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**Admitted Pro Hac Vice*

**IN THE THIRD JUDICIAL DISTRICT COURT
 IN AND FOR SALT LAKE COUNTY, STATE OF UTAH**

LEAGUE OF WOMEN VOTERS OF UTAH,
 MORMON WOMEN FOR ETHICAL
 GOVERNMENT, STEFANIE CONDIE,
 MALCOLM REID, VICTORIA REID,
 WENDY MARTIN, ELEANOR
 SUNDWALL, and JACK MARKMAN,

Plaintiffs,

v.

UTAH STATE LEGISLATURE, et al.,

Defendants.

**FIRST SUPPLEMENTAL
 DECLARATION OF CHRISTOPHER
 WARSHAW**

Case No. 220901712

Honorable Dianna M. Gibson

CHRISTOPHER WARSHAW hereby declares and states as follows:

1. I am over 21 years of age and am in all respects competent to make this declaration. These facts are based on my personal knowledge.
2. I have been retained by counsel for Plaintiffs in the above-captioned action to offer expert opinion and analysis regarding certain matters. I submit this First Supplemental Declaration in supplementation of my prior declaration and attached report, filed October 7, 2025. A true and correct copy of a supplement to my report, entitled *A Supplement to Section 6.3.3 of my Declaration on Methods to Determine Whether Utah Congressional Plans Favor or Disfavor a Political Party*, dated October 13, 2025, is attached hereto. The content of this supplement to my report is true and accurate to the best of my knowledge, and I would testify consistently with its contents if called to do so.
3. I declare under penalty of perjury of the laws of the State of Utah that the foregoing is true and correct.

EXECUTED this 13th day of October 2025, in Maryland, United States.

/s/ Christopher Warshaw

A Supplement to Section 6.3.3 of my Declaration on Methods to Determine Whether Utah Congressional Plans Favor or Disfavor a Political Party

Christopher Warshaw*

October 13, 2025

*Professor, McCourt School of Public Policy, Georgetown University. Note that the analyses and views in this report are my own, and do not represent the views of Georgetown University.

In Section 6.3.3 of my previous report, I completed a preliminary assessment of the ensemble analysis test in SB 1011. I performed this preliminary analysis after an initial, time-constrained review of the test, which was added to SB 1011 on the day of legislative approval. In preparation for further analysis of the various enacted and submitted maps in Utah, I have had time to complete a more detailed review of this test. Based on this further review, I am submitting a supplement to my earlier report. This supplement clarifies Section 6.3.3 of that report.

I have now come to the conclusion that what SB 1011 describes as the ranked marginal deviation (RMD) test is likely intended to follow a version of the ranked marginal deviation test proposed by Herschlag et al. (2020, 34) and implemented in Utah by King et al. (2022, 144). The mathematical formulation from Herschlag et al. (2020) is:

$$\sqrt{\sum_{j=1}^J (m_j - \nu_j)^2} \quad (1)$$

where m_j is the median Democratic vote share from the ensemble of simulations for district $_j$, ν_j is the Democratic vote share on the plan being evaluated for district $_j$, and J is the number of districts. In short, this unsigned metric compares absolute deviations in two-party vote shares between ranked districts in the proposed plan and ranked districts in an ensemble of simulations. This enables a fairly straightforward comparison of absolute differences between districts in the proposed and simulated maps, which could be probative as part of an evaluation of whether a proposed map has been drawn to favor a particular party.

I think the RMD test proposed by Herschlag et al. (2020) has attractive theoretical properties for comparing proposed and simulated maps. Moreover, academic work has shown that it works well in Utah. King et al. (2022, 144–145) finds that this “metric tracks fairly well with LRVS, as changing the vote share of Republicans in the least Republican district necessitates changing the vote share in other districts as well. Plans that are gerrymandered in either direction (as measured by LRVS) are associated with larger ranked-marginal deviation, which indicates that this metric is performing well and giving a fairly good signal.” In particular, gerrymandered “plans with a very high percentage of Republican voters in the least Republican district ... are correctly flagged with a large value of RMD.” So, I think the ranked deviations test is a reasonable way to evaluate partisan intent in a proposed districting plan in Utah.

The test described in SB 1011 Section (1)(a)(ii)(A) seems to modify the RMD test in Herschlag et al. (2020, 34) in several ways.

- Herschlag et al. (2020, 31) makes it clear that the simulations in an ensemble must “adher[e] to non-partisan design criteria” in law. There appears to be no detailed description in SB 1011 about the criteria to use for constructing an ensemble, nor that the simulations are required to follow the criteria in Proposition 4.
- The test in SB 1011 uses the “average vote share for the reference party” rather than the median across simulations (Section (1)(a)(ii)(A)(III)).¹ Due to the fact there is no formula in the bill, it is also somewhat confusingly worded about whether this language is referring to the average vote share for all the districts in a given simulation or the average vote share across simulations for each ranked district. For my initial report, I thought it was the former, but I now think it is intended to mean the latter. Additionally, unlike in Herschlag et al. (2020), SB 1011 divides the sum of squared deviations in Equation (1) by the number of districts prior to taking the square root.
- SB 1011 requires a determination of whether the RMD’s in the proposed plan exceeds the RMD’s in 95% of the simulations. It also requires the “culling the [benchmark] ensemble to include only redistricting plans that pass the partisan bias test, as described in Subsection (1)(c)(ii).” Section 4(b) then states that “Absent clear and convincing evidence of purpose, a redistricting plan that is within the acceptable bounds of the ensemble analysis does not purposefully favor or disfavor a political party under Subsection (4)(a).”

There are three important issues that raise concerns about this implementation of the RMD test in SB 1011. I think that these issues could render the test unreliable as applied in SB 1011.

First, it is important for the simulations in any ensemble to closely follow the requirements of Proposition 4. Otherwise, these simulation do not represent a valid benchmark for proposed maps, and they would not be probative for determining partisan favoritism. For instance, it is unclear whether the simulations used by Dr. Trende in his evaluation of the enacted map follow the requirements of Proposition 4.

Second, SB 1011 Section (1)(a)(iii)(B) requires “culling the ensemble to include only redistricting plans that pass the partisan bias test, as described in Subsection (1)(c)(ii).” As I described in my initial report, the partisan bias test is not applicable to Utah and yields paradoxical and nonsensical results. In practice, this requirement is likely to require the elimination of most plans that enable Democrats to win a seat under real-world

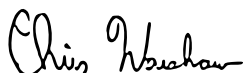
1. I take “average” to refer to the mathematical mean rather than the median.

electoral conditions in Utah. In my view, this requirement would fatally undermine the application of the RMD test to determine whether a map was drawn in favor of one party.

Finally, as I discussed above, SB 1011 Section (1)(a)(iii) states that partisan favoritism can only be inferred if a plan's RMD's are greater than in 95% of an ensemble of simulations. See also Section 4(b). In my view, a plan that deviates from an ensemble at a lower threshold could still have been drawn with partisan intent, as indicated by other quantitative and qualitative information, including the other suitable tests of partisan favoritism in Utah that I described in my initial report.

This supplement about the appropriate usage of the ranked marginal deviation test does not alter any of the other opinions in my report about the best metrics to evaluate partisan advantage on maps in Utah, or the inapplicability of the partisan bias or mean-median difference tests in Utah.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.



October 13, 2025

References

- Herschlag, Gregory, Han Sung Kang, Justin Luo, Christy Vaughn Graves, Sachet Bangia, Robert Ravier, and Jonathan C Mattingly. 2020. "Quantifying gerrymandering in north carolina." *Statistics and Public Policy* 7 (1): 30–38.
- King, Annika, Jacob Murri, Jake Callahan, Adrienne Russell, and Tyler J Jarvis. 2022. "Mathematical Analysis of Redistricting in Utah." *Statistics and Public Policy* 9 (1): 136–148.