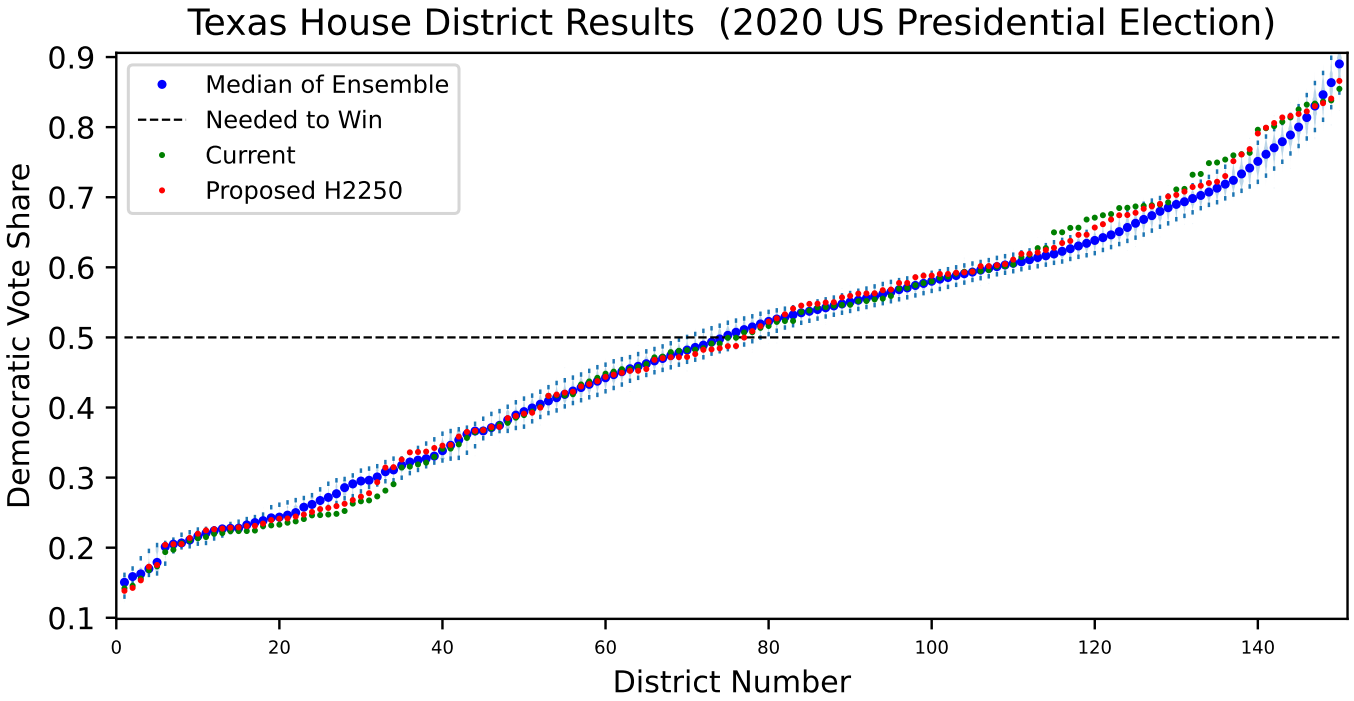


Figure 1

MUM_TX Statement on H2250

Math For Unbiased Maps TX (MUM_TX) is an interdisciplinary, nonpartisan coalition of Texas mathematicians, political scientists and philosophers working to ensure a fair and transparent redistricting process. Our research concerns the development and application of ensemble sampling techniques, and in particular their application to the current TX redistricting cycle. In brief, we use *Markov Chain Monte Carlo* techniques to generate a large number of random, legally valid maps which can then be used as an unbiased baseline to understand what a typical map should look like. Conversely, when a proposed map is an outlier from the ensemble, this may be an indication of gerrymandering.

We have applied our methods to the Congressional maps that have been made available by the Texas Legislative Council. We generated a table of two important statistics that are commonly used by political scientists to assess partisan gerrymandering: the mean-median score and partisan bias score. You can find the table at our webpage: www.smu.edu/Dedman/Research/Institutes-and-Centers/DCII/Scholarship/Research-Cluster-on-Political-Decision-Making/TXGerryWatch.

We compared the proposed map to an *ensemble* of 1,000,000 randomly-drawn maps. In Figure 1, districts are ordered by the number of votes a Democratic candidate for US Congress would have received in the 2020 election, had voters used "straight ticket" voting. On average, maps within our ensemble (blue dots) exhibit smoothly increasing vote shares as one moves from Republican-leaning to Democratic-leaning districts. This smooth increase is the hallmark of an unbiased map.

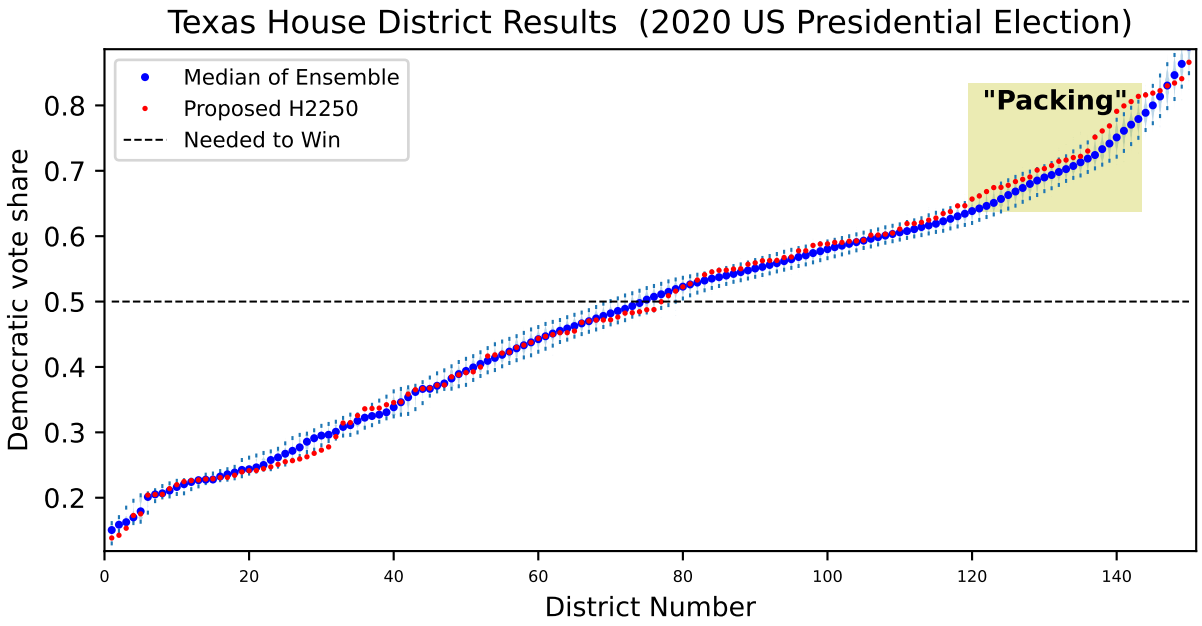


Figure 2

In Figure 2, we show the same data, but now identify two signatures of gerrymandering: "cracking" (where opposition voters are diluted to create safe districts for the majority) and "packing" (where these voters are concentrated to dilute their overall voting power).

We also compute two common numbers that political scientists use to "score" maps. The first such number is called the "mean-median" score: the difference in statewide vote percentage between the Republicans and Democrats required for them to win the majority of the chamber. The second such score is called the "partisan bias" score: the difference in the number of seats each party wins if each were to earn 50% of the vote. A positive score in either favors Democrats.

Of course, no plan is going to be perfectly aligned with the ensemble, so just how gerrymandered is this plan? A little? A lot? An extreme amount? This question can be answered using statistics, by comparing each score above to the *distribution* of those scores within the 1,000,000 - map ensemble. This is done in Figure 3. The second row shows the joint distribution of mean-median and partisan bias.

In Figure 4 we present another "violin" plot, but with districts sorted according to the the fraction of the voting age population that is Black + Hispanic.

We next ask the question "How many Districts have an BHVAP over 50%?" (or 60%, or 70%, etc..). The BHVAP is the combined Black and Hispanic voting age population. These histograms show the values for the ensemble, and the value for the Proposed map is shown in red. In Figure 5 we show the number of districts that have BHVAP above 50% and 70%; that is the number of districts that are majority-minority, vs. the number of Districts that are ***overwhelmingly*** majority-minority.

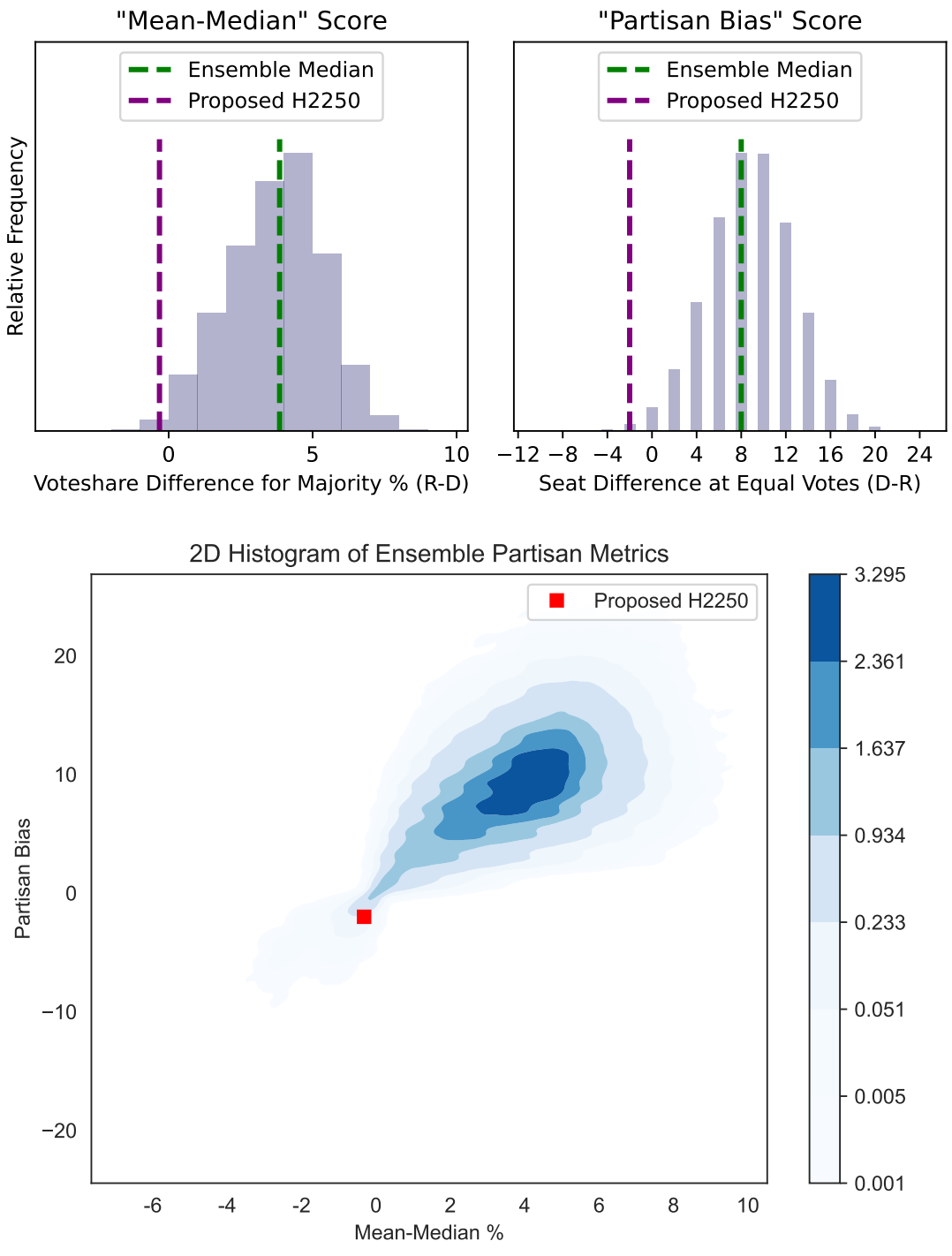

"Mean-Median" Score
Ensemble Median
Proposed H2250
Relative Frequency
0
5
10
Voteshare Difference for Majority % (R-D)
"Partisan Bias" Score
Ensemble Median
Proposed H2250
−12 −8 −4 0 4 8 12 16 20 24
Seat Difference at Equal Votes (D-R)
2D Histogram of Ensemble Partisan Metrics
Proposed H2250
Partisan Bias
20
10
0
−10
−20
-6 -4 -2 0 2 4 6 8 10
Mean-Median %
3.295
2.361
1.637
0.934
0.233
0.051
0.005
0.001

Figure 3

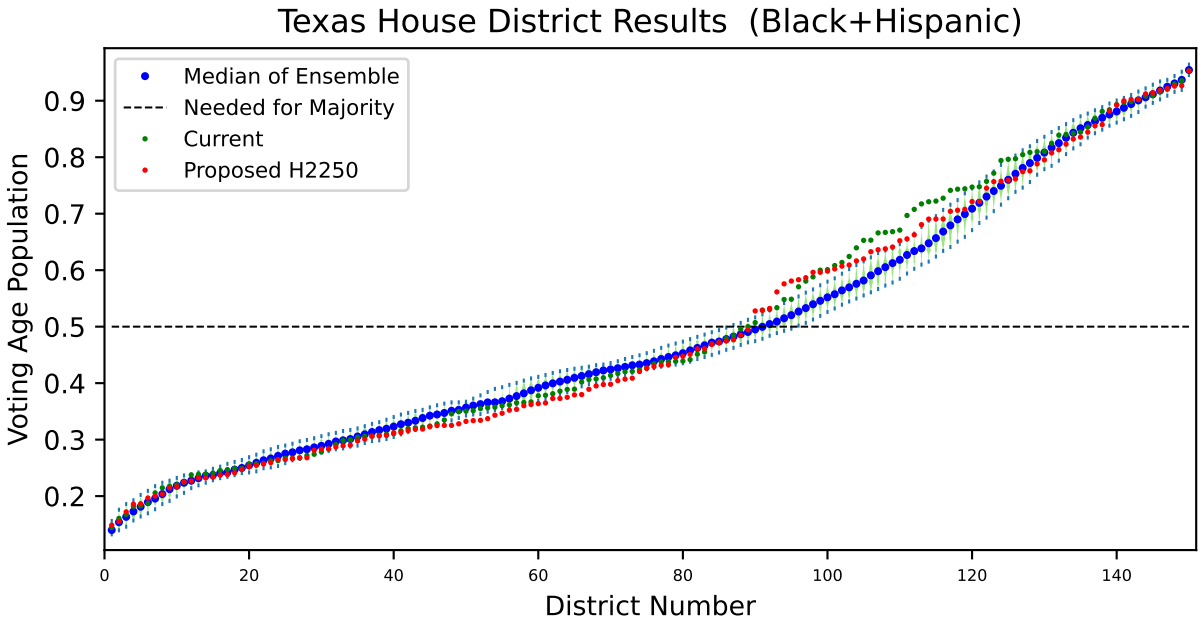


Figure 4

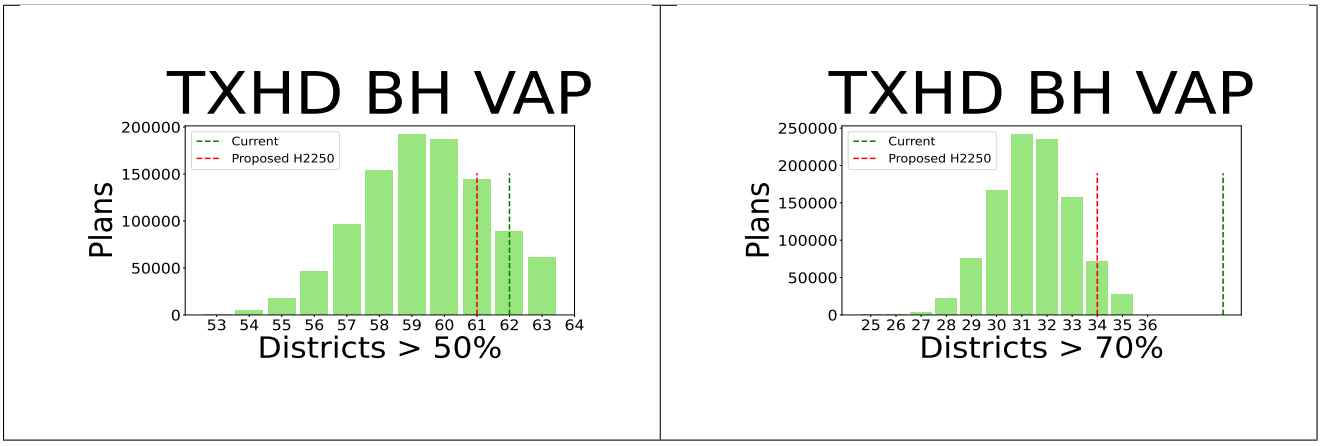
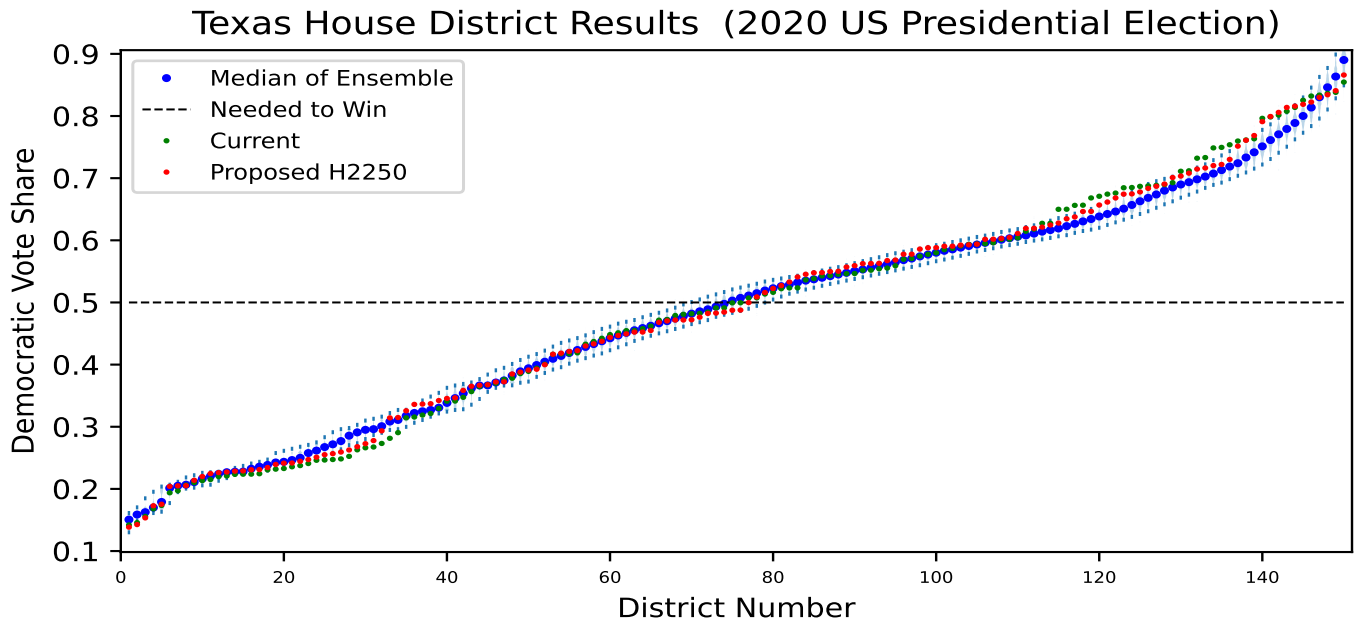
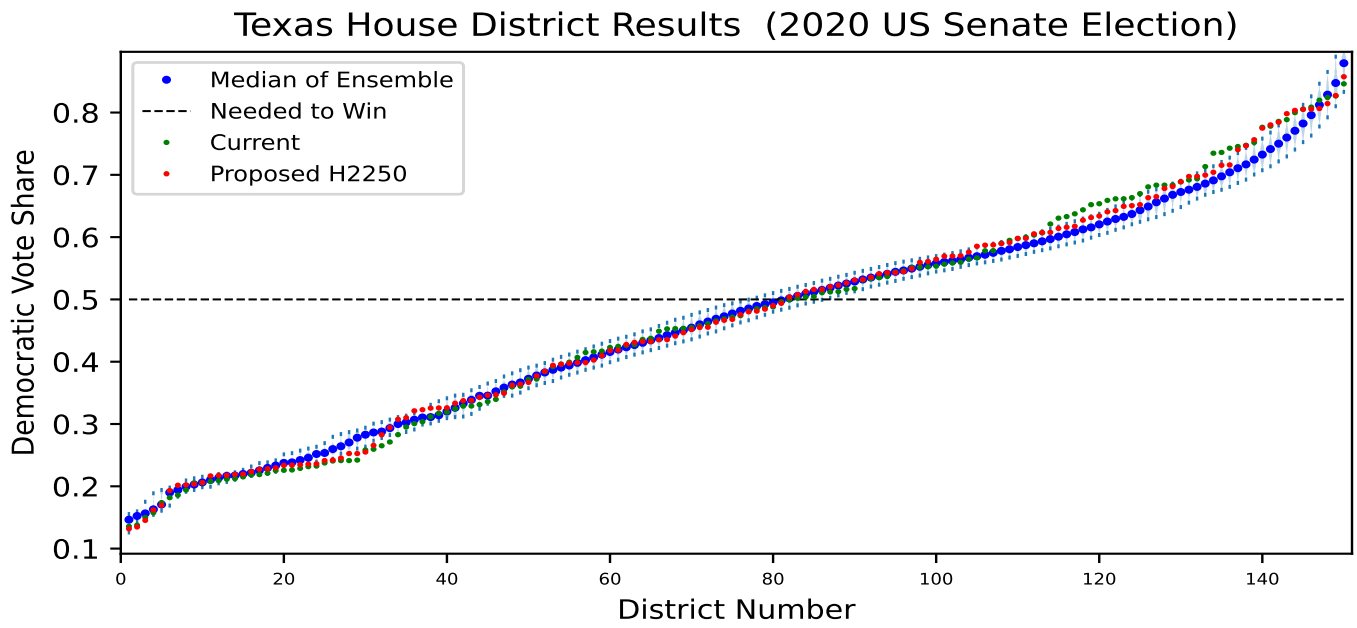
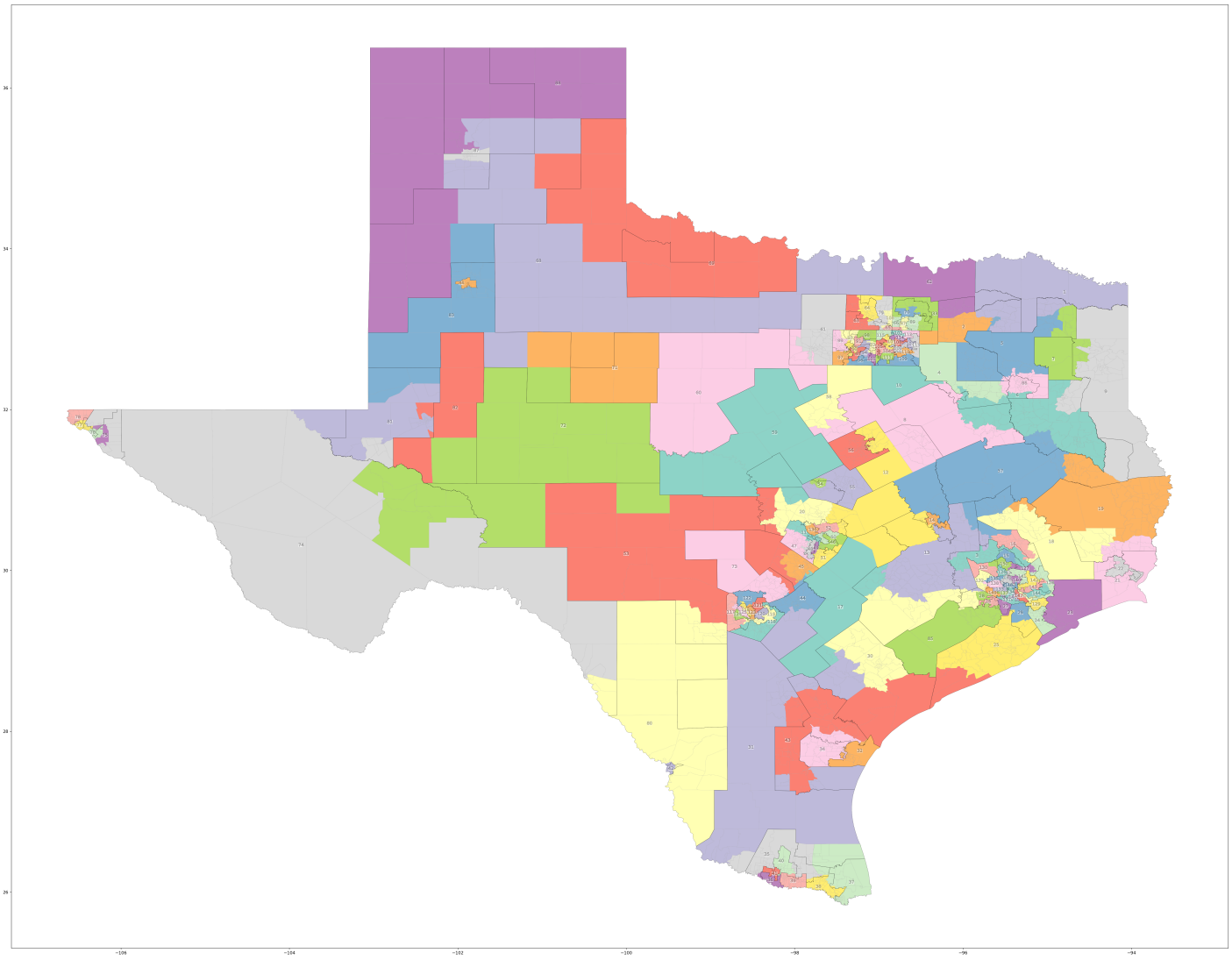


Figure 5

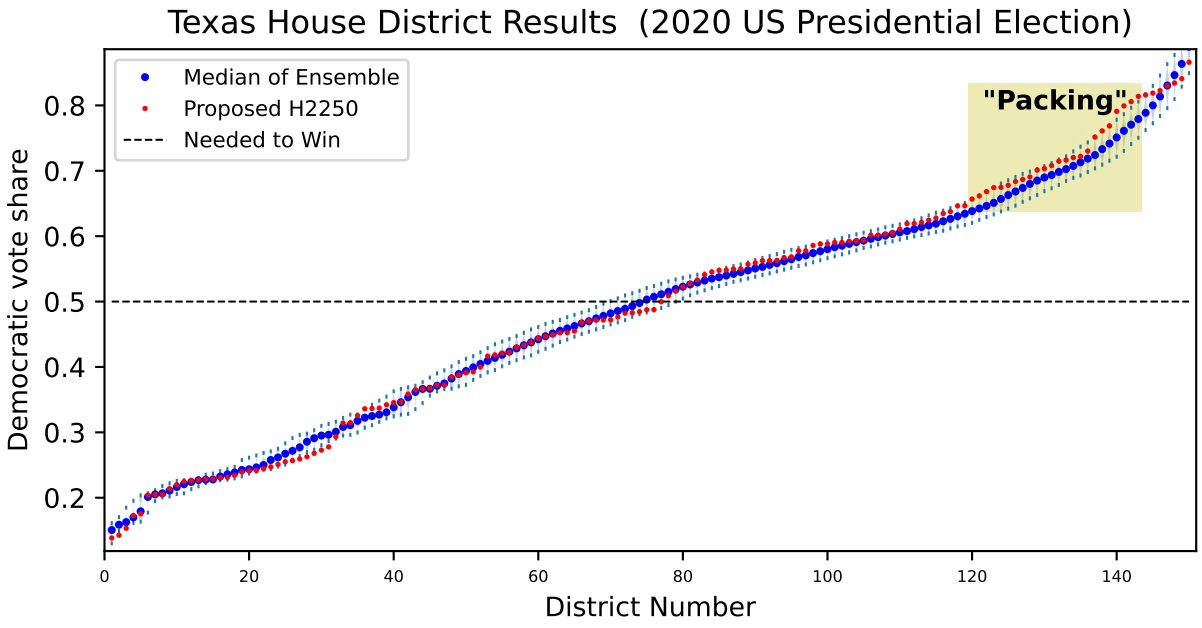
Appendix: All Plots

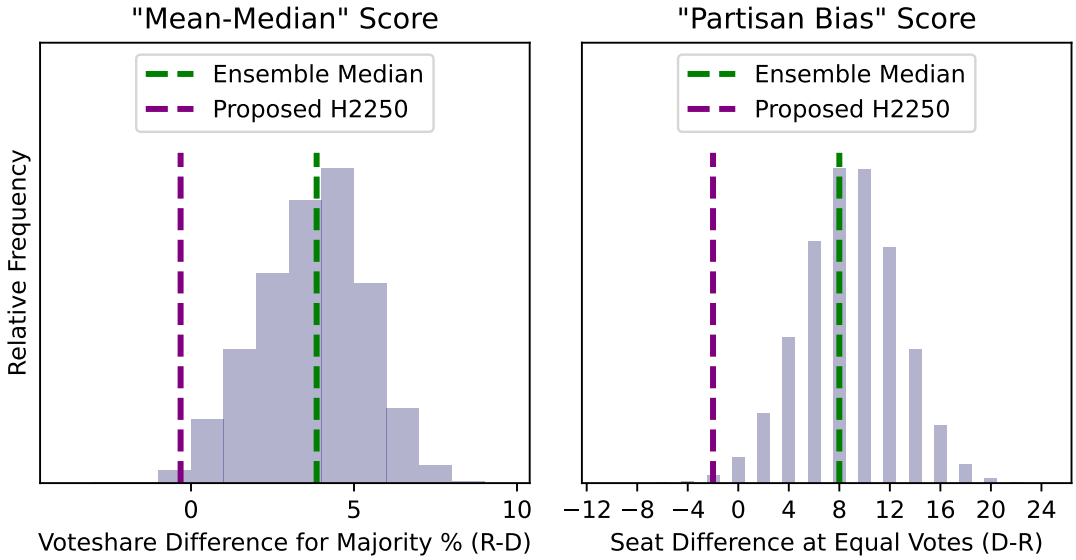


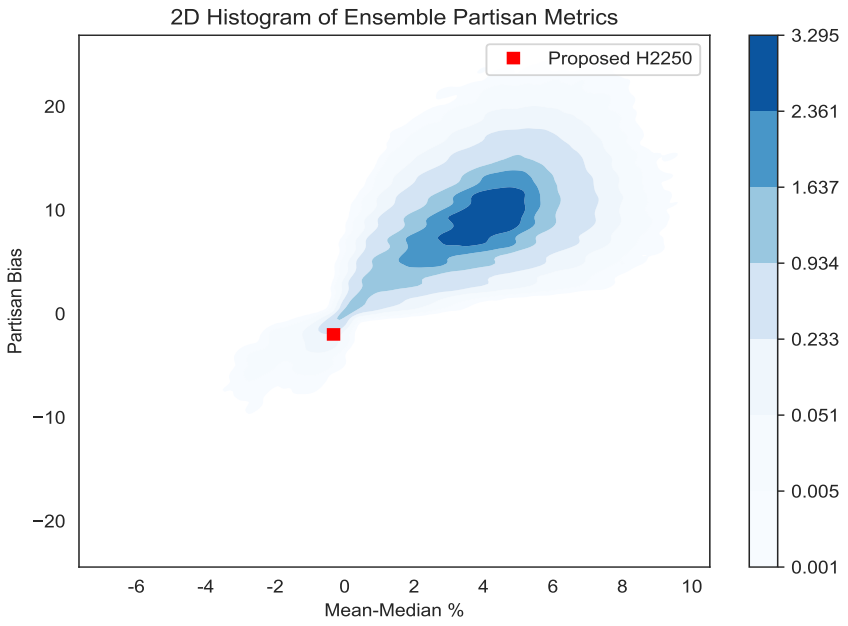


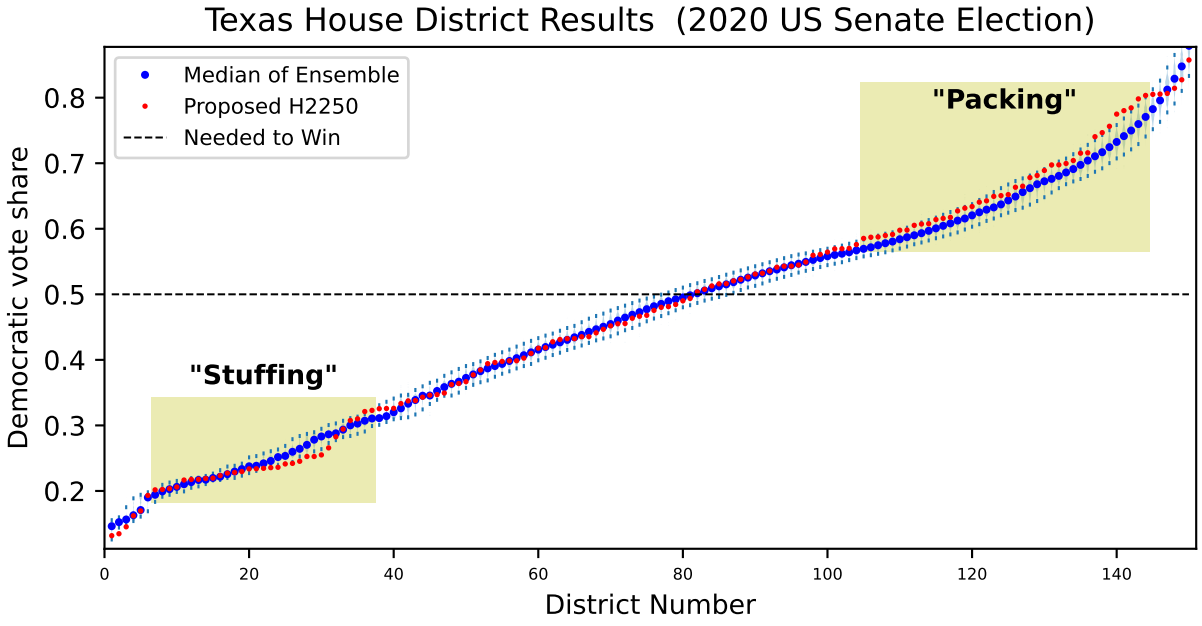


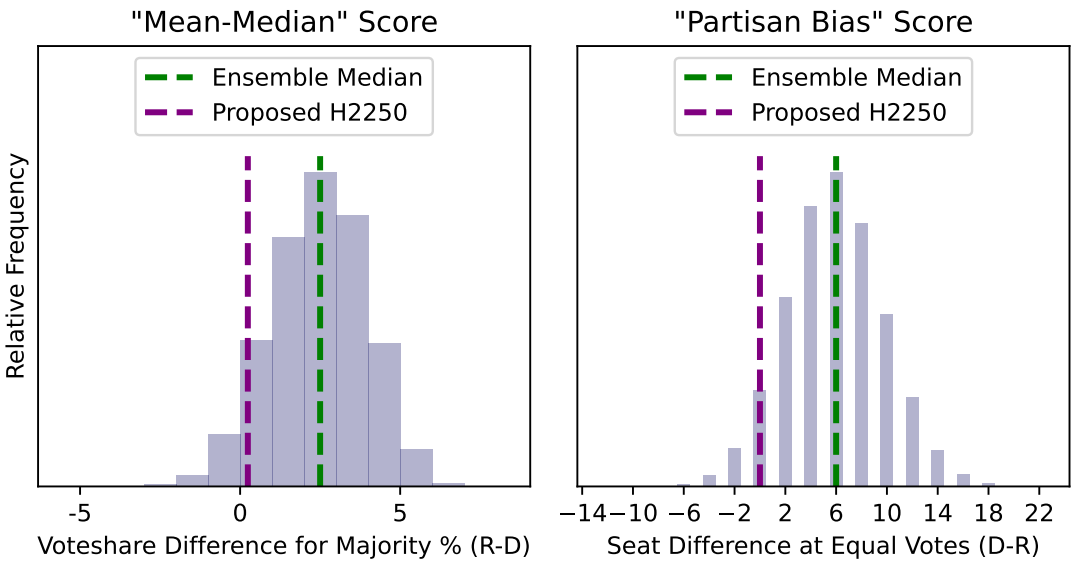
Click here to download a higher resolution version of this image.

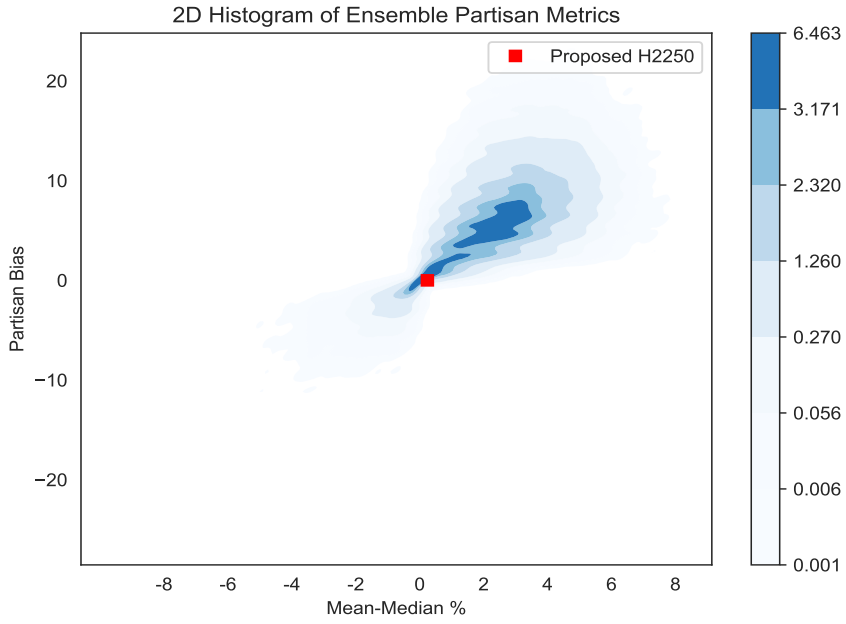

Texas House District Results (2020 US Presidential Election)
Median of Ensemble
Proposed H2250
Needed to Win
"Packing"
Democratic vote share
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
20
40
60
80
100
120
140
District Number

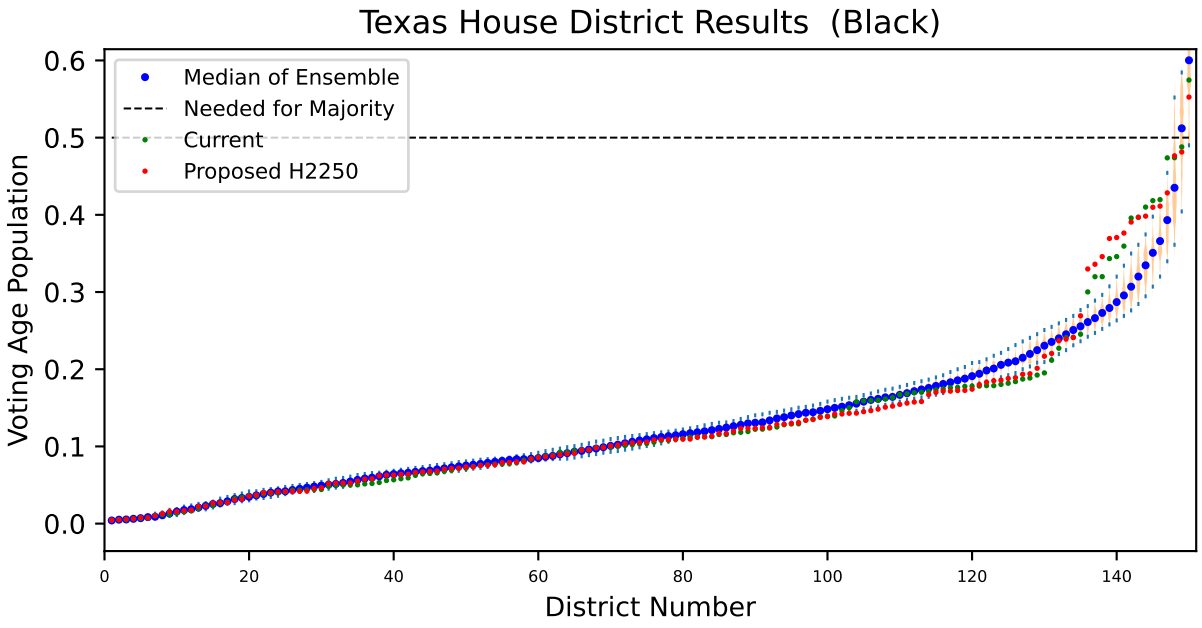

"Mean-Median" Score
Ensemble Median
Proposed H2250
Relative Frequency
0
5
10
Voteshare Difference for Majority % (R-D)
"Partisan Bias" Score
Ensemble Median
Proposed H2250
−12 −8 −4 0 4 8 12 16 20 24
Seat Difference at Equal Votes (D-R)

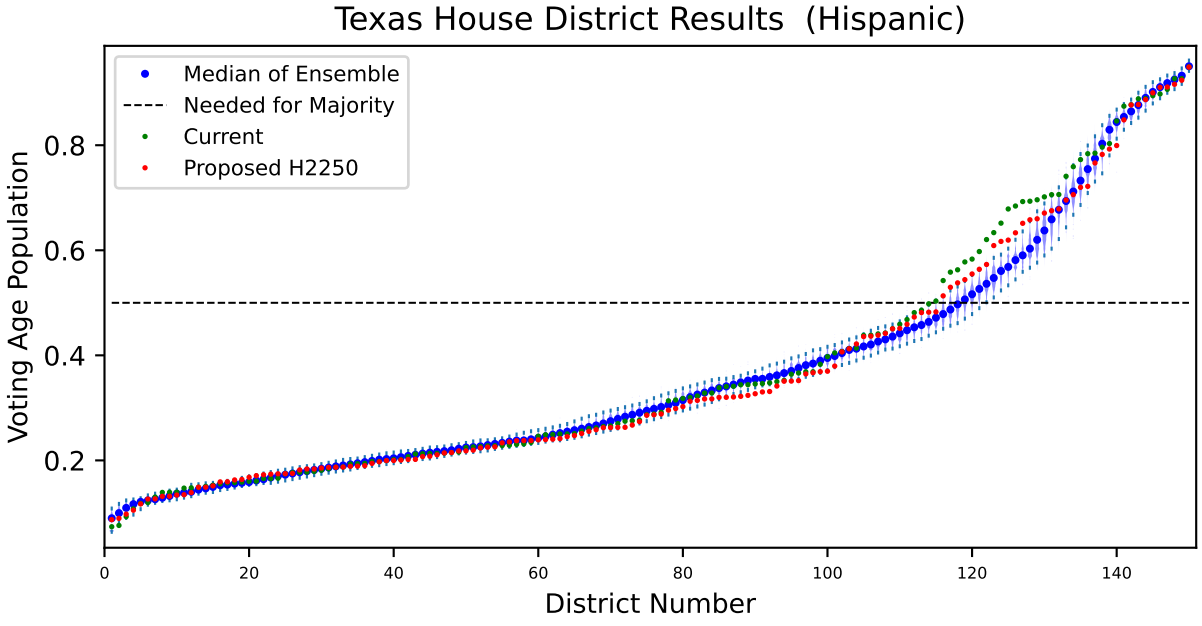

2D Histogram of Ensemble Partisan Metrics
Proposed H2250
Partisan Bias
Mean-Median %
20
10
0
−10
−20
-6
-4
-2
0
2
4
6
8
10
3.295
2.361
1.637
0.934
0.233
0.051
0.005
0.001

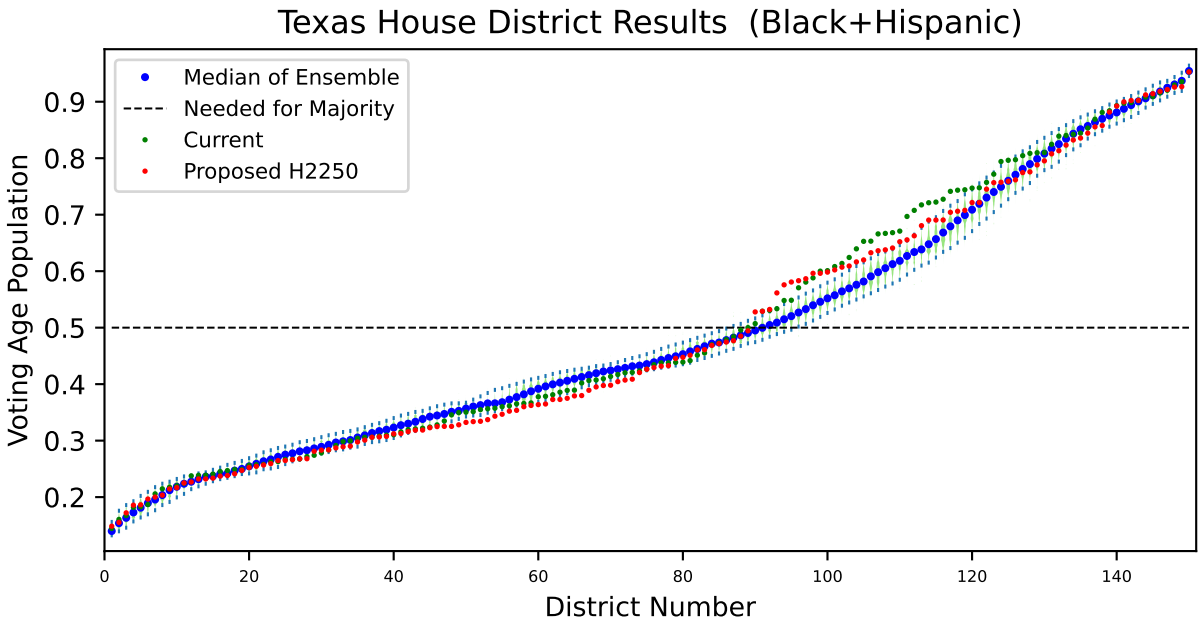

Texas House District Results (2020 US Senate Election)
Median of Ensemble
Proposed H2250
Needed to Win
"Packing"
"Stuffing"
Democratic vote share
District Number
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
20
40
60
80
100
120
140

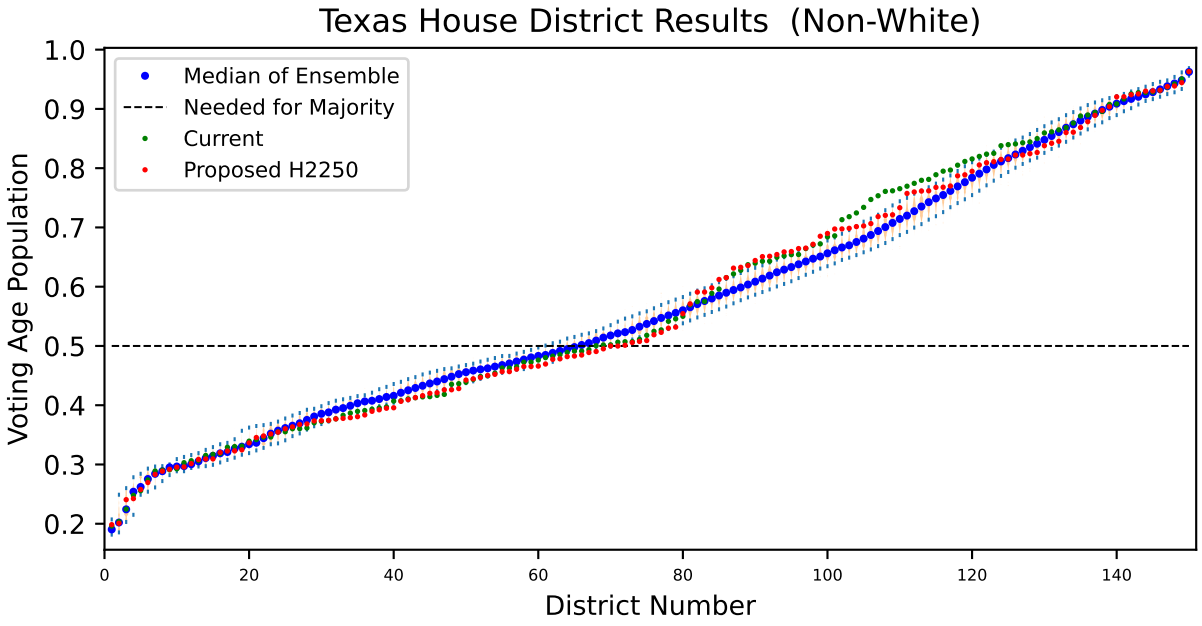

"Mean-Median" Score
Ensemble Median
Proposed H2250
Relative Frequency
-5
0
5
Voteshare Difference for Majority % (R-D)
"Partisan Bias" Score
Ensemble Median
Proposed H2250
−14 −10 −6 −2 2 6 10 14 18 22
Seat Difference at Equal Votes (D-R)

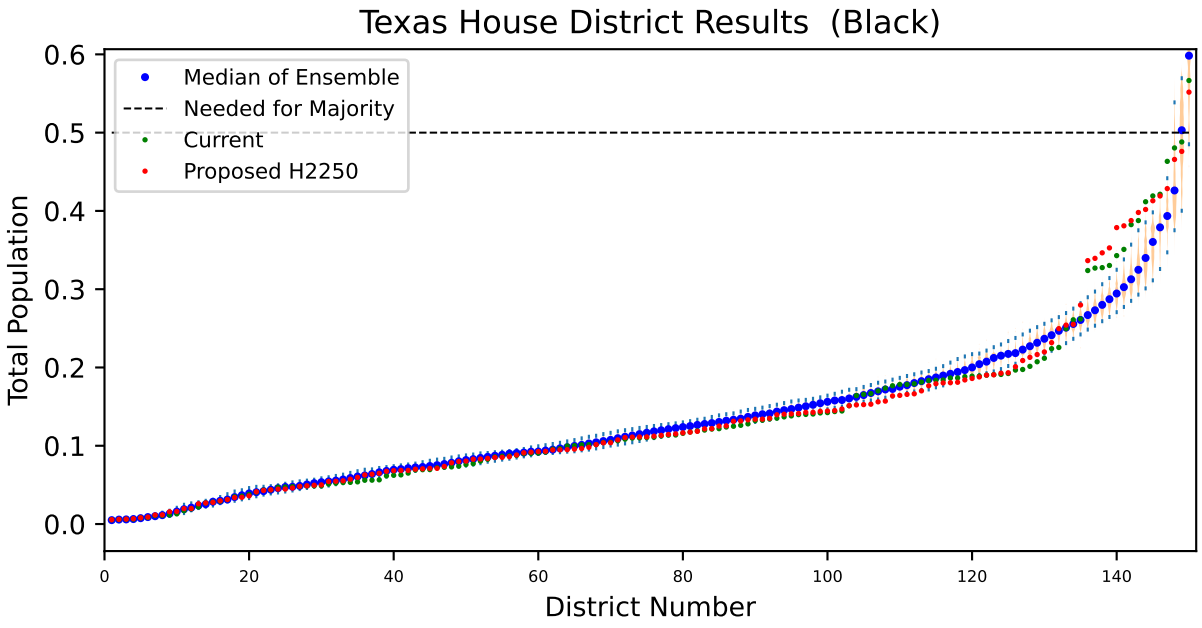

2D Histogram of Ensemble Partisan Metrics
Proposed H2250
Partisan Bias
20
10
0
−10
−20
-8
-6
-4
-2
0
2
4
6
8
Mean-Median %
6.463
3.171
2.320
1.260
0.270
0.056
0.006
0.001

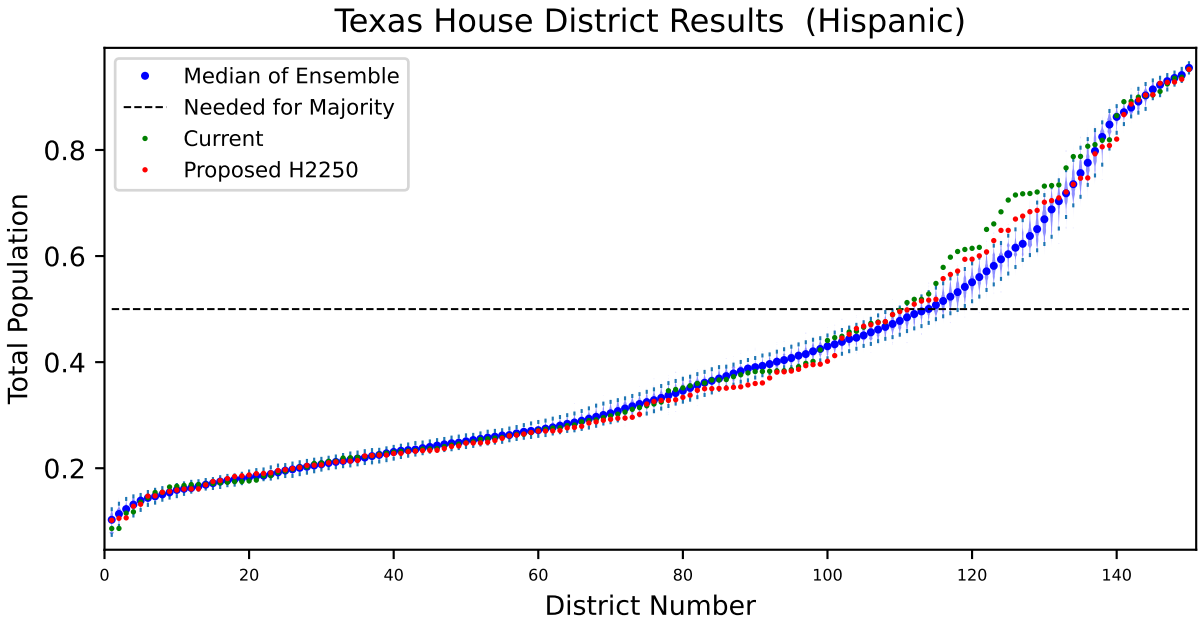

Texas House District Results (Black)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Voting Age Population
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
20
40
60
80
100
120
140
District Number

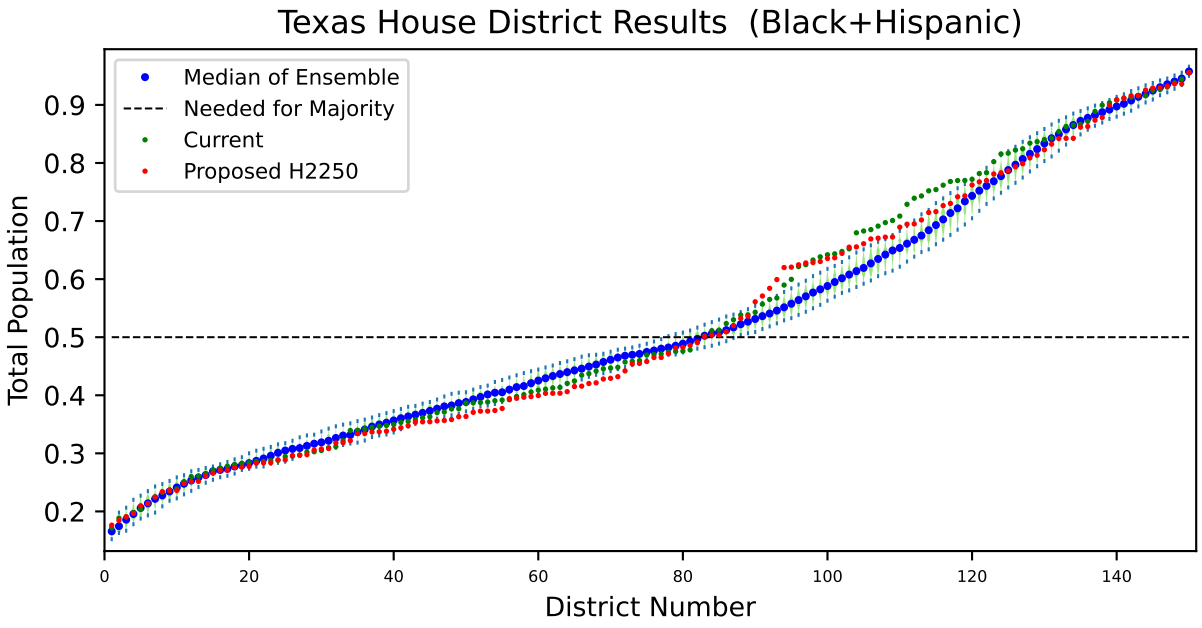

Texas House District Results (Hispanic)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Voting Age Population
0.2
0.4
0.6
0.8
0
20
40
60
80
100
120
140
District Number

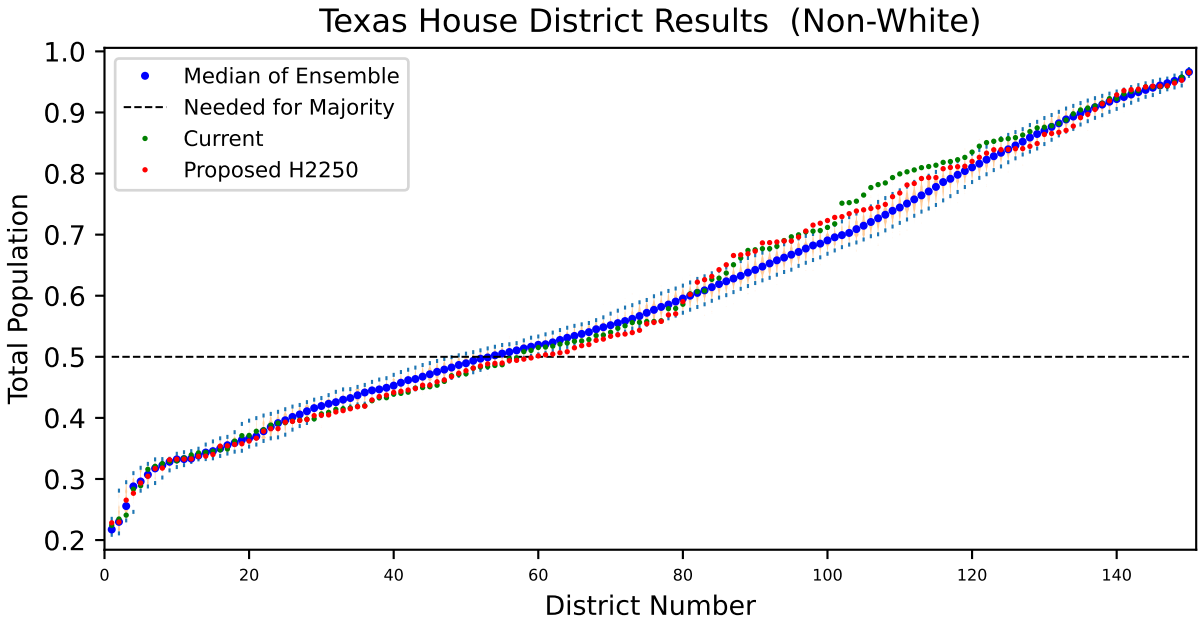

Texas House District Results (Black+Hispanic)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Voting Age Population
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
20
40
60
80
100
120
140
District Number

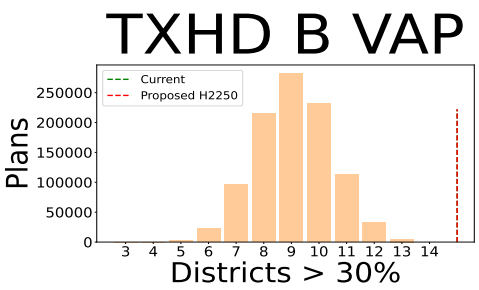

Texas House District Results (Non-White)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Voting Age Population
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
20
40
60
80
100
120
140
District Number

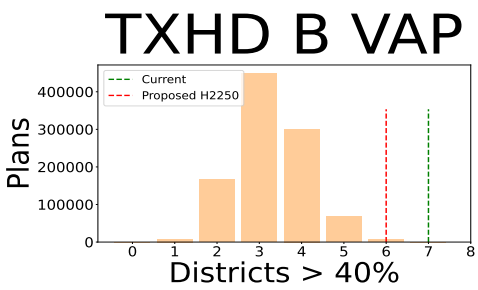

Texas House District Results (Black)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Total Population
District Number
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
20
40
60
80
100
120
140

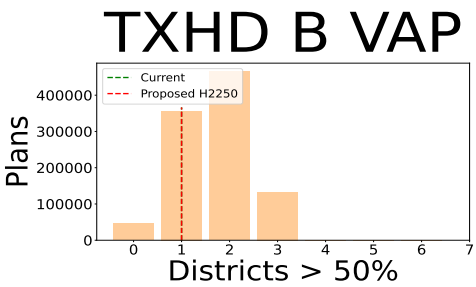

Texas House District Results (Hispanic)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Total Population
District Number
0.2
0.4
0.6
0.8
0
20
40
60
80
100
120
140

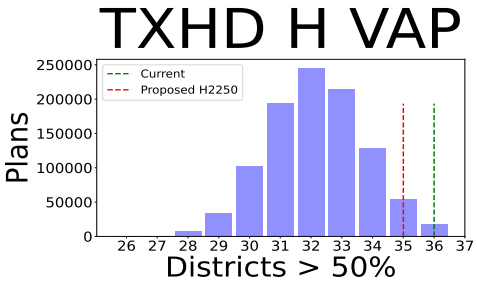

Texas House District Results (Black+Hispanic)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Total Population
District Number
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
20
40
60
80
100
120
140

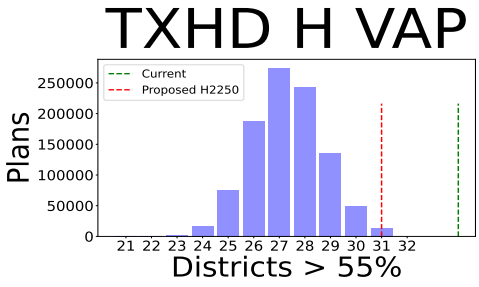

Texas House District Results (Non-White)
Median of Ensemble
Needed for Majority
Current
Proposed H2250
Total Population
District Number
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
20
40
60
80
100
120
140

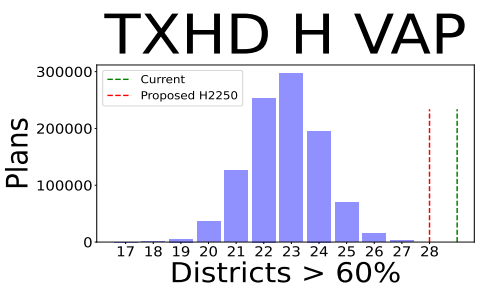

TXHD B VAP
Current
Proposed H2250
Plans
250000
200000
150000
100000
50000
0
3 4 5 6 7 8 9 10 11 12 13 14
Districts > 30%

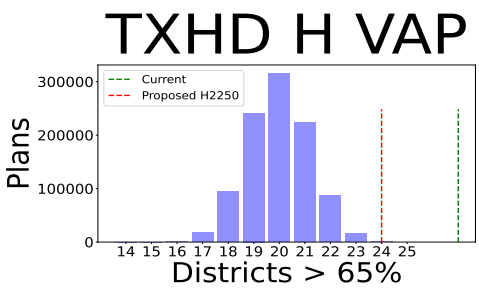

TXHD B VAP
Current
Proposed H2250
Plans
400000
300000
200000
100000
0
0 1 2 3 4 5 6 7 8
Districts > 40%

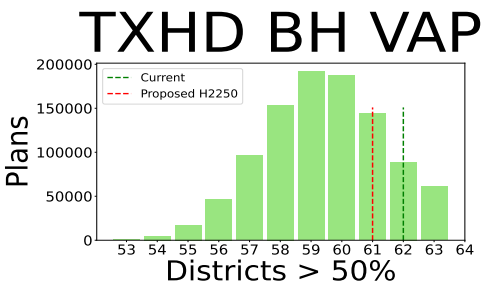

TXHD B VAP
Current
Proposed H2250
Plans
400000
300000
200000
100000
0
0 1 2 3 4 5 6 7
Districts > 50%

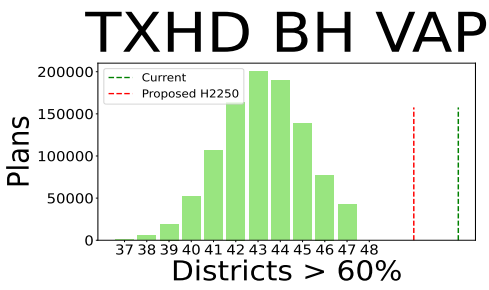

TXHD H VAP
Current
Proposed H2250
Plans
250000
200000
150000
100000
50000
0
26 27 28 29 30 31 32 33 34 35 36 37
Districts > 50%

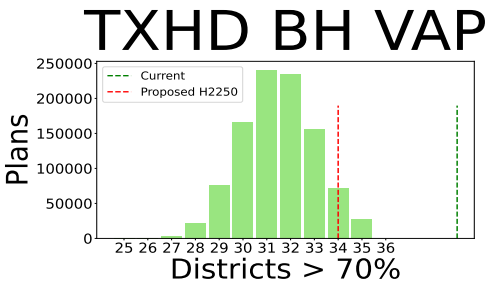

TXHD H VAP
Current
Proposed H2250
Plans
250000
200000
150000
100000
50000
0
21 22 23 24 25 26 27 28 29 30 31 32
Districts > 55%

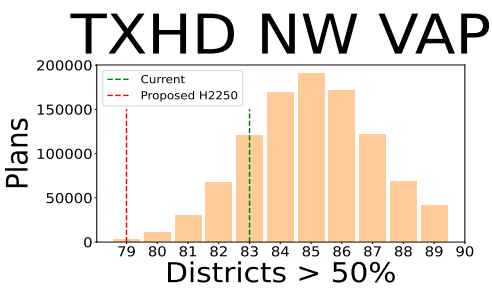

TXHD H VAP
Current
Proposed H2250
Plans
300000
200000
100000
0
17 18 19 20 21 22 23 24 25 26 27 28
Districts > 60%

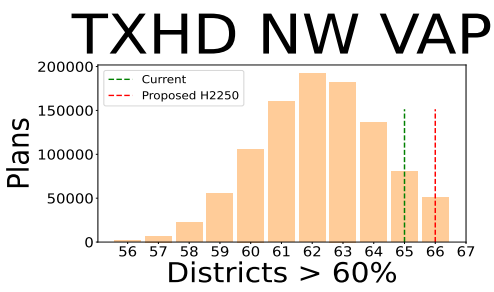

TXHD H VAP
Current
Proposed H2250
Plans
300000
200000
100000
0
14 15 16 17 18 19 20 21 22 23 24 25
Districts > 65%

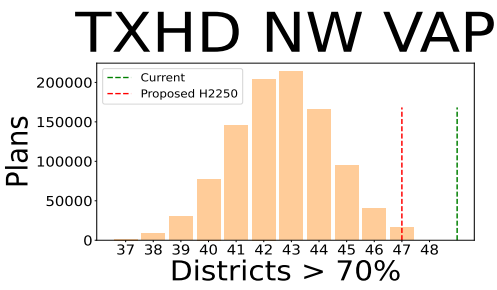

TXHD BH VAP
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
53 54 55 56 57 58 59 60 61 62 63 64
Districts > 50%

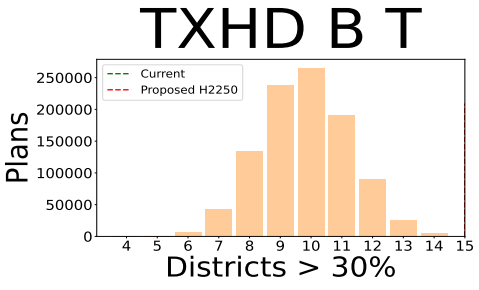

TXHD BH VAP
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
37 38 39 40 41 42 43 44 45 46 47 48
Districts > 60%

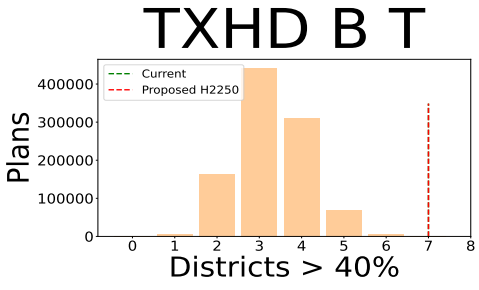

TXHD BH VAP
Current
Proposed H2250
Plans
250000
200000
150000
100000
50000
0
25 26 27 28 29 30 31 32 33 34 35 36
Districts > 70%

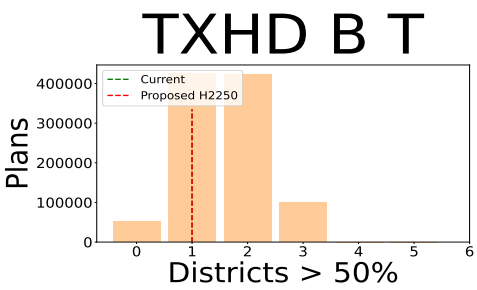

TXHD NW VAP
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
79 80 81 82 83 84 85 86 87 88 89 90
Districts > 50%

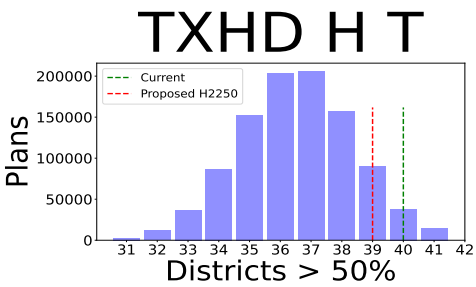

TXHD NW VAP
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
56 57 58 59 60 61 62 63 64 65 66 67
Districts > 60%

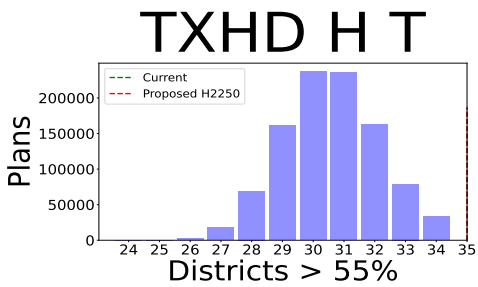

TXHD NW VAP
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
37 38 39 40 41 42 43 44 45 46 47 48
Districts > 70%

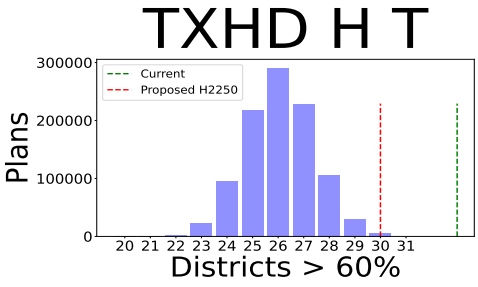

TXHD B T
Current
Proposed H2250
Plans
250000
200000
150000
100000
50000
0
4 5 6 7 8 9 10 11 12 13 14 15
Districts > 30%

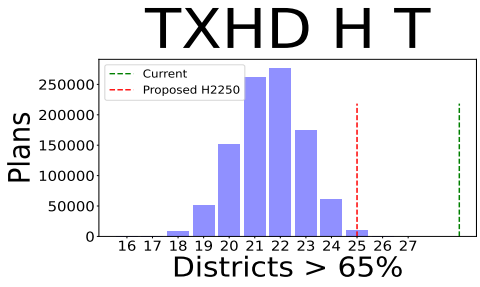

TXHD B T
Current
Proposed H2250
Plans
400000
300000
200000
100000
0
0 1 2 3 4 5 6 7 8
Districts > 40%

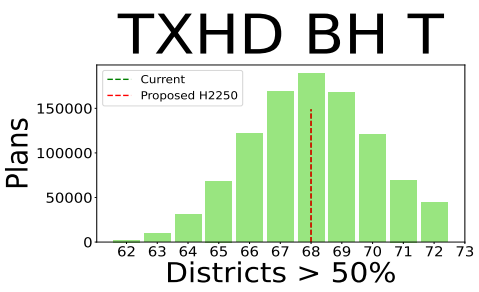

TXHD B T
Current
Proposed H2250
Plans
400000
300000
200000
100000
0
0 1 2 3 4 5 6
Districts > 50%

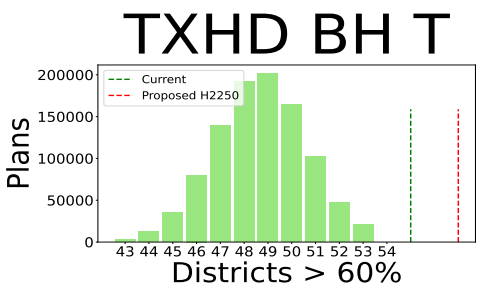

TXHD H T
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
31 32 33 34 35 36 37 38 39 40 41 42
Districts > 50%

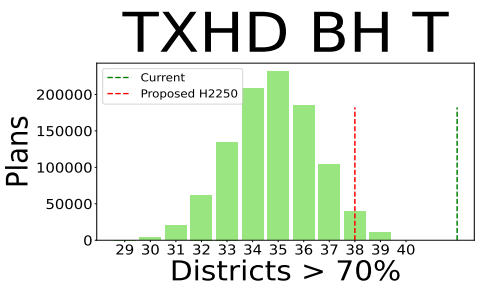

TXHD H T
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
24 25 26 27 28 29 30 31 32 33 34 35
Districts > 55%

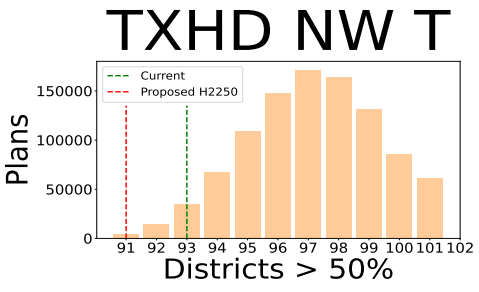

TXHD H T
Current
Proposed H2250
Plans
300000
200000
100000
0
20 21 22 23 24 25 26 27 28 29 30 31
Districts > 60%

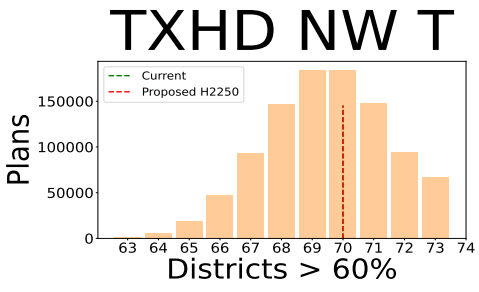

TXHD H T
Current
Proposed H2250
Plans
250000
200000
150000
100000
50000
0
16 17 18 19 20 21 22 23 24 25 26 27
Districts > 65%

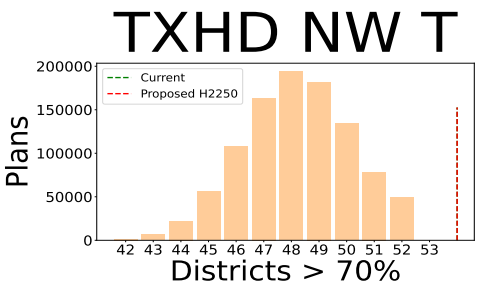

TXHD BH T
Current
Proposed H2250
Plans
150000
100000
50000
0
62 63 64 65 66 67 68 69 70 71 72 73
Districts > 50%

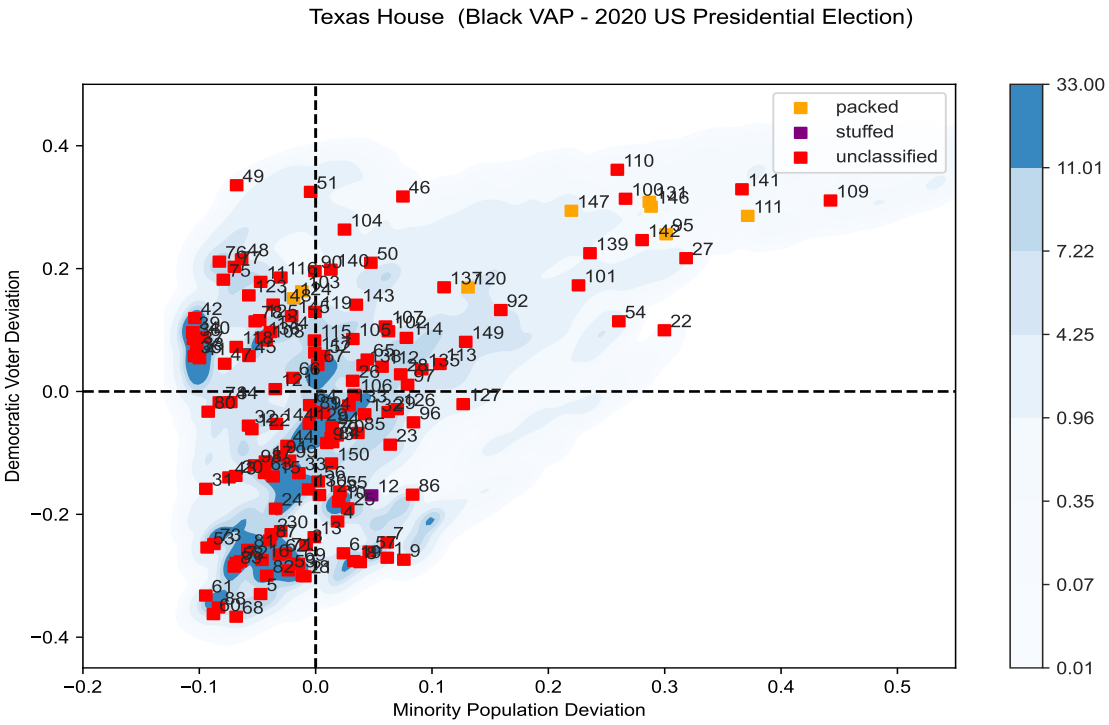

TXHD BH T
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
43 44 45 46 47 48 49 50 51 52 53 54
Districts > 60%


TXHD BH T
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
29 30 31 32 33 34 35 36 37 38 39 40
Districts > 70%

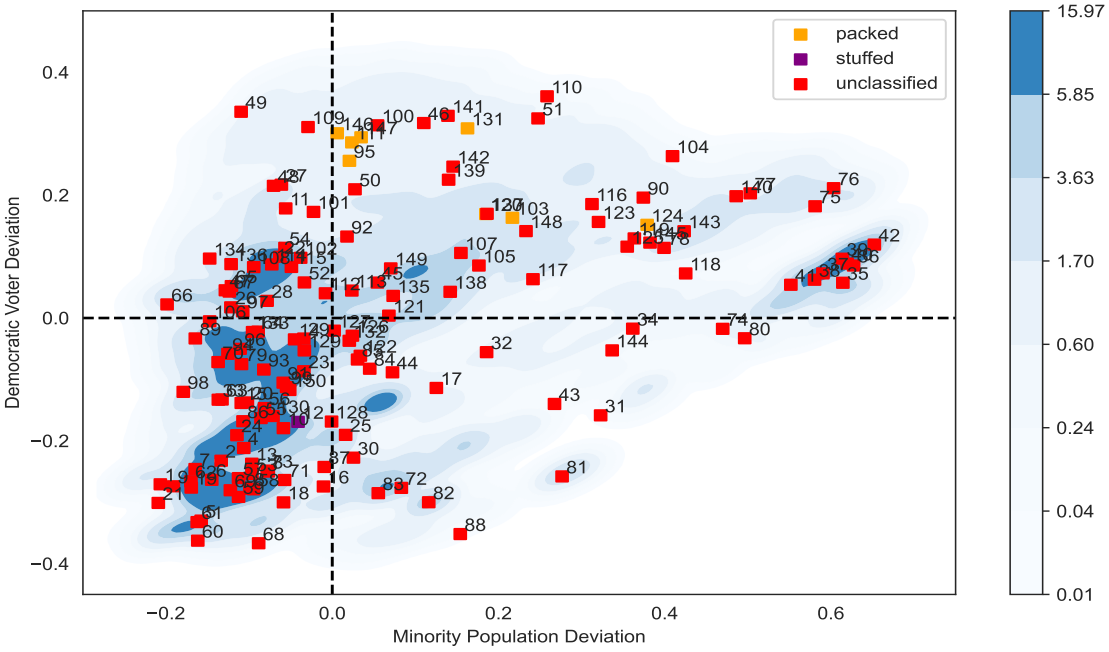

TXHD NW T
Current
Proposed H2250
Plans
150000
100000
50000
0
91 92 93 94 95 96 97 98 99 100 101 102
Districts > 50%


TXHD NW T
Current
Proposed H2250
Plans
150000
100000
50000
0
63 64 65 66 67 68 69 70 71 72 73 74
Districts > 60%

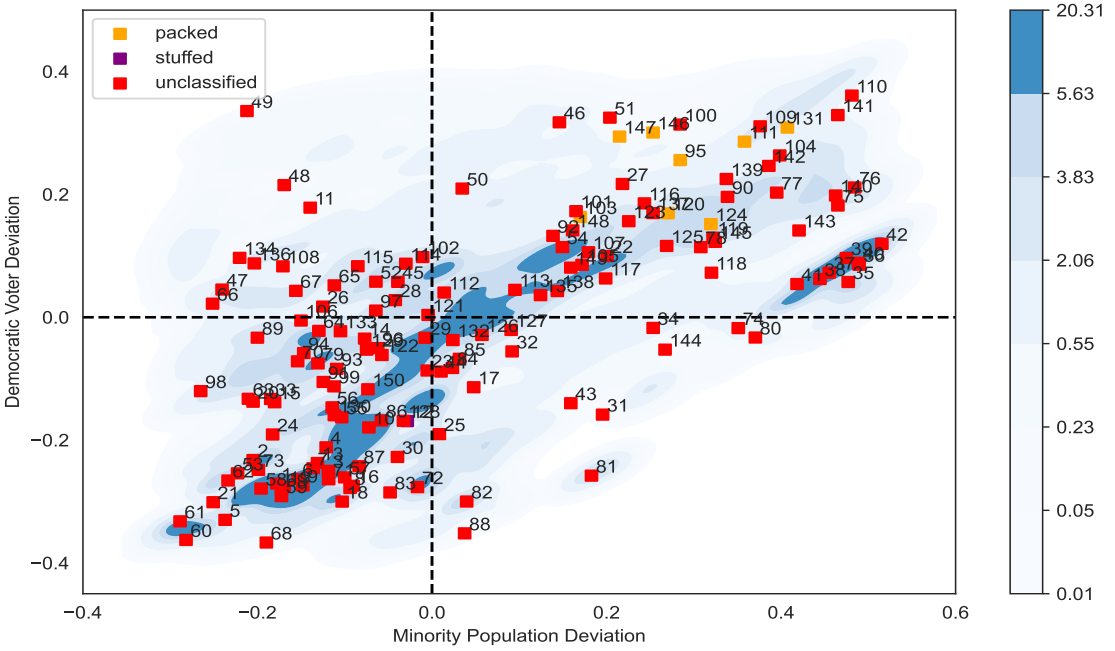

TXHD NW T
Current
Proposed H2250
Plans
200000
150000
100000
50000
0
42 43 44 45 46 47 48 49 50 51 52 53
Districts > 70%


Texas House (Black VAP - 2020 US Presidential Election)
packed
stuffed
unclassified
Democratic Voter Deviation
Minority Population Deviation
0.4
0.2
0.0
−0.2
−0.4
−0.2
−0.1
0.0
0.1
0.2
0.3
0.4
0.5
33.00
11.01
7.22
4.25
0.96
0.35
0.07
0.01

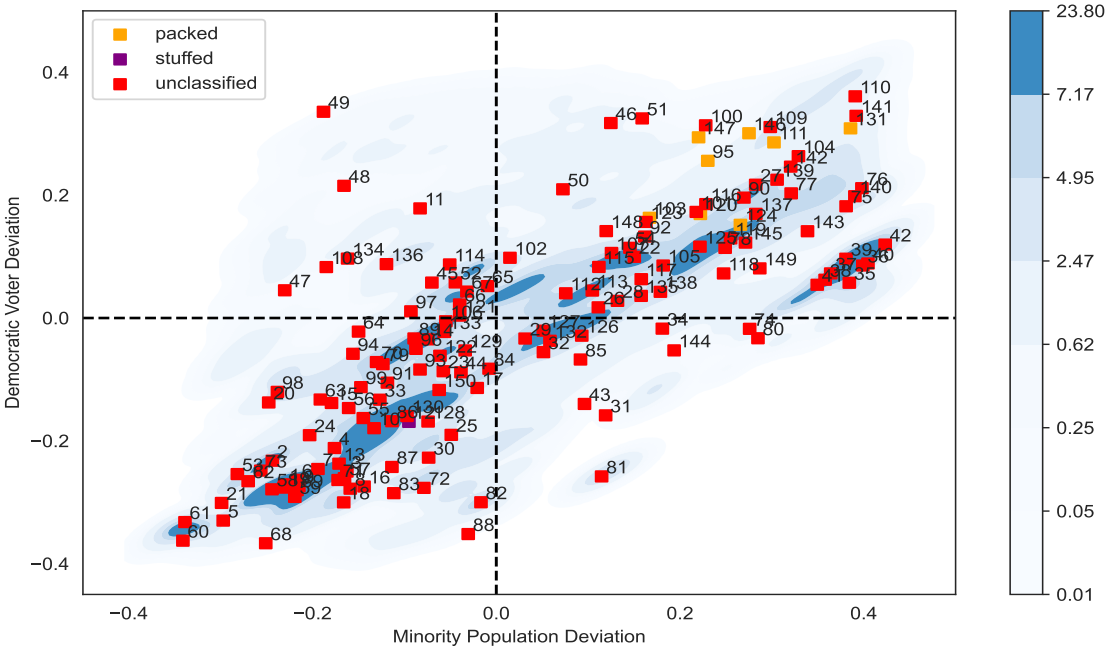
Texas House (Hispanic VAP - 2020 US Presidential Election)



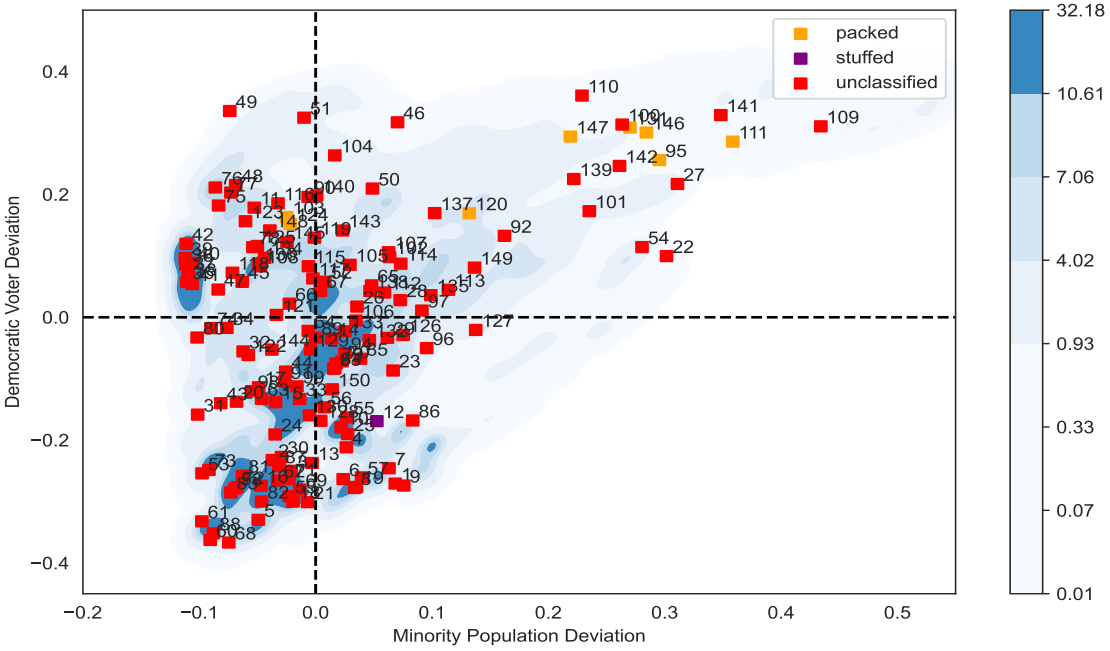
Texas House (Black+Hispanic VAP - 2020 US Presidential Election)



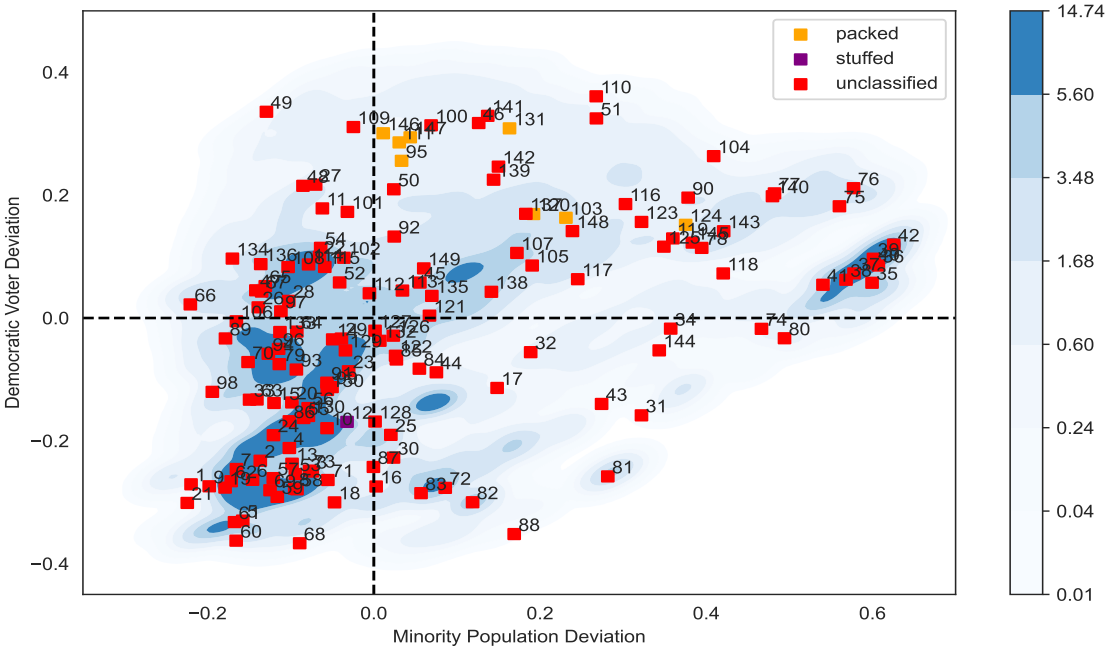
Texas House (Non-White VAP - 2020 US Presidential Election)



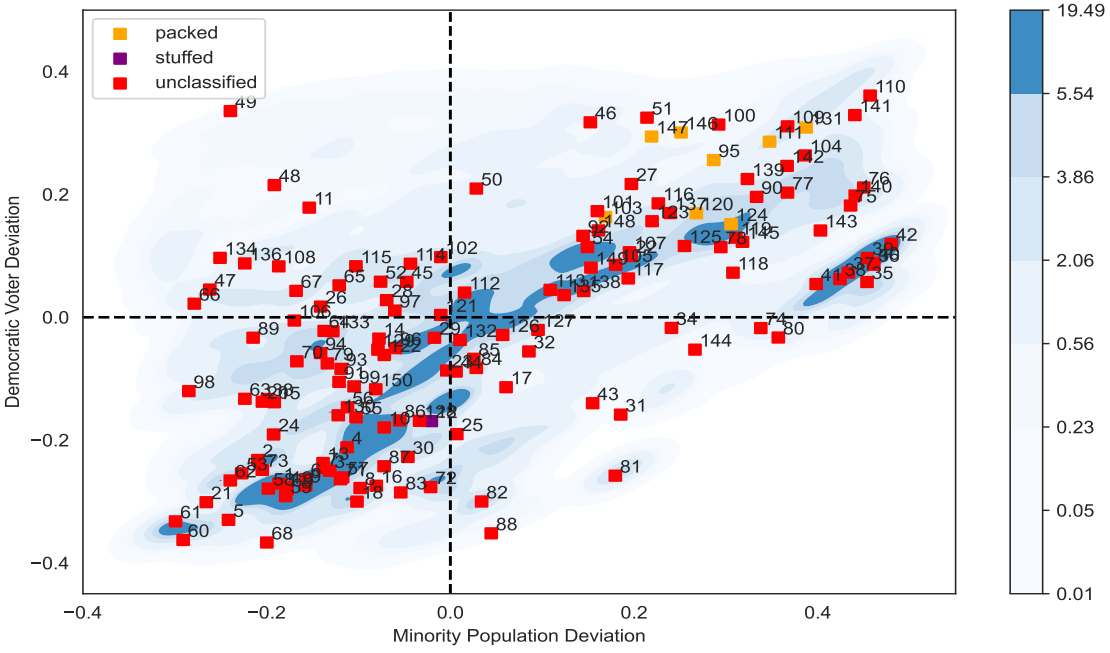
Texas House (Black T - 2020 US Presidential Election)



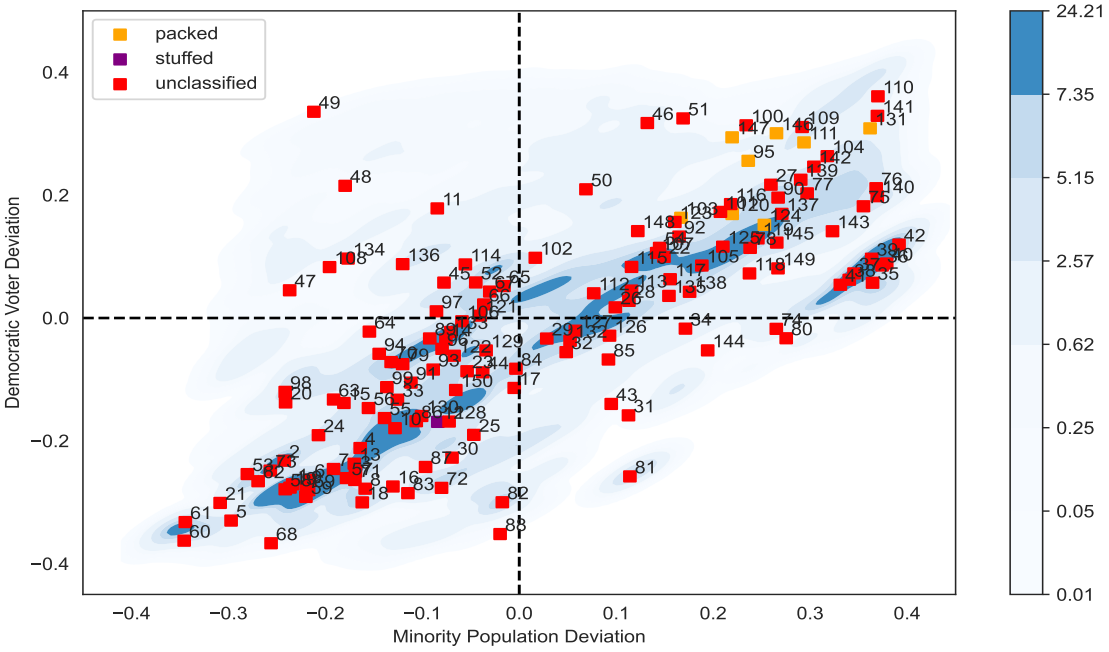
Texas House (Hispanic T - 2020 US Presidential Election)



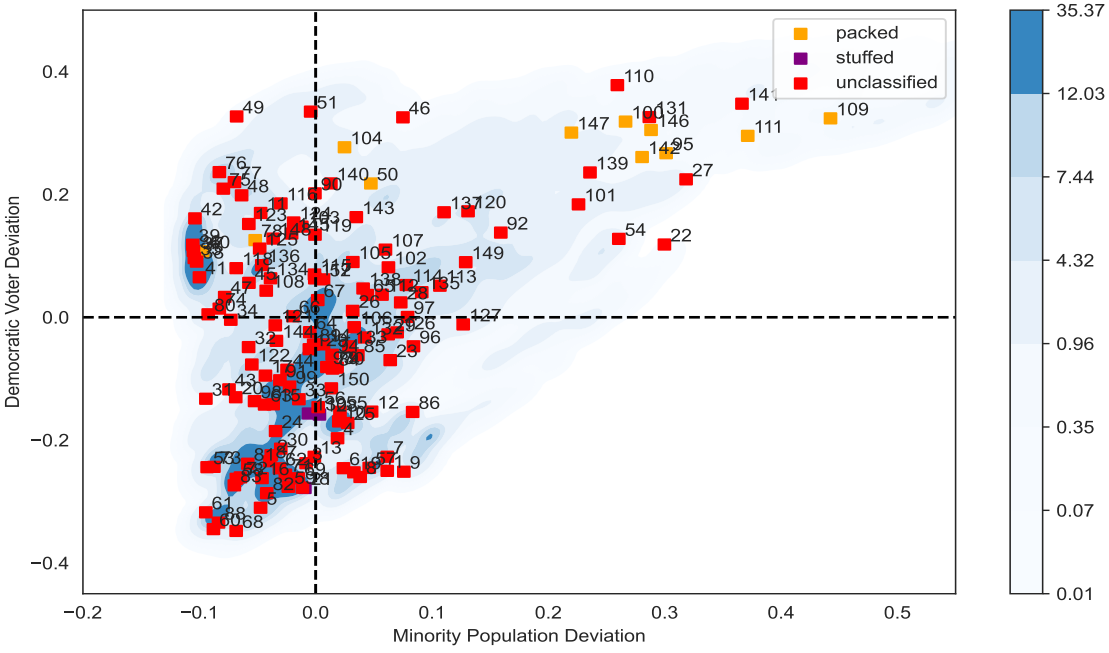
Texas House (Black+Hispanic T - 2020 US Presidential Election)



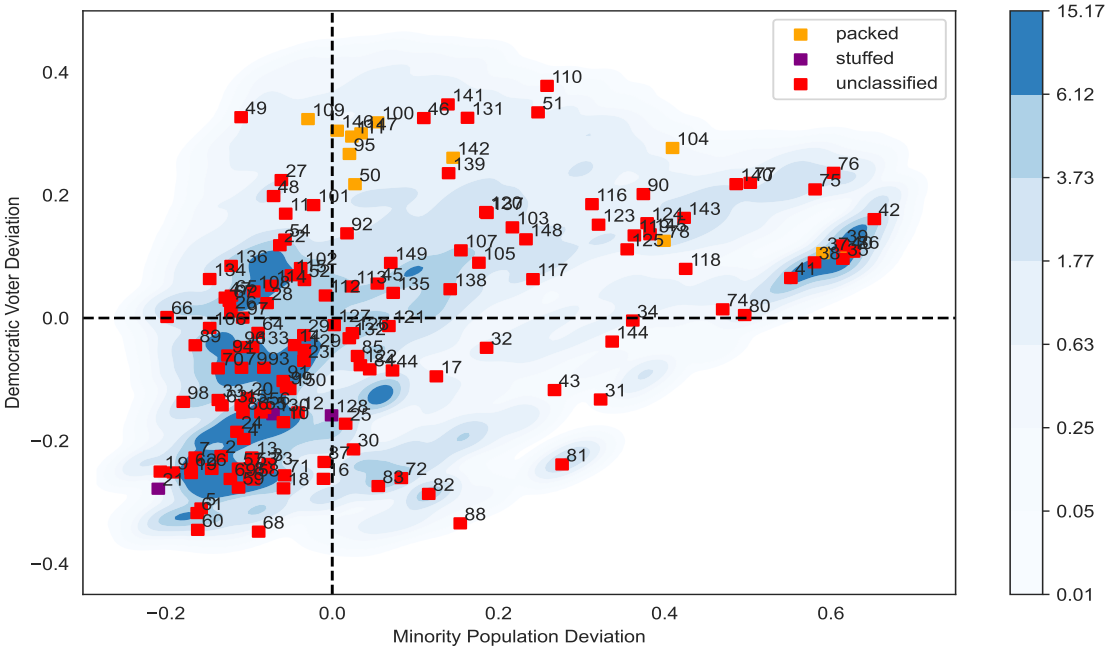
Texas House (Non-White T - 2020 US Presidential Election)



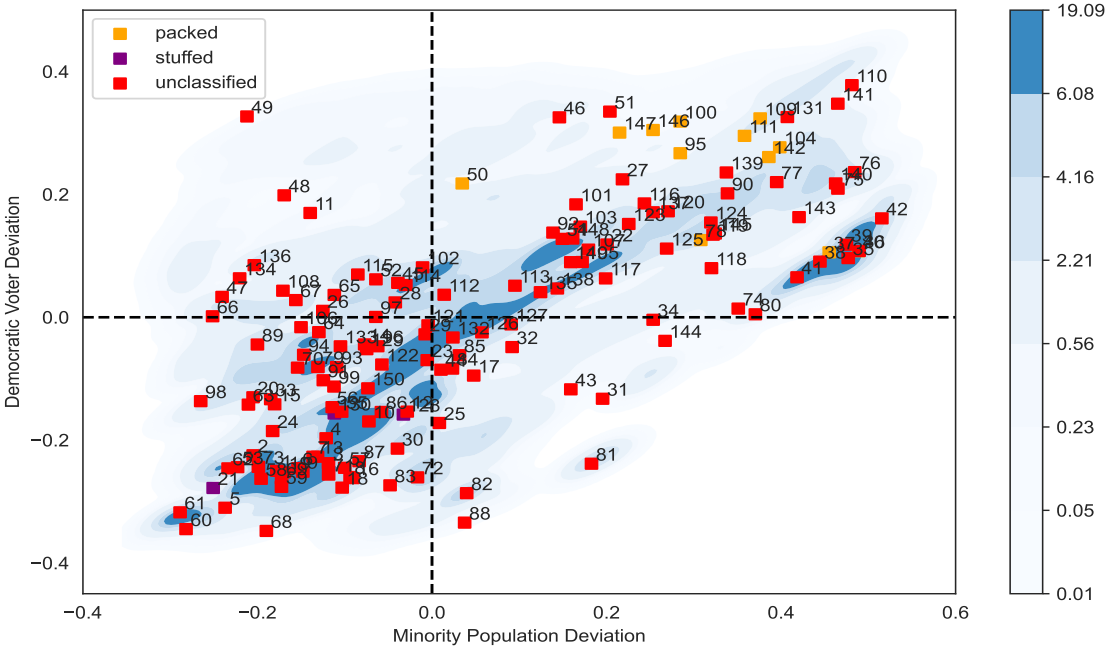
Texas House (Black VAP - 2020 US Senate Election)



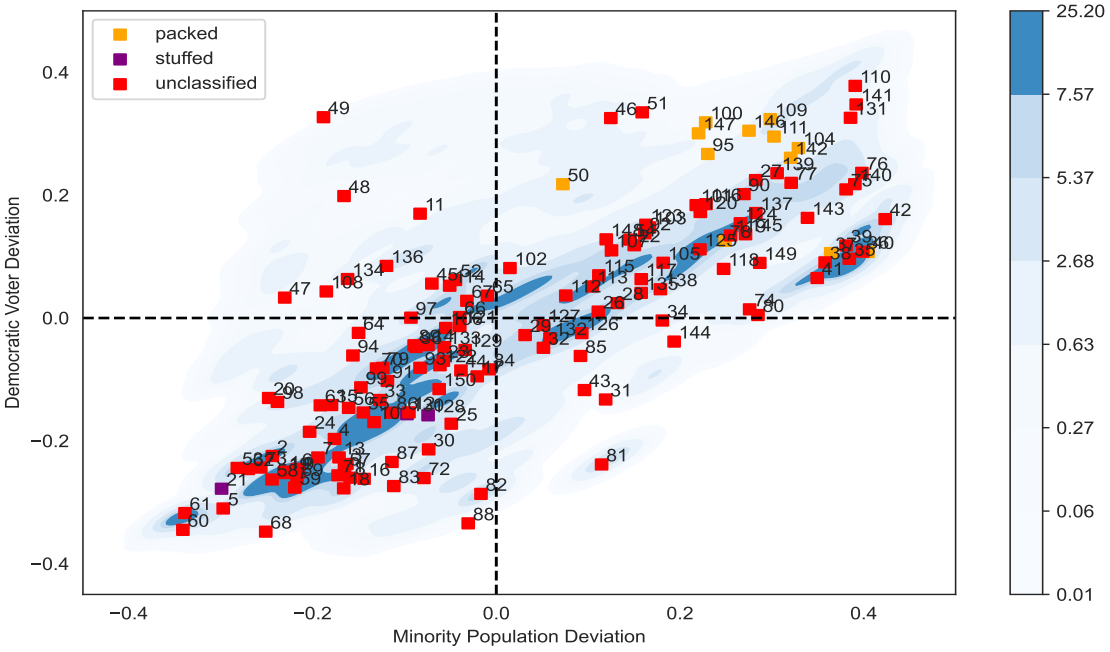
Texas House (Hispanic VAP - 2020 US Senate Election)



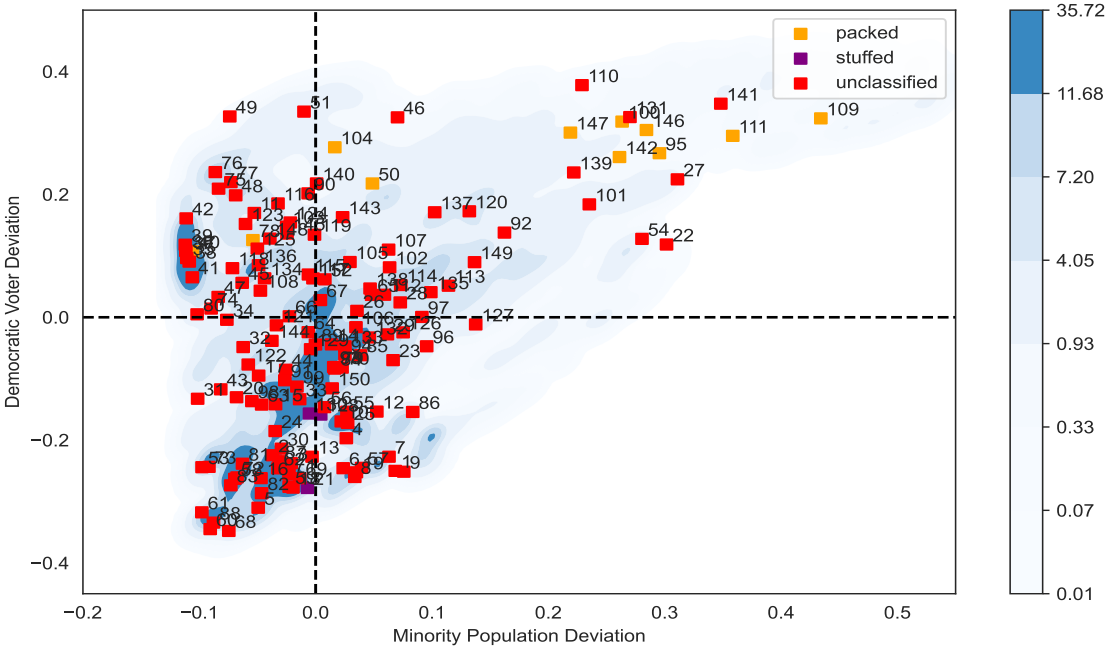
Texas House (Black+Hispanic VAP - 2020 US Senate Election)



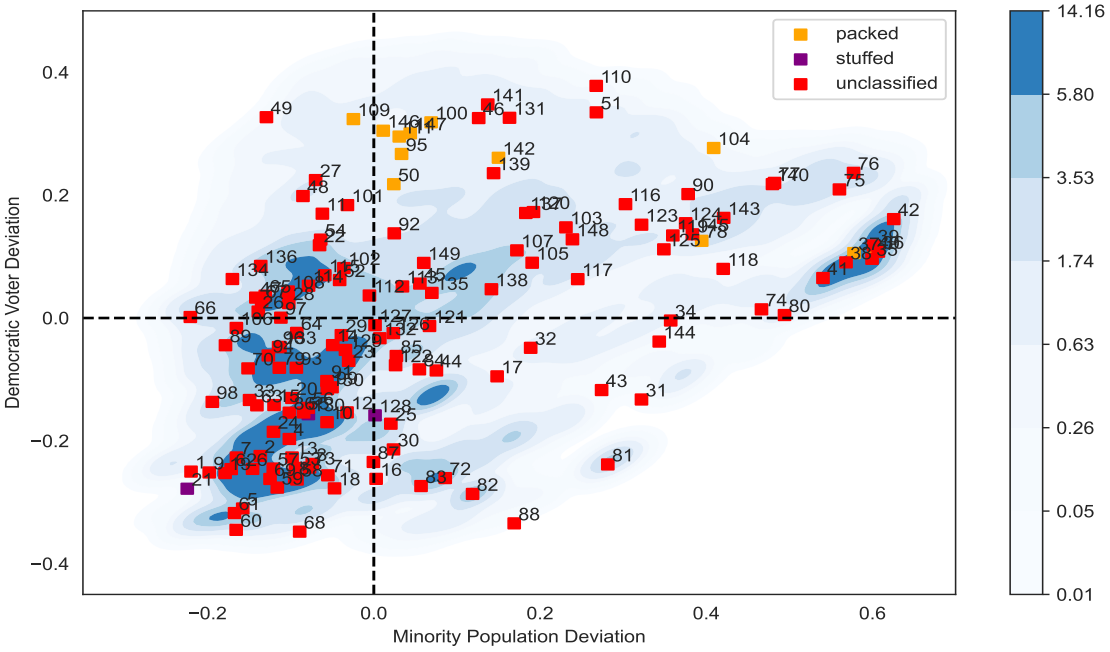
Texas House (Non-White VAP - 2020 US Senate Election)



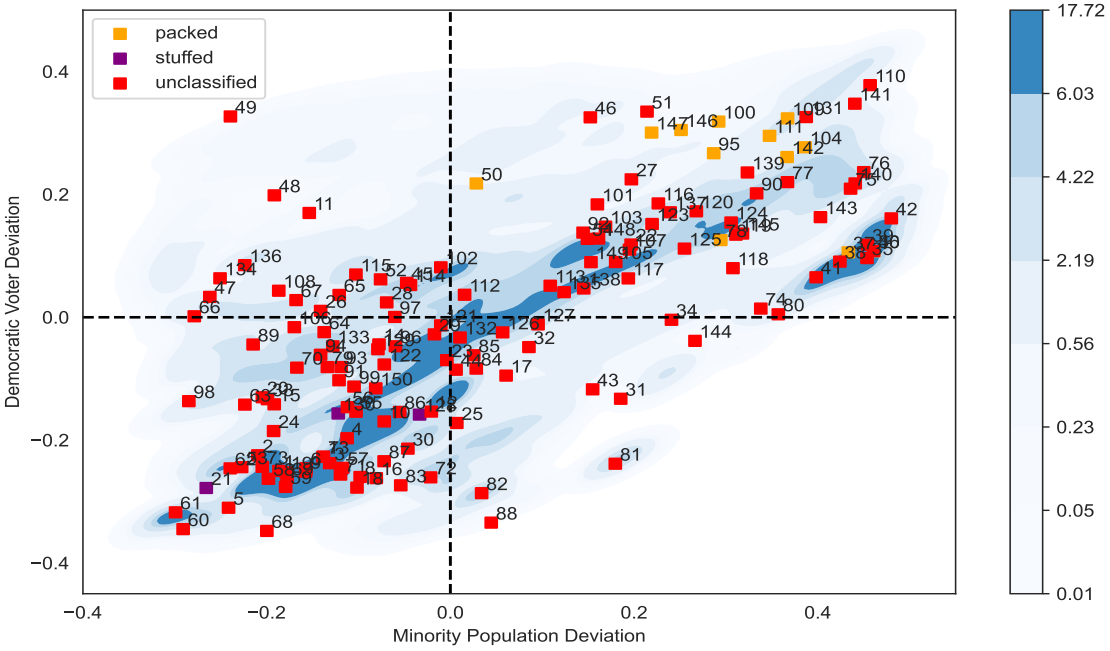
Texas House (Black T - 2020 US Senate Election)

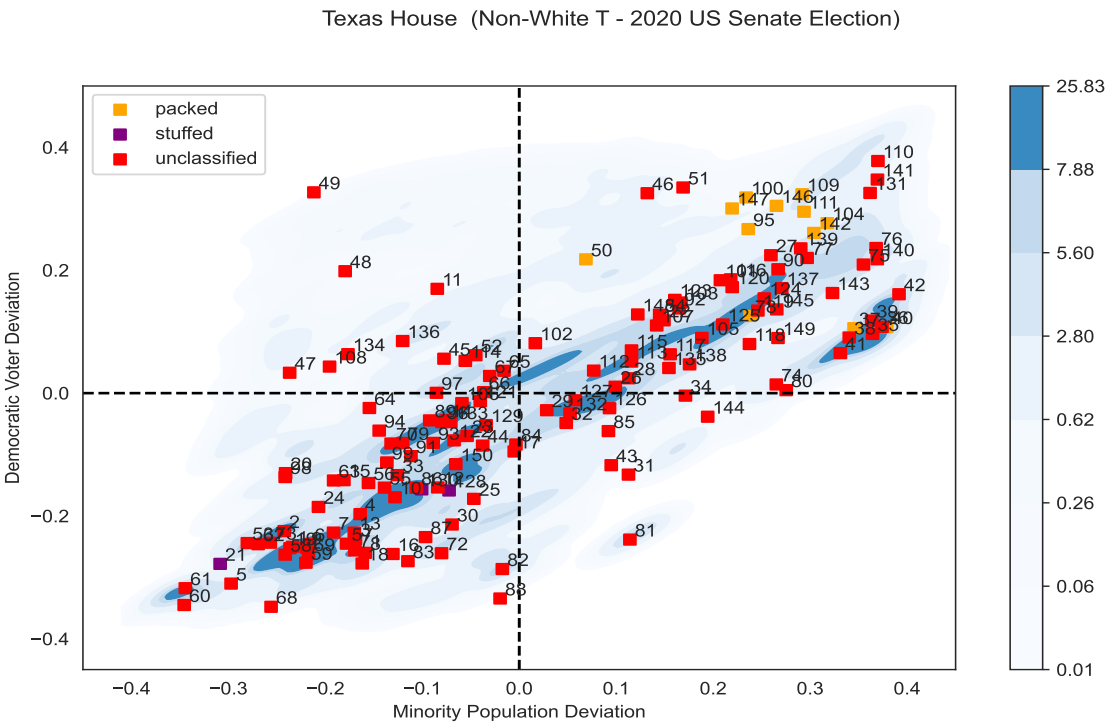


Texas House (Hispanic T - 2020 US Senate Election)



Texas House (Black+Hispanic T - 2020 US Senate Election)




Texas House (Non-White T - 2020 US Senate Election)
packed
stuffed
unclassified
Democratic Voter Deviation
Minority Population Deviation
0.4
0.2
0.0
−0.2
−0.4
−0.4
−0.3
−0.2
−0.1
0.0
0.1
0.2
0.3
0.4
25.83
7.88
5.60
2.80
0.62
0.26
0.06
0.01