

# Evaluating the 2021 Enacted Congressional Plan

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## 1 Overview

We compare the enacted CST-13 congressional redistricting plan in North Carolina to a collection of maps that are representative of a non-partisan redistricting criteria. Our collection of maps and the criteria used to generate them are presented in our previous analysis [?]. Our distribution favors plans with compact districts and keeps counties intact.

## 2 Results

Figure 1 gives the *Collected Seat Histograms* for the ensemble sampled from the distribution. This figure also shows how many Democrats the CST-13 enacted plan would have elected under the votes from a variety of historic elections.<sup>1</sup> 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 set of votes, the primary message of this plot is that the enacted CST-13 plan is largely stuck electing 4 of 14 Democrats despite large shifts in the statewide vote fraction and across a variety of election structures. This non-responsiveness is not observed in the ensemble.

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<sup>1</sup>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>

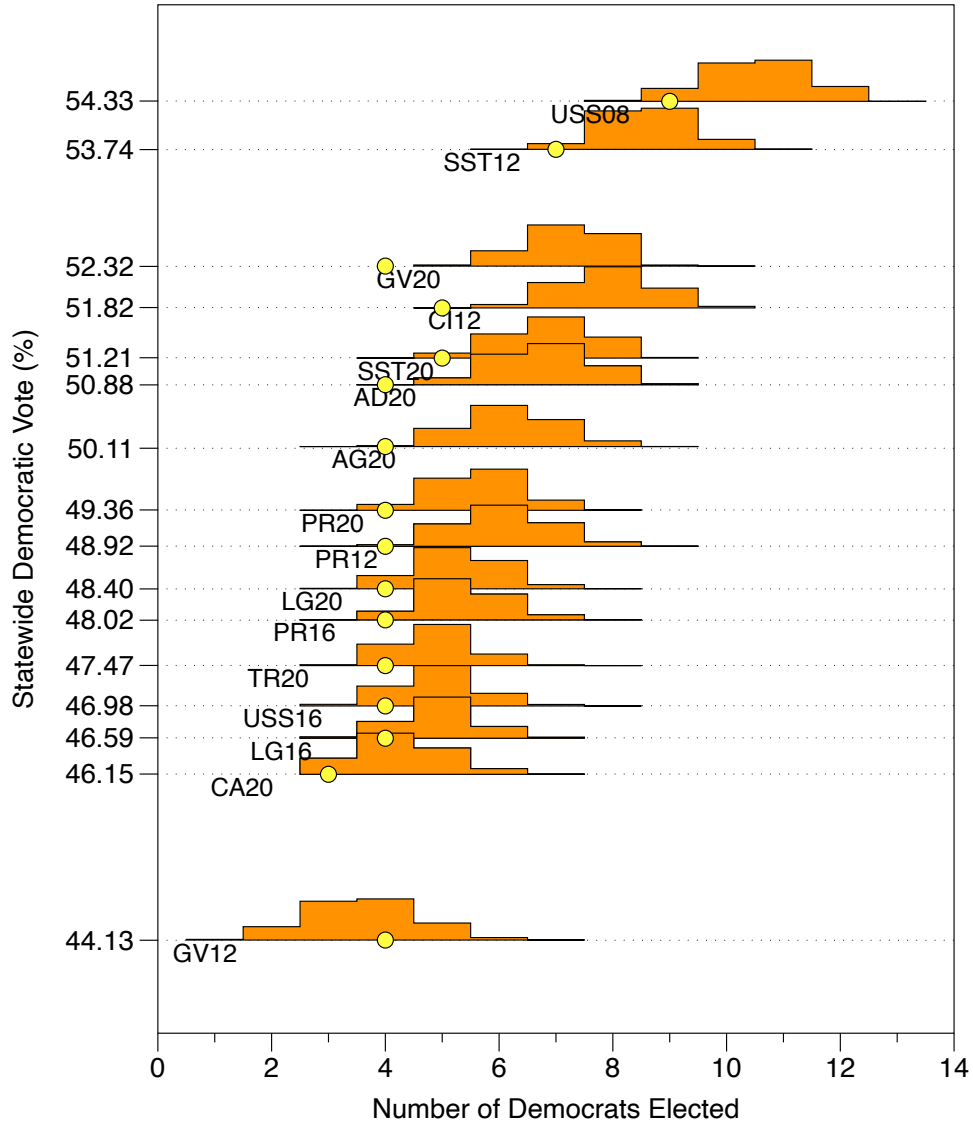


Figure 1: Each histogram represents the range and distribution of possible Democratic seats won in the ensemble of plans; the height is the relative probability of observing the result. We only include a selection of the historic vote counts for clarity. Abbreviations contain the year in the last two 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. The yellow dots represent the results from the enacted CST-13 plan under the various historic votes.

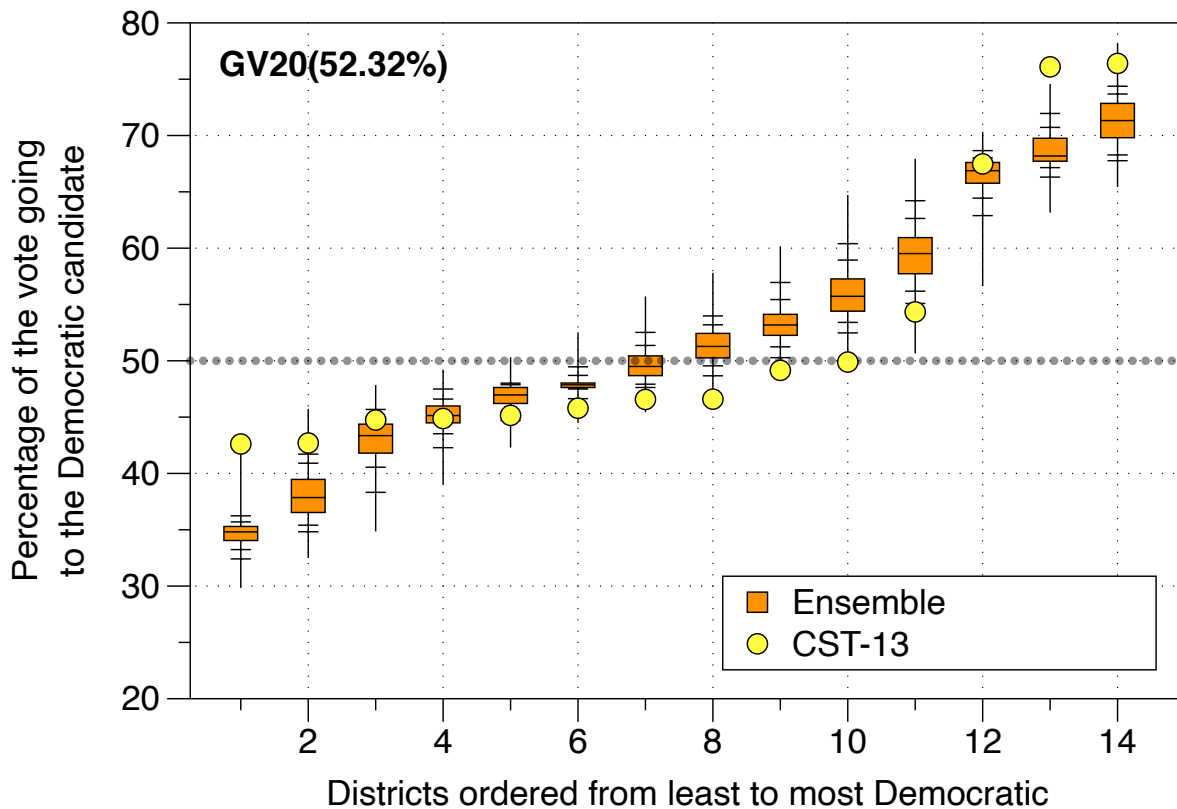


Figure 2: Ranked Ordered Marginal Boxplots using Governor 2020 votes.

### 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 14 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.

Figures 2-4 give the box-plots of the marginal vote fraction distribution under a representative collection of elections. The elections used were chosen to span the range of statewide vote fractions seen in Figure 1.

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.

We examine a variety of elections and consistently find that the two most Democratic districts contain significantly more Democratic voters than are seen in the ensemble. We also see that two most Republican districts contain significantly fewer Republicans than we see in the ensemble. Finally, we see that districts in the middle have fewer Democrats than is expected from the ensemble. This suggests that Democrats have been removed from these middle districts and that Republicans have been removed from the most Republican districts and placed into the middle, more competitive districts.

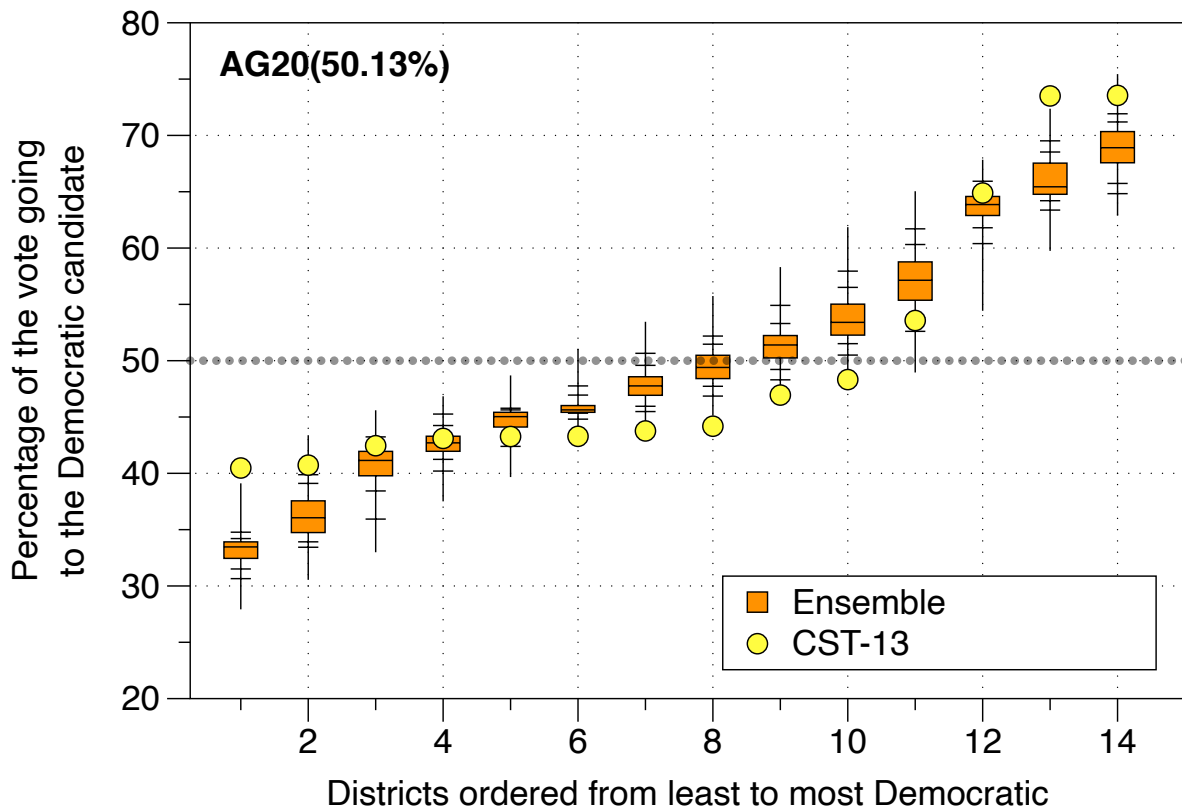
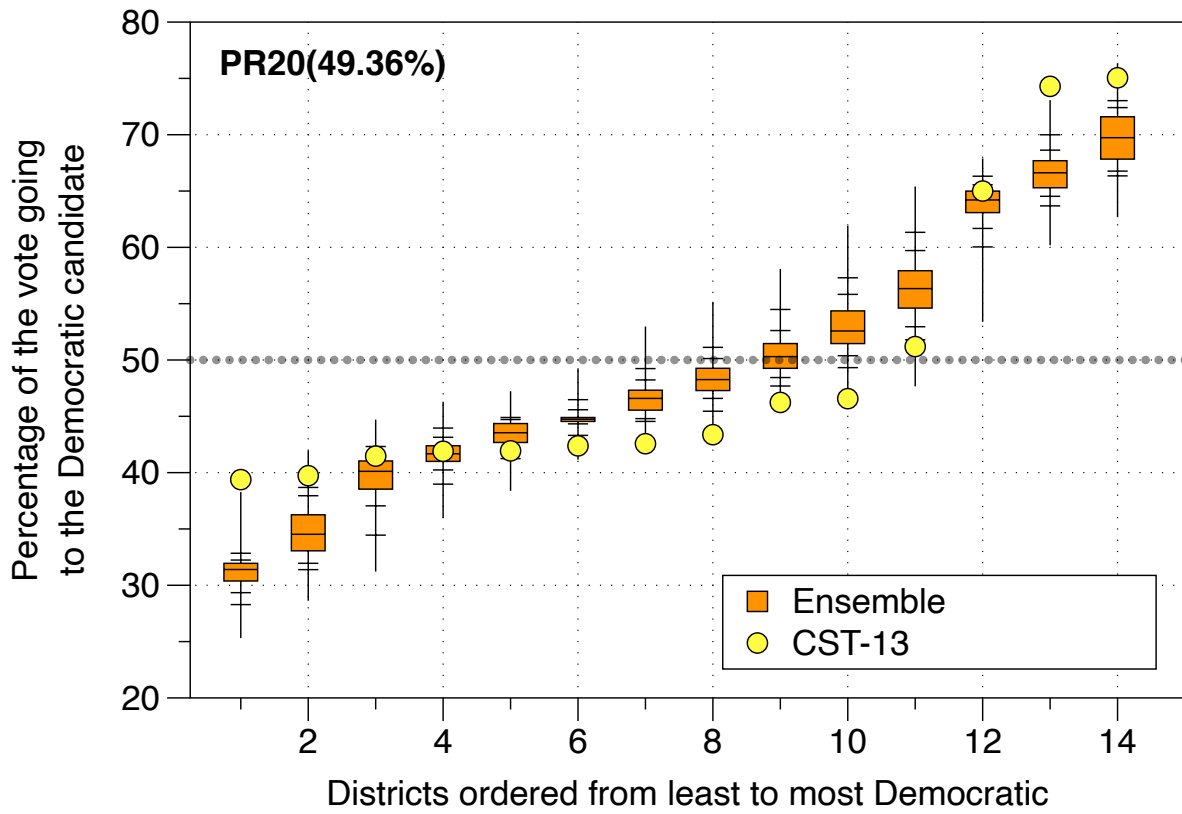


Figure 3: Ranked Ordered Marginal Boxplots using President and Attorney General 2020 votes.

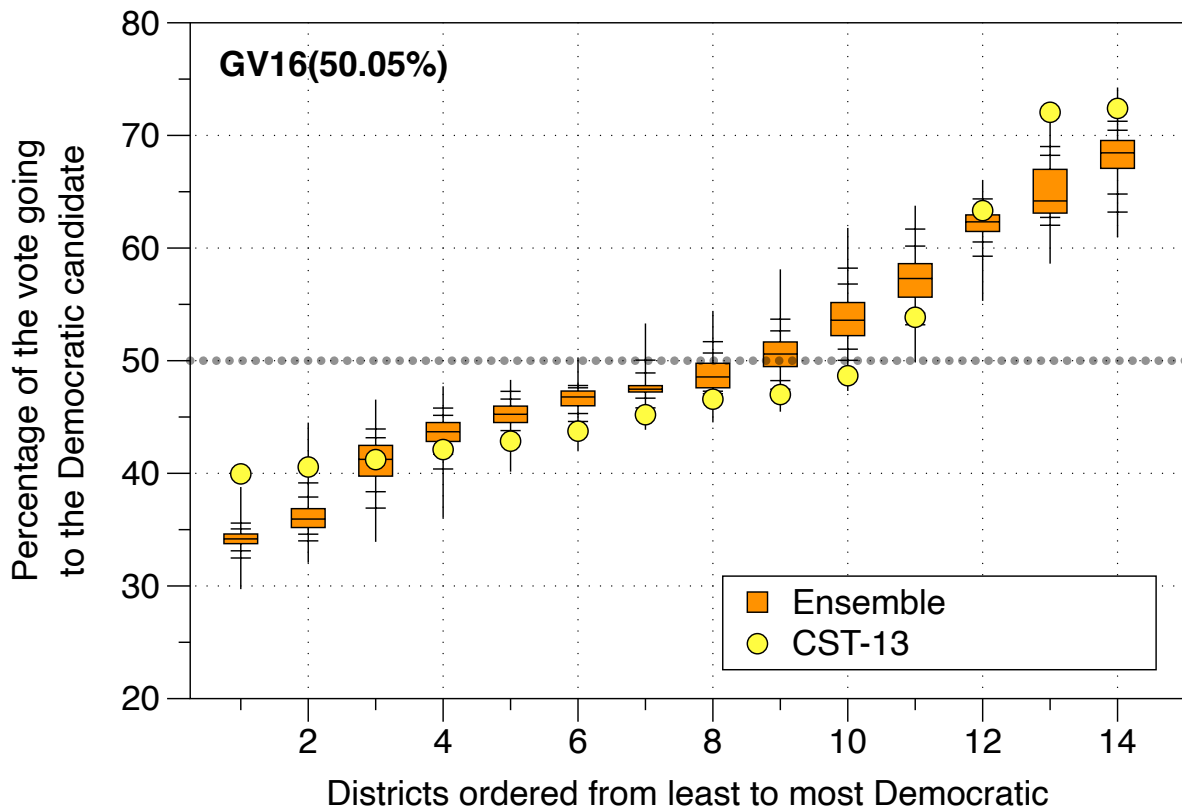
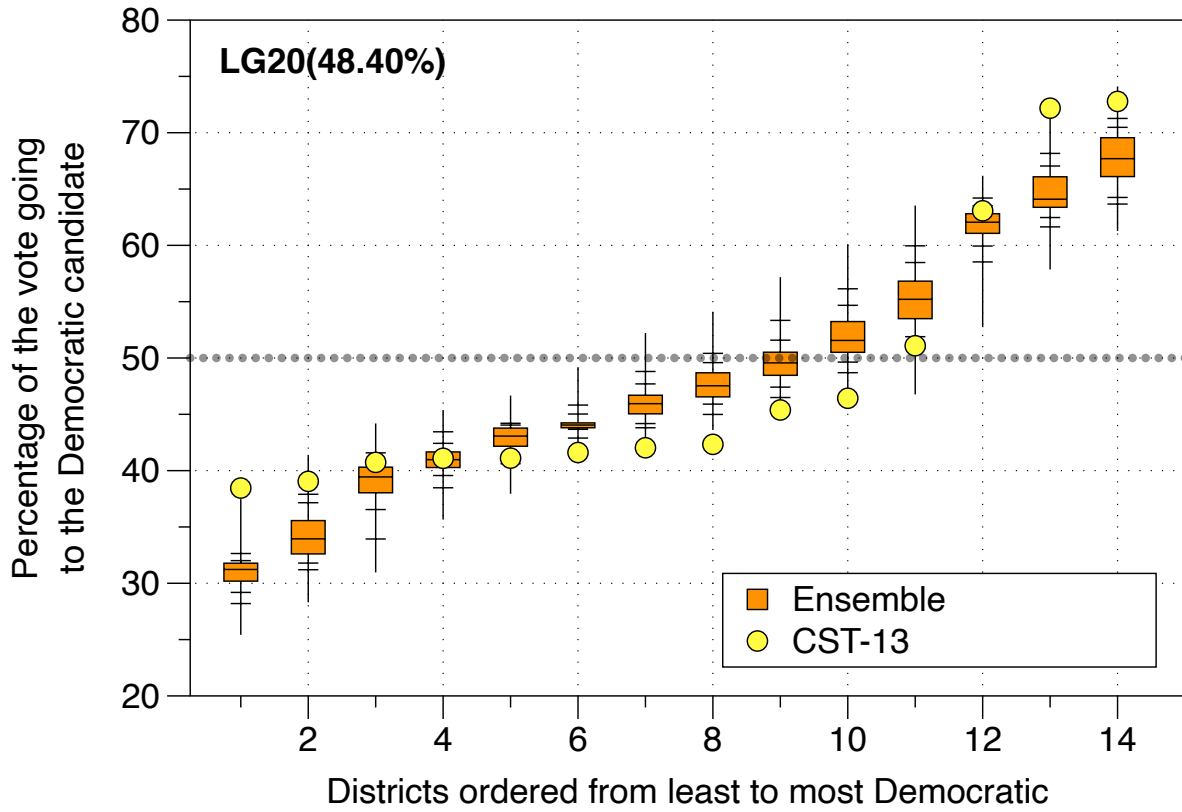


Figure 4: Ranked Ordered Marginal Boxplots using the 2020 Lieutenant Governor and 2016 Governor votes.

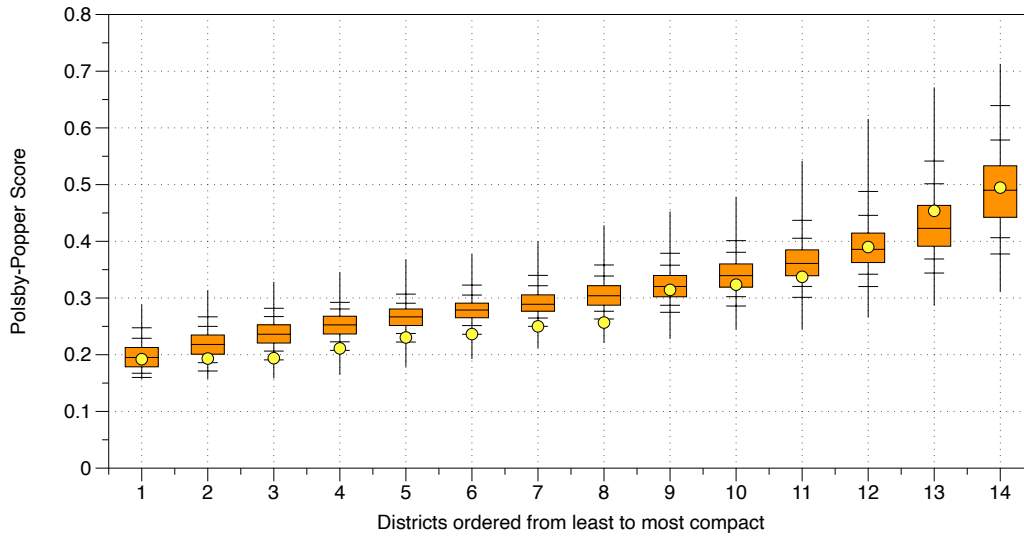


Figure 5: The yellow dots display the ordered Polsby-Popper score of the 14 districts in the CST-13 plan.

## 4 Distribution of Compactness

In Figure 5, we give the box-plots for the ranked ordered marginal distribution for the compactness score, namely the Polsby-Popper score (see companion methods document). We compare the ensemble of plans with the CST-13 plan.