

East Lansing, March 29, 2021

To:

Dr. Matt Grossman, Director of the Institute for Public Policy and Social Research

REPORT ON TEST ELECTORAL DISTRICT MAPS (Revised April 1st, 2021).

This is a report on the following electoral district maps of the State of Ohio:

Map A: <https://districtr.org/plan/13151>

Map B: <https://districtr.org/plan/13209>

Map C: <https://districtr.org/plan/13212>

Map D: <https://districtr.org/plan/13228>

Map E: <https://districtr.org/plan/13232>

Map F: <https://districtr.org/plan/13278>

Map G: <https://districtr.org/plan/13288>

I first evaluate these maps according to the following characteristics.

1. **Completeness.** The map is “*complete*” if all areas of the State are assigned to a district. If some areas remain unassigned, the map is “*incomplete*,” and I indicate the % of the population unassigned to any district.
2. **Equal population.** I compare the population of the most populous district to the population of the least populous district. If the difference is more than 0.5%, I note the map as “unequal” and indicate the maximum deviation, as a percentage of the district population. Maps with as little as a 0.7% deviation have been ruled unconstitutional.
3. **Contiguity.** A district is “*contiguous*” if all its territory is connected, where islands are considered connected to the mainland county to which they belong. If a district has disconnected pieces, then I mark it as “*not contiguous*.” Because the current exercise is to draw Ohio maps by putting together precincts, and because many Ohio precincts are themselves made of disconnected pieces, this contiguity requirement is harder to satisfy in this exercise than it will be in the actual redistricting in Michigan. In Michigan, it is rarer for precincts to be disconnected, and in its drawing of official MI maps, the Commission will be able to split districts into smaller units -typically census blocks- if needed. For this reason, I apply a laxer criteria of contiguity than the legal one in this report, ignoring violations due to the disconnected nature of some precincts.

Maps should satisfy these three criteria, prior to an evaluation of more complex criteria. Among these more difficult criteria, the first three ranked by the MI Constitution are: compliance with the Voting Rights Act, respecting communities of interest, and partisan fairness. The Commission has dedicated legal counsel for compliance with the VRA, so this report defers to legal experts on this criterion; “communities of interest” should be defined

by the communities themselves through public input, so this criterion cannot be evaluated in this test exercise of OH. I thus consider partisan fairness as the fourth criterion to evaluate the maps in these reports.

4. **Partisan Fairness.** I compute two measures of partisan fairness.

4a. “Partisan Bias.” This is the number of seats that a party would get, in excess of half of the delegation, in a counterfactual election in which the vote share was 50%-50% for the top-two parties. The counterfactual election results are obtained starting from an actual election result by switching votes uniformly in every district from the state-wide winner to the state-wide runner-up party. Once you do that, each party should get half the seats (7.5 seats in a 15 district map), and if a party gets more, the map is deemed biased in its favor in amount equal to the excess number of seats above 7.5 in this counterfactual.

4b. “Artificial Partisan Advantage.” This is the number of seats a party gets in excess of a benchmark computed by assigning seats to each party in proportion to the population in counties in which the party wins most votes.¹ The excess seats relative to the county-based benchmark is a partisan advantage created by the map in use.

I compute these measures using the results in the elections to the 2016 US House of Representatives, and the 2016 US Presidential election, and averaging over these two. I use these two elections because for both of these, districtr automatically computes results per district in the new test maps, allowing for an immediate analysis. For the actual proposal of future MI maps, the measures should be computed using all the most recent elections, including the 2018 and 2020 elections.

In 2016 in Ohio, the GOP got 58.2% of the 2-party vote for the US House election, and 54.3% in the Presidential election, so to create the counterfactual tied elections to compute the Partisan Bias, we switch 8.2% of votes in each district the GOP to the Democratic party from the US House election results, and 4.3% in each district from the Presidential election results. The benchmark assigning seats by county gives 10 seats to the GOP according to the 2016 US House results, and 9.3 seats according to the US Presidential result, so the averaged benchmark is 9.65 seats, and if the GOP would have won more seats than this under a proposed map, the excess constitutes an artificial partisan advantage (equivalently, the benchmark is 6.35 seats to the Democratic party; if it would have obtained more under a proposed map, that indicates an artificial partisan advantage in its favor).

I first present a summary of results for all maps, and then I discuss each map individually.

¹ For the most recent academic survey of these and other measures of partisan fairness, see B. Burden and C. Smidt, Oct-Dec 2020, “Evaluating Legislative Districts Using Measures of Partisan Bias and Simulations.” SAGE Open 1-12, available at <https://journals.sagepub.com/doi/10.1177/2158244020981054>

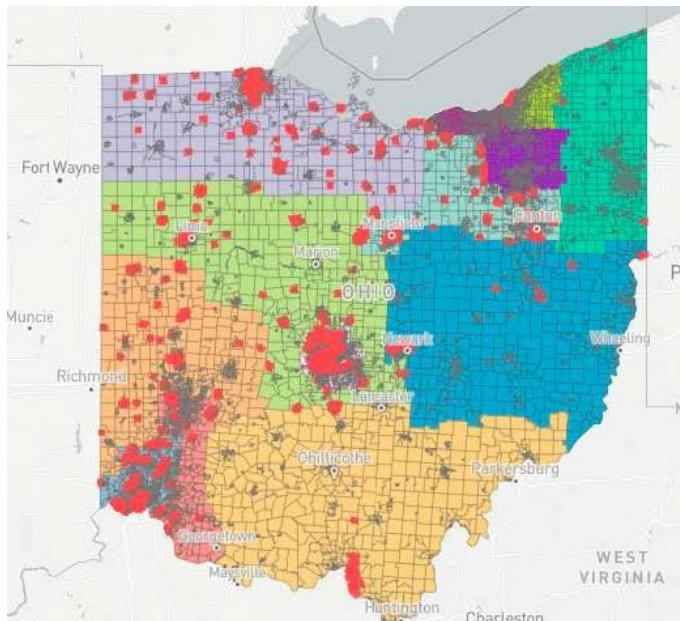
For a discussion for the general public, see J. Eguia, Oct 2020: “New electoral districts are coming – an old approach can show if they’re fair”, The Conversation, available at: <https://theconversation.com/new-electoral-districts-are-coming-an-old-approach-can-show-if-theyre-fair-150591>

SUMMARY

Map	Complete?	Equal Population?	Contiguous?	Partisan Bias	Artificial Partisan Advantage	Avg GOP seats
Official map	Yes	Yes	Yes	+2 GOP	+2.35 GOP	12 (of 16)
Map A (13151)	No (>13.5%)	No (>14.3%)	No	n.a	n.a.	
Map B (13209)	Yes	No (>3.9%)	Yes	+0.5 GOP	+0.95 GOP	10 of 15
Map C (13212)	No (>3.4%)	No (>1.1%)	No	n.a.	n.a	
Map D (13228)	No (>0.2%)	No (>3.5%)	Yes	0	+2.45 GOP	11.5 of 15
Map E (13232)	No (<0.1%)	No (>4.0%)	No	+0.5 GOP	+1.45 GOP	10.5 of 15
Map F (13278)	No (<0.1%)	No (0.68%)	No	+1 GOP	+0.95 GOP	10 of 15
Map G (13288)	No (>1.8%)	No (>17.6%)	No	+1 Dem	+0.45 GOP	9.5 of 15

These maps would need to be edited to assign all precincts to a district, to better equalize population across districts, and to attain contiguity. Almost all of them are much fairer, under any measure, than the OH 2011 official maps.

EVALUATION OF MAP A (13151)



1. Complete task?

No.

Numerous precincts (highlighted in red) are unassigned to any precinct. The population in unassigned precincts totals over 1,598,000 in population, which is over 13% of the total population of the state, and more than enough to fill in more than 2 congressional districts. As a result, only 13 districts are drawn.

2. Equal population?

No. The population of the most populous of the drawn districts (District 8) is over 802,000, while that of the least populous (District 12) is less than 703,000. The difference is over 14% of the size of the smaller district, far surpassing the limits tolerated by the Courts.

3. Contiguity.

No. There are multiple islands of pieces of a district entirely surrounded by another. See for instance the map of the city of Cincinnati.

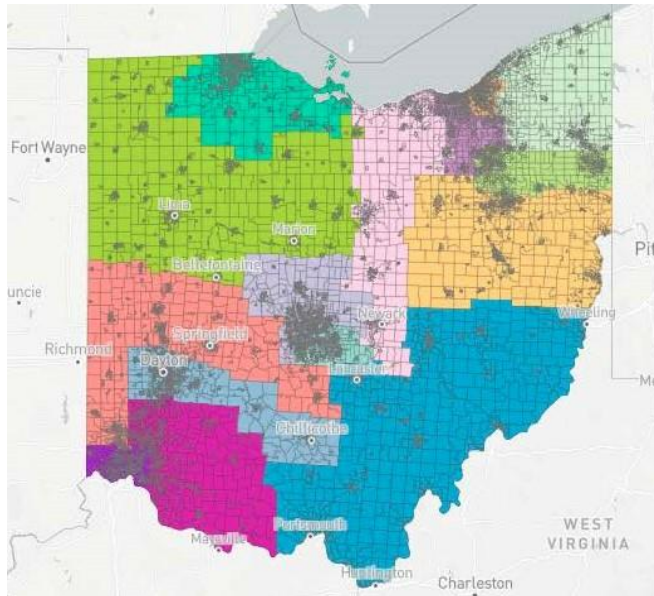
4. Partisan Fairness.

Since the map is not complete, and is missing two districts, I do not evaluate the map on this regard.

Summary Evaluation

This submitted map does not meet fundamental technical requirements of the redistricting task. To remedy this map, it would first be necessary to assign all currently unassigned precincts to a district, and doing so while attaining equal population would require extensively redrawing district boundaries.

EVALUATION OF MAP B (13209)



1. Complete task?

Yes. This is a complete district map of OH with 15 districts.

2. Equal population?

No. The population of the most populous of the drawn districts (District 10) is over 781,000, while that of the least populous (District 12) is less than 752,000. The difference is over 3.9% of the size of the smaller district, far surpassing the limits tolerated by the Courts.

3. Contiguity.

Yes, districts are contiguous.

4. Partisan Fairness.

According to the 2016 US House election results, the GOP would have won 11 seats according to this map, while in the benchmark by counties it earned 9.38, for an artificial advantage of 1.62 seats. In the tied-election counterfactual result derived from this election, the GOP would have won 8 seats, for a partisan bias of 0.5.

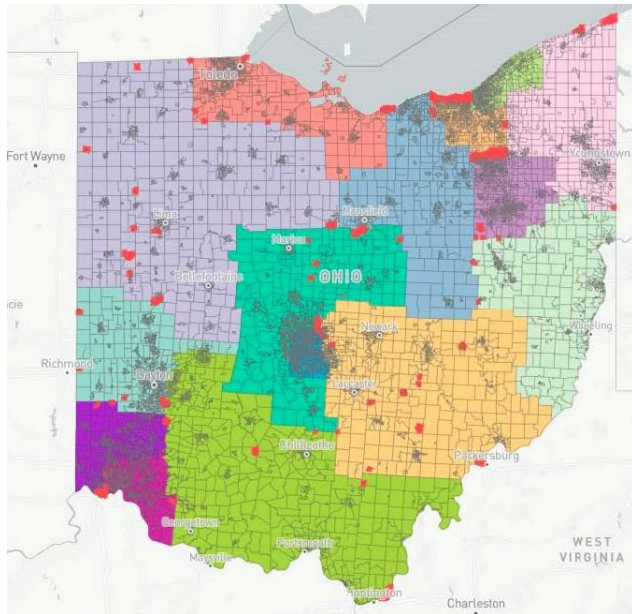
Using the 2016 US Presidential election results, the GOP would have won 9 seats according to this map, and 8.71 in the county-based benchmark, for an artificial advantage of 0.29 seats; while in the related tied counterfactual, it would have won 8, for a partisan bias of 0.5.

On average thus, the partisan bias is 0.5 and the artificial advantage is 0.95 seats, both favoring the GOP. This map is, nevertheless, much fairer than the official one adopted by OH in 2011.

Summary Evaluation

This submitted map does not meet the equal population requirement of the redistricting task. To remedy this map, it would first be necessary to remove some precincts from District 10, and to add some precincts to District 12, which would require adjusting the boundaries of other districts in between these two. After these transfers, Partisan Fairness should be re-evaluated in the remedied map.

EVALUATION OF MAP C (13212)



1. Complete task?

No. Numerous precincts (highlighted in red) are unassigned. The population of these unassigned precincts is over 400,000.

2. Equal population?

No. Due to the unassigned population, District 15 is a rump district with less than half the population of all other districts. Excluding this rump district, the population of the most populous district (District 4) exceeds the population of the least populous district (District 6) by over 1.1%, which surpasses the limits tolerated by the Courts.

3. Contiguity.

No. There is an island of District 2 surrounded by District 3, in Centerbough.

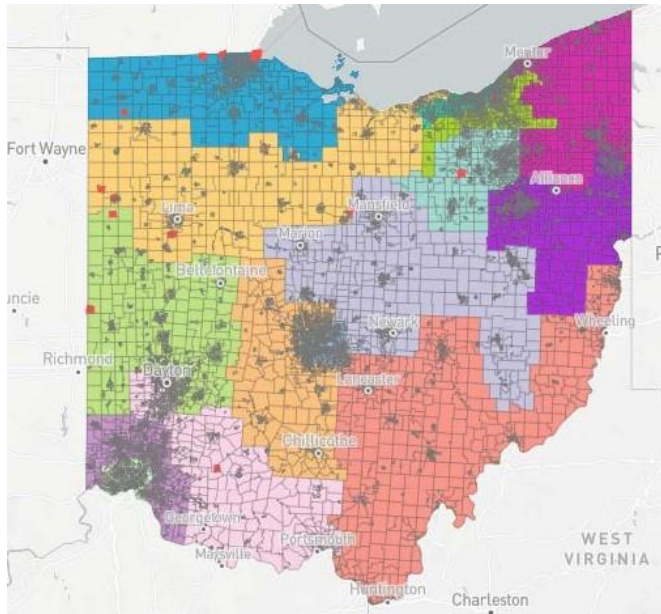
4. Partisan Fairness.

Due to large unassigned population, there are only 14 full districts in this map (plus an underpopulated rump district 15), so I do not evaluate partisan fairness of this incomplete map.

Summary Evaluation

This submitted map does not meet the fundamental requirement of the redistricting task, which is to assign all the area and population of the state to districts. To remedy this map, it would first be necessary to assign all currently unassigned precincts to a district, and doing so while maintaining equal population would require extensively redrawing district boundaries.

EVALUATION OF MAP D (13228)



1. Complete task?

No. Several precincts (highlighted in red) are unassigned. The population in these unassigned precincts is over 26,000 inhabitants.

2. Equal population?

No. The population of the most populous district (District 1) is over 771,000, while that of the least populous (District 15) is less than 746,000. The difference is over 3.5% of the size of the smaller district, far surpassing the limits tolerated by the Courts. Excluding District 15, the difference between the population of District 1 and District 14 is over 1.1%, still above the limits tolerated by the Courts.

3. Contiguity.

Yes, districts are contiguous.

4. Partisan Fairness.

According to the 2016 US House election results, the GOP would have won 12 seats according to this map, while in the benchmark by counties it earned 9.38, for an artificial advantage of 2.62 seats for the GOP. In the tied-election counterfactual result derived from this election, the GOP would have won 7 seats, for a partisan bias of 0.5 favoring the Democratic party.

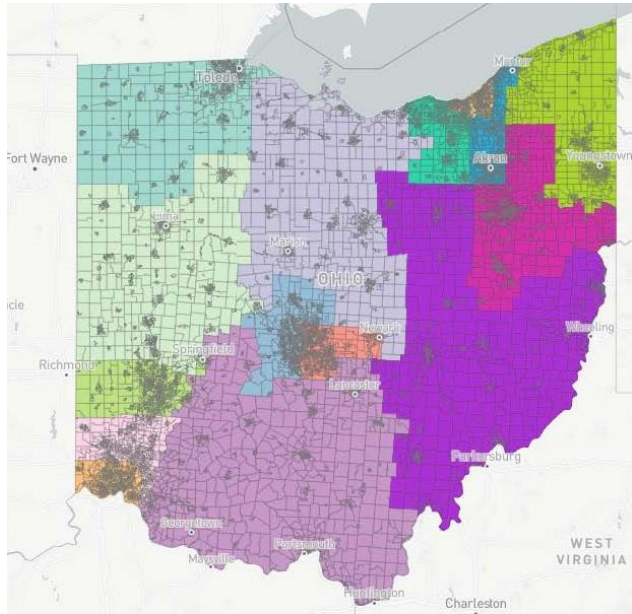
Using the 2016 US Presidential election results, the GOP would have won 11 seats according to this map, and 8.71 in the county-based benchmark, for an artificial advantage of 2.29 seats; while in the related tied counterfactual, it would have won 9, for a partisan bias of 0.5 for the GOP.

On average thus, the partisan bias is 0 and the artificial advantage is 2.45 seats favoring the GOP. This map gives an equal split of seats at tied elections, but it greatly favors the GOP at election results like those in 2016, so it is “fair” according to the measure concerned about the hypothetical tied election, and unfair according to the one that looks only at actual vote counts.

Summary Evaluation

This submitted map does not meet the fundamental requirement of the redistricting task, which is to assign all the area and population of the state to districts. To remedy this map, it would first be necessary to assign all currently unassigned precincts to a district, and doing so while maintaining equal population would require some redrawing of district boundaries.

EVALUATION OF MAP E (13232)



5. Complete task?

No. One precinct with population 1,639 (at the southern border of OH, surrounded by District 14) is unassigned. I assume this was an oversight, that this precinct is meant to be part of District 14, so I remedied the map adding this precinct to District 14 before continuing the evaluation

6. Equal population?

No. The population of the most populous of the drawn districts (District 2) is over 782,000, while that of the least populous (District 12) is less than 752,000. The difference is over 4% of the size of the smaller district, far surpassing the limits tolerated by the Courts.

7. Contiguity.

No. There is an isolated precinct belonging to District 15, surrounded by District 10 (in Milford Center).

8. Partisan Fairness.

According to the 2016 US House election results, the GOP would have won 11 seats according to this map, while in the benchmark by counties it earned 9.38, for an artificial advantage of 1.62 seats. In the tied-election counterfactual result derived from this election, the GOP would have won 8 seats, for a partisan bias of 0.5.

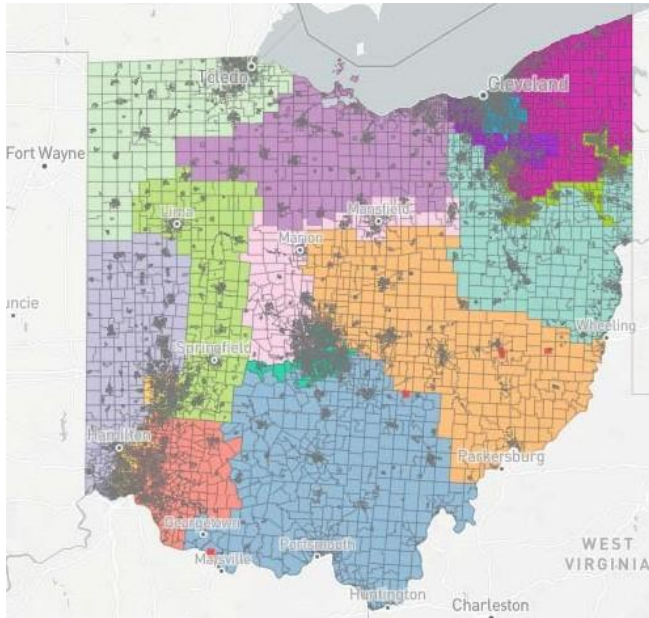
Using the 2016 US Presidential election results, the GOP would have won 10 seats according to this map, and 8.71 in the county-based benchmark, for an artificial advantage of 1.29 seats; while in the related tied counterfactual, it would have won 8, for a partisan bias of 0.5.

On average thus, the partisan bias is 0.5 and the artificial advantage is 1.45 seats, both favoring the GOP. This map is, nevertheless, much fairer than the official one adopted by OH in 2011.

Summary Evaluation

This submitted map does not meet the equal population requirement of the redistricting task. To remedy this map, it would first be necessary to remove some precincts from District 2, and to add some precincts to districts 14 and 15, which would require adjusting the boundaries of other districts in between these. After these transfers, Partisan Fairness should be re-evaluated in the remedied map.

EVALUATION OF MAP F (13278)



1. Complete task?

No. A few precincts (highlighted in red) with total population of 6,181 are unassigned. , surrounded by District 14) is unassigned. As these precincts are surrounded by districts 10 and 11, the map can be remedied by assigning each precinct to the district that surrounds it.

2. Equal population?

Marginal. The population of the most populous of the drawn districts (District 1) is over 769,700, while that of the least populous (District 15) is less than 764,500. The difference is 0.68% of the size of the smaller district. Such a difference would only stand in Court if the State can justify why this difference was necessary.

3. Contiguity.

No. Districts 12 and 14 are not contiguous. District 12 contains an isolated cluster of precincts within Findlay, and District 14 contains an isolated cluster of precincts within Ottawa.

4. Partisan Fairness.

According to the 2016 US House election results, the GOP would have won 10 seats according to this map, while in the benchmark by counties it earned 9.38, for an artificial advantage of 0.62 seats to the GOP. In the tied-election counterfactual result derived from this election, the GOP would have won 9 seats, for a partisan bias of 1.5 to the GOP.

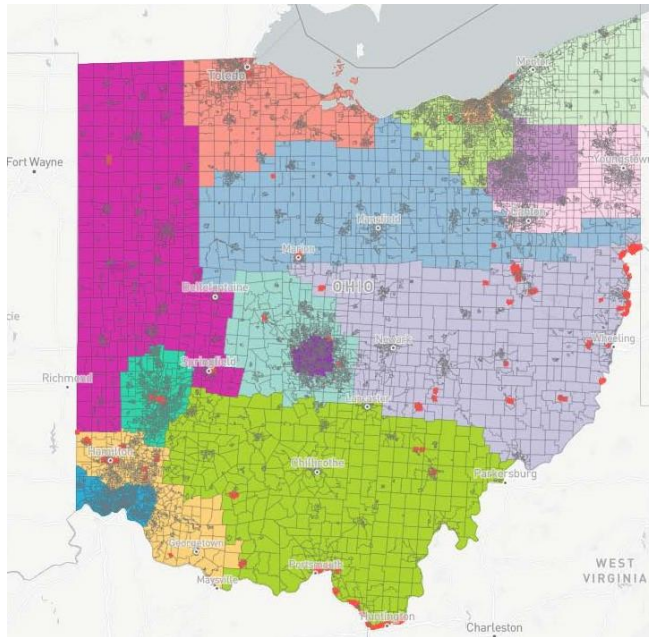
Using the 2016 US Presidential election results, the GOP would have won 10 seats according to this map, and 8.71 in the county-based benchmark, for an artificial advantage of 1.29 seats; while in the related tied counterfactual, it would have won 8, for a partisan bias of 0.5, both favoring the GOP.

On average thus, the partisan bias is 1 and the artificial advantage is 0.95 seats, both favoring the GOP. This map is, nevertheless, much fairer than the official one adopted by OH in 2011.

Summary Evaluation

This submitted map does not meet the fundamental requirement of the redistricting task, which is to assign all the area and population of the state to districts. To remedy this map, it would first be necessary to assign all currently unassigned precincts to a district, and doing so while maintaining equal population would require some redrawing of district boundaries. Further, this map violates contiguity; to become contiguous, adjacent districts 12 and 14 need to swap non-contiguous precincts, again adjusting boundaries to preserve population equality.

EVALUATION OF MAP G (13288)



1. Complete task?

No. Numerous precincts (highlighted in red) are unassigned. The population of these unassigned precincts is over 136,000.

2. Equal population?

No. Due to the population in unassigned districts, District 15 is an incomplete district, with about 17% smaller population than all others. Even among the more evenly populated districts 1 through 14, the population of the most populous of the drawn districts (District 9) is over 774,000, while that of the least populous (District 4) is less than 766,000. The difference is over 1.1% of the size of the smaller district, surpassing the limits tolerated by the Courts.

3. Contiguity.

No. There are isolated precincts assigned to District 5, entirely surrounded by District 10, north of Toledo.

4. Partisan Fairness.

According to the 2016 US House election results, the GOP would have won 10 seats according to this map, while in the benchmark by counties it earned 9.38, for an artificial advantage of 0.62 seats for the GOP. In the tied-election counterfactual result derived from this election, the GOP would have won 7 seats, for a partisan bias of 0.5 for the Democratic party.

Using the 2016 US Presidential election results, the GOP would have won 9 seats according to this map, and 8.71 in the county-based benchmark, for an artificial advantage of 0.29 seats for the GOP; while in the related tied counterfactual, it would have won 6, for a partisan bias of 1.5 for the Democratic party.

On average thus, the partisan bias is 1 seat for the Democratic party and the artificial advantage is 0.45 seats favoring the GOP. The map is, under either measure, much fairer than the official one adopted by OH in 2011.

Summary Evaluation

This submitted map does not meet the fundamental requirement of the redistricting task, which is to assign all the area and population of the state to districts. To remedy this map, it would first be necessary to assign all currently unassigned precincts to a district, and doing so while maintaining equal population would require extensively redrawing district boundaries.

ADDITIONAL BACKGROUND

The task in this exercise was to divide Ohio into fifteen districts, by assigning each precinct to a district. It was conducted using Districtr. An alternative free software to create these maps is DRA2020, available at davesredistricting.org. DRA2020 allows users to create maps by census blocks (smaller, more detailed units), and it automatically provides an array of evaluation tools for any map created by users. Ultimately, the ICRC may also use commercial software.

In its actual map-drawing, the ICRC is not restricted to draw districts by grouping precincts. It can, instead, break precincts and assign individual census blocks to districts. Census blocks are the smallest US Census unit, often the size of a city block, and with an average population of about 50 inhabitants per block. Precincts are composed of census blocks (precincts, on average, have approximately 1,100 registered voters, so about thirty blocks). The advantage of mapping by precinct is that the precinct is the smallest unit at which electoral data is collected. So if a map breaks precincts apart, and it assigns different blocks within a precinct to different districts, then we do not know the electoral results in these districts in past elections. So there is a justification for keeping precincts whole, in order to have precise results of past election in the newly drawn districts.

Keeping precincts whole (or, for that matter, keeping census blocks whole) makes it impossible to exactly equalize the population of different districts. Nevertheless, since a single precinct typically has population no greater than 2,000 inhabitants, population can be approximated to within 2,000 inhabitants across districts while keeping precincts whole. A population of approximately 2,000 inhabitants is about 0.25% of the population of Congressional district, about 0.75% of a MI Senate district, or about 2% of a Michigan House district. US Courts have applied strict standards of population equality in congressional district maps, rejecting a map with a difference in population across districts as small as 0.7% for not being well-justified (although the US Supreme Court accepted as valid a better-justified deviation of as much as 0.79%)^{2,3}. For state legislative maps, the threshold of acceptability has traditionally been much larger, of as much as 10% of population difference.

Contiguity has two possible interpretations: “rook” contiguity and “queen” continuity. Two areas are “queen” contiguous even if they are connected by a single point, like, say, Colorado and Arizona. But to be “rook” continuous, there must be not just a point, but a whole border of contiguity, so you can, for instance, drive say a herd of cattle from one area to the other without any head of the cattle straying out of the connected areas. You cannot do that between Colorado and Arizona, but you can between say Michigan and Indiana. It may be ambiguous if the MI Constitution accepts “queen” contiguity, so satisfying “rook” contiguity has the advantage of eliminating this doubt.

There are two substantively different interpretations of “partisan fairness.” The first seeks to eliminate any difference or bias in how votes translate to seats for each party, so that if a party gets k seats out of a vote share v , then another party should also get k seats, if it gets vote share v . Ways

² *Karcher v. Daggett*, 462 U.S. 725 (1983).

³ *Tennant v. Jefferson County* 567 U.S. 758 (2012).

to measure this include the “partisan bias” I use here, which measures the deviation from a tied seat outcome in a hypothetical tied election; “partisan symmetry”, which considers the hypothetical in which parties reversed their vote share to see if in that case they would also reverse their seat share (deviations from this reversal being evidence of “asymmetry”); and the “mean-median” test, which measures what vote share a party would need to get, in order to win half the districts (or a half plus one), among others. Note that the “mean-median” test is more relevant for legislative assemblies, in which winning half the seats or a half plus one is key to controlling the chamber; it is less relevant for the MI delegation to the US Congress, in which one additional seat is equally important, regardless of whether it tips the majority of the delegation.

The second approach notes that some of the asymmetry or bias in seat outcomes is due not to how the maps are drawn, but due instead to the geographic distribution of voters. A party with well distributed voters will do better, for most possible maps, than another one with many of its voters clustered together. This second approach accepts this geographic advantage, and defines as unfair any advantage provided by the maps in addition to this natural advantage that some parties enjoy. The artificial partisan advantage used here captures this additional advantage provided by a map, by comparing the outcomes to a benchmark that uses a fixed map of counties to assign seats (weighing the number of seats per county by population). An alternative approach that also measures this additional advantage is to computationally generate a large ensemble of maps (and by large, we mean millions or billions of maps), is to check the distribution of outcomes in this large ensemble, and to reject a proposed map if it is extreme relative to the ensemble.

It may be advisable for the Commission to measure its proposed maps of Michigan according to all these measures, before adopting a map that performs well in the set of measures relevant for notion or notions of fairness that the Commission deems pertinent.

In addition to these criteria, which I have used in this report on this test exercise, the actual maps of Michigan must also be evaluated according to the following criteria, ranked in order of relevance:

- Compliance with the Voting Rights Act (equal in importance to population equality, and higher than contiguity or partisan fairness).
- Respect for Communities of Interests (lower importance than population equality or contiguity, but higher than partisan fairness).
- Fairness to incumbents and challengers, respect for jurisdictional boundaries, and compactness (all of these have lower priority than any of the criteria discussed in this report).

Please feel encouraged to reach out to me with any query about this report. This report may be shared publicly.

Thank you for your interest in my evaluation of these maps.
Yours sincerely,

A handwritten signature in black ink, appearing to read 'Jon X. Eguia', with a stylized, cursive script.

Jon X. Eguia