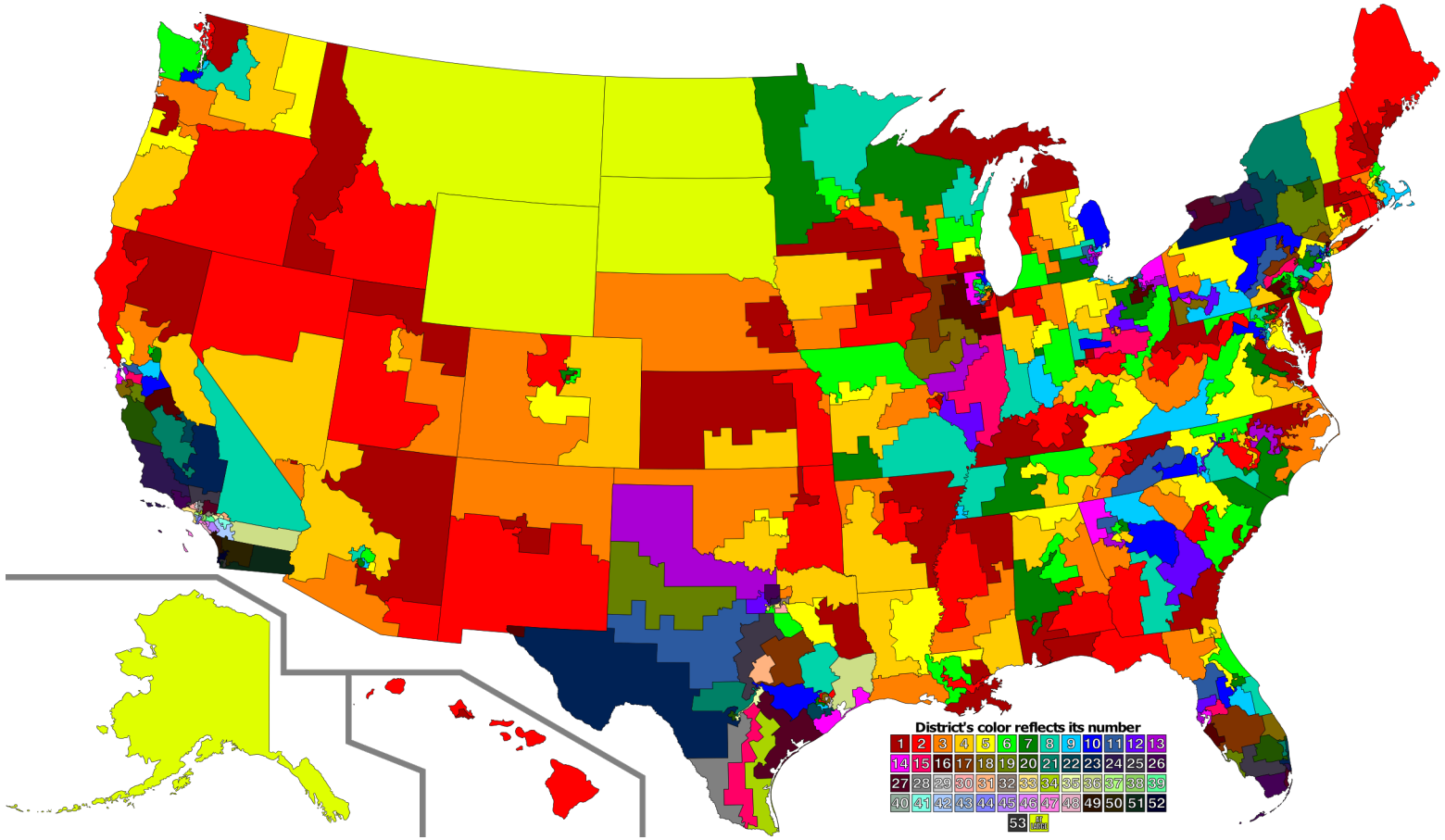
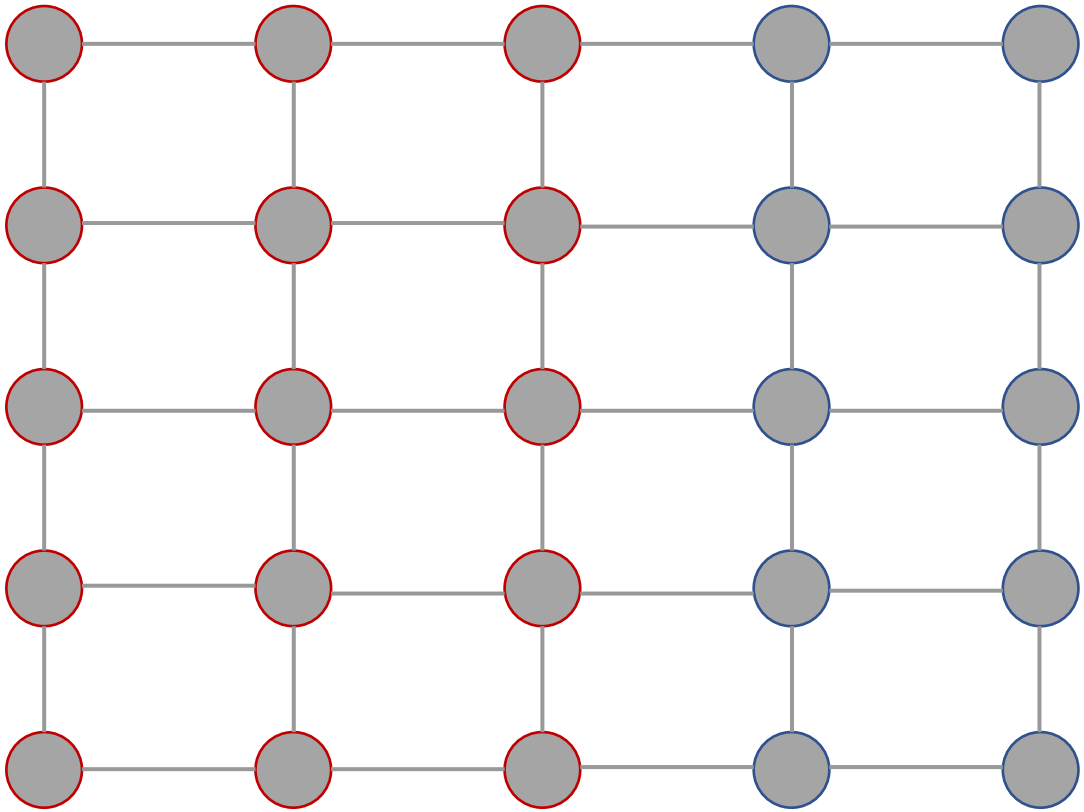
Big City vs. the Great Outdoors Voter Distribution and How It Affects Gerrymandering

Allan Borodin, Omer Lev, Nisarg Shah, Tyrone Strangway

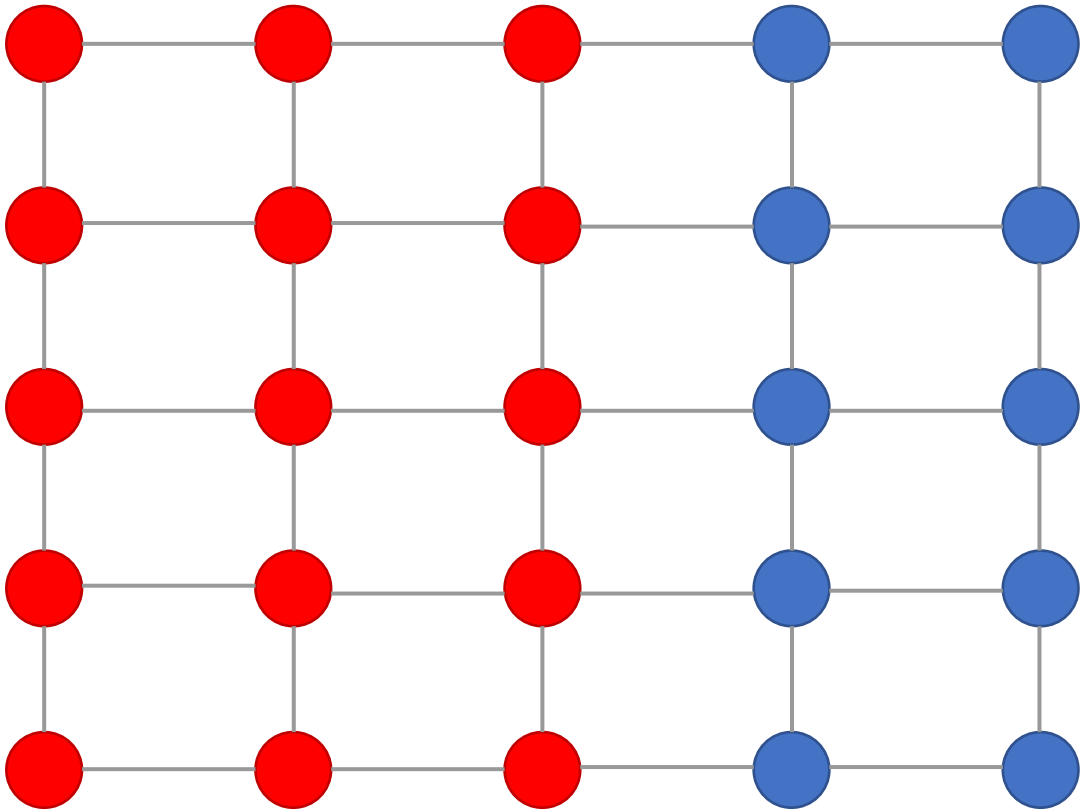
Gerrymandering



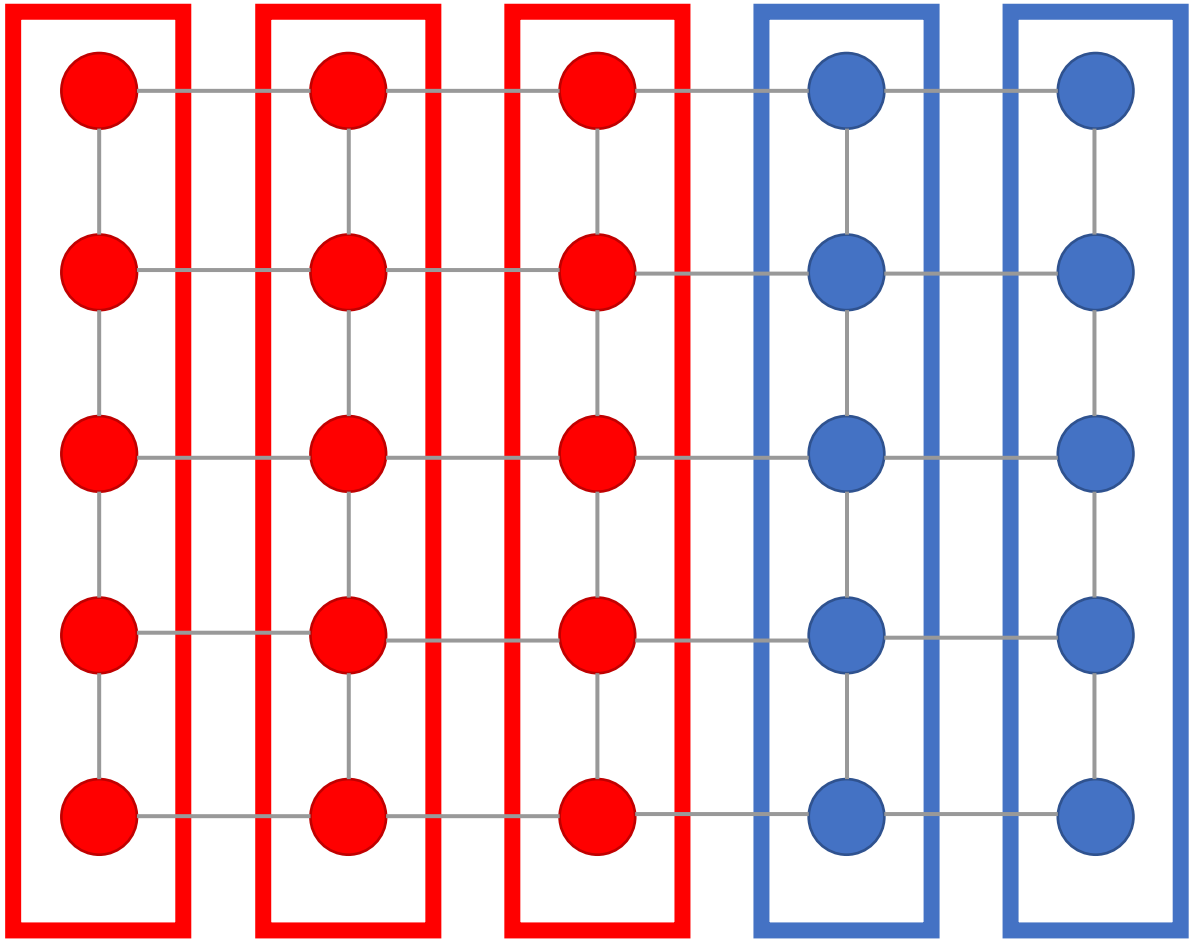
Gerrymandering



Gerrymandering

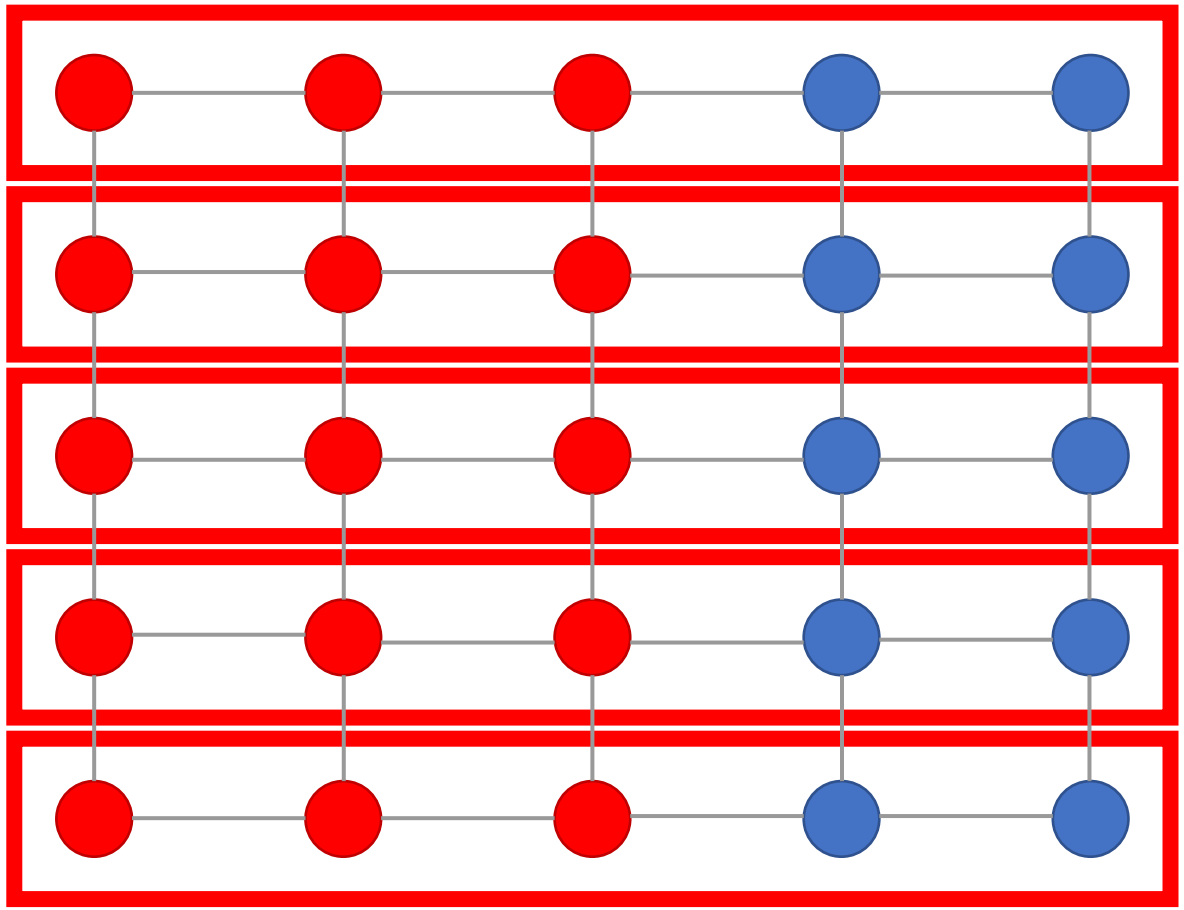


Gerrymandering
proportional



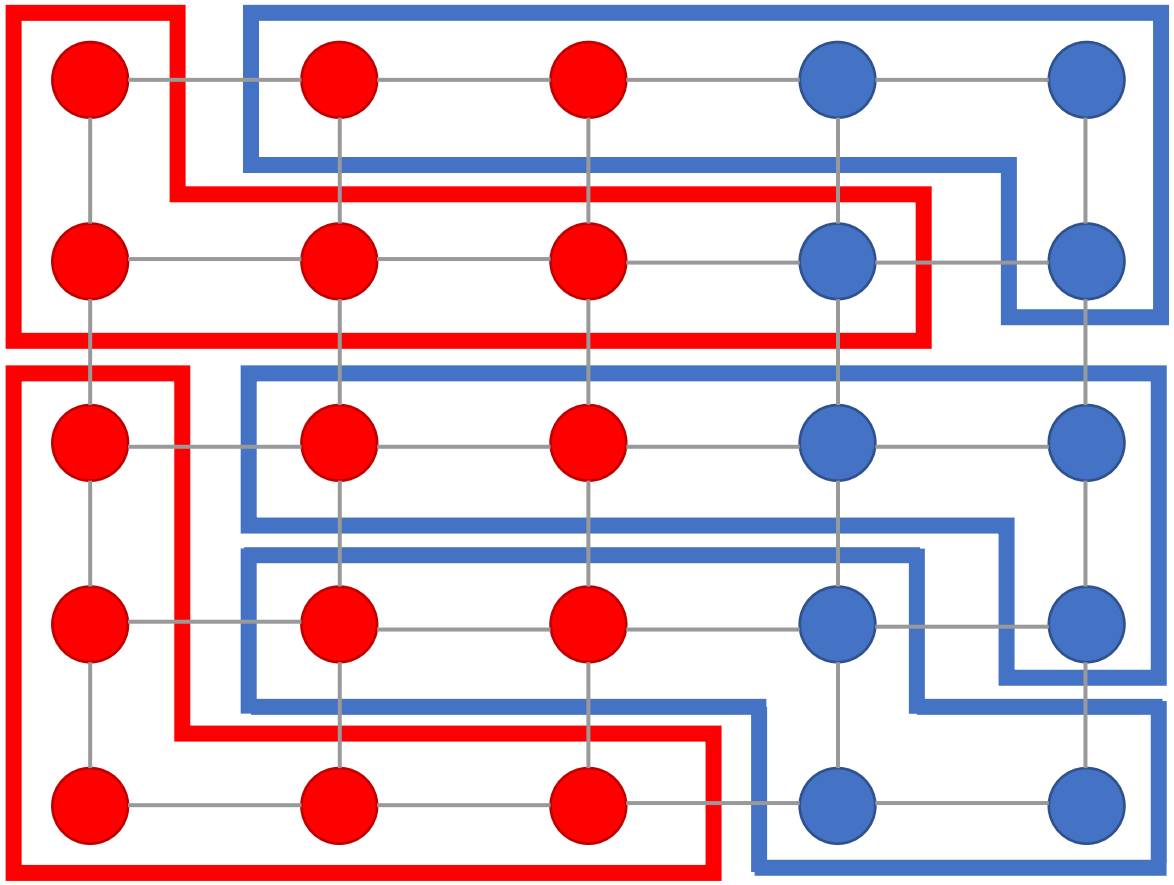
Gerrymandering

Red



Gerrymandering

blue



Gerrymandering complexity

Open question:

Is dividing a planar graph into 2 equal sized connected components NP-hard?

(Dyer and Frieze 1985 show NP-hard for general graphs, and hypothesize same in planar case)

Goals

Prevent gerrymandering!!

Goals

~~Prevent gerrymandering!!~~

Goals

~~Prevent gerrymandering!!~~

Detect gerrymandering!!

Goals

~~Prevent gerrymandering!!~~

~~Detect gerrymandering!!~~

Goals

~~Prevent gerrymandering!!~~

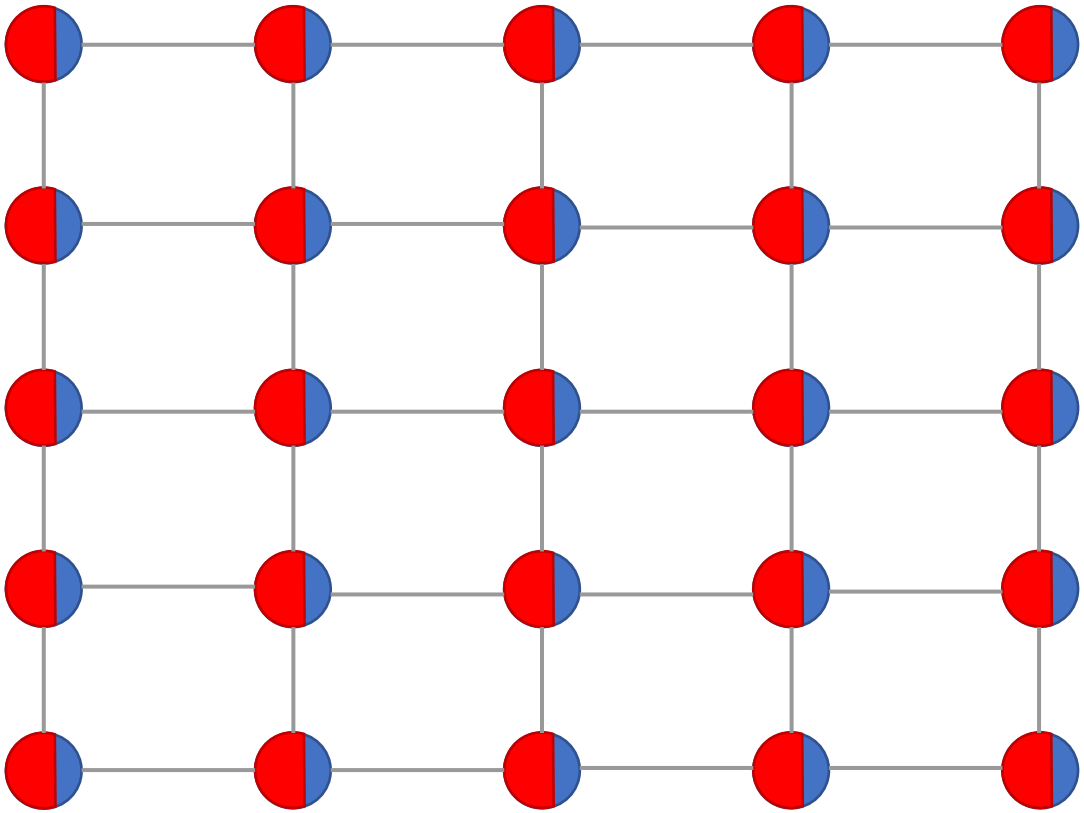
~~Detect gerrymandering!!~~

Study the effect of voter distribution on gerrymandering

Gerrymandering power

The difference between the number of districts a party **should have**, under a fairness criterion (e.g., **proportional to its support size**) and the maximal number of districts it can get under **optimal gerrymandering**.

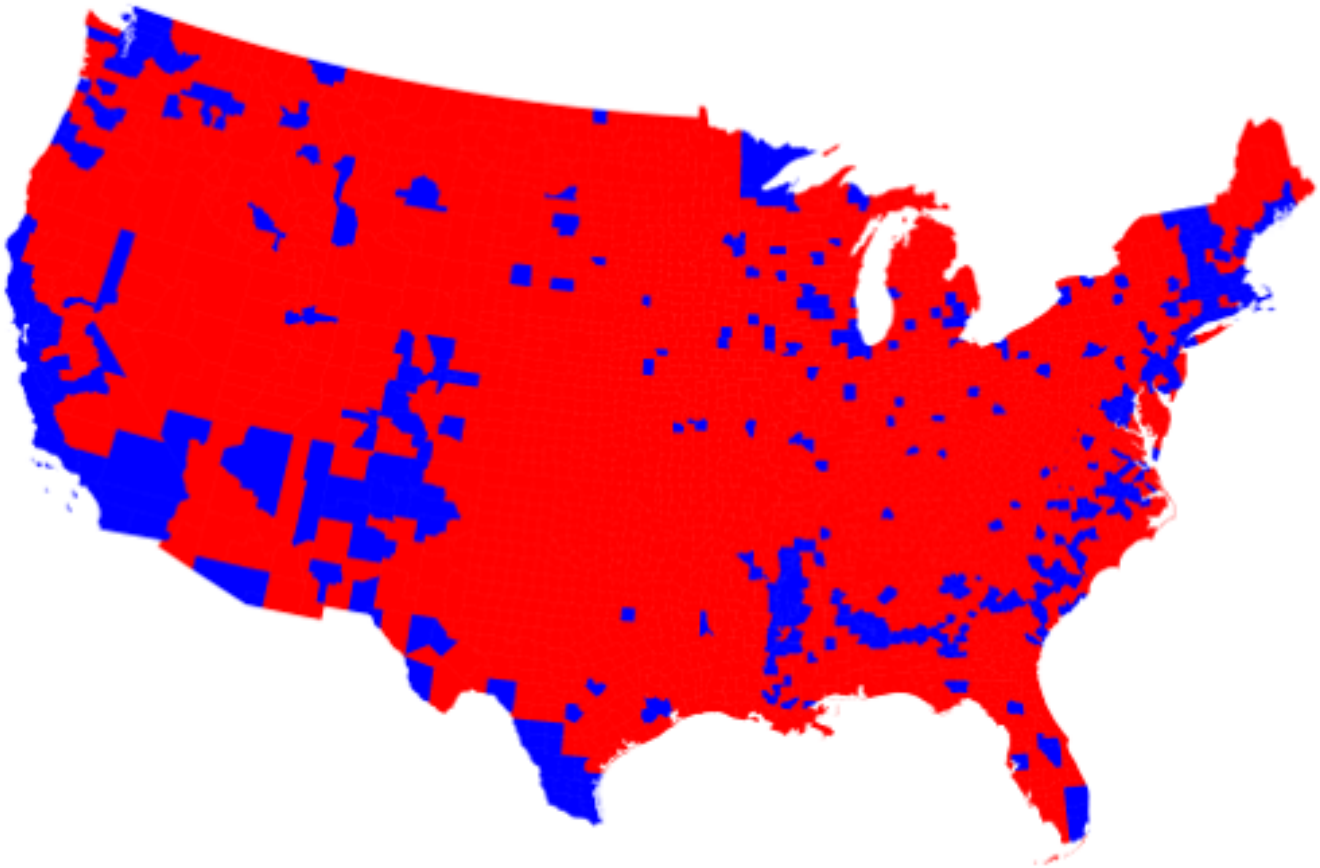
Homogenous population



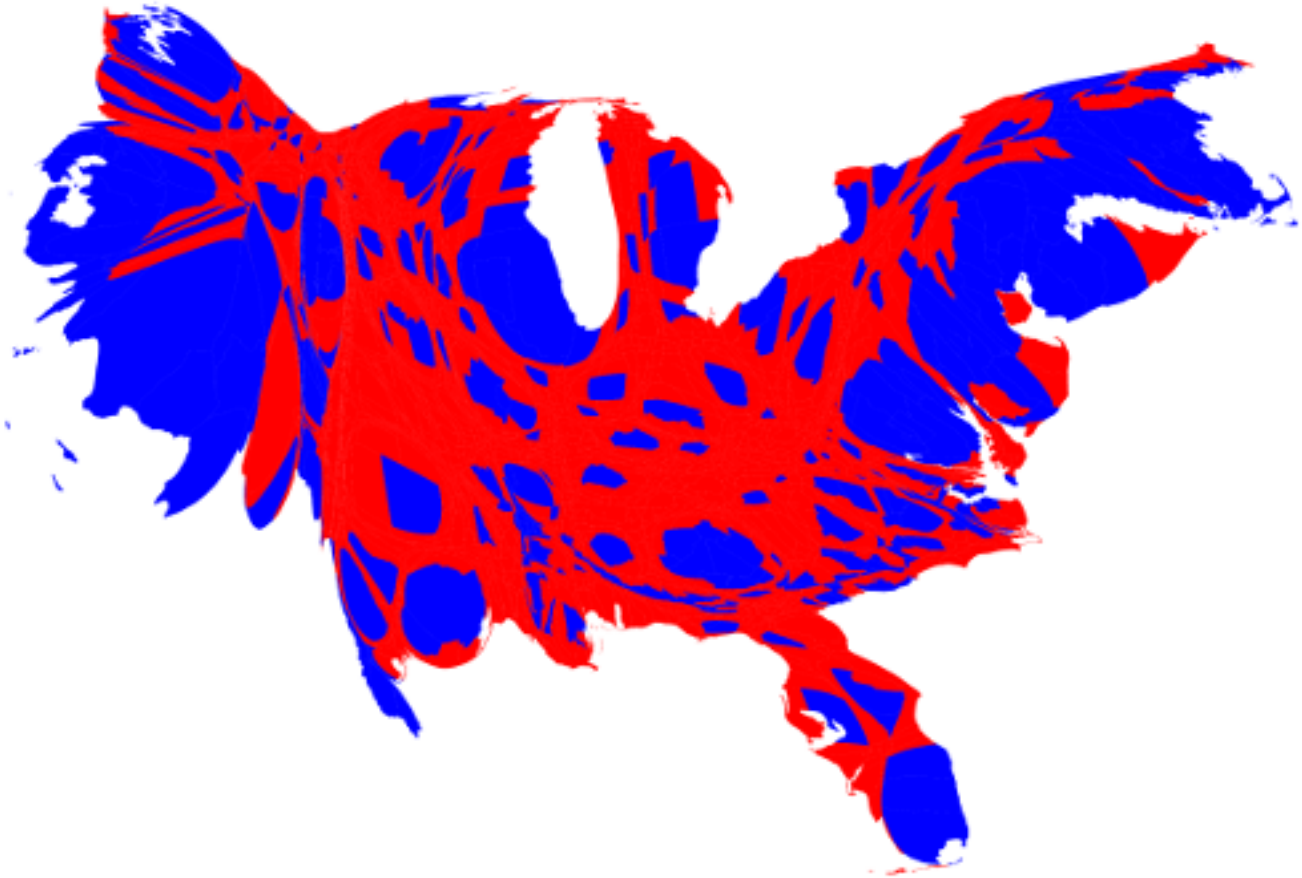
Recently...
US (2016)

Popular vote: **48.04%** 45.95%

US 2016 results.
geography



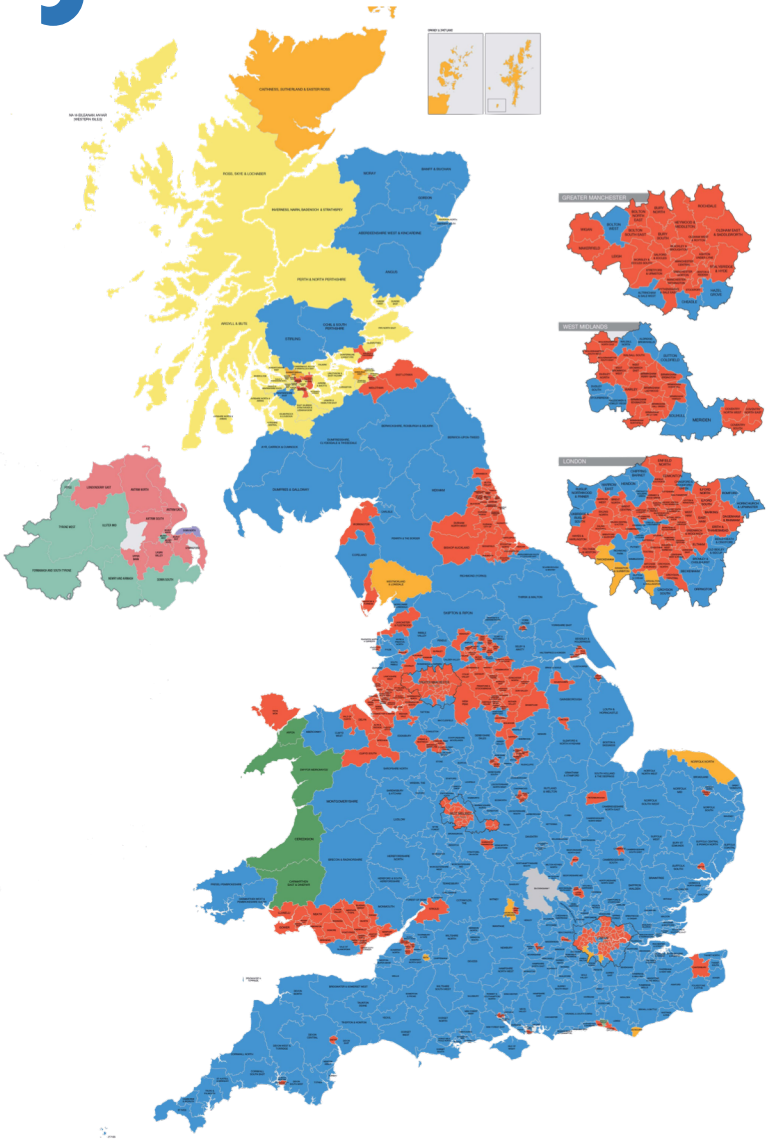
US 2016 results,
geography & population



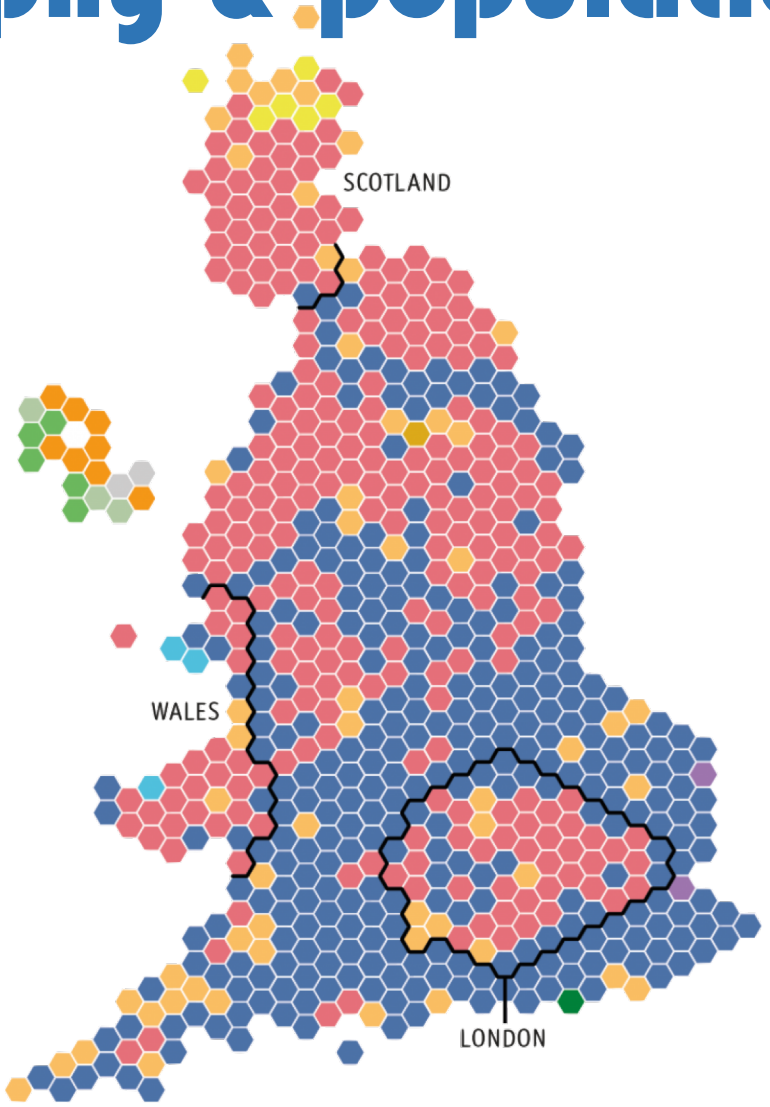
Recently...
UK (2010)

Popular vote:	**36.1%**	29%
MP share:	**47.08%**	39.69%

UK 2010 results.
geography



UK 2010 results,
geography & population

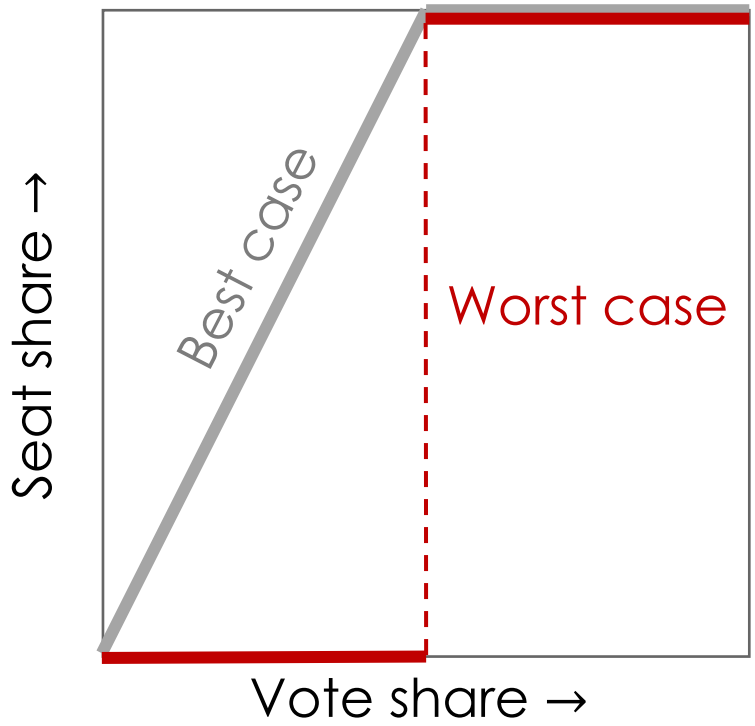


Continuous grid

For voter densities μ_1 and μ_2:

For worst case: a sharp transition at 50%

(in best case, can't achieve more than double their voter share)

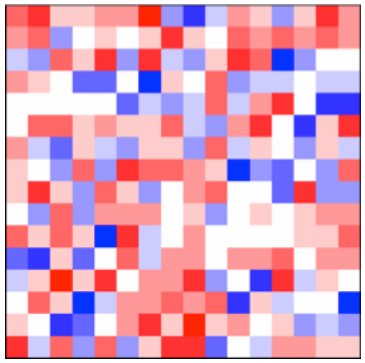


Discrete grid

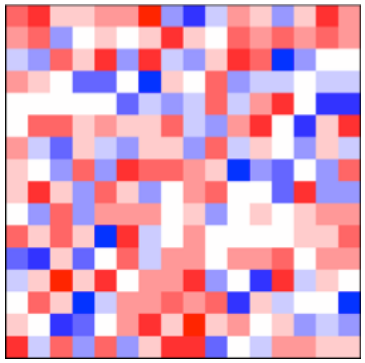
For 2 districts

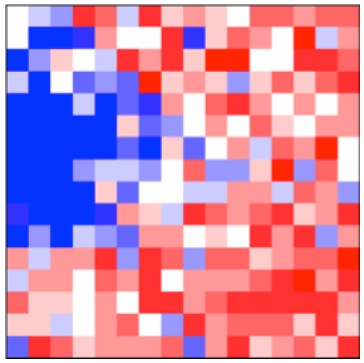
$\frac{1}{2} + \frac{1}{n}$ voting share guarantees winning both districts

Urban / rural divide

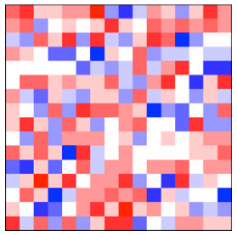


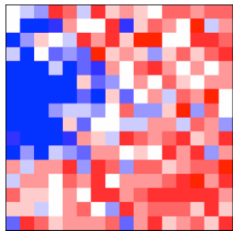
Urban / rural divide

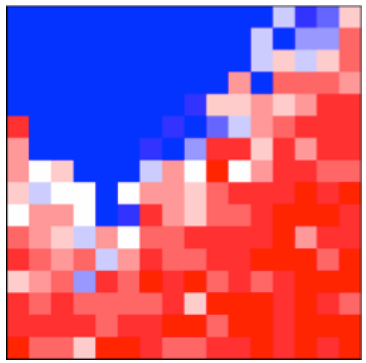


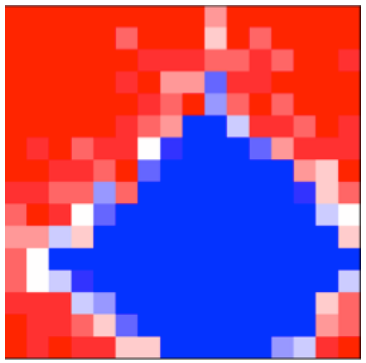


Urban / rural divide





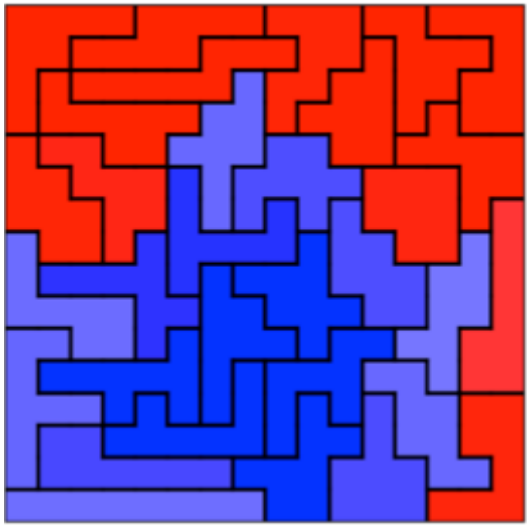




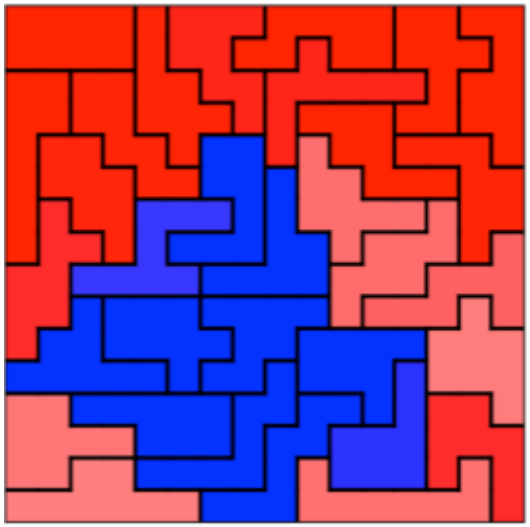
Optimal Gerrymandering

Vote Share
55:45

Urban optimal share
~44:56

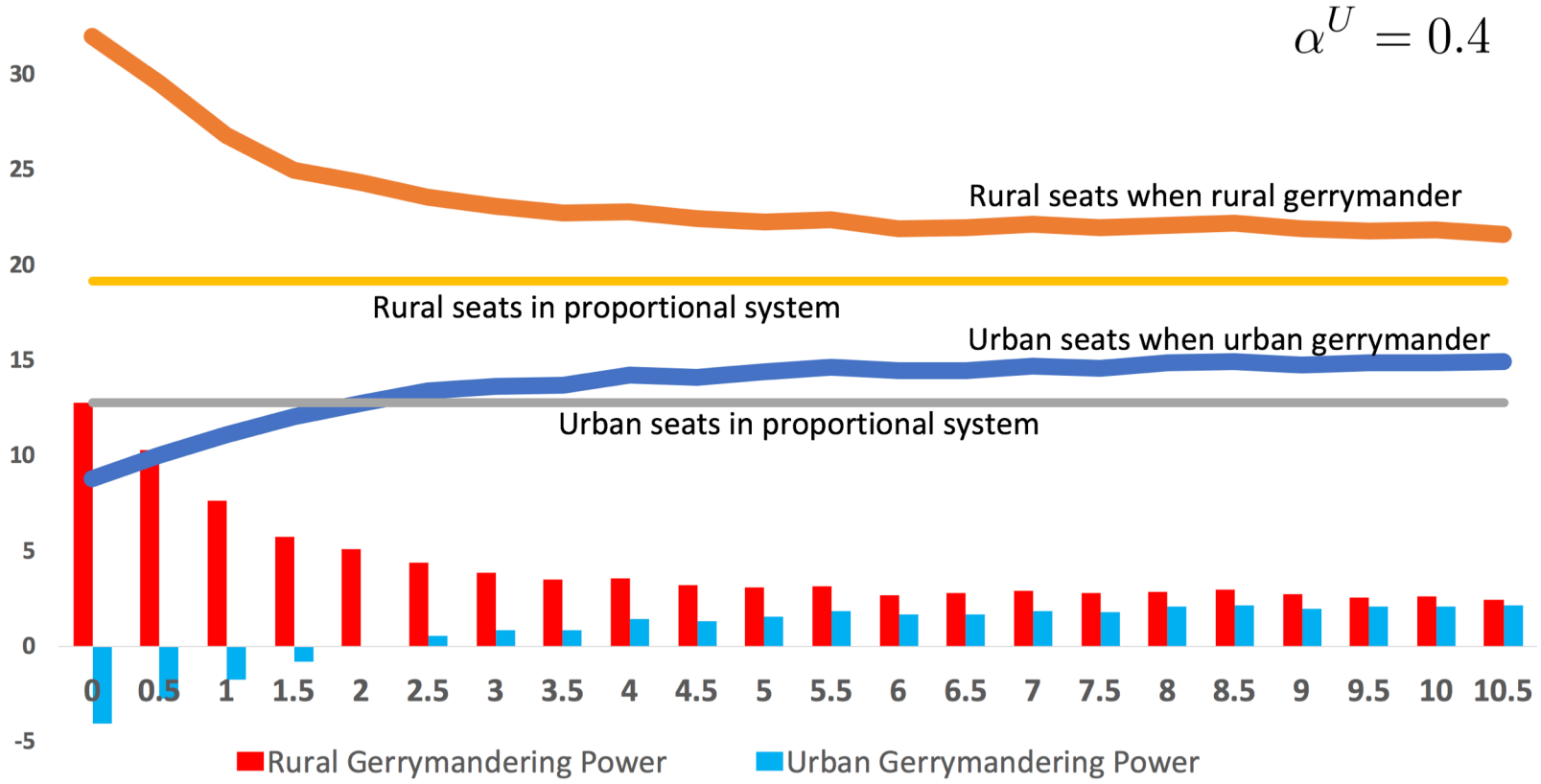


Rural optimal share
~66:34

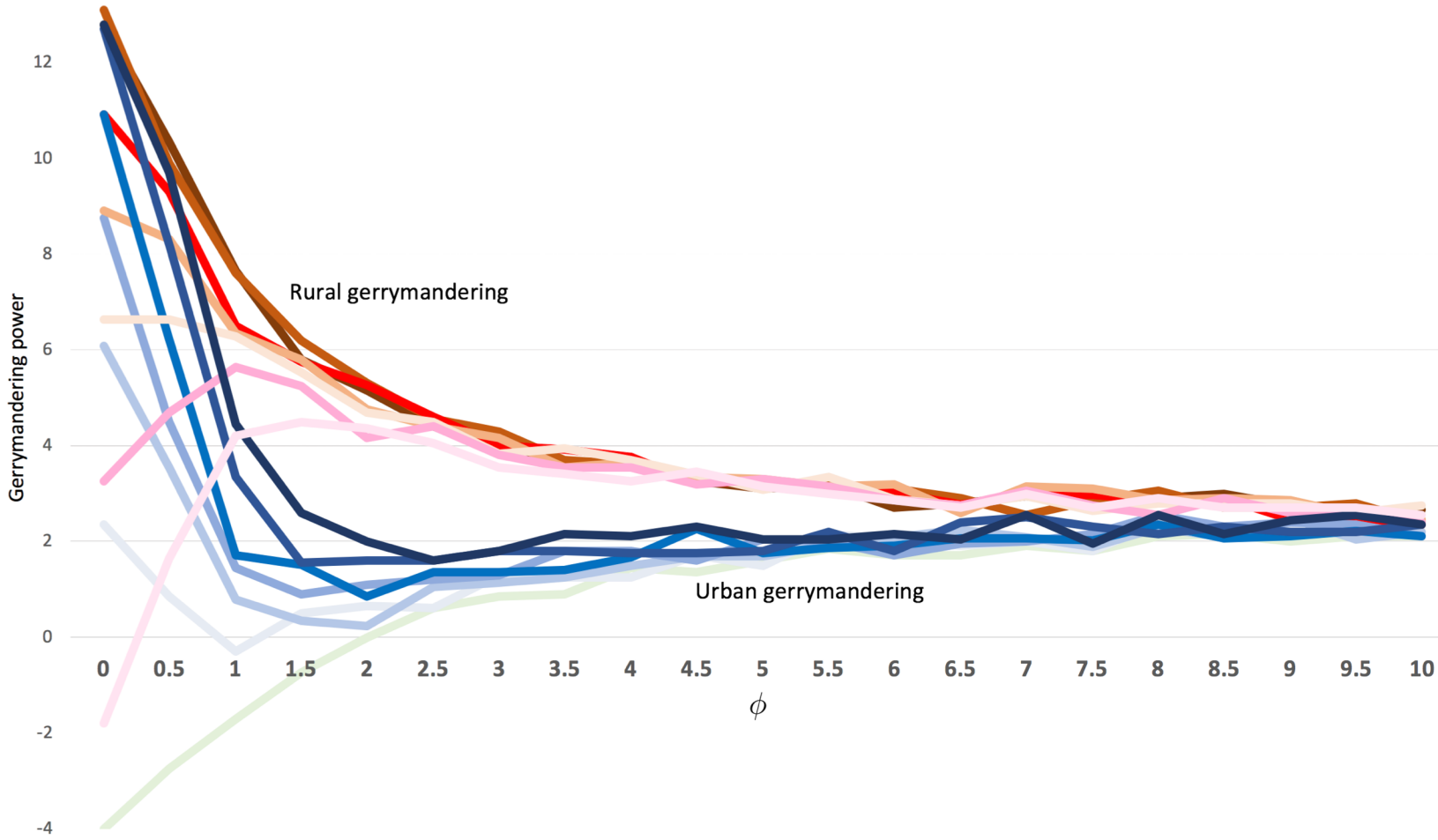


Urban / rural divide

urban = 40% : rural = 60%



Urban / rural divide



What's next?

Extend theory: larger grids

different voter distributions

More **variables**, more explanation power

Data, data, **DATA**!

More robust **simulations**

Suburb/exurb effect?

Axiomatic approach?

The End

Thanks for listening!