



[Gerrymandering analyzer from Prof. Sam Wang, Princeton University](#)

Election to be analyzed: U.S. House election of 2012 in PA

Districts to be sampled for fantasy delegations: U.S. House results of 2014 in all 50 states

The PA state delegation of 2012 had 18 seats, 5 Democratic/other and 13 Republican.

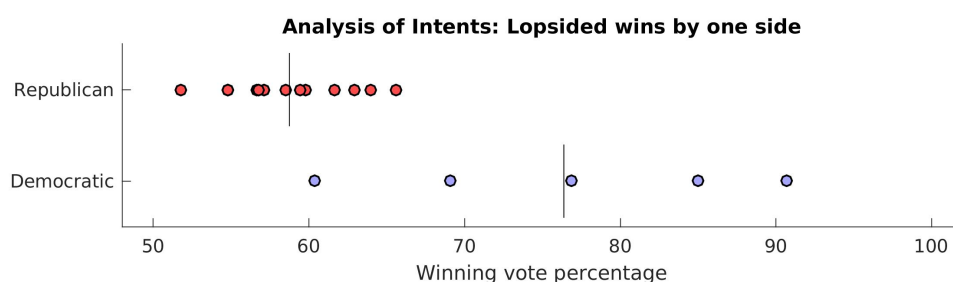
Uncontested races are assumed to have been won with 80% of the vote.

The average Democratic share of the two-party total vote was 51.0% (raw).

## Analysis of Intent

If a political party wishes to create for itself an advantage, it will pack its opponents to win overwhelmingly in a small number of districts, while distributing its own votes more thinly. To test for a lopsided advantage, one can compare each party's winning margins and see if they are systematically different. This is done using the [two-sample t-test](#). In this test, the party with the *smaller* set of winning margins has the advantage.

**First Test of Intent: Probing for lopsided win margins (the two-sample t-test):** The difference between the two parties' win margins meets established standards for statistical significance. The probability that this difference in win margins (or larger) would have arisen by partisan-unbiased mechanisms alone is 0.03.

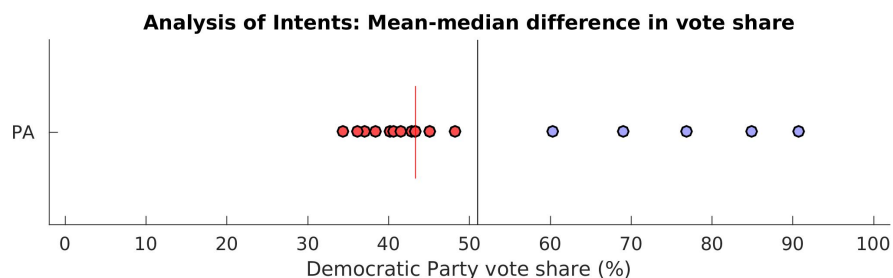


**Second Test of Intent: Probing for consistent advantages for one party (mean-median difference and/or chi-square test):** The choice of test depends on whether the parties are closely matched (mean-median difference) or one party is dominant (chi-square test of variance).

When the parties are closely matched in overall strength, a partisan advantage will be evident in the form of a difference between the mean (a.k.a. average) vote share and the median vote share, calculated across all districts. Partisan gerrymandering arises not from single districts, but from patterns of outcomes. Thus a single lopsided district may not be an offense - indeed, single-district gerrymandering is permitted by Supreme Court precedent. Rather, it is combinations of outcomes

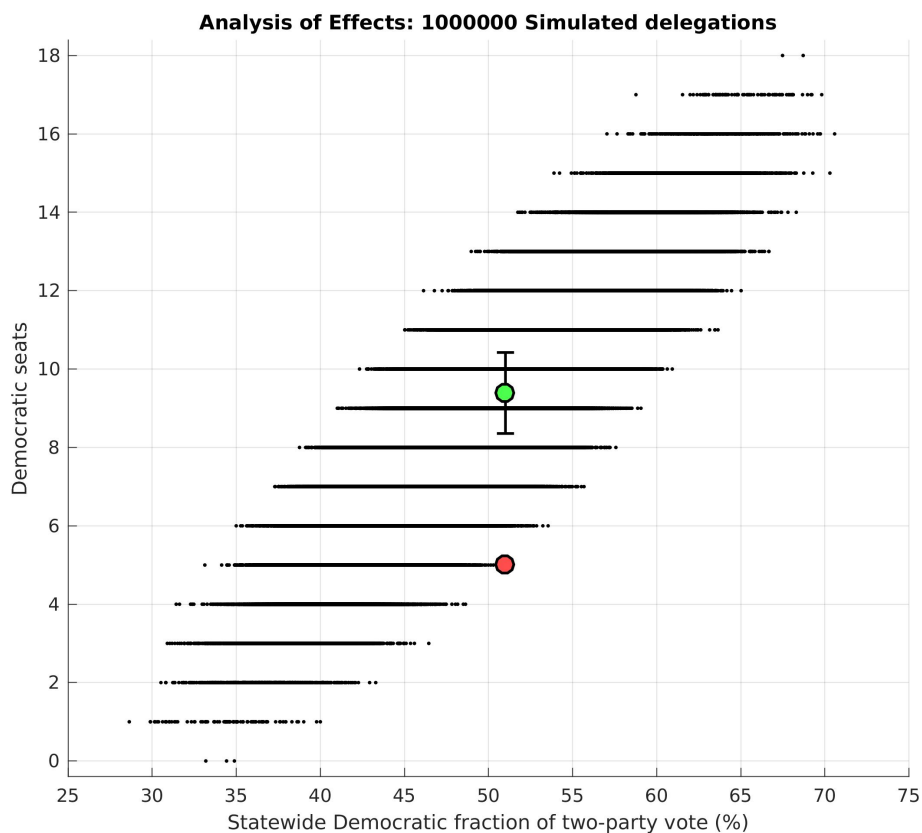
that confer undue advantage to one party or the other.

The mean-median difference is 7.7% in a direction of advantage to the Republican Party. The mean-median difference would reach this value in 0.7% of situations by a partisan-unbiased process. This difference is statistically significant ( $p < 0.01$ ), and is extremely unlikely to have arisen by chance.



### Test of effects: How many extra seats did either party gain relative to party-neutral sampling?

**(fantasy delegations):** It is possible to estimate how the state's delegation would be composed if votes were distributed according to natural variations in districting. This is done by drawing districts at random from a large national sample, and then examining combinations whose vote totals are similar to the actual outcome. In the following simulations, individual districts used to build "fantasy delegations" were flipped at random, thus generating a partisan-symmetric distribution. Consequently, these simulations ignore population clustering and show what would occur in a fully partisan-symmetric situation.



In this election, the average Democratic vote share across all districts was 51.0%, and Democrats won 5 seats. 16556 fantasy delegations with the same vote share had an average of 9.4 Democratic seats (green symbol), with a standard deviation of 1.0 seats (see error bar). The actual outcome (red symbol) was therefore advantageous to Republicans. This advantage meets established standards for statistical significance, and the probability that it would have arisen by partisan-unbiased mechanisms alone is less than 0.001.

The above calculations are based on Samuel S.-H. Wang, "Three Tests for Practical Evaluation of Partisan Gerrymandering," 68 Stan. L. Rev. XX (2016). For further information, contact [sswang@princeton.edu](mailto:sswang@princeton.edu).