Four pickle files were created:

- parties.pickle - contains the political parties information and details
- propositions.pickle - contains the law propositions details

[2]Python module for serializing and de-serializing a Python object structure

- votes.pickle - contains the voting sessions and the individual votes
- congressmen.pickle - contains the information and details about the deputies

All files are included with the code delivered except for the votes.pickle which has a bigger size(around 250 MB).

## 2.2 Building the Networks

### 2.2.1 Parties Voting Network

The information retrieved from the APIs cannot be used directly. Firstly, they have to be read and put into a network format.

To accomplish that a network representing the votes of the parties was created. For each vote in each voting session for each law proposition, a node was created for each political party that the deputy represented at that time. When a deputy has a vote equal to another deputy (from a different party), an edge is created between these two parties. If the edge already exists, the weight is increased by one unit.

The result is a weighted network, which contains 56 nodes and 1082 weighted edges. The network is saved as g_parties.net, in a pajek format.

### 2.2.2 States Voting Network

With the same information saved in the pickle files, a network representing the states was created.

For each vote in each voting session for each law proposition, a node was created for each state that the deputy represented at the time of voting, ignoring the fact that the deputy might have represented other states through the time.

Similarly to the Parties Voting Network(2.2.1), when a deputy has a vote equal to another deputy (from a different state), an edge is created between these two states. If the edge already exists, the weight is increased by one unit.

The result is another weighted network, which contains 27 nodes and 351 weighted edges. The network is saved as g_states.net, in a pajek format.

## 2.3 Networks Analysis

For the network analysis, both networks were created in memory as a Networkx[2] network.

### 2.3.1 Parties Voting Network

For the Voting Parties network, before plotting the network, a community detection algorithm was used. The best_partition method, from the community[3] library, computes the partition of the graph nodes, which maximizes the modularity using the Louvain heuristics.

After the communities were detected, the network was plotted(figure 2) as a circle, with each edge having its width proportional to its weight, which represents the voting affinity between two parties.

The plot reassembles, even less gradually, the political ideology spectrum of the political parties. One definition from a paper[4] from 2009, creates three groups: left, center, and right, while others might consider a more continuous spectrum with five or six groups.

If the two discovered partitions (blue and red) are considered as left and right, it matches most of the parties with their ideological classification.

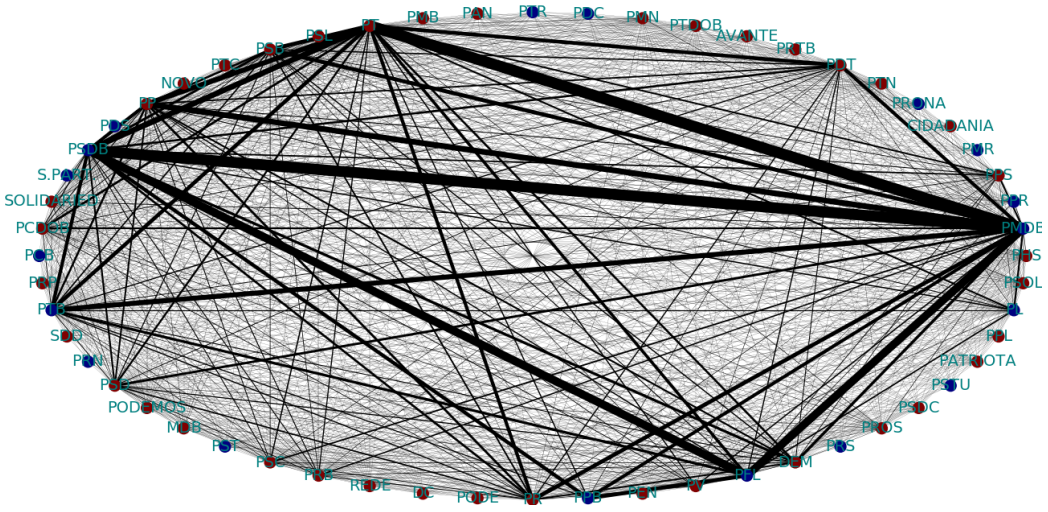


Figure 2: Parties Voting - Each node color represent one of the two partitions.

Other things that might be visualized in the plot is that some parties, which usually are classified as "center", PMDB for example, have a strong

voting relationship with parties from both clusters(i.e., PT and PSDB). Also, it is possible to visualize that far left and right-wing parties are also well represented as they have weak connections (i.e., PCDOB(Communist) and PSL(Liberal)).

### 2.3.2 State Voting Network

The voting affinity by the state network, besides the information about the weight on the edges, also contains the geographical position of the nodes. Each node has the position of its capital in Brazil.

The network is plotted, as shown in figure 3, with its nodes in black and with each of its edges with the width and the edge color representing how strong is the voting affinity. The edge color makes it easier to visualize strong links: weak links are black and strong links gradually ascend to white.

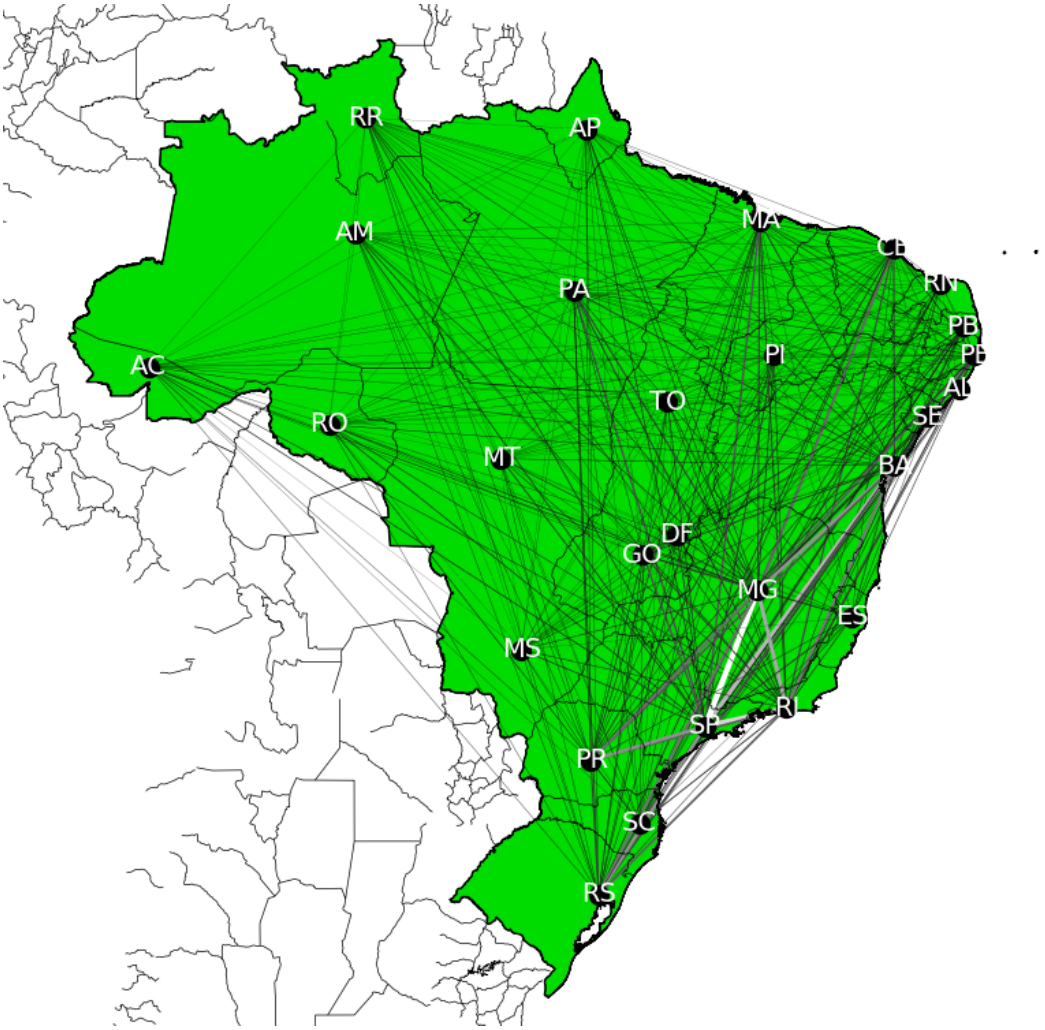


Figure 3: States Voting - Nodes are positioned in each State capital and the edges widths and colors represent the weight.

Brazil has 26 states plus the *Distrito Federal(DF)*, Brazil's capital. There are also five macro-regions: South, Southeast, Central-West, Northeast, and North. In figure 3, states from the Southeast region (SP, MG, RJ, and ES), that is the most economically developed and most dense, show a high voting affinity, forming a clique. Other rich states(BA, RS and PR) from other regions also have a strong voting affinity with SP and MG.

# 3 Conclusion

As expected and seen in Brazil politics, a smooth and gradual spectral division between left and right does exist in Brazil. The voting analysis shows that parties with similar ideology tend to vote similarly, and extreme sided parties tend not to have an affinity. Despite the vast number of parties in Brazil, political power is concentrated in alliances among a few parties.

Another expected result is that the States that have a higher economic influence in the country also has a high influence in voting and tend to attract voting from other States while States with less economic resources do not have such influence. Despite the vast number of parties in Brazil, political power is concentrated in alliances among a few parties.

Even though, when the networks are created, the meta-data(data about the party, deputy, age of deputy, the date party was created, etc.) is not available, the topology of the network is sufficient to approximate what happens in the real world with the parties and the states represented in the voting.

In summary, a network is a powerful tool to understand conditions that cannot be easily identified with some other computer techniques that do not take into account the connection and the relationship between the data.

# References


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