

# STAT – S670: Exploratory Data Analysis

## Mini Project 2: POLARIZATION OF IDEOLOGY AMONG SENATORS

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### 1. Introduction:

In this exploratory data analysis project, we have used the Congress dataset for analysis. Three specific set of questions have been answered through the series of graphs and related inferences. These graphs function in the following way:

- Identify the polarization in any two years of congress
- Identify the polarization over time
- Identify the ideological position of one senator

We draw the following inferences from the above:

- Polarization of Democrats and Republicans in the year 1999 and 2009
- Polarization over time for each year
- Plotting the average distance of senator John McCain and Mitch McConnell from each party every year

### 2. Polarization of Senators in the year 1999 and 2009

#### *Goal of finding the Polarization over two years:*

The goal of executing this analysis is to find the polarization in two years namely 1999 and 2009, by looking at the voting records of every party. Taking into consideration PCA, we aim to use PCA on the senators' bills matrix, thereby constructing a relationship between the senators and their votes. Likewise, we want to identify any kind of similarity or difference between the PCA plots for the two years and check if they fall on a one dimensional liberal or conservative axis respectively.

#### *Procedure:*

After encoding the variables (as 'Yea': 1, 'Nay': -1, else 0), Principal Component Analysis was performed on the senator votes for the years 1999 and 2009. Additionally, we have considered  $PC1 = 0$  as the liberal to conservative axis.

#### 2.1 Polarization of Senators in the year 1999:

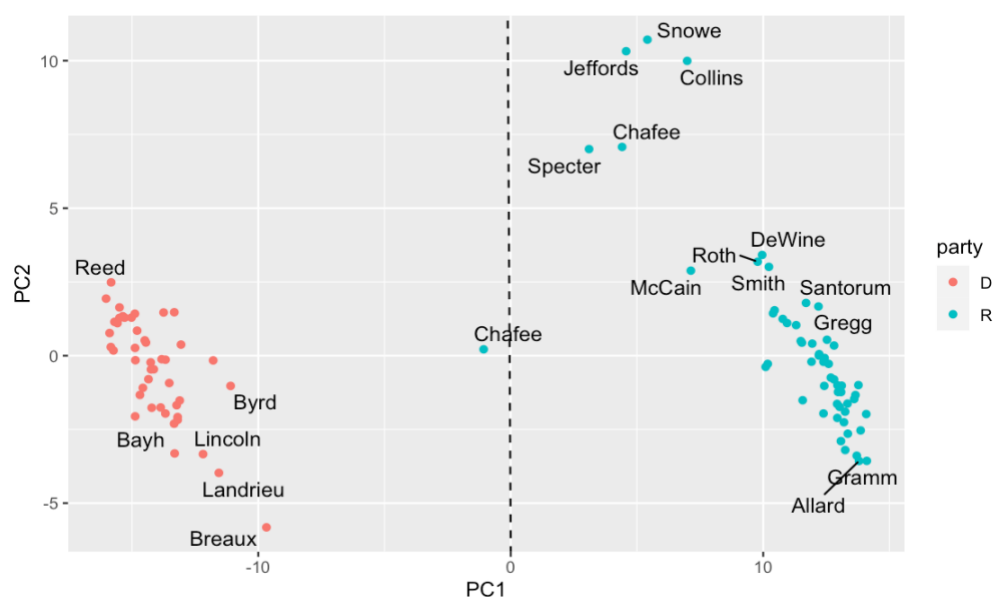


Fig 1. Polarization of number of votes of the Senators for the year 1999

As per Fig. 1, in the year 1999, we can clearly see that there are very few liberal senators compared to their counterparts the conservatives on their number of votes for the year 1999. Senator Chafee is the outlier in the Republican party.

## 2.2 Polarization of Senators in the year 2009:

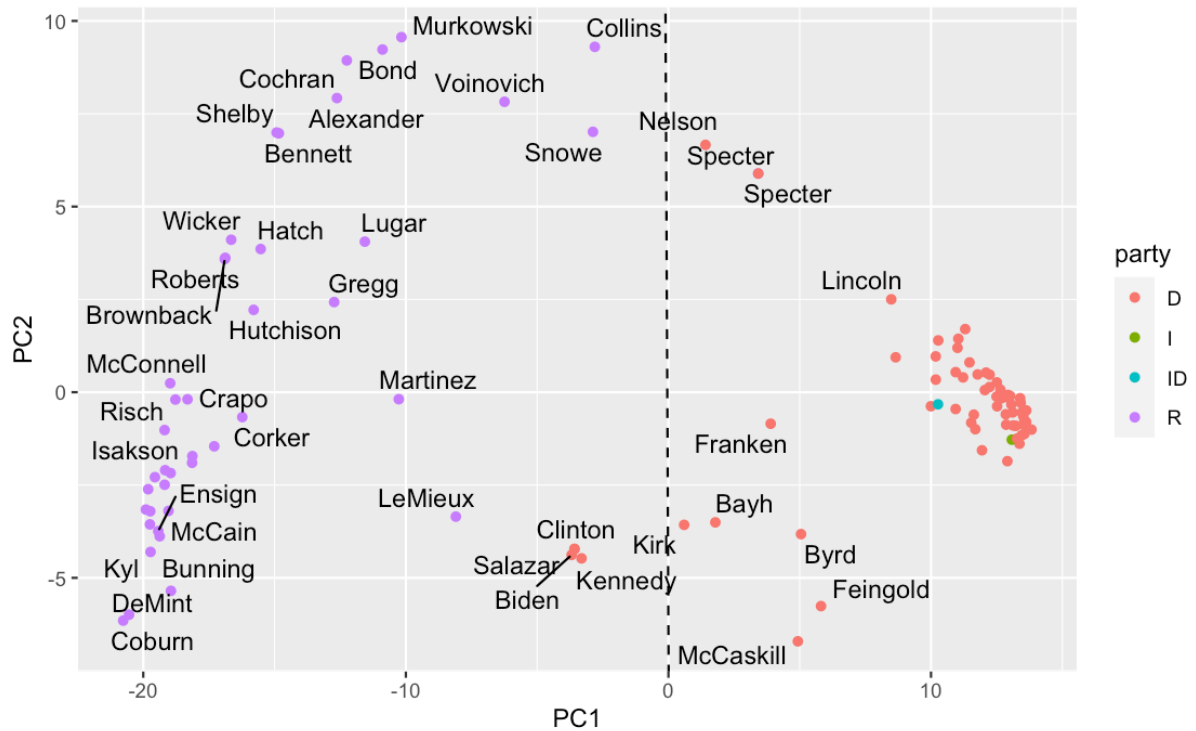


Fig 2. Polarization of number of votes of the Senators for the year 2009

As per Fig. 2, in the year 2009, we can clearly see that the number of liberal senators has increased compared to their counterparts the conservatives on their number of votes for the year 2009. There are many conservatives' democrats but not as conservative as their Republican counterparts.

The pattern is not similar for the two years which we have selected i.e., 1999 and 2009 as one can clearly see in Fig. 1. And Fig. 2., The growth of conservatives is the major change in both the years as we can see with the spread of the plot. On comparing Fig.1 and Fig.2., we can see that the Republicans are more liberal than the Democrats in 1999 but as we move down the lane to 2009, we notice that the Republicans become more conservative and less liberal than the Democrats.

In conclusion, we can infer that the polarization has increased in 2009 as compared to 1999 and is significantly different from each other.

## 3. Polarization over time:

### *Goal of finding the Polarization over time:*

The major goal of this analysis is to do a detailed study of the voting records of Democrats and Republican parties between the years 1990 to 2015 respectively. By using PCA and predominantly MDS in the respective cases, we aim to construct a measure to describe the polarization over all the years, by calculating the measure of average distance between the scores for Democrats and Republicans. Likewise, we check if polarization has increased over time considering all complicated and exceptional scenarios.

### Procedure:

After encoding the variables (as 'Yea': 1, 'Nay': -1, else 0), we have performed multidimensional scaling on the party votes. After determining each senator's relative position, we have considered the Democrat votes as D and the Republican votes as R over all the years to calculate the distance between the total number of votes earned by each party respectively. Finally, the average distance of each parties' votes has been calculated from the reference points. Additionally, we have also found the difference between the average distance of democratic votes and republican votes and plotted it as shown in Fig 4 above.

### 3.1 Polarization between 1990 - 2014:

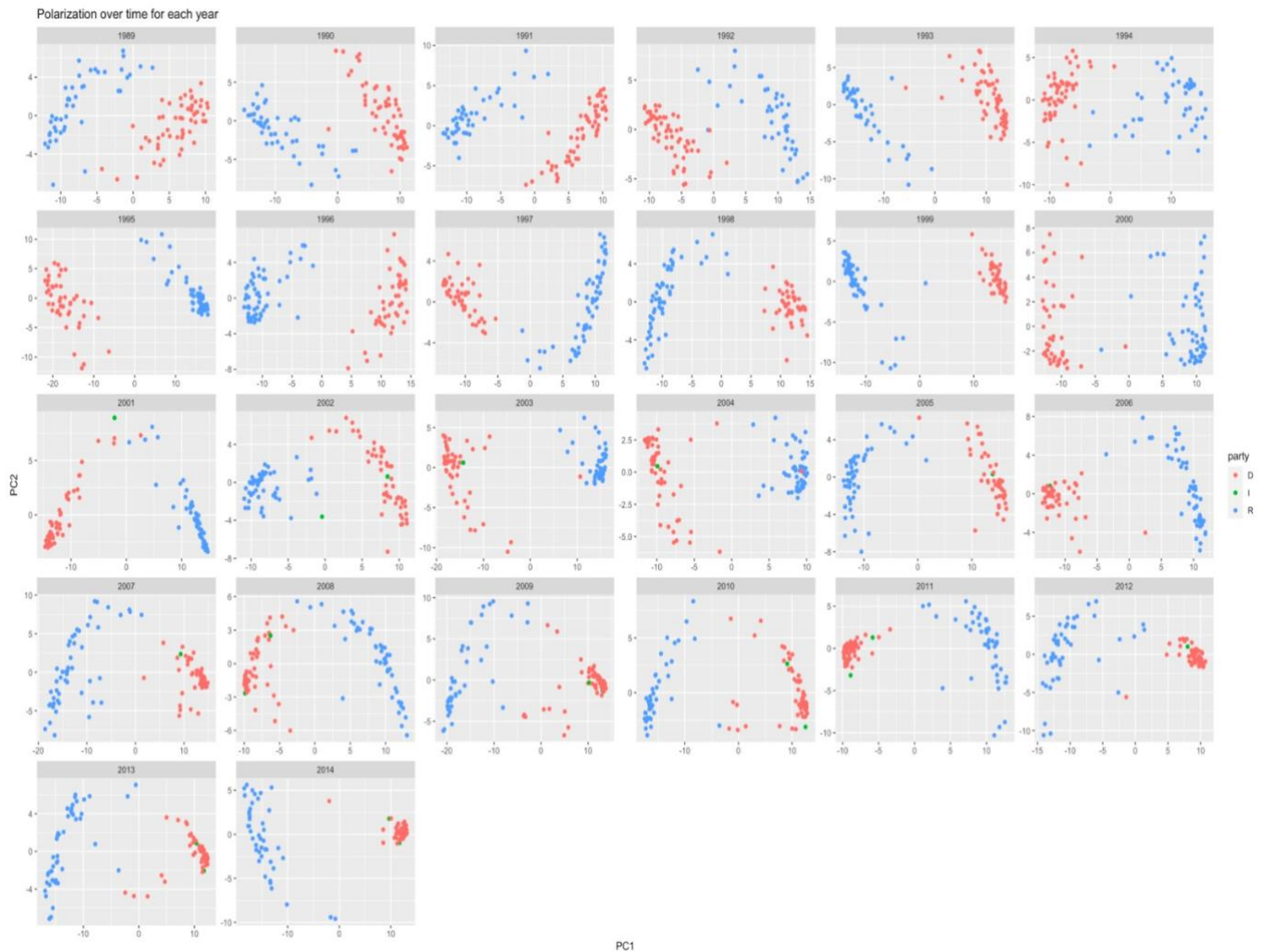


Fig 3. Polarization over time for each year

Fig. 3., depicts a year wise polarization of the votes earned by the Democrats and Republicans respectively. This polarization plot over the years has PC1 on the x axis i.e.: the most variation in the number of votes and PC2 on the y axis i.e.: the second most variation in the pattern of votes.

Now, as we draw inference from the plot, we can clearly tell that there have been clusters formed for the Democrats and Republicans respectively in each year. This tells us that the polarization for both the parties has been very different over the years, although the range of difference has not been consistent. Additionally, we can also infer that for the years in which the blue dots are close to zero, the polarization is less and when it is farther away, the polarization is higher. This is similar for the case of red dots representing the Democrat votes.

Predominantly, we can tell that the polarization for Republicans have increased over time, whereas in the case of democrats it has reduced.

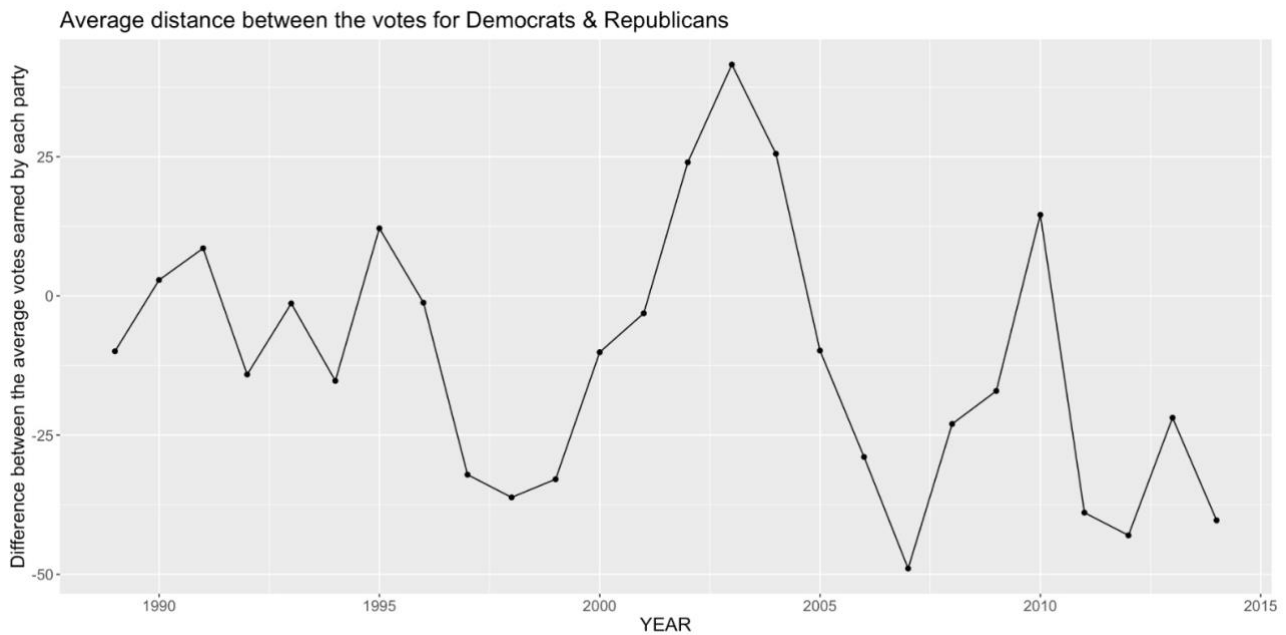


Fig 4. Average distance between the votes of Democrats and Republicans

As observed in Fig.4., the gap between Democratic and Republican votes is quite large. Noticeably, some of the datapoints that are very close to 0 like in years 1990, those between 1993 to 1994 and 1996, represents less polarization in contrary to those datapoints which are little farther away from 0, thereby represent slightly higher polarization just like in years 1997 and those between 2010 - 2014. Additionally, we can say that the datapoints which are the farthest from the 0th point like in years 2003 experiences the highest polarization. In a nutshell, we can infer that the polarization has been increasing in its own way over all the years between 1990 to 2015 considering some exceptional scenarios. We have calculated the difference in voting pattern (D-R)

One of the major limitations of the above analysis is that the variance within the parties have not been considered. The average position of the parties might be skewed for some years.

#### 4. Ideological Positioning of Senator:

##### *Goal of identifying ideological position of senator:*

The goal of the analysis is to identify the absolute changes in the parties' ideologies. Two senators, i.e., John McCain and Mitch McConnell will be used as reference points to find how radical the ideologies of the parties are.

Senator Mitch McConnell's ideologies have remained staunchly conservative over the years. Senator John McCain's ideologies, on the other hand, change over time, making it difficult to categorize him politically [1].

##### *Procedure:*

After encoding the variables (as 'Yea': 1, 'Nay': -1, else 0), multidimensional scaling was performed on the senator votes. After determining each senator's relative position, Senator Mitch McConnell and Senator John McCain were used as a reference (for all years) to calculate the distance between the other senators and the reference points. The final process took into account the average distance of each year from reference points.

#### 4.1. Ideological Positioning of Senator John McCain and Mitch McConnell:

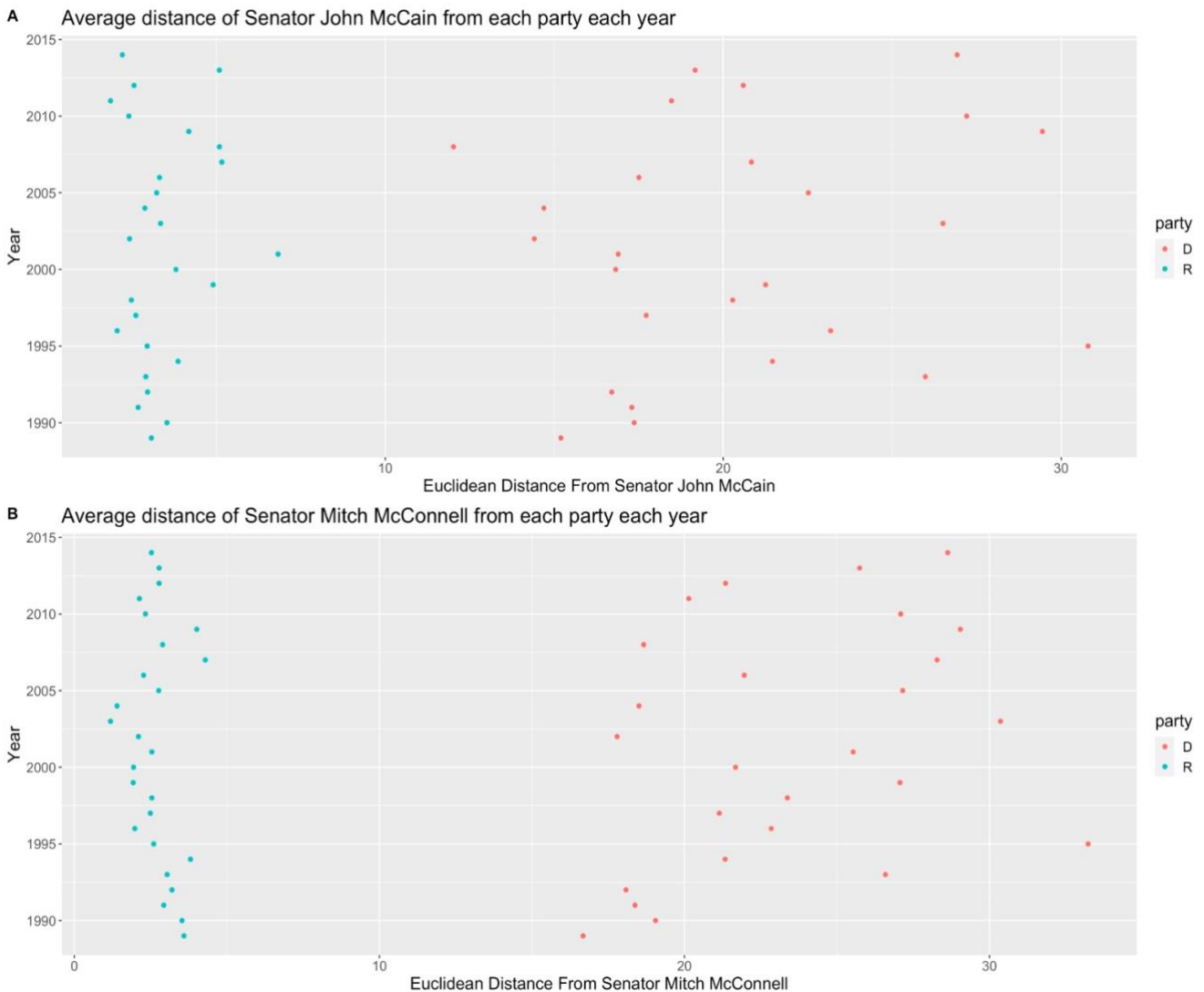


Fig 5. Average distance of Senators John McCain and Mitch McConnell from each party every year

From Fig.5., we observed that the average distance between Senator Mitch McConnell and the ideology for a specific year for the Republican party is less than five every year, whereas the distance between Democrat ideology and Senator Mitch McConnell has increased. This indicates that the Republican ideology has become more conservative over the years as Mitch McConnell's ideologies are staunchly conservative. This implies that the polarization between the two parties' ideologies has increased.

This claim is further solidified if we look at the average distance between Senator John McCain and the ideology for a specific year. The distance between Republican ideology and Senator John McCain has increased, whereas the distance between Democrat ideology and Senator John McCain has decreased.

One of the limitations of the above analysis is that the variance within the parties have not been considered. The average position of the parties might be skewed for some years.

#### 5. Conclusion:

The overall analysis from all the sections above, analysis the rise in ideological polarization in US politics. The middle of the political spectrum has hollowed out. In conclusion, according to the analysis done, we infer that the Republican Party is responsible for the recent increase in polarization.

#### 6. References:

[1]. John McCain Wikipedia: [https://en.m.wikipedia.org/wiki/John\\_McCain](https://en.m.wikipedia.org/wiki/John_McCain)