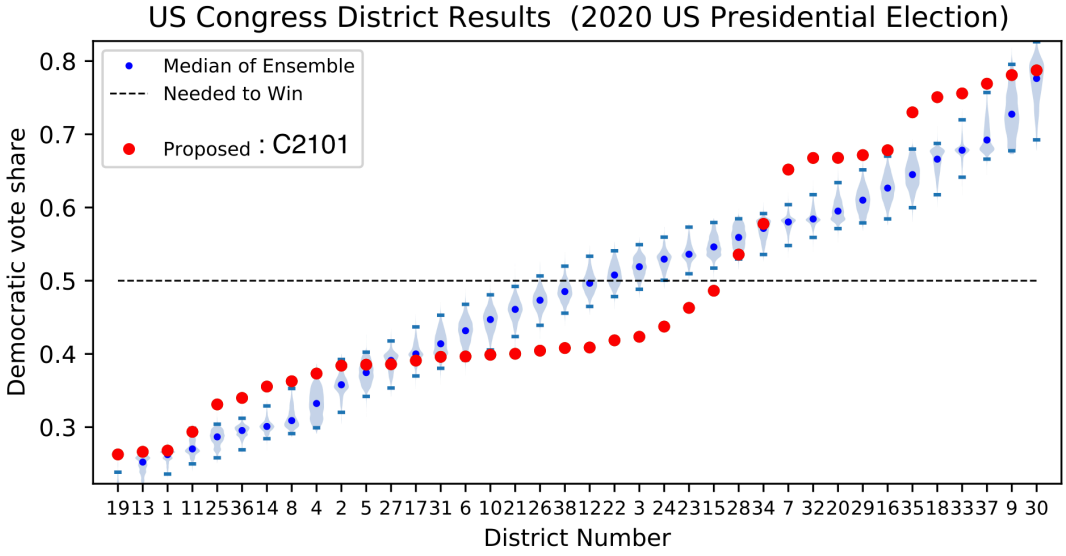
MUM_TX Statement on C2101, C2102-C2105

Friday, October 1, 2021

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 applied our methods to the Congressional maps that have been made available by the Texas Legislative Council. As of 9/30/21, we had seen 5 maps posted: C2101, which was submitted by Sen. Huffman (R), and C2102, C2103, C2104, and C2105, submitted by members of the public. 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.

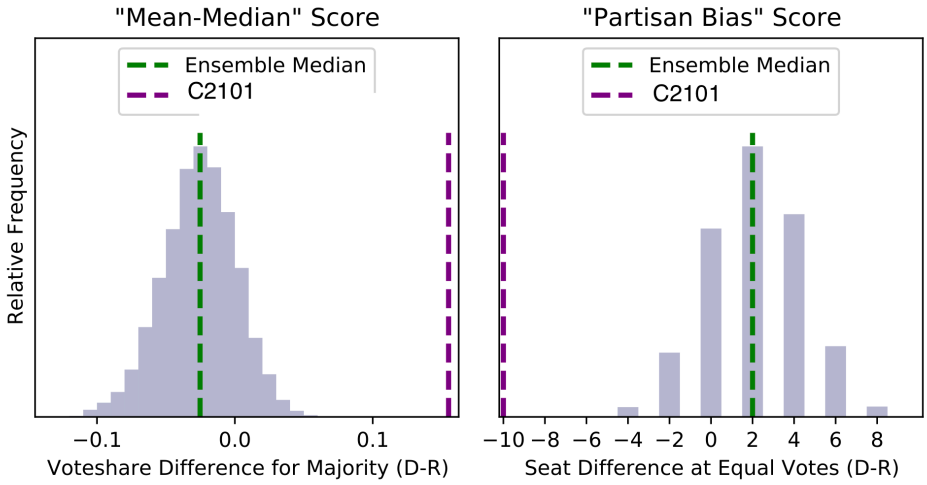
We have also performed more detailed analysis for these maps below.



We begin with C2101, which was proposed on 9/27/21. We compared the proposed map to an *ensemble* of 500,000 randomly-drawn maps. In this figure, 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. But in the proposed map (red dots), the increase is highly disjointed, a clear sign of gerrymandering.

We note several specific features of the proposed plan. First, Democratic voters are disproportionately removed from a swath of districts in between 10 and 15 (District numbers are along the x-axis) that would be competitive in an unbiased map (a process known as "cracking"), and placed into uncompetitive districts such as 32, 20, 29, 35, 18, and 33 (a process known as "packing"). Second, the list of outcomes between Districts 2 and 3 (a total of 13 districts) is very nearly flat, which is a hallmark of maps created with the assistance of computer algorithms designed to automate the gerrymandering process. Finally, the predicted vote share between Districts 15 and 7 changes abruptly by about 2*0 points,* with only 2 districts in between (28 and 34) -- this represents a "wall" designed to protect legislators from changing voter opinions over time.



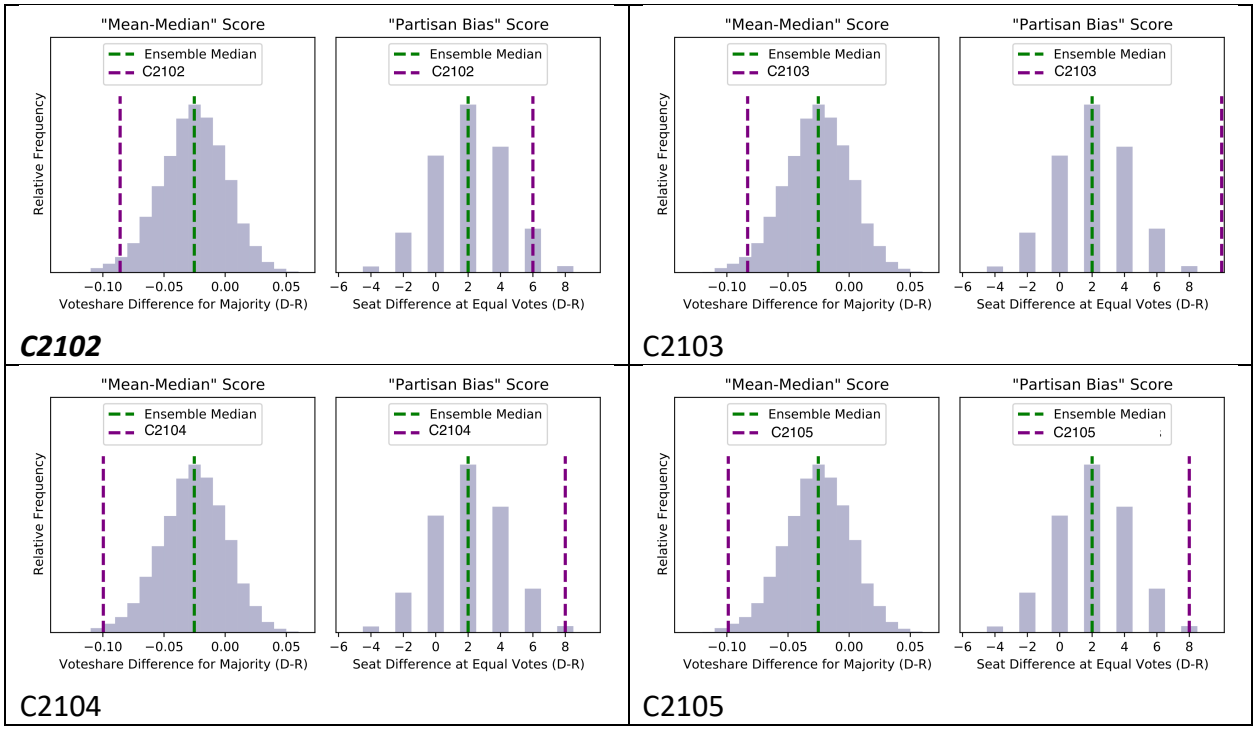
We also compute two common numbers that political scientists use to "score" maps. The first such number is called the "mean-median" score: the difference in statewide vote percentage each party would need to win the majority of the chamber. For the proposed map, the Republican Party would need to win only **42.25%** of the vote to win 19 seats, while the Democratic Party would need to earn **57.75%**; the difference of these numbers gives a "mean-median" score of **15.5** (note: to get these numbers from the figure, scale up by a factor of 100). 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. For the proposed map, the Republican Party would win **24 seats** with 50% of the vote, while the Democratic Party would win only **14 seats**; the difference of these numbers gives a "partisan bias" score of **–10**.

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 100,000-map ensemble. This is done in the figure below, and the results are

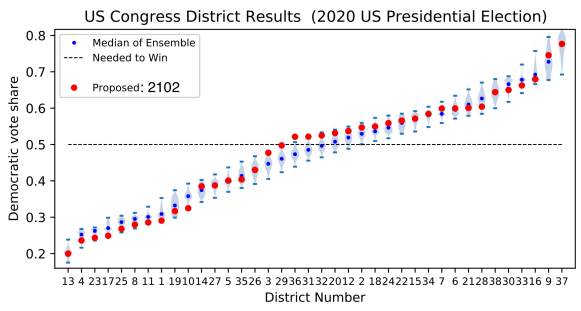
disappointing. As shown in the following figure, both the "mean-median" and "partisan bias" scores are very far from their typical values within an unbiased ensemble. In fact, both the mean-median and the partisan bias scores were more extreme than any value we saw in our ensemble. **Not a single map** in our ensemble had a mean-median score greater than that of the proposed map, and **not a single map** had a partisan bias score as negative. **We are currently generating a larger ensemble to validate these findings.**

We next consider C2102, C2103, C2104, and C2105, which were submitted by members of the public. As such, we are skeptical that they will be seriously considered by the committee. That would be unfortunate: because while all four plans appear to have been constructed to benefit the Democratic Party, they are all less manipulated than C2101.

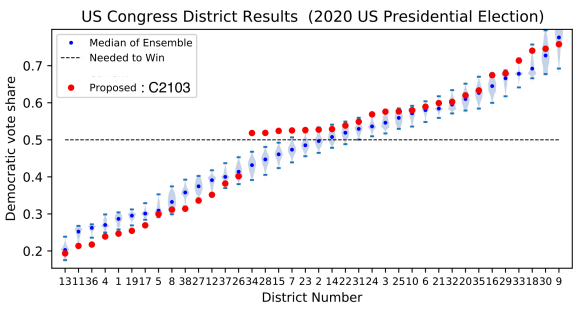
We distinguish C2102, in particular. While its MM and PB scores are still on the flanks of their respective distributions, they are still less of an outlier than any of the other plans (with 3% of plans in the ensemble scoring "worse" -- i.e. more biased towards the Democratic Party -- on both scores). For context, the absolute largest mean-median value in our ensemble was 6.8, while the minimum partisan bias was –6; **the scores for C2101, at 15.5 and –10 respectively, are completely off the scale.**



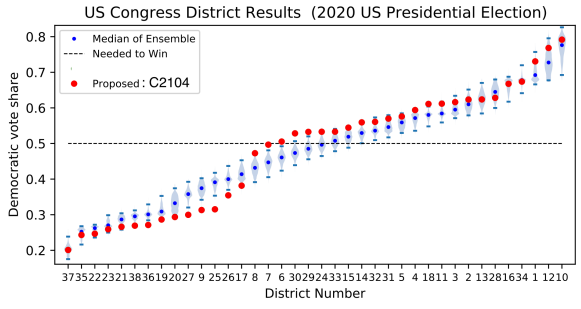
We note that in C2102, the vote shares of individual districts are largely representative of the ensemble behavior; with the exception of District 36, all of the red dots lie between the 1%-99% percentiles of the blue "violins". This contrasts with C2101, in which the red dots in the center of the district map seem to show no relationship with the typical values.



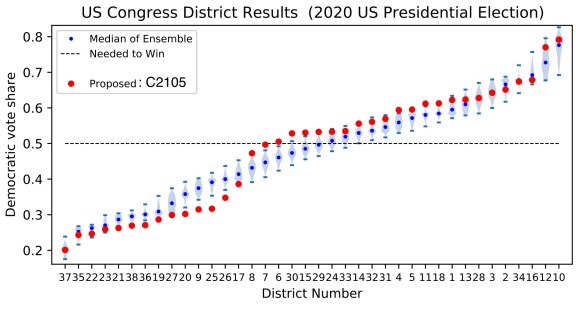
C2102



C2103



C2104



C2105

We briefly summarize all values in the following Table.

Plan	Mean-median (MM)	MM percentile	Partisan Bias (PB)	PB percentile	Favors?	Less gerrymandered than...
Ensemble	-2.5		2		NA	
C2101	15.5	100%	-10	0%	R	0 out of 100,000
C2102	-8.6	1.8%	6	90.0%	D	330 out of 100,000
C2103	-8.3	2.2%	10	99.91%	D	0 out of 100,000
C2104	-10.0	0.51%	8	98.6%	D	3 out of 100,000
C2105	-9.9	0.54%	8	98.6%	D	3 out of 100,000

Update, October 2, 2021:

We note that at 100,000 maps, the medians of the ordered vote-share vectors are already well converged. However, the shapes and the ranges of the individual histograms may continue to shift slightly. Therefore to demonstrate robustness of our conclusions, we updated our ensemble to contain 500,000 maps, and the results are equally damning.

Plan	Mean-median (MM)	MM percentile	Partisan Bias (PB)	PB percentile	Favors?	Less gerrymandered than...
Ensemble	-2.5		2		NA	
C2101	15.5	100%	-10	0%	R	***0 out of 500,000***
C2102	-8.6	1.8%	6	90.0%	D	1546 out of 500,000
C2103	-8.3	2.2%	10	99.91%	D	27 out of 500,000
C2104	-10.0	0.51%	8	98.6%	D	45 out of 500,000
C2105	-9.9	0.54%	8	98.6%	D	48 out of 500,000

Finally, the vote-share vector plot for C2101, with an updated ensemble, demonstrates that the pattern of extreme gerrymandering remains the same; the distributions of the ordered vote-shares have not shifted in any way that could conceivably explain the extreme pattern evidenced by the Republican-proposed map.