Analysis of the Geopolitical Landscape for the 2020 North Carolina State Legislative Senate Districts

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1 Overview

In this analysis of the geopolitical landscape of the North Carolina State using the 2020 Census data, we provide two different summary plots derived from two different distributions on redistricting plans. The two distribution differ in that one values the preservation of municipalities and the second, all things being equal, is agnostic to the preservation of municipalities. Both distributions favor plans with compact districts. The details of the distributions are given in the accompanying document "Methods used in the Analysis of 2020 North Carolina State Legislative Redistricting Landscape."

2 Results

Figure 1 gives the *Collected Seat Histograms* for the ensemble sampled from the distribution which does not consider preserving Municipalities (MCDs). Figure 2 gives the *Collected Seat Histograms* but for the ensemble sampled from the distribution which does consider preserving Municipalities (MCDs). To critique a particular map against the backdrop our non-partisan ensemble, one needs only plot the seat outcome under that map under a given election on our plot for the same election.[1] In addition to looking at a collection of historic votes, it is also useful to examine how the ensemble shifts under changes to the statewide vote fraction on a particular set of votes. This may be accomplished, for example, by using a uniform swing analysis. We omit such investigation in this work, but such studies may be achieved with the provided data and we plan to implement this in future analysis.

Without reference to a particular map, the primary message of these plots is that when maps are drawn only considering only the nonpartisan redistricting criteria the result is a responsive map. By a responsive map, we mean a map whose electoral outcomes change as the peoples will, expressed in the votes, changes. Our experience with non-partisan map ensembles over the last decade, in North Carolina as well as states such as Maryland and Wisconsin, confirm this observation. Again and again, we see that when political data is not considered the resulting maps are responsive to significate changes in the voters's preference. Even when there are swings in public opinon as expressed in the vote, the outcomes of these non-responsive maps do not change commensurately.

In contrast, many of the maps used in North Carolina over the last decade were significantly less responsive. Under the enacted maps, the number of elected officials from each party changes little dispite sizable swings in the people's preferences as expressed at the ballot box.

3 Ranked Ordered Marginal Boxplots

The following figures plot the typical range of the most Republican district to most Democratic district. Ranges are represented by box-plots. In these box-plots, 50% of all plans have corresponding ranked district that lies within the box; the median is given by the line within the box; the ticks mark the 2.5%, 10%, 90% and 97.5% quartiles; the extent of the lines outside of the boxes represent the range of results observed in the ensemble. There are 120 seats; any box that lies above the 50% line on the vertical axis will elect (or typically elect) a Democrat; any box that lies below the 50% line will elect (or typically elect) a Republican.

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[1] One can find the shapefiles, election data, and the voting data on our ensembles at our online archive: `https://git.math.duke.edu/gitlab/gjh/redistricting2020results.git`
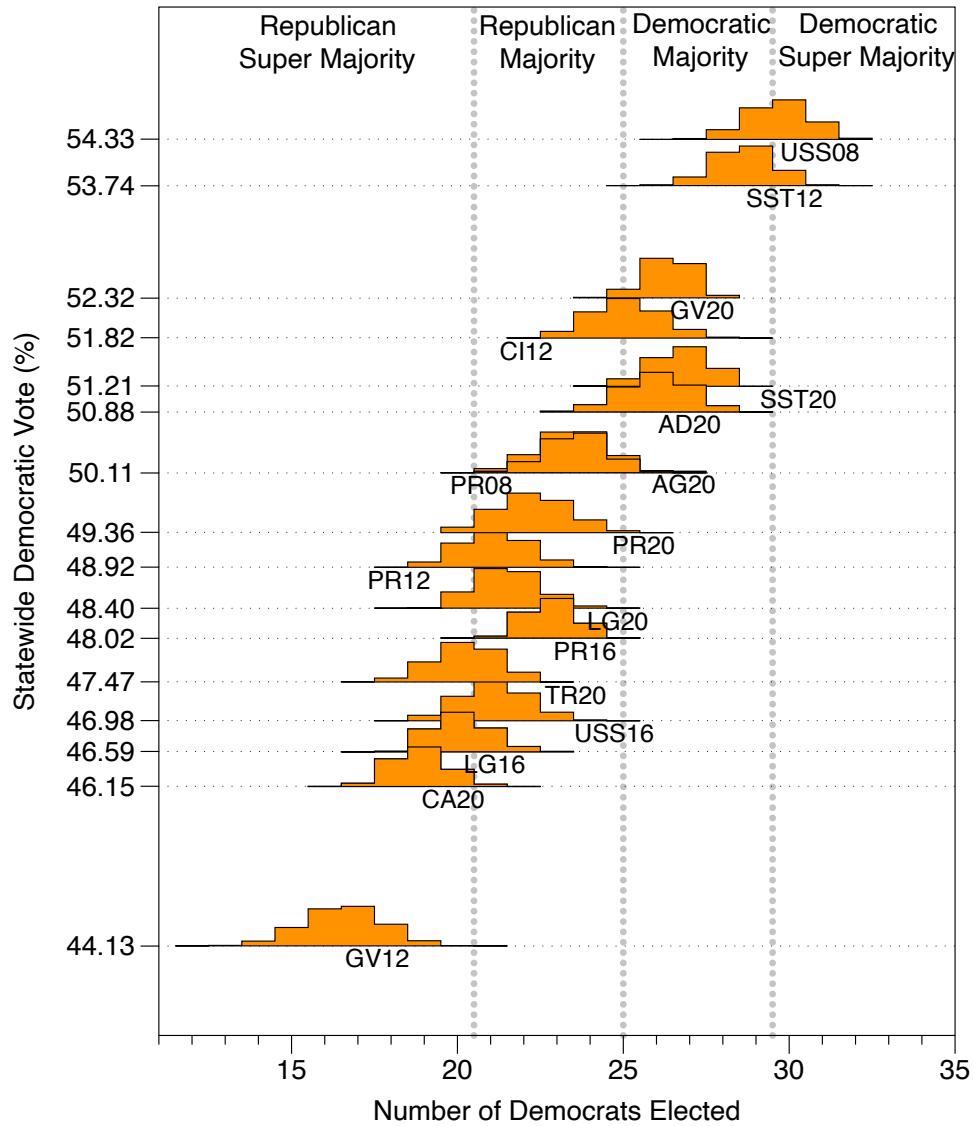
Figure 1: Each orange distribution represents the range of possible Democratic seats won in the ensemble of plans which do not consider Municipalities under a given set of historic votes; the height is the relative probability of observing the result. We only include a selection of the historic vote counts for clarity. Abbreviations contain the year in the last two characters and the race in the first few characters: AG for Attorney General, USS for United States Senate, CI for Commissioner of Insurance, GV for Governor, LG for Lieutenant Governor, and PR for United States President. On the left axis, we provide selected Democratic statewide vote percentages.
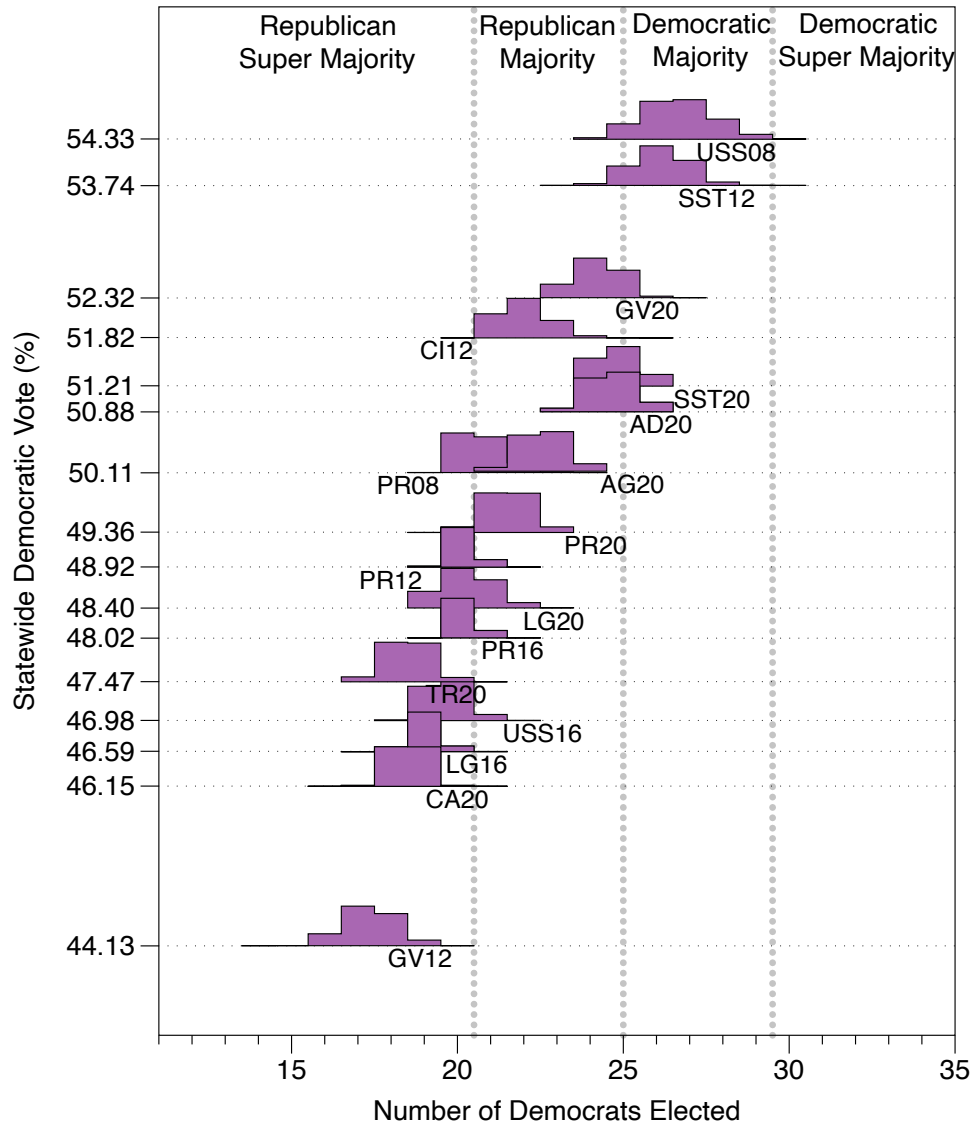
Figure 2: The same as Figure fig:SenateCEAH except the ensemble used is concentrated on plans that also respect the boundaries of municipalities.
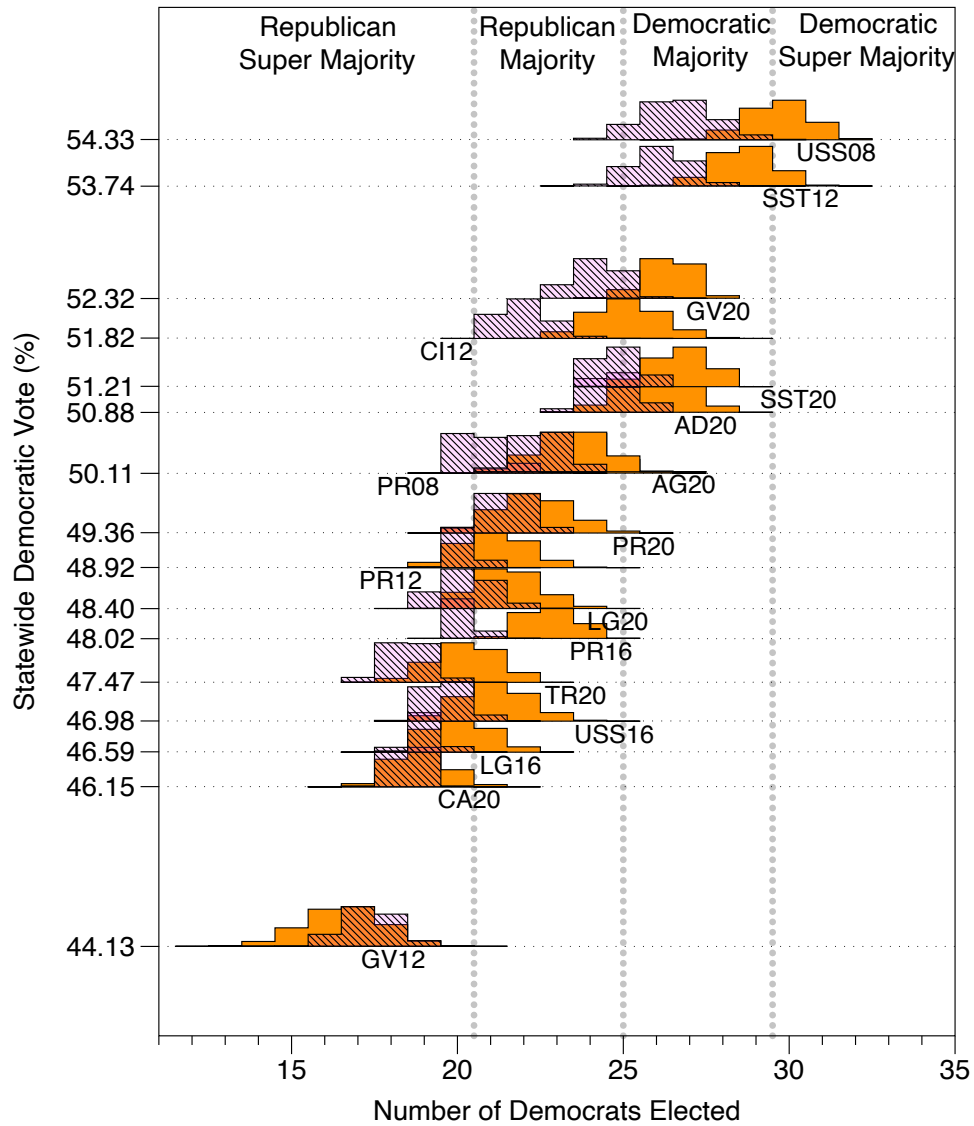
Figure 3: This figure combines Figure 1 and Figure 2 so that they can be compared.

Figures 4-6 give the box-plots of the marginal vote fraction distributions under a representative collection of elections. The elections used were chosen the span the range of statewide vote fractions seen in Figures 1-3 and the ensemble of plans are drawn from the distribution that preserves municipalities. Figures 7-9 are same plots but for the distribution which does not consider the municipalities. Figures 10-12 combine the previous figures so that they can be compared.

We can take a proposed plan with a set of votes and plot the ordered district returns over the box plots. If the districts of an enacted plan lie either far above or far below the ensemble at a particular ranking, this can indicate that the district was either packed or cracked to provide an atypical result.
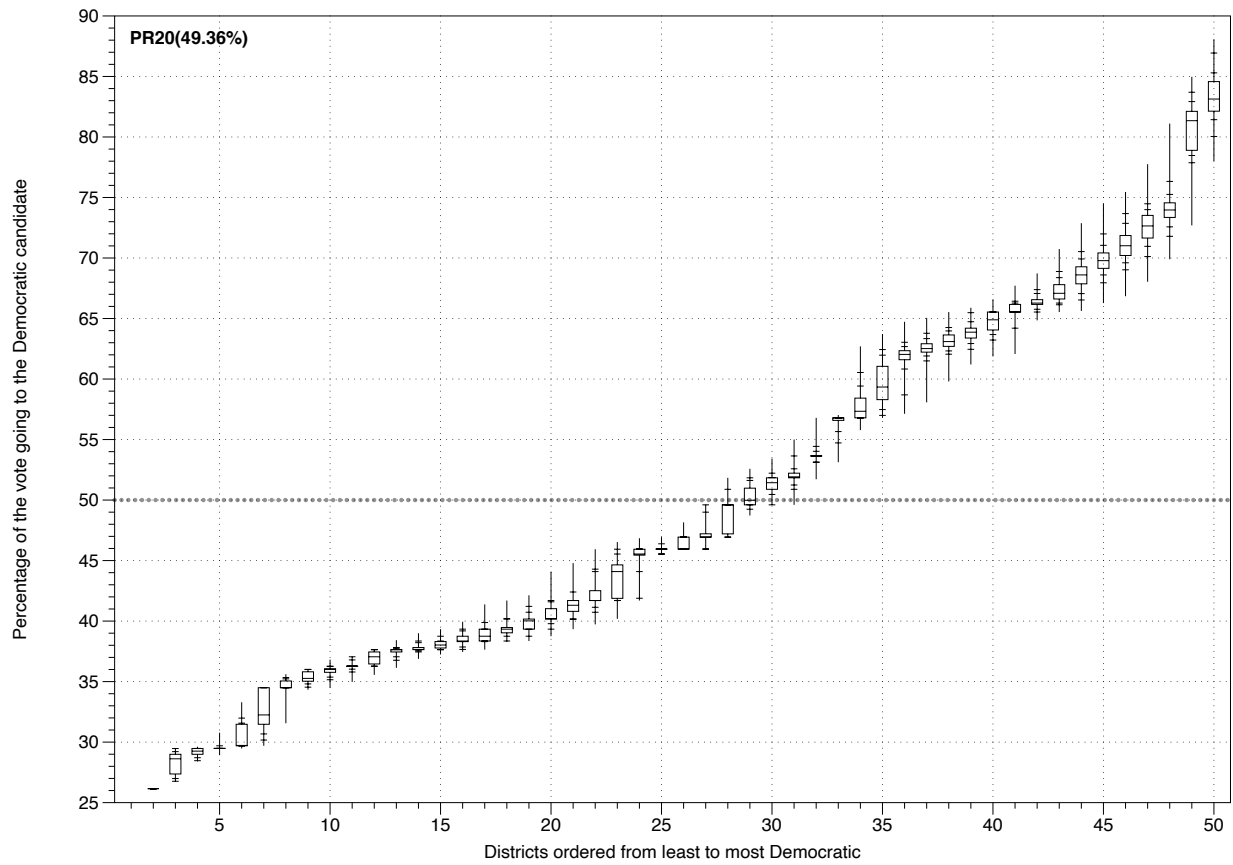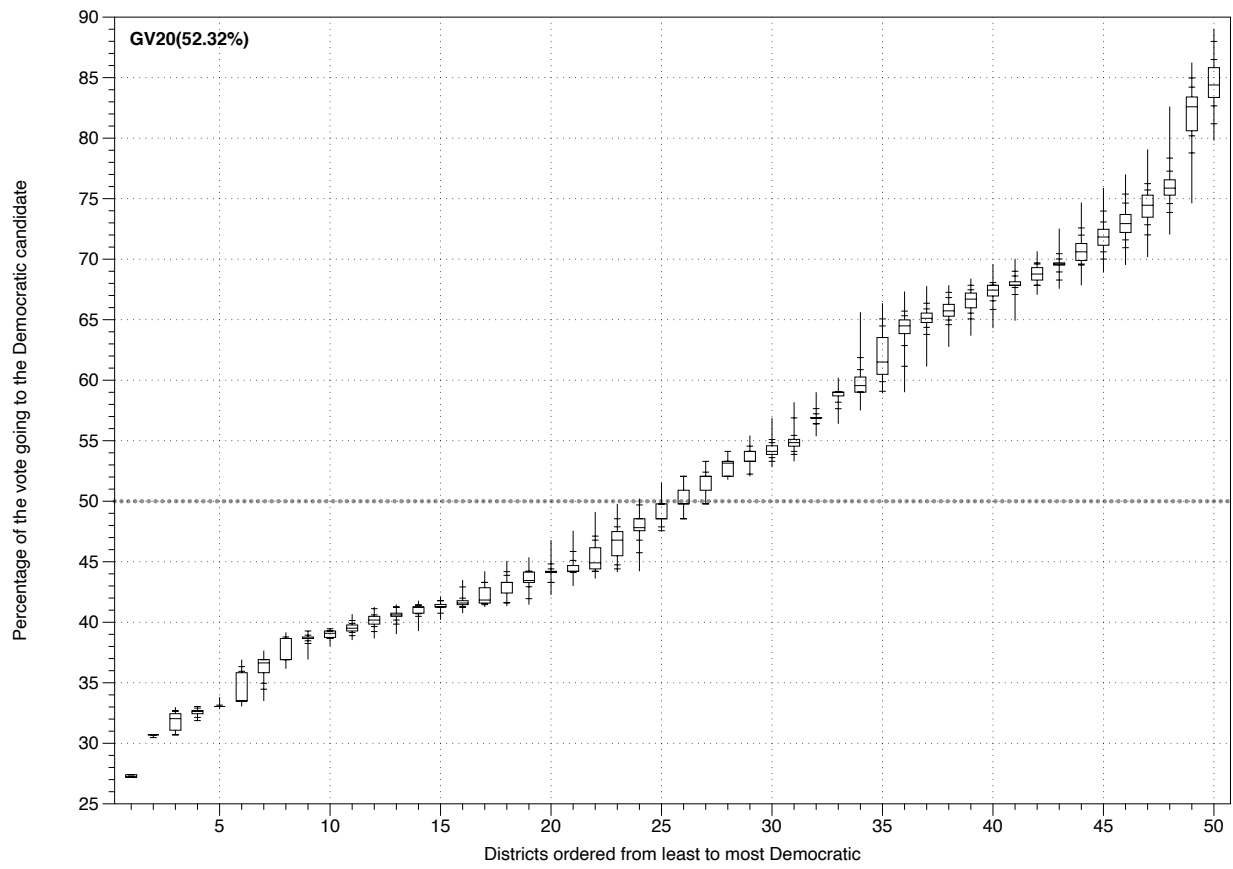
Figure 4: Ranked Ordered Marginal Boxplots considering MCD and using Governor 2020 votes and President 2020 votes.
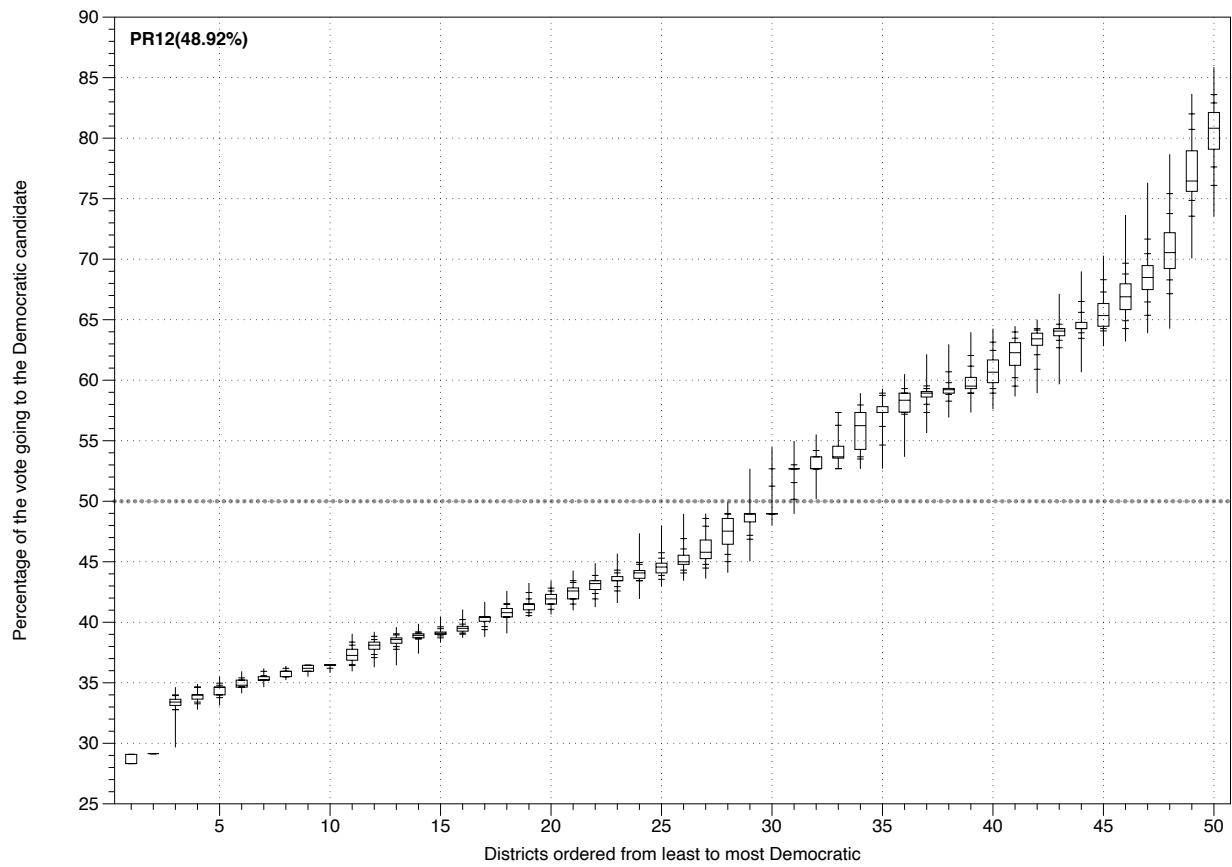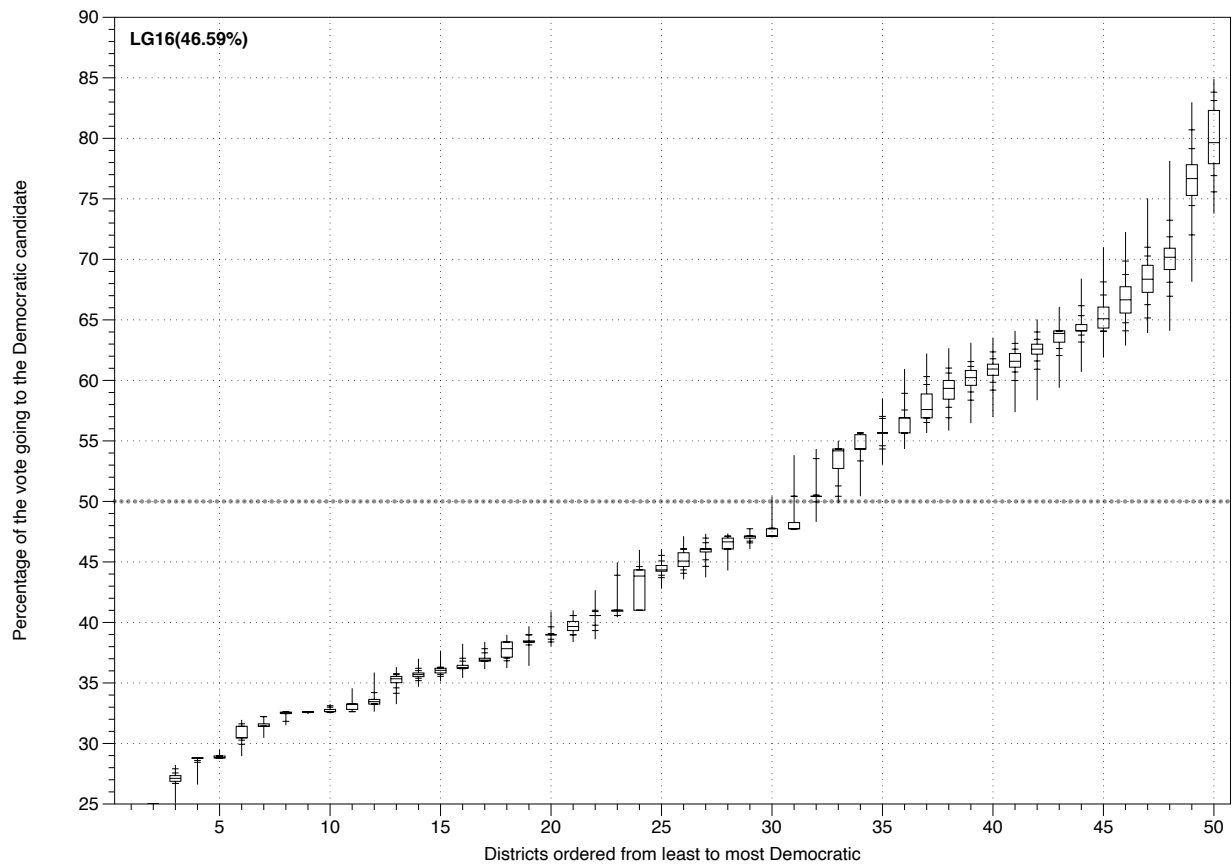
Figure 5: Ranked Ordered Marginal Boxplot distribution considering MCD and using Secretary of State 2012 votes an President 2008 Votes.
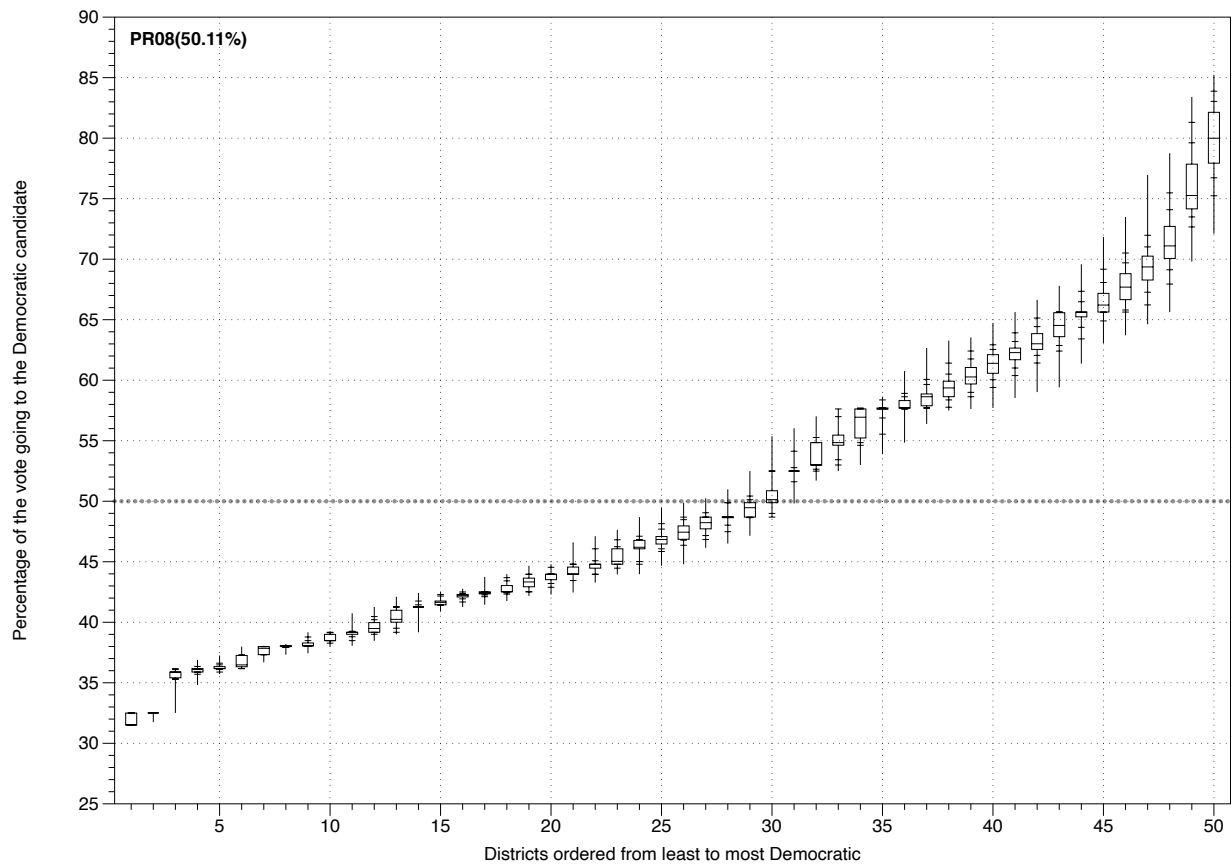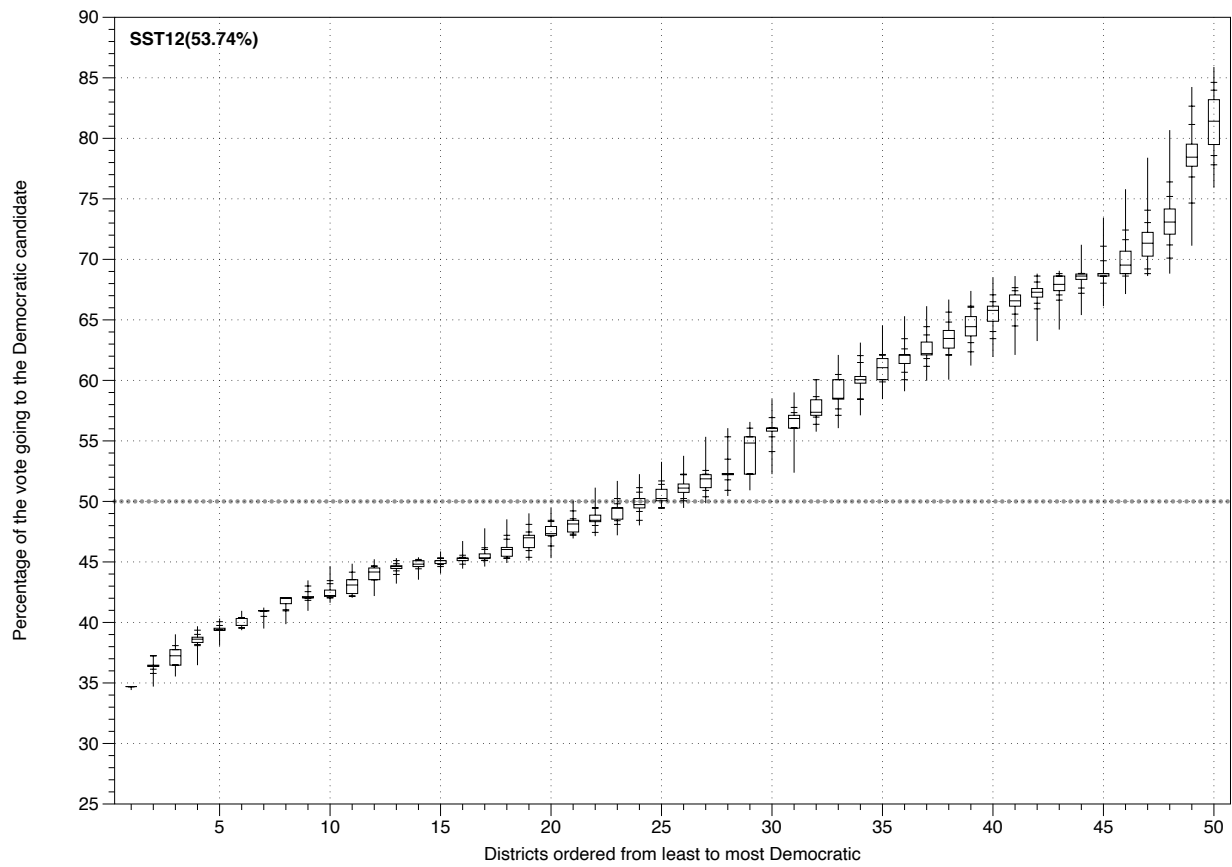
Figure 6: Ranked Ordered Marginal Boxplot distribution considering MCD and using Secretary of State 2012 votes an President 2008 Votes.
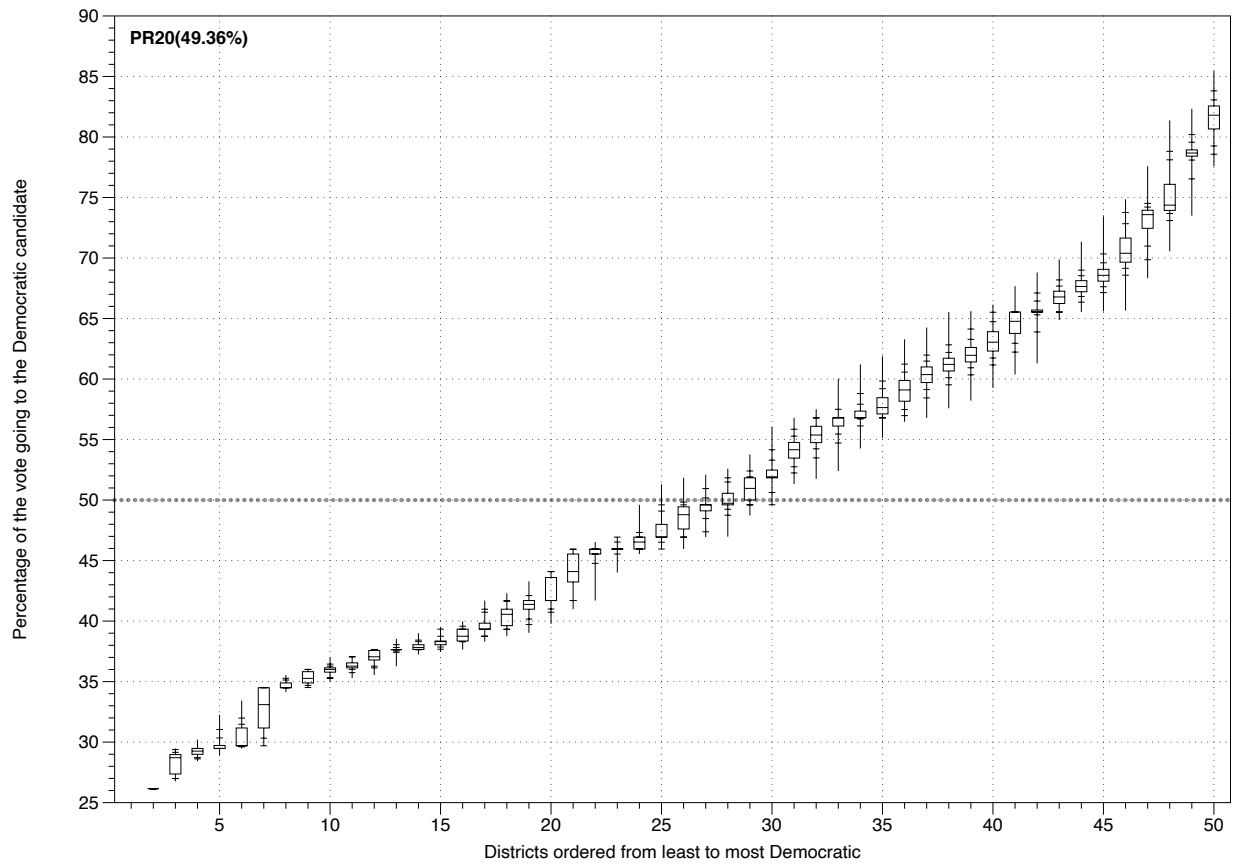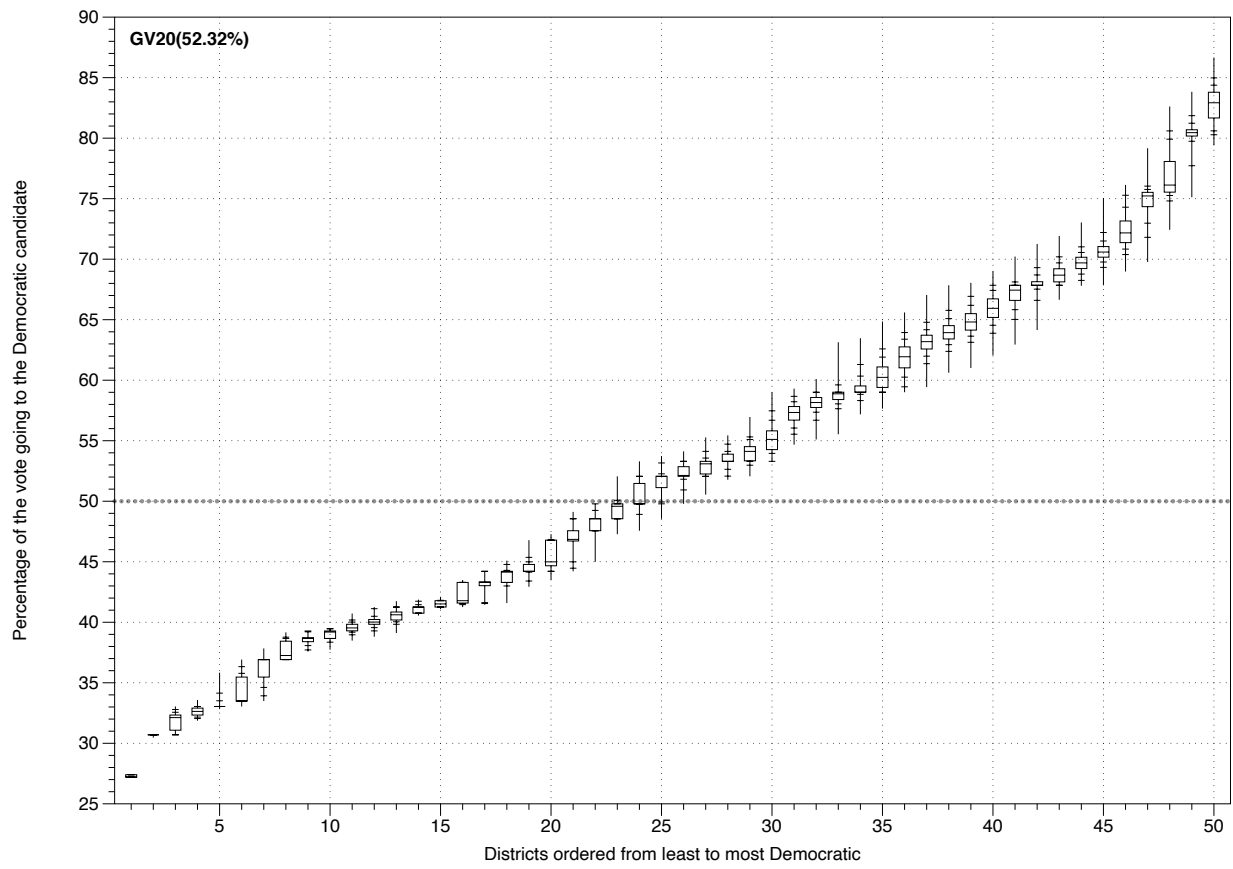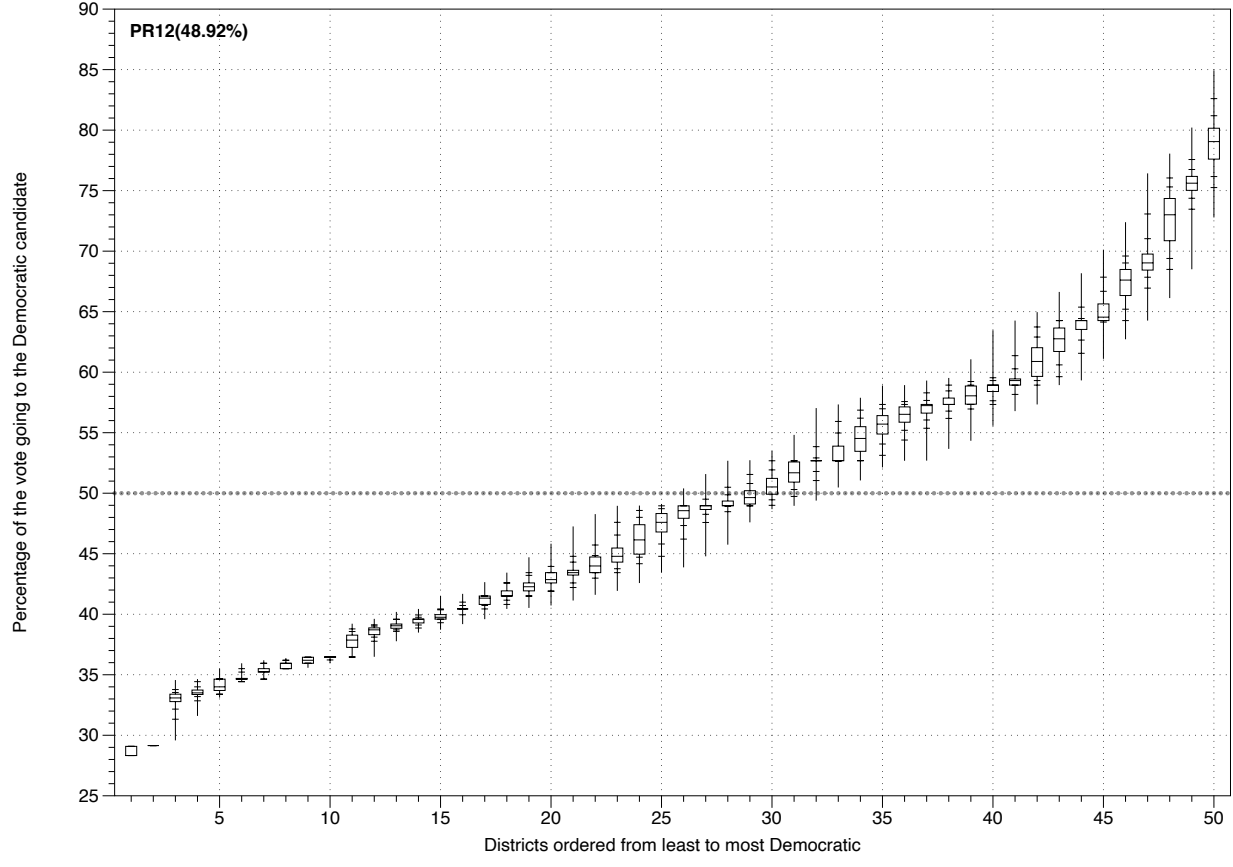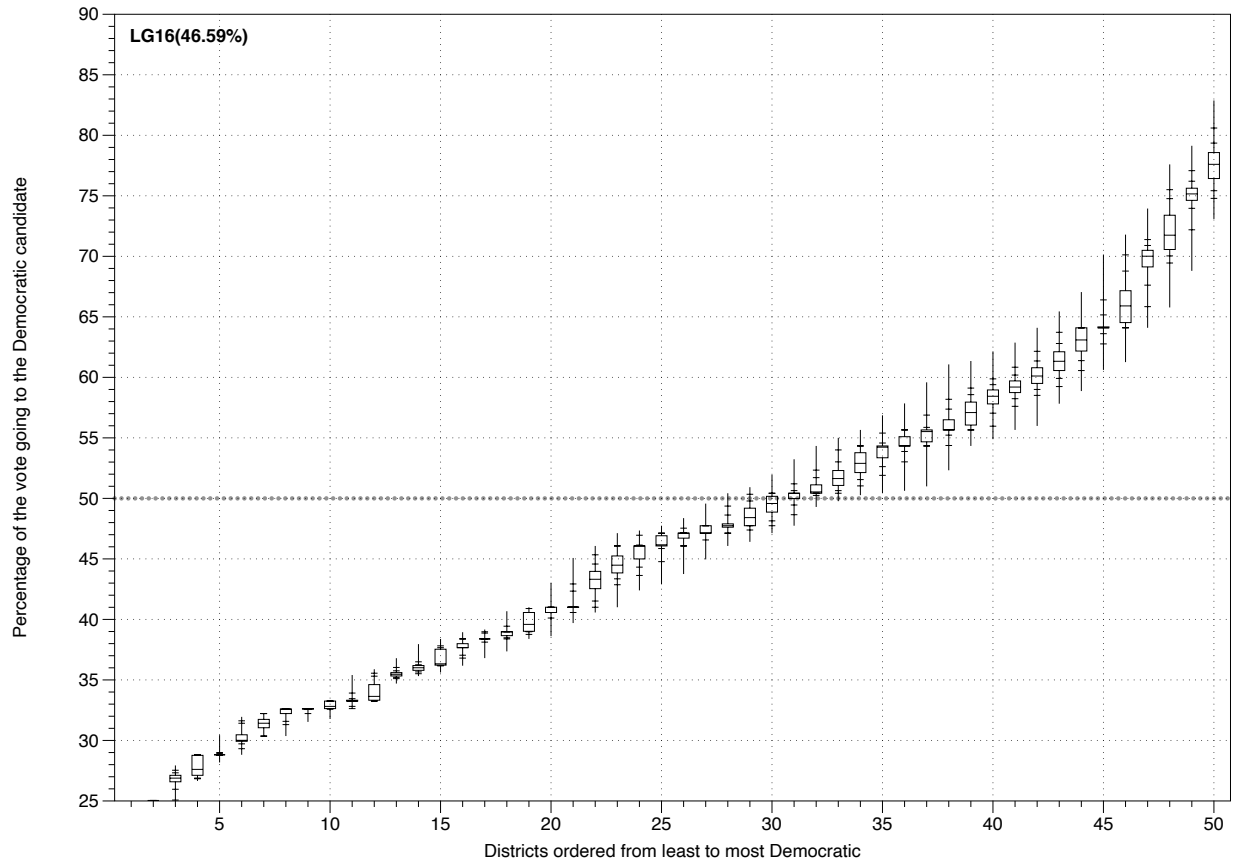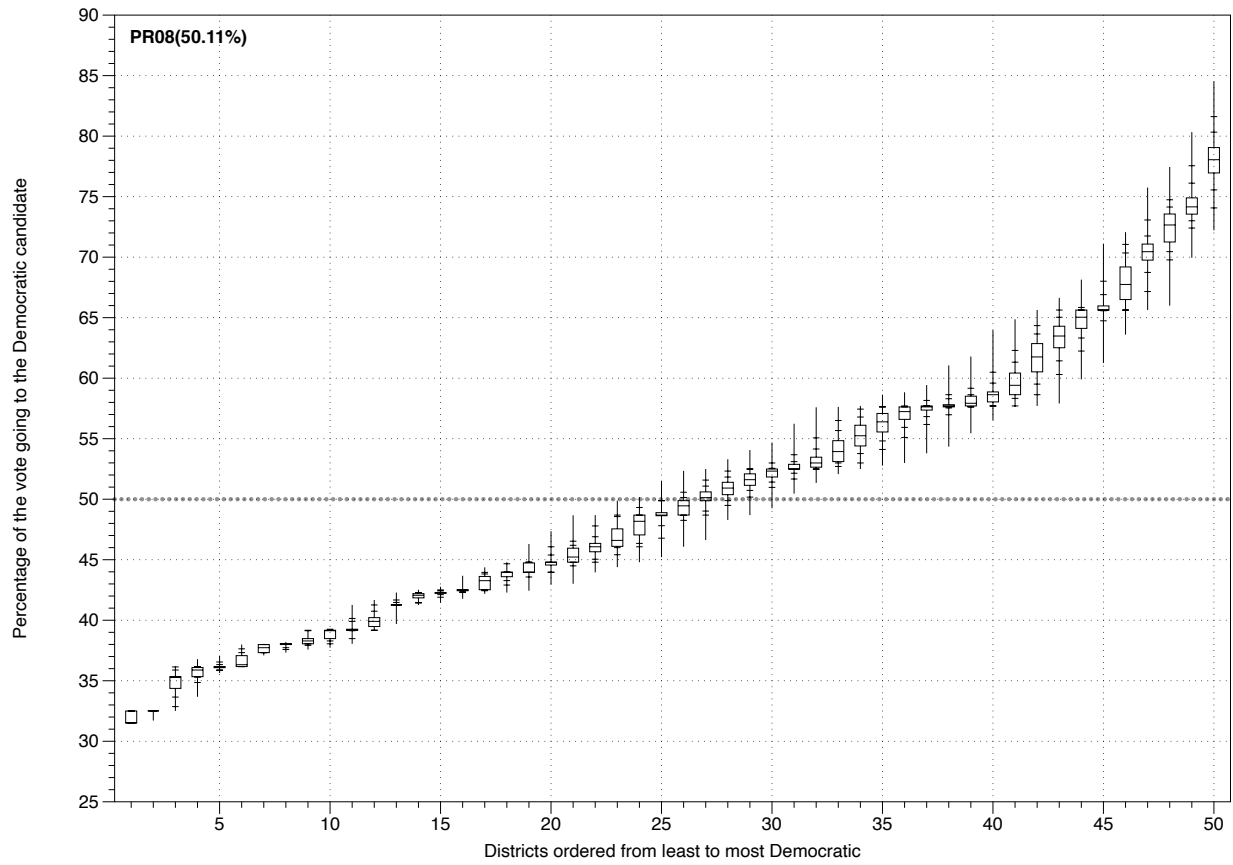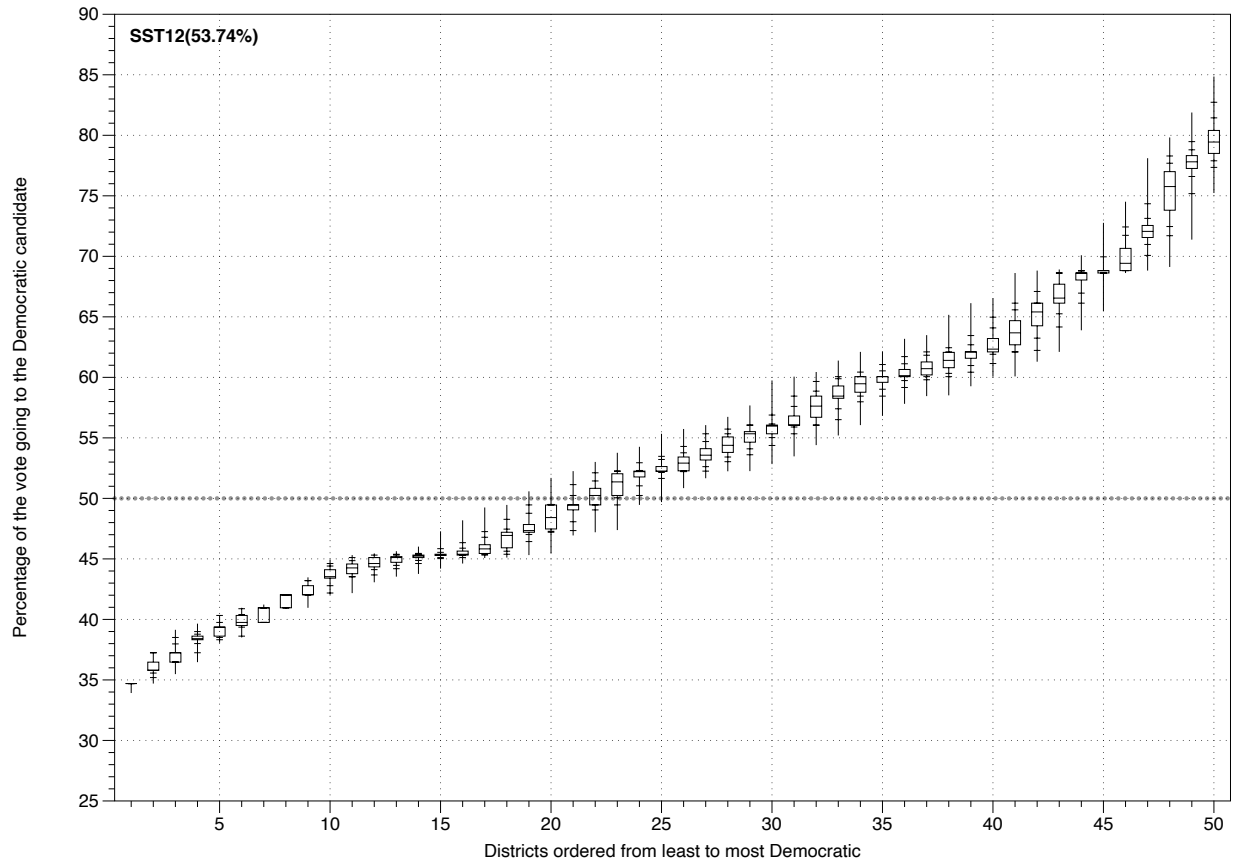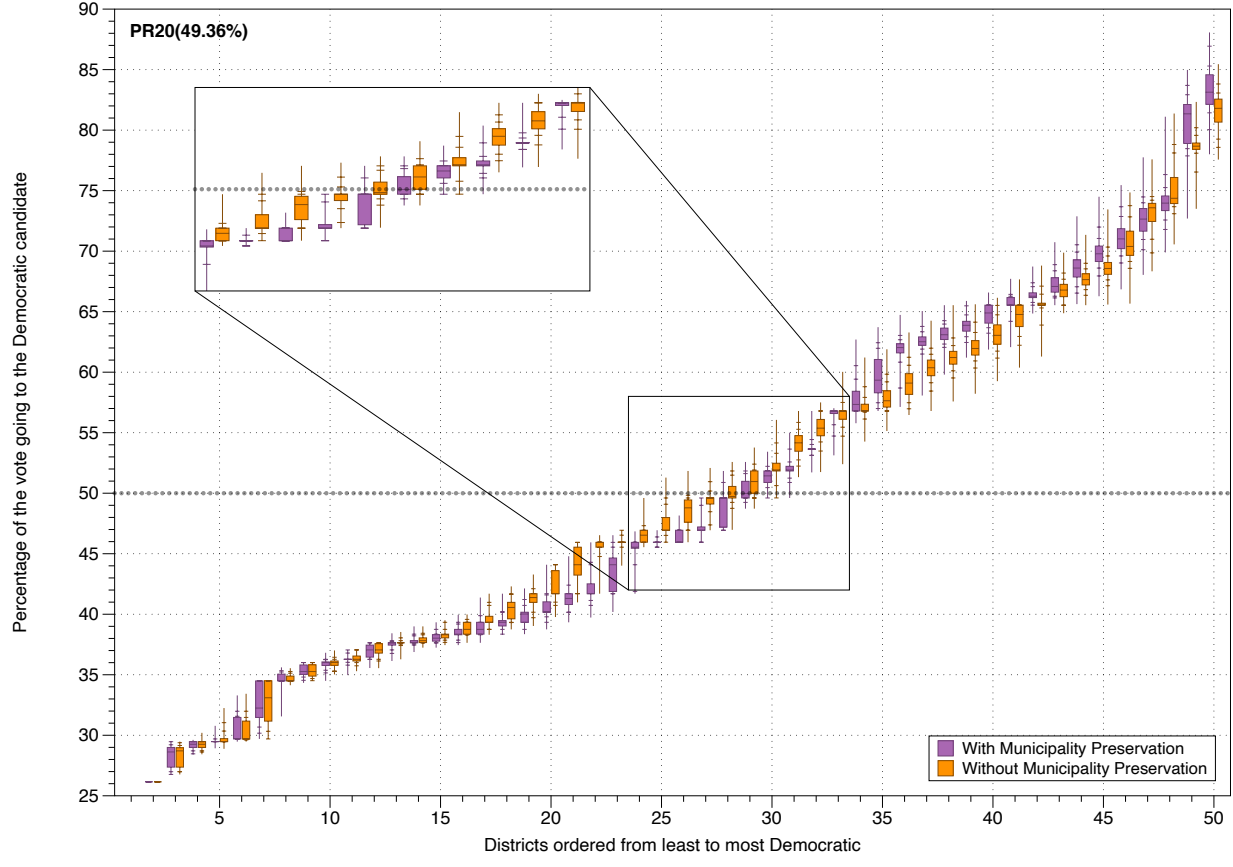
Figure 7: Ranked Ordered Marginal Boxplots not considering MCD and using Governor 2020 votes and President 2020 votes.

Figure 8: Ranked Ordered Marginal Boxplots not considering MCD and using Lieutenant Governor 2016 votes and President 2012 votes

Figure 9: Ranked Ordered Marginal Boxplot distribution not considering MCD and using Secretary of State 2012 votes an President 2008 Votes.
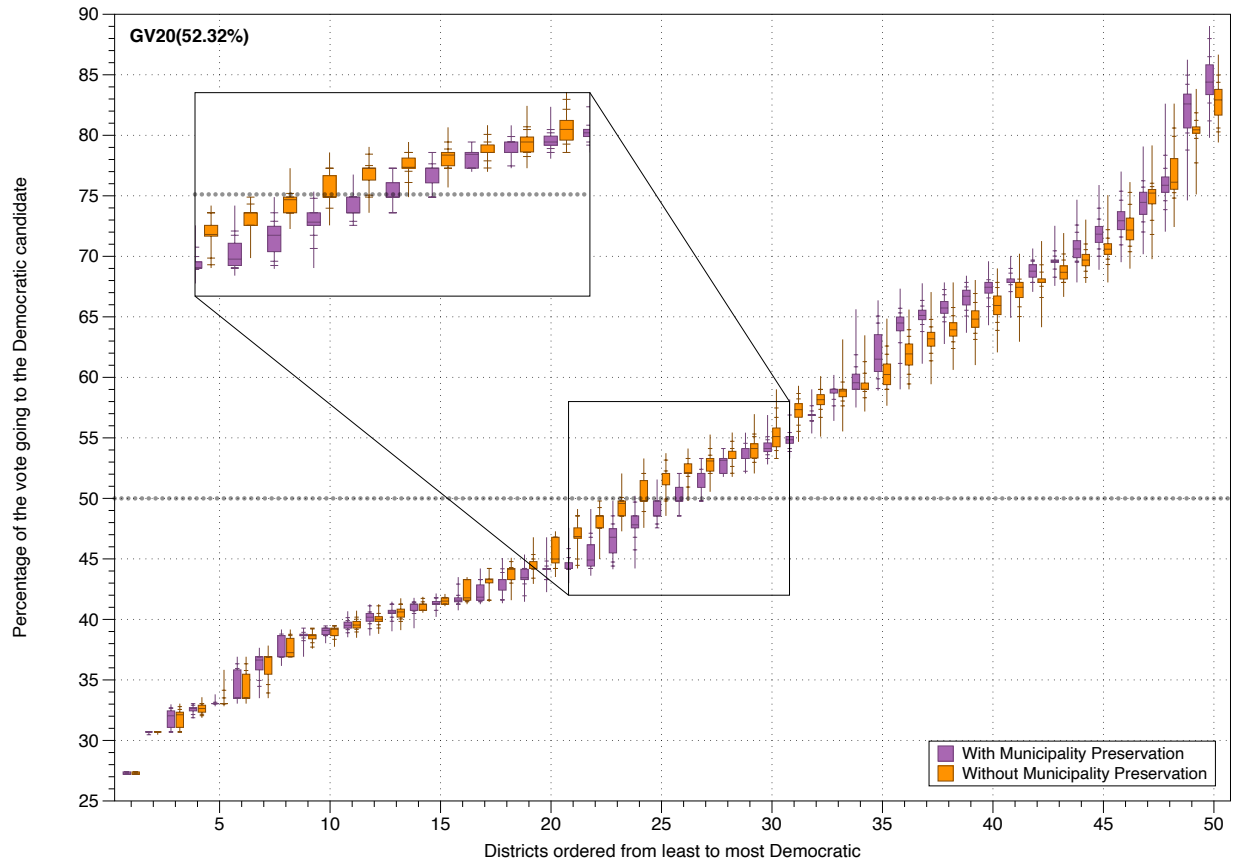
Figure 10: Comparing the Ranked Ordered Marginal Boxplots for the two distributions using Governor 2020 votes and President 2020 votes.
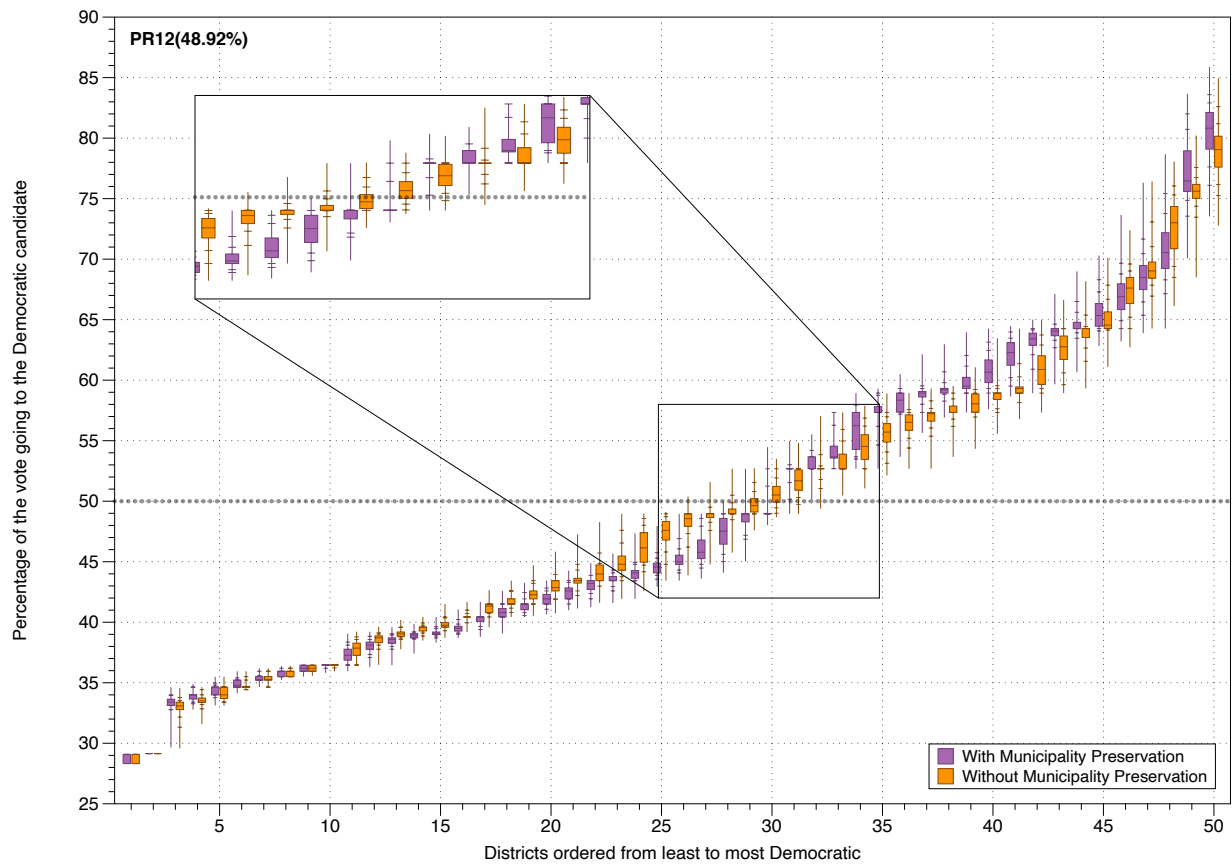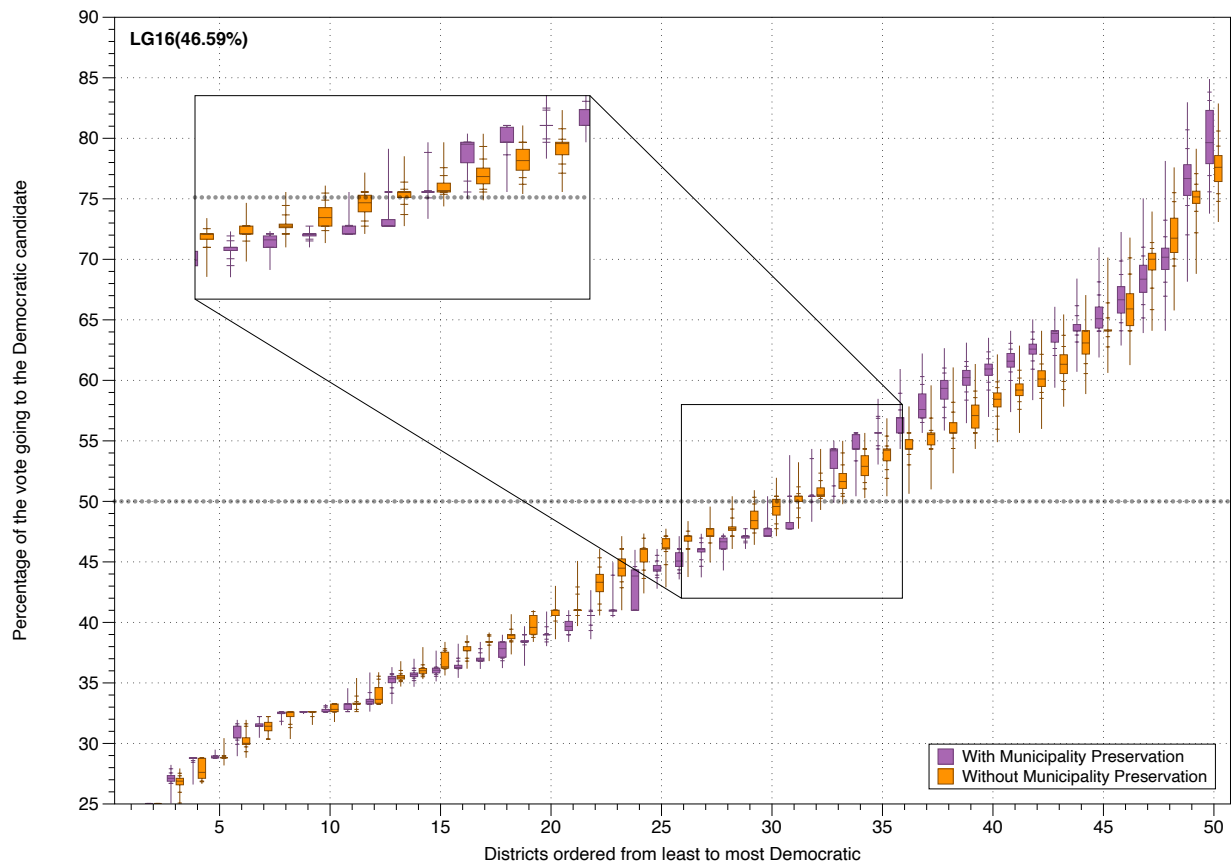
Figure 11: Comparing the Ranked Ordered Marginal Boxplots for the two distributions using Lieutenant Governor 2016 votes and President 2012 votes
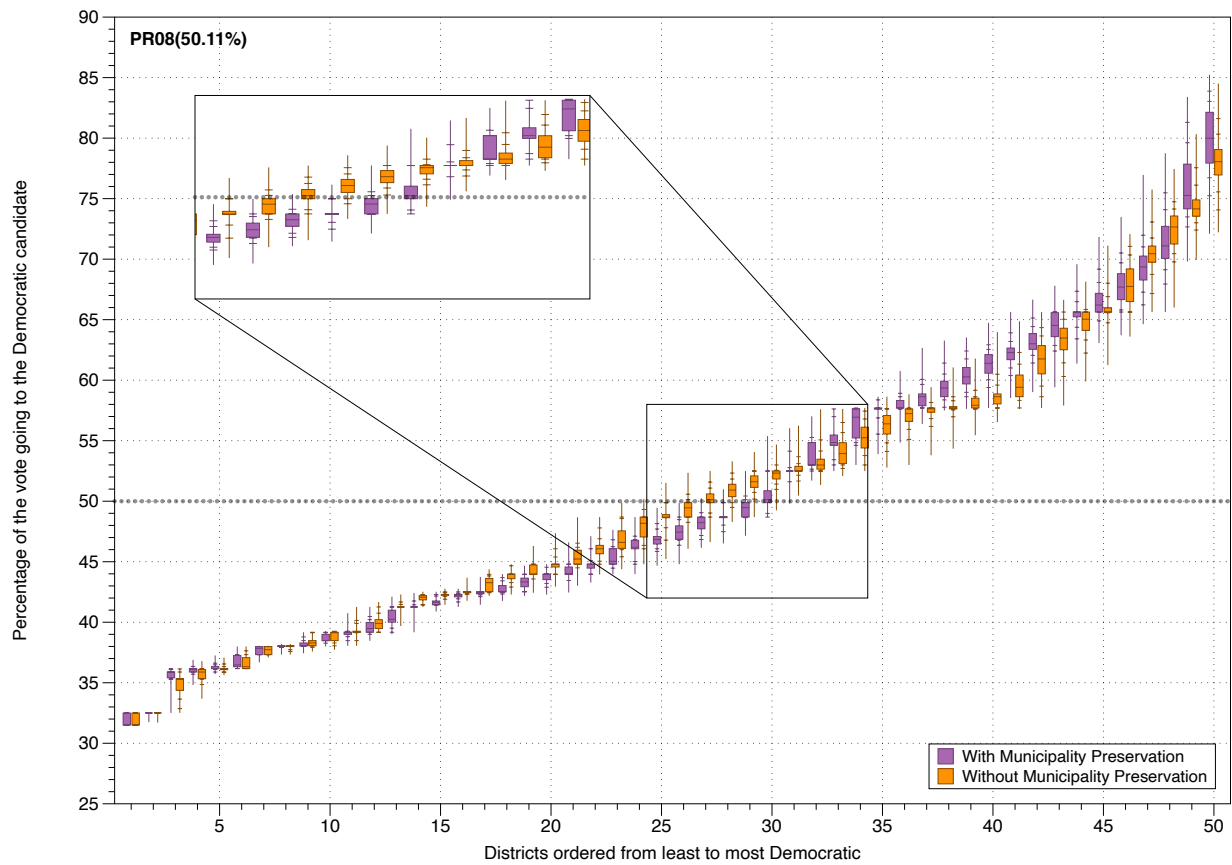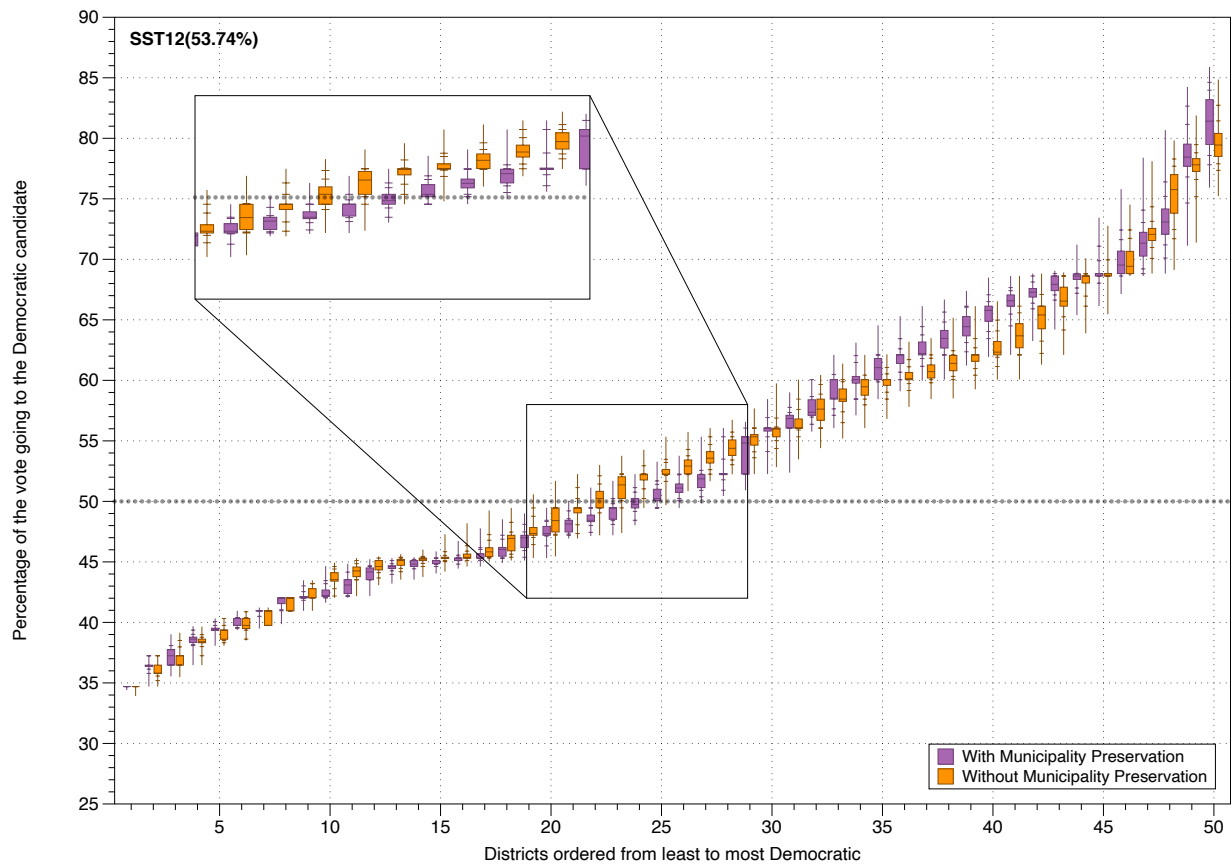
Figure 12: Comparing the Ranked Ordered Marginal Boxplots for the two distributions using Secretary of State 2012 votes an President 2008 Votes.
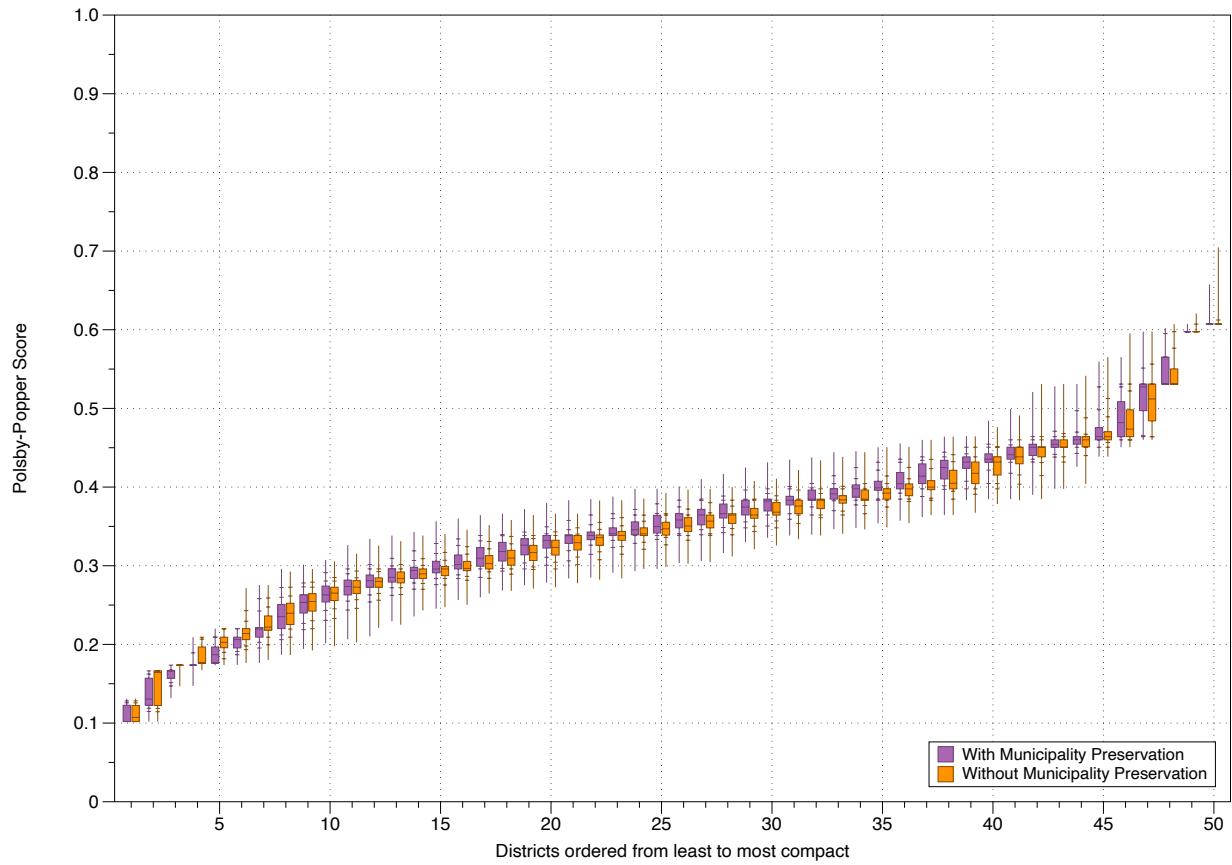
Figure 13: The ranked compactness score of each district for the distribution both considering municipalities and not considering municipalities

4 Distribution of Compactness

In Figure 13, we give the box-plots for the ranked ordered marginal distribution for the compactness score, namely the isoperimetric ratio (see companion methods document), for both the distribution with and with out municipality consideration.