Stat 470/670 Mini Project 2: Politics in the United States

Team members: Akhila Sakiramolla (asakiram), Mitali Tavildar (mtavilda), Riya Shetty (rishett)

Introduction:
This Mini Project aims to study politics in the United States and understand if the country is becoming more ideologically polarized. For this, we have made use of the US congress data of its members and bills over many years, from 1989 and 2014. This gives information about congressional voting records and roll call votes taken by the Senate.

Data description:
We have 2 datasets for each year, starting from 1989 to 2014 - one giving each senator's vote on each of the bills for which there was a roll call vote in that year, and one describing the senators (name, id, state, party).

Problem statement:
To find the political ideologies of the people studying politics in the United States who believe that the country is becoming more ideologically polarized.

Approach and findings:
To understand if politics in the US is becoming ideologically polarized, we initially tried to understand voting records for one earlier session (1989) and one later session (2014). For this, we applied PCA to the senators by bills matrix where we make a plot describing the relationships between the senators. We did this to understand how the ideologies of both parties changed over time i.e., how is it currently and how was it a long time ago. We notice that there is an increase in polarization now than before. This may have been caused by various factors like due to changes in ideologies of certain party members etc., (detailed explanation in **Polarization in two years** section).

As we observed that there is a significant difference in polarization between parties now and a long time ago, we wanted to understand if it is a systemic increase over time or if it is a factor of some years or any other factors. For this, we applied PCA to the senators by bills matrix across all the years (1989 to 2014) and plotted the relationship between senators. We observed that there is no continuous increase in polarization over the years, as there is a decrease for some random years in between. It may be caused due to many factors at the time, something complicated seems to be happening across different years and we cannot explain this with some simple straightforward reasoning. (detailed explanation in **Polarization over the years** section)

We have seen the polarization trends over the years, which is not a continuous increase pattern but is increasing towards the end. We wanted to understand if the changes in polarization can be attributed to a single party's change in ideologies or to both parties. In order to do this, we considered two senators - Mitch McConnell (Republican party) and John McCain (Democratic

party), who served for all 26 years - for whom we observed their relative ideological positions with respect to their parties as well as the parties' ideological positions with respect to these senators. We noticed that the stance of Mitch McConnell appears to be relatively constant throughout the years, whereas the stance of John McCain kept changing. There also seems to be a change in the ideology within parties over the years with respect to these senators. This may have been caused due to various factors over the years, for the individual senators as well as the parties (detailed explanation in **The ideological position of one senator** section)

Analysis

I. Polarization in two years:

To identify if the politics in the United States is becoming more ideologically polarized i.e., either liberals are becoming more liberal, conservatives are becoming more conservative, or both, the first step we took is we tried to understand how the ideologies of both parties changed over time i.e., how is it currently and how was it a long time ago. We did this by studying the voting records of all the senators for one earlier session (1989) and one later session (2014), under the assumption that this would provide us with a significant difference in the polarization over these two years.

For this, we have used the PCA on the senators by bills matrix to find the difference in the opinions of the senators in these two years. We chose PCA for this example because it minimizes dimensions, preserving covariance of data. The principal components represent the directions of the data that explain a maximal amount of variance. The first principal component represents the maximum variance direction in the data. Similarly, the second principal component represents the second most maximum variance direction in the data and so on.

For this we first joined the 2 datasets, that is the votes data and every senator's information which helped us make the necessary plots required in arriving at the conclusions. Both the parties i.e., Republicans and Democrats are both close to the PC1 that is both the parties represent maximum variance in correspondence to the data. The outliers of both the data are closer to PC2.

1989: (Refer to Fig - 1)

1. The Republican and Democratic parties are equally divided into two groups according to the variances. Since the data is less polarized it can be said that there are some senators in both parties that sometimes may agree with the decisions of the opposite party. Both the parties have almost the same distribution of variance.
2. We see that for the year 1989 there was a good amount of intersection between the senators i.e., in layman's terms the senators weren't strongly polarized which resulted in the intersection between the ideologies of the Republicans and the democrats.
3. Similarly, senators like Armstrong and Matsunaga were the outliers for these data, Armstrong for the Republicans and senator Matsunaga for Democrats, it can be seen that the data has way too many outliers even this may be because the PC1 and PC2 may not

have sufficient distribution of the variance (**Refer to Appendix Fig - 3**) to compare and we may need to check the distribution over more PC's.

2014: (Refer to Fig - 1)

1. For the year 2014, it can be observed that there is a new party namely the Independent party which has senators who have an independent opinion. It can be seen that senator Sanders belongs to the Independent party but seems to be more in agreement with the democratic party than the republican party since the senator is more close to the republican party.

2. We also observe that the variance that is the spread of the Republican party is more towards the equilibrium where it can be said that the Republican party is not as strong Democratic party. We also observe that the data is more clustered in the year 2014 than in the year 1989.

3. Outliers for the data in both parties can be senators Cochran, Coburn, Collins, and Baucus. With these senators, there are chances that the senator may agree with the decisions of their party but may also agree with the decisions of the opposite party.
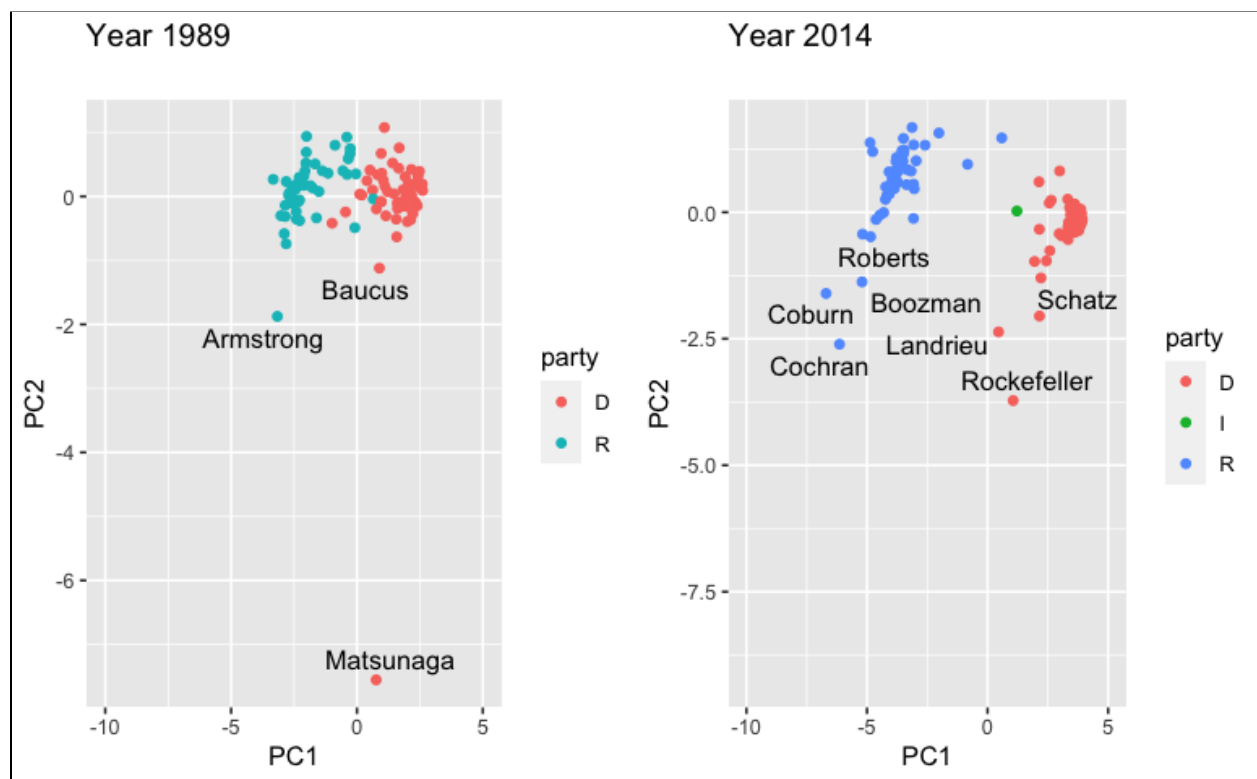
Fig - 1 PCA plot of the votes and member information for the years 1989 and 2014

From this analysis, we observed that for the year 1989 both the parties are not very polarized and there seems to be an overlap of ideologies between the parties (**Refer to Fig - 1**). Whereas, in the year 2014 (**Refer to Fig - 1**), we notice that there is a clear polarization between parties as there's no overlap between senators anymore except for a few outliers in both the

parties. We can conclude that the patterns in both the years (1989 and 2014) are not similar and the polarization clearly increased between these 2 years. It looks like they fall on a one-dimensional liberal/conservative axis in the year 2014, whereas not in the case of 1989.

II.   Polarization over the years:

Now that we understood that there is clear polarization over years, the next step we took is we tried to understand if this is a phenomenon due to a systematic increase over years. To understand the data more clearly we plotted the polarization over the years which helped us get a clear description of the opinions/ideologies of the senators that have changed over time. We looked at the distribution of the opinions of all the senators in each year from 1989 to 2014 (**Refer to Fig-2**).
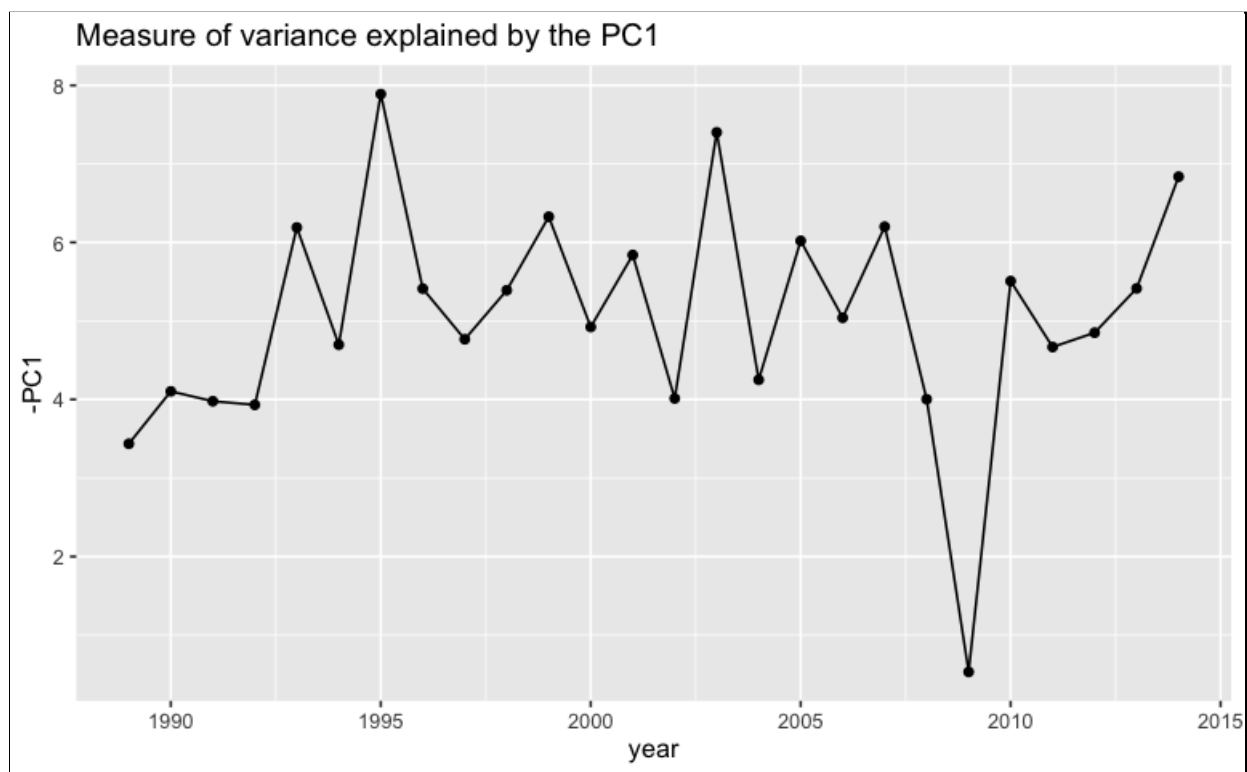
Fig - 2 Measure of variance explained by the PC1

1. From the plots it can be understood that the variance of the data has spread over the years. That is previously, in the earlier years like 1989, 1990, up to the year 2000 it can be seen that both the parties that are Republican and Democratic are both close to the PC1 that is both the parties represent maximum variance in correspondence to the data, with very few exceptions.
2. We can observe that polarization was very less in 1989 (also seen in Fig-1), which maybe due to senators being centrists rather than extrimists, but after that, it started increasing in the next few years (1990 - 1993) and reducing again in 1994. Whereas in 1995, it

increased more rapidly than before but started to reduce in the years after, but the parties are still clearly polarized as they are separated. There are few exceptions where the parties are not clearly polarized like in the years - 2002, and 2008. (**Refer to Fig-3, Refer to Appendix for individual PCA plots for these years**)
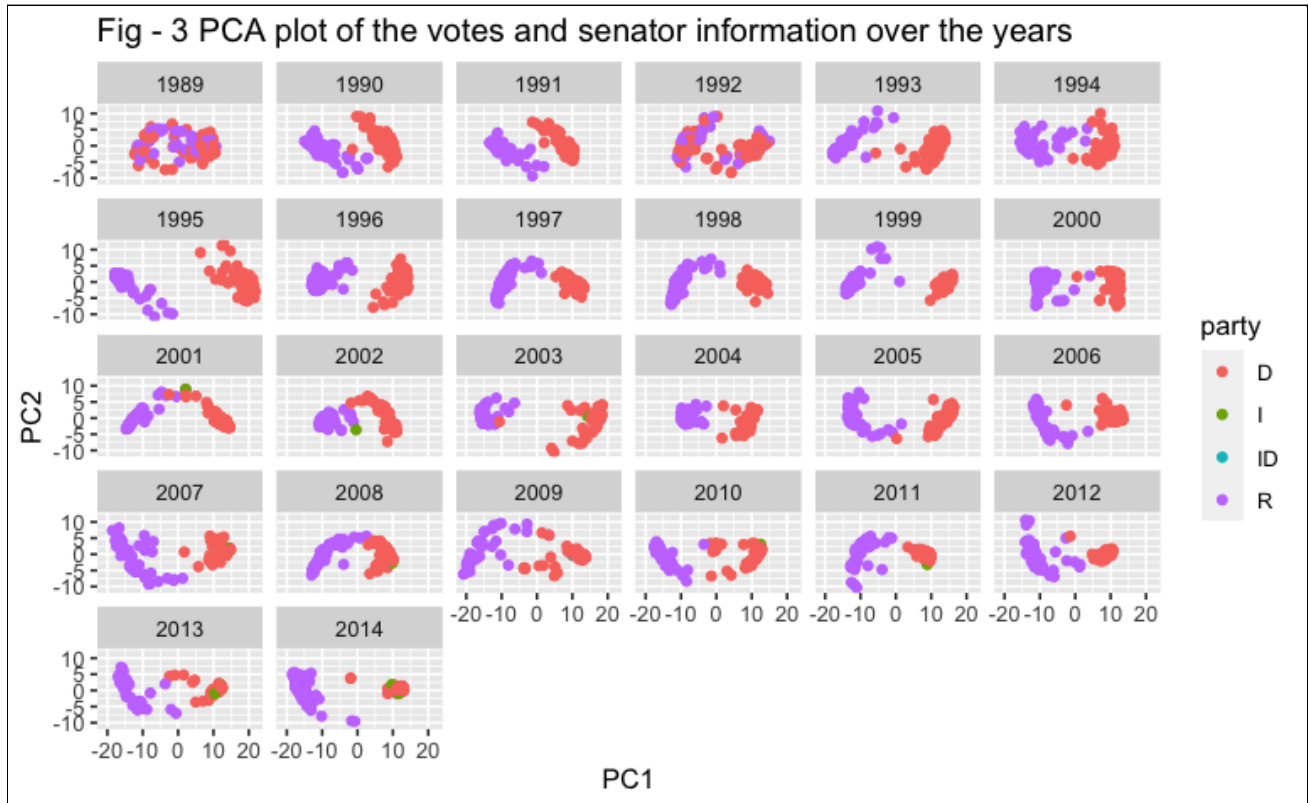

Fig - 3 PCA plot of the votes and senator information over the years

3. From the year 2001, we see that few senators became independent i.e., the senators who have an independent opinion leaning towards either the Republican or Democratic Party. However, in 2001, it can be observed that the independent senator was more in agreement with the Democratic party than the Republican party (**Refer to Appendix Fig - 1**).
4. It can be seen that over the years, the variance in the data is more that is many senators are not just dedicated to one party they have agreements with the decisions of the opposite party as well.
5. Initially, in the earlier years, the number of outliers was comparatively less whereas in the later years the number of outliers also increased. This results in the data being more spread out which is maximum variance in the data.
6. For the year 2009, it can be seen that the variance of the data is high such that the democratic party is more close to PC1 and PC2. The democratic party is more clustered. Whereas in comparison the Republican data is more spread out and is more close to the PC2 than PC1. Also in the year 2009, we can infer that there are senators who have ID polarization as well (**Refer to Fig - 2**).

We also looked at the difference between the average of PC1 scores (explains max variance) for both parties as a measure to describe polarization (**Refer to Fig - 2**). This may not be the most accurate measure to explain variance as we are considering PC1 only, which does not explain the complete variance and also we do not know within party variance.

From this, we observed the change in polarization over years (also seen in Fig-3), which is not a continuously increasing pattern. Here we see that the year 1995 has maximum polarization whereas the year 2009 has the minimum. This may have been due to various reasons like the Republican Revolution of '94 which refers to the Republican Party's success in the 1994 U.S. mid-term elections which led to some senators switching to the Republican party after the elections. It also led to the end of the conservative coalition, a bipartisan coalition of conservative Republicans and Democrats. These may have led to the maximum polarization in 1995.

From this analysis, we conclude that there is a change in polarization over years, it's increasing during some years and decreases during the rest. All of it cannot be attributed to a single reason as many factors would've affected the parties and senators. So something complicated seems to be happening across different years and we cannot explain this with some generalized straightforward reasoning. There may be many factors that affect the decision on the bills by the senators whose explanation is beyond the scope of these visualizations and hence arriving at conclusions such as this where there is only one factor that is the variance may not be legitimate.

III.   <u>The ideological position of one senator:</u>

We have seen the polarization trends over the years, which is not a continuous increase pattern but is increasing towards the end. We wanted to understand if the changes in polarization can be attributed to a single party's change in ideologies or to both parties. In order to do this, we wanted to study two things:

1) Position of some senators over all the 26 years and observe how their stance changed with respect to their party
2) Position of both parties and how their stance changed with respect to these senators over all the 26 years.

To do this, we first looked at senators who have served for all the 26 years belonging to either party. There are 13 such senators belonging to different states. From these 13 senators, we considered two senators:

1) Mitch McConnell - senator from Kentucky state, belongs to the Republican party
2) John McCain - senator from Arizona state, belongs to the Republican party

We observed that, Mitch McConnell's stance stayed constant with respect to the average of Republican party's opinion throughout the years (**Refer to Fig - 4**). Whereas, for John

McCain, his stance kept changing randomly throughout the years with respect to average of Reuplican party's opinion (**Refer to Fig - 5**).

We also looked at how the position of parties with respect to these senators is changing throughout the year. We observe that the variance within parties is changing throughout years but not in a constant manner. We also see that the polarization between parties is increasing over years but its not continuously increasing. It is increasing drastically for some years like 1995 nut it is also reducing again for some years like 2002. So, if we consider in the case of Mitch McConnell, his position with respect to the Republican party is staying constant whereas it is changing for other senators in the party, which in turn effected the overall polarisation of the party. (**Refer to Fig 6, Refer to code for plots for all years**)
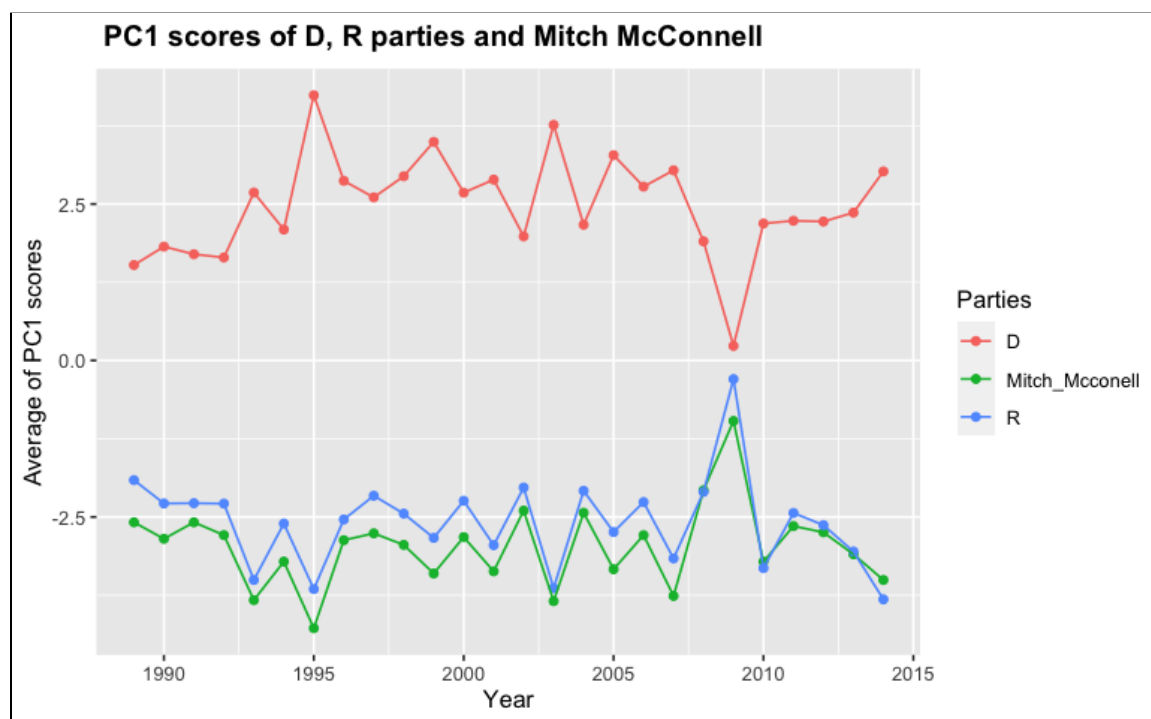
Fig - 4 PC1 scores of D, R parties and Mitch McConnell
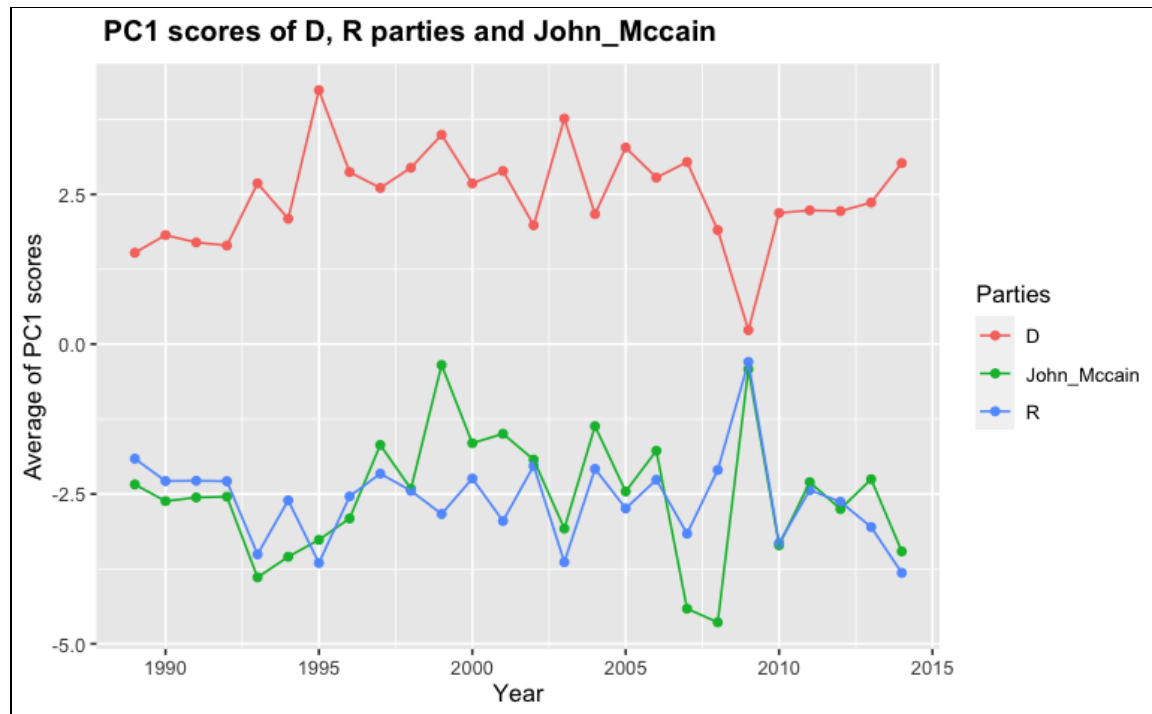
Fig - 5 PC1 scores of D, R parties and John_Mccain
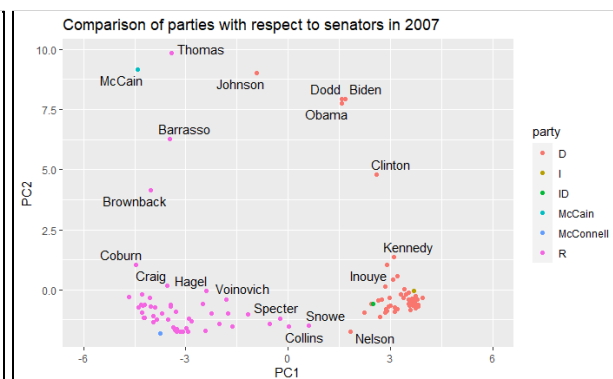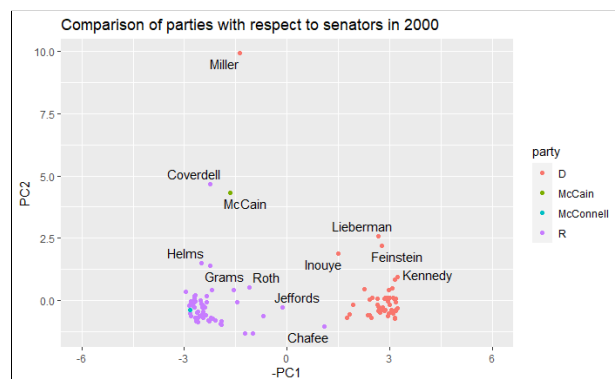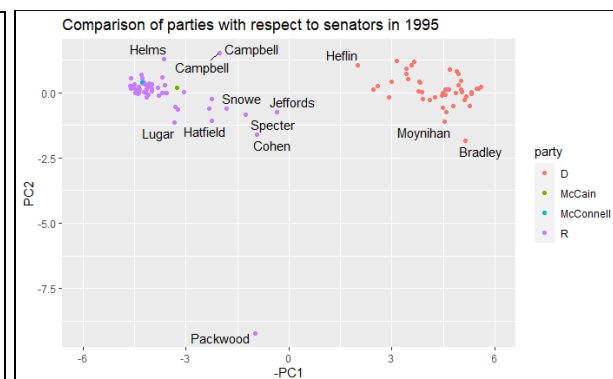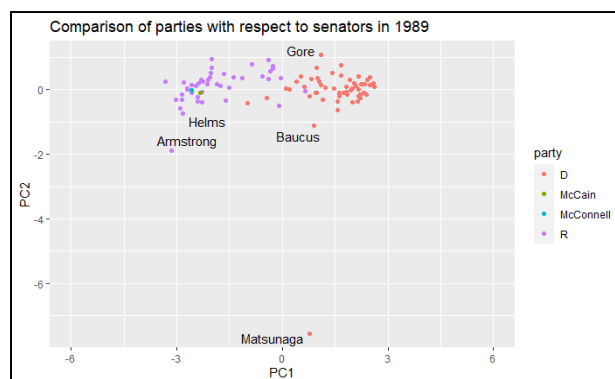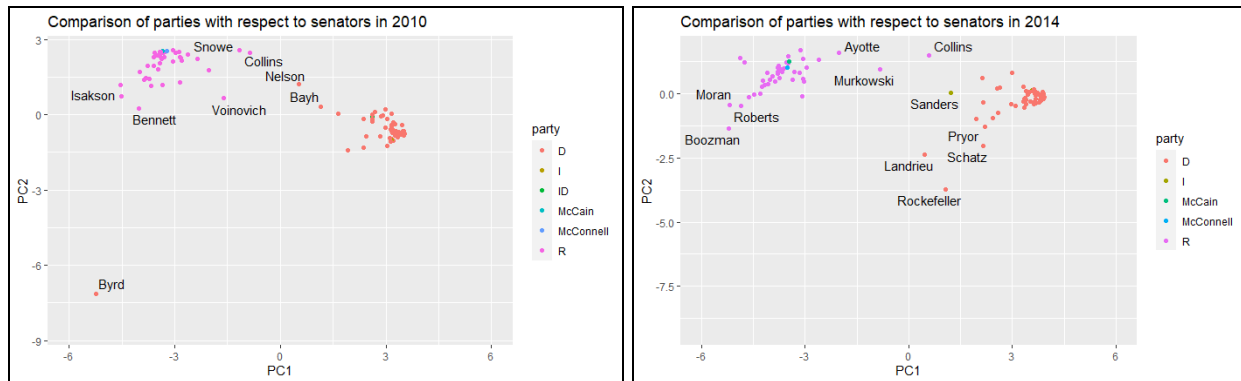
Fig - 6 Relative positions of both parties with respect to senators McConnell and McCain

Conclusion:

From the plots it can be seen that over the years the polarizations i.e., the change in ideologies of the parties has **increased** over years. There have been cases such as in the case of the Senators Mitch McConnell and John Mccain it can be seen that the senator John McCain in the year 2006 - 2007 was an extreme Republican but later in the year between 2008 - 2009 he was more towards the equilibrium that is he was in agreement with the Democrat party as well.

We want to conclude our data analysis by stating that the polarization has increased over the years. We observed that for the two years - 1989 and 2014, there was a clear increase in polarization after plotting the general trend of parties over the years (excluding the minor spikes). The ploarizations over the years can be caused due to various internal and external factors among these parties such as the

1. Increasing Global news channels, these can be main cause for the shift in the ideologies since, the global news impacts the thoughts of the people directly.
2. Redistricting, Over the last few years we have heard cases about the manipulation of electoral borders to favor a political party in the US elections, this may have resulted in presenting a shift in the ideologies of the senators.
3. Religious, ethnic, and other cultural divides within the public have often influenced the emergence of polarization such as the racial discrimination prevalent in the US.

We also checked this by plotting the general trend of the two parties relative to the senators, and we noticed that the difference has not remained the same, but has definitely increased.
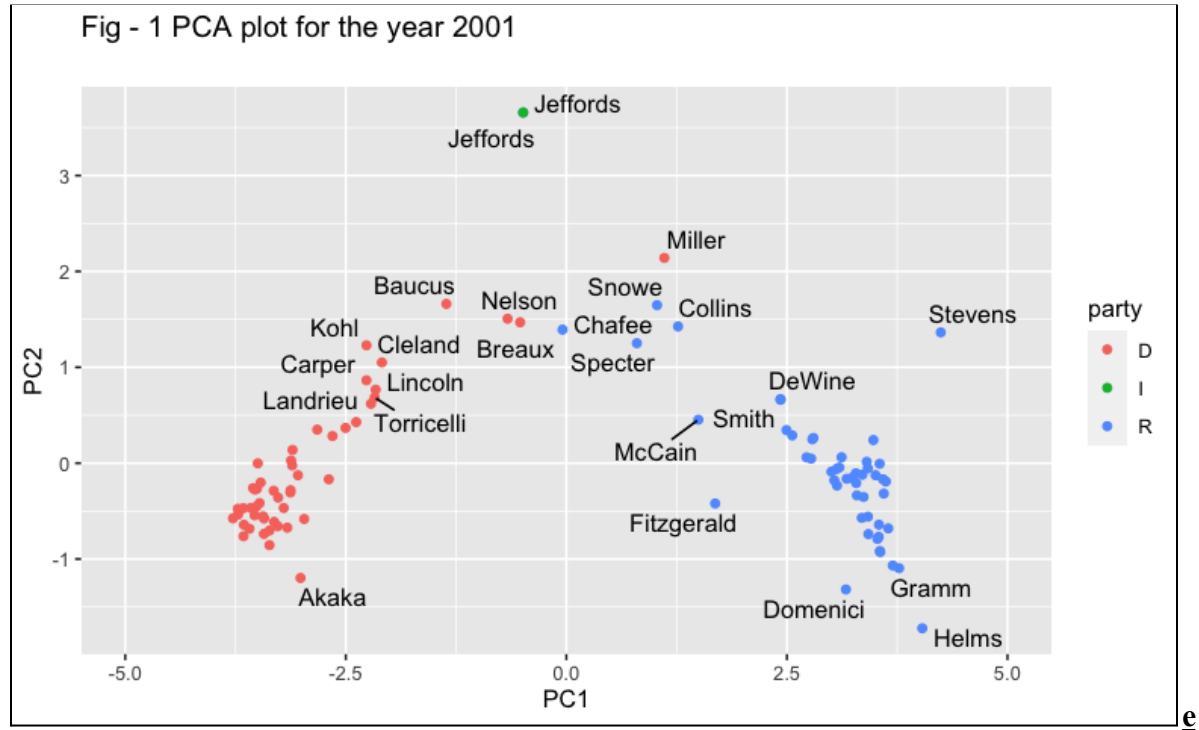
Appendix

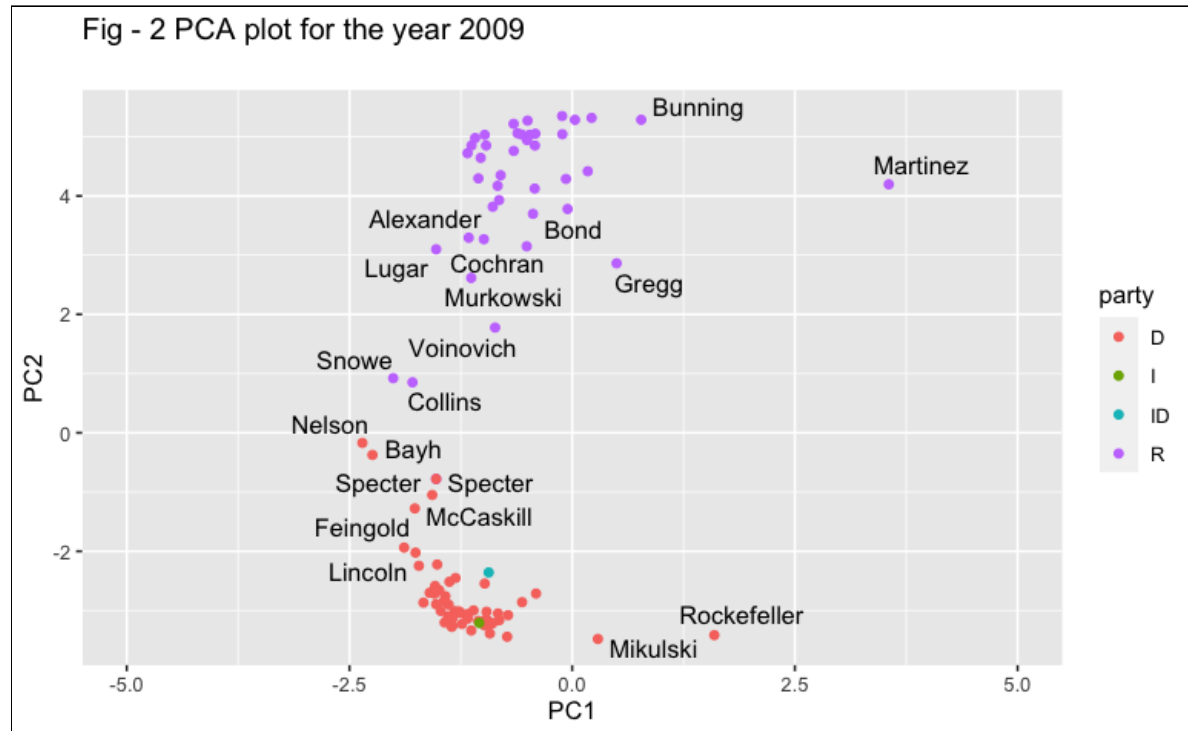**Fig - 1 PCA plot for the year 2001**
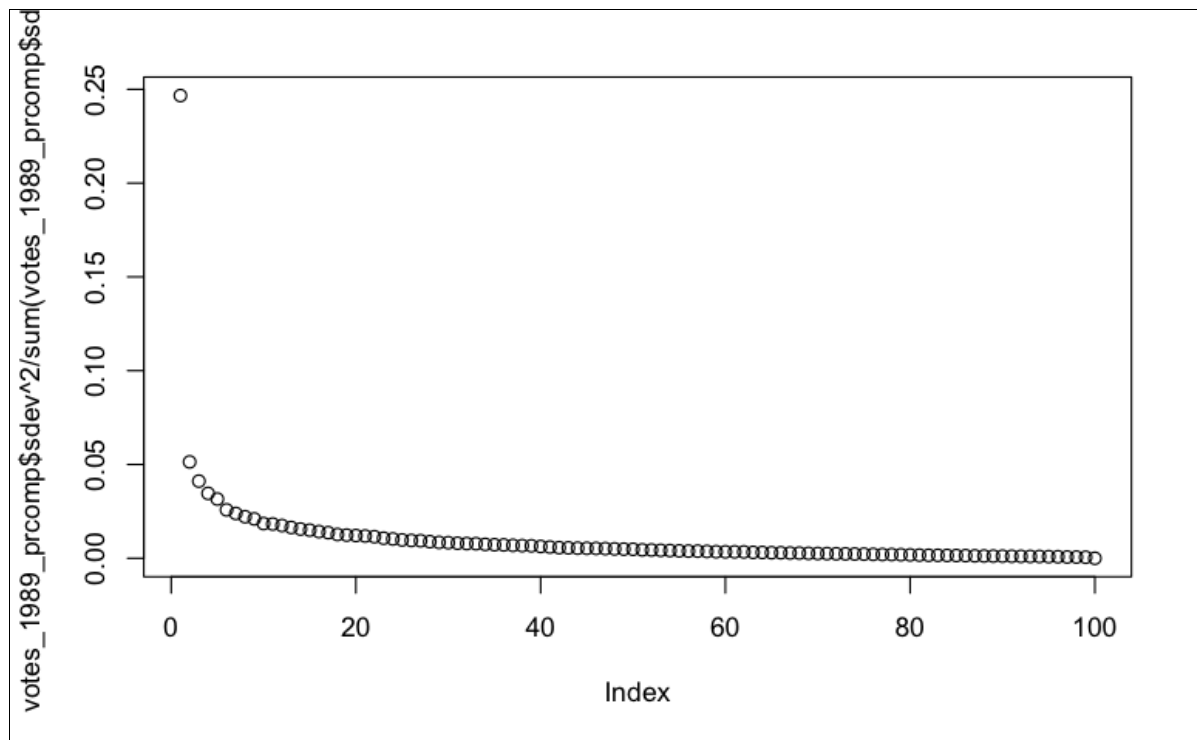

Fig - 2 PCA plot for the year 2009

Fig - 3 Distribution of the Variance plot for the year 1989
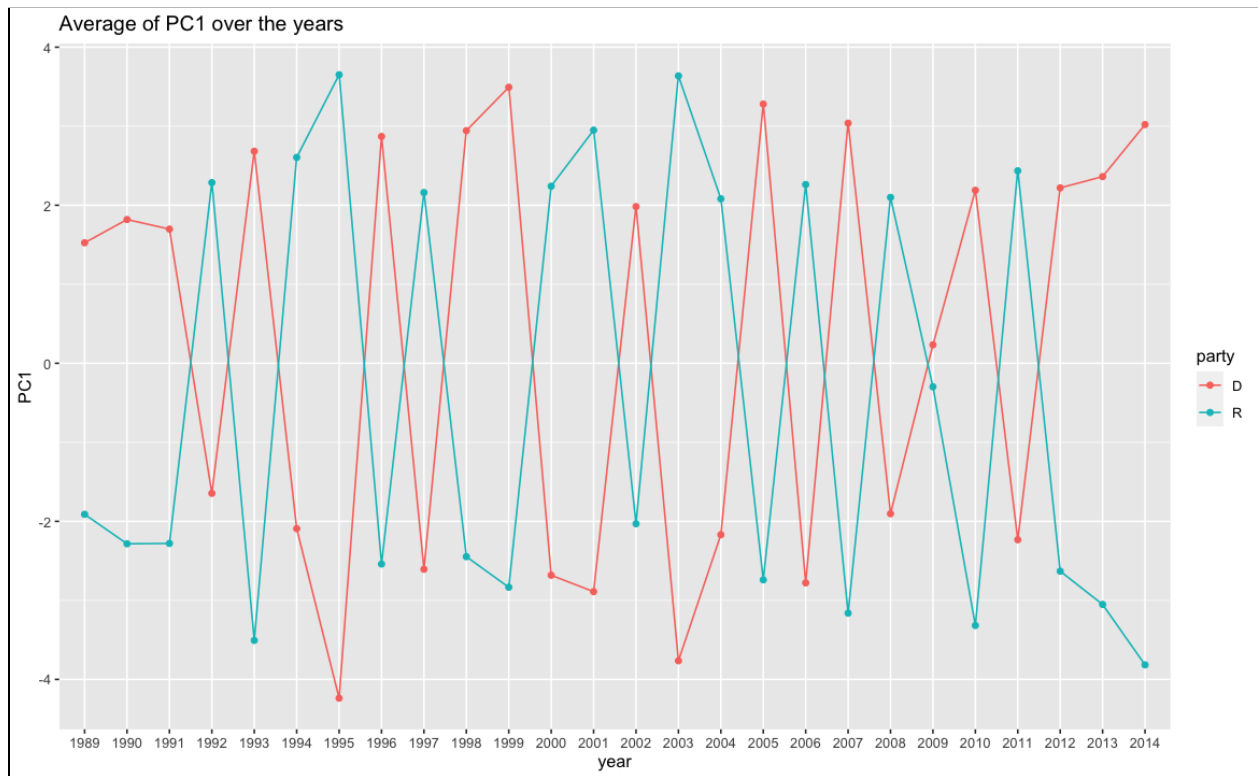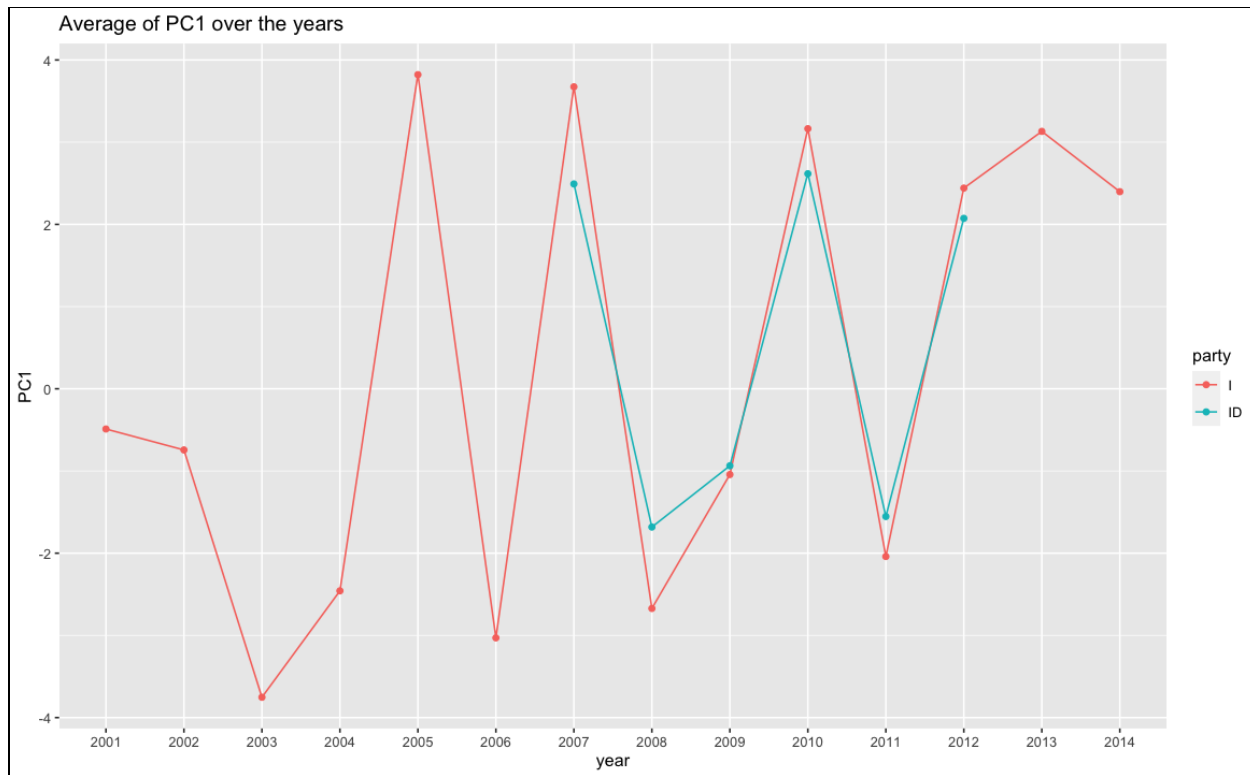

Fig - 4 Average of PC1's over the years
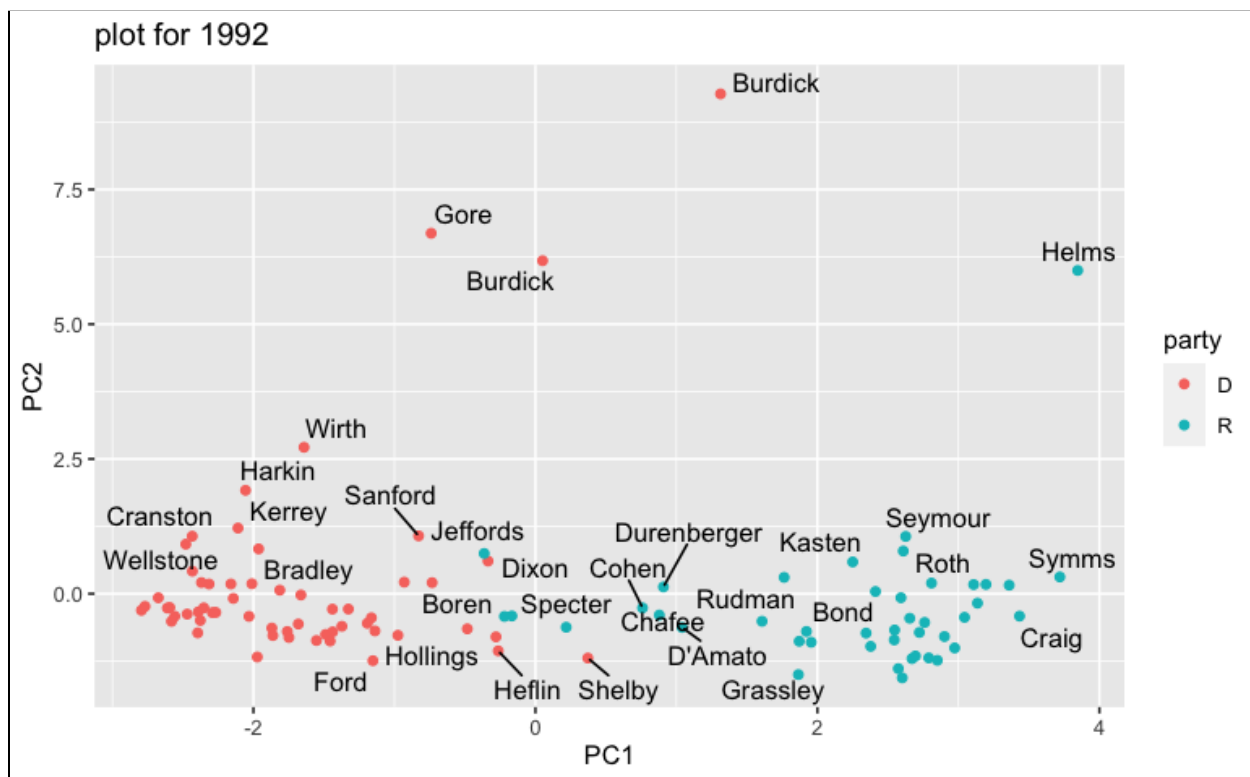
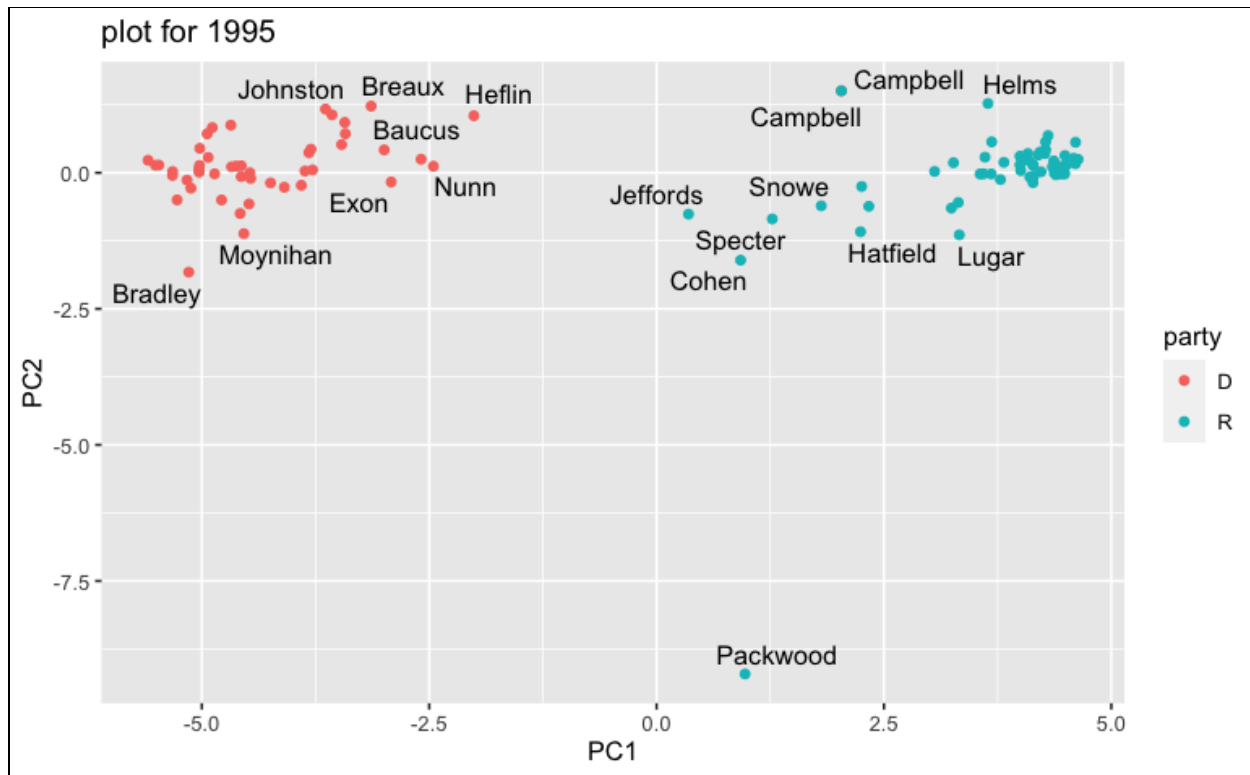**Fig - 5 Average of PC1's over the years**

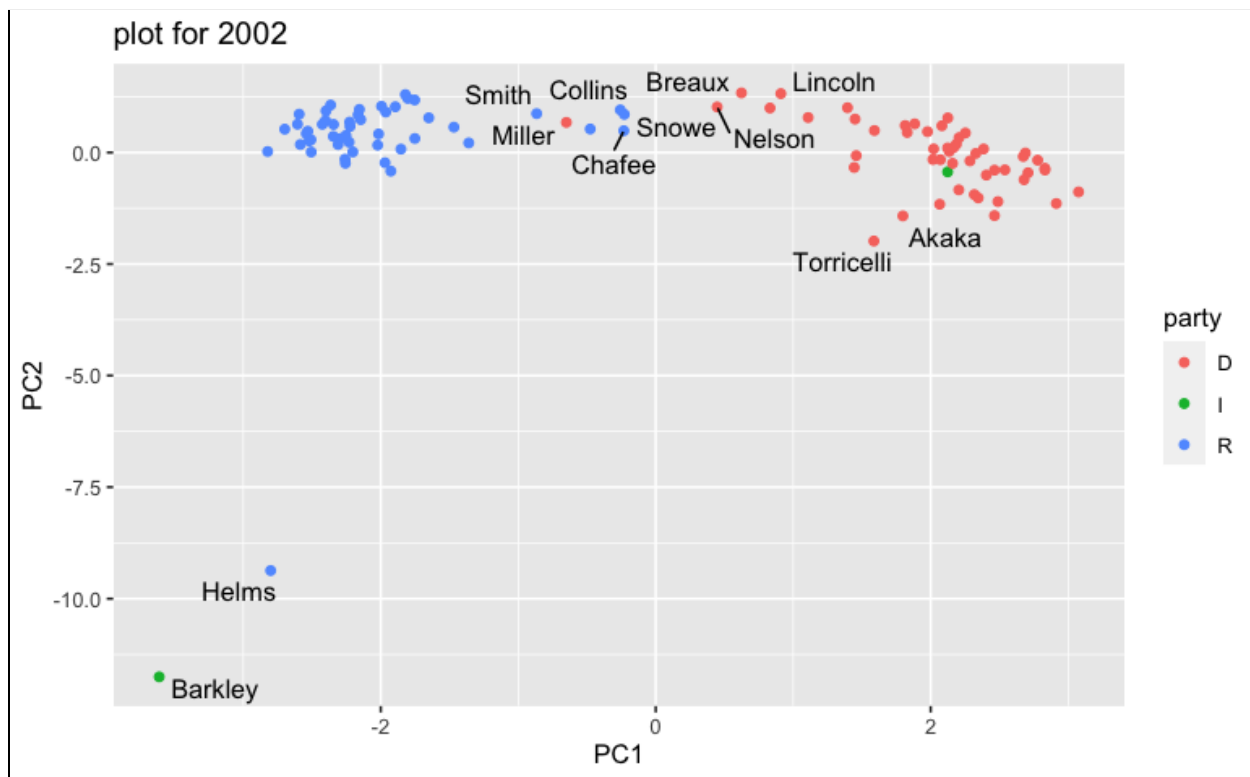**Fig - 6 Plot for 1992**
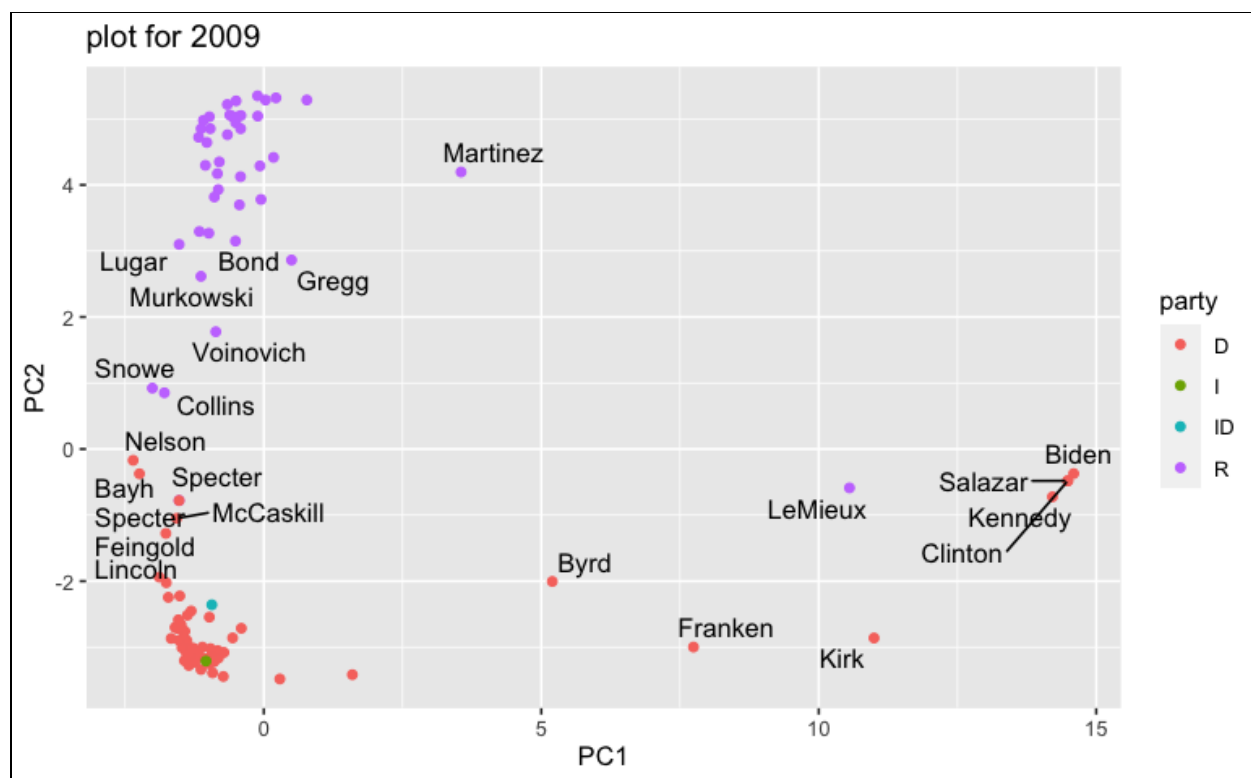
Fig - 7 Plot for 1995

Fig - 8 Plot for 2002

Fig - 9 Plot for 2009