Malapportionment, party bias and responsiveness in Mexico's mixed-member system

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Motivation

How does redistricting affect representation?

- Taking map drawing out of the hands of politicians does not necessarily ensure a fair result

Does malapportionment introduce political bias?

- Sparsely populated areas get same representation as the densely populated

How does Mexico fare?

1. Malapportionment is substantial
2. Political distorsions?
   - Not much party bias
   - but big large-party bonus
   - party sensitivities to boundary changes differ a lot

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Road map

1. Malapportionment
2. Redistricting in Mexico
3. Data
4. Results: party bias, responsiveness, swing ratios

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Comparative perspective

UK and US

- instills bias when one party strong in small districts (as Tories were up to 1997, Johnston 2002)
- Reapportionment Revolution removed bias in different, predictable degrees (Cox&Katz 2002)
- no party bias from malapp. after mid-1960s (Grofman et al. 1997)

Worldwide description

Samuels&Snyder (2001): mean absolute district deviation from ideal size in 78 countries

Rank	case	MAL	Year
1	Tanzania	0.262	1995
2	Korea	0.208	1996
3	Ecuador	0.204	1998
4	Kenya	0.195	1997
5	Ghana	0.178	1996
11	Chile	0.151	1997
12	Argentina	0.141	1995
14	Colombia	0.132	1994
16	Spain	0.096	1996
17	Brazil	0.091	1998
31	Mexico	0.064	1997
40	UK	0.046	1997
64	US	0.014	1992
78	Israel	0.000	1999

Some sources of malapportionment

Malapportionment can be intentional or not

	Source	Intentional?
(1)	relative population shifts	no
(2)	apportionment of seats to states	no
(3)	optimization rules	?
(4)	use of old population estimates	?
(5)	gerrymandering	yes

Some findings:

- (4) affects (2) and (3)
- Redistricting affects parties quite differently (PAN most sensitive, PRI least)

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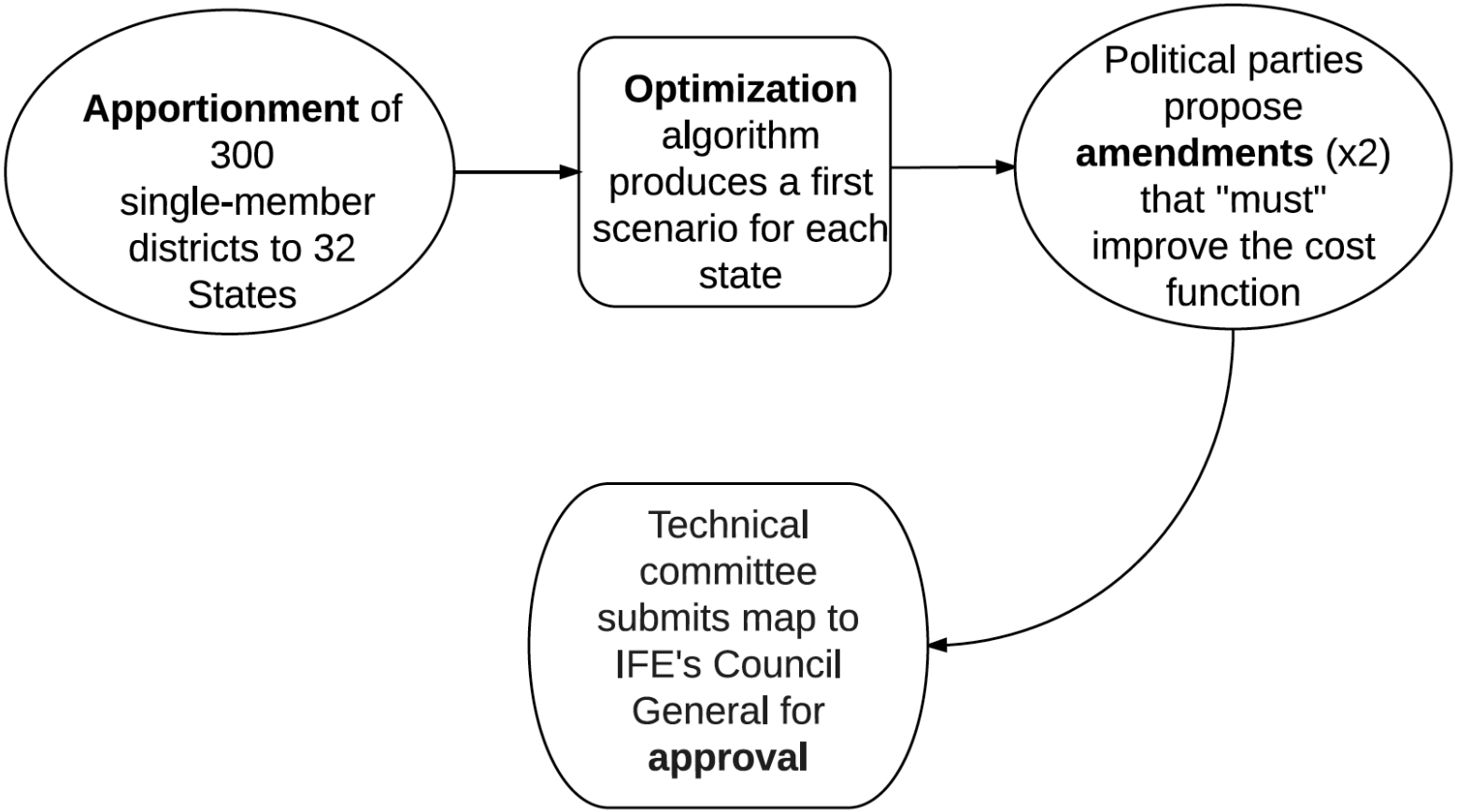
Background on Mexico

- 32 states, 2.5k municipalities, 67k electoral *secciones*
- Hegemonic party 1929–2000
- Lower chamber of Congress elected every 3 years
  - SMD only until 1961
  - Mixed system since 1979: 300 SMD + 200 PR seats
- Single-term limits removed in 2018
- Autonomous EMB (IFE, now INE) organizes elections and redistricting

The redistricting process



Apportionment

Hamilton method used:

- The quota (or price of a seat) is $Q = \frac{\text{nation's population}}{300}$
- First allocation is $\frac{\text{state's population}}{Q}$, rounded down
- Every state gets 2 seats min
- Unallocated seats, if any, awarded to states with largest fractional remainders

Most recent decennial census must be used

- ... but no obligation to redistrict as soon as available
- 6-year lag on average: 199**7**, 200**6**, 201**5**

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The redistricting process

Redistricting by experts in 1997, 2006, 2015 (abandoned), and now 2018

1. apportionment of 300 seats to 32 states
2. optimization algorithm $\rightarrow$ proposal
3. parties propose amendments ("must" improve score)
4. new map

$$\texttt{Score} = .4 \times \texttt{PopBalance} + .3 \times \texttt{MunicBoundaries} + .2 \times \texttt{TravelTime} + .1 \times \texttt{Compactness}$$

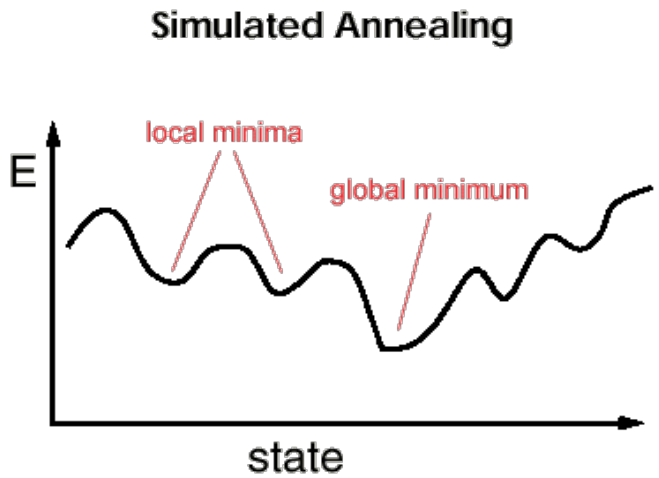
IFE considers $\pm 15\,\%$ imbalance normal (!)

Optimization algorithm

Simulated annealing = probabilistic meta-heuristic for optimization locates a good approximation to the global optimum of the cost function in a large search space

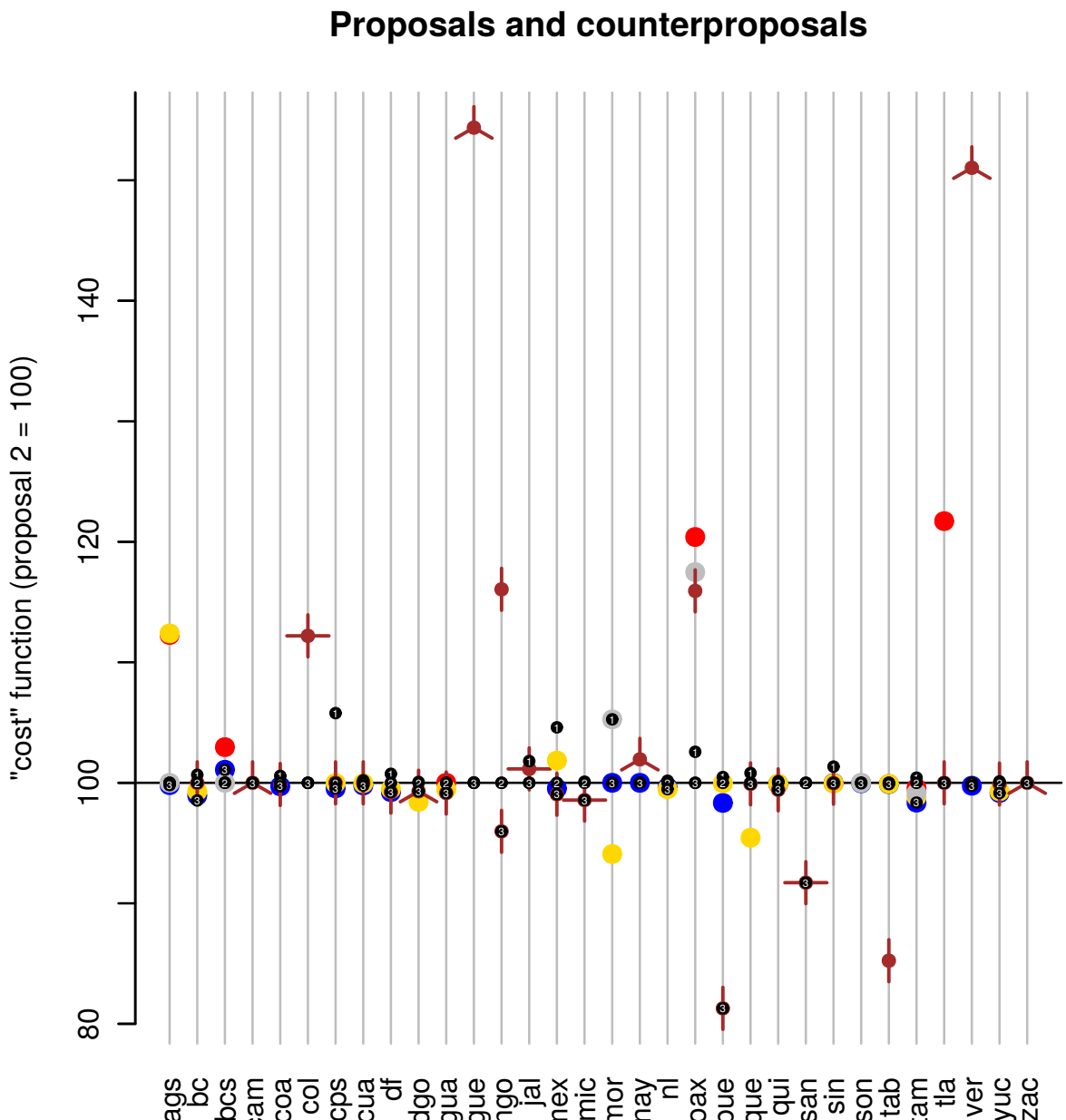
Thousands of iterations using electoral *secciones*

Combinatorial optimization algorithm used to generate the first scenario in each state



EMB claims that this is a public process, but the operation and procedures are done behind closed doors

Party amendments



Party amendments

- Humans can beat the computer $\rightarrow$ enables manipulation
- Smoking gun: four maps improved score but not adopted
- Unobserved: maps improving score but hurting parties?
- Increased similarity of final map to status quo: parties protecting strongholds?
- Asymmetric party capacity to produce counterproposals: by far, PAN most effective. Benefits?
- Party learning process

The bigger project

Draw Mexico project = offspring of *Public Mapping Project in U.S.*

Remove opaqueness from redistricting process

`DistrictBuilder` is open-source, web-based software

- enables widespread DIY redistricting thru cloud computing
- internet lets anyone draw/inspect maps: crowdsourcing
- redistricting contests in 6 US states $\rightarrow$ hundreds of legal plans

Application to Mexico ▸ Link: MexDemo (Donations anyone?)

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Expectations

- Countryside has lost size relative to cities for decades
- PRI's bases of support (Ames 1970, Moreno 2003):
  - rural
  - less educated
  - less better-off
  - older

Hypotheses:

1. Does malapportionment introduce PRI-favoring bias?
2. If so, against PAN? PRD? both?
3. Does redistricting remove/reduce bias?

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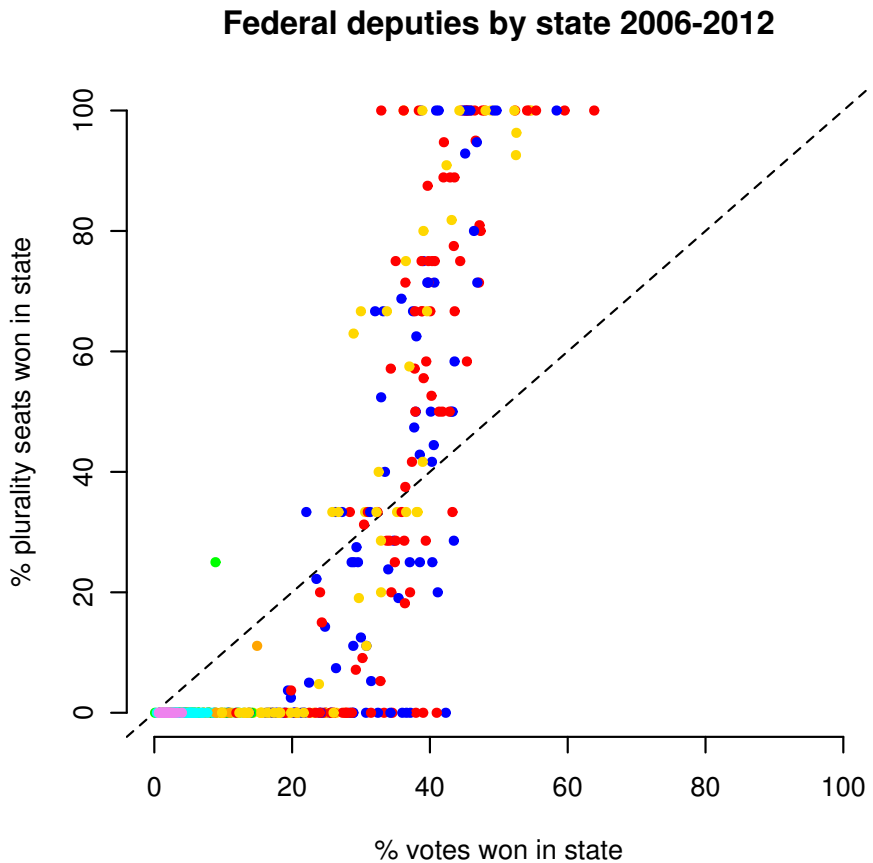
Votes and SMD seats 2006, 2009, 2012

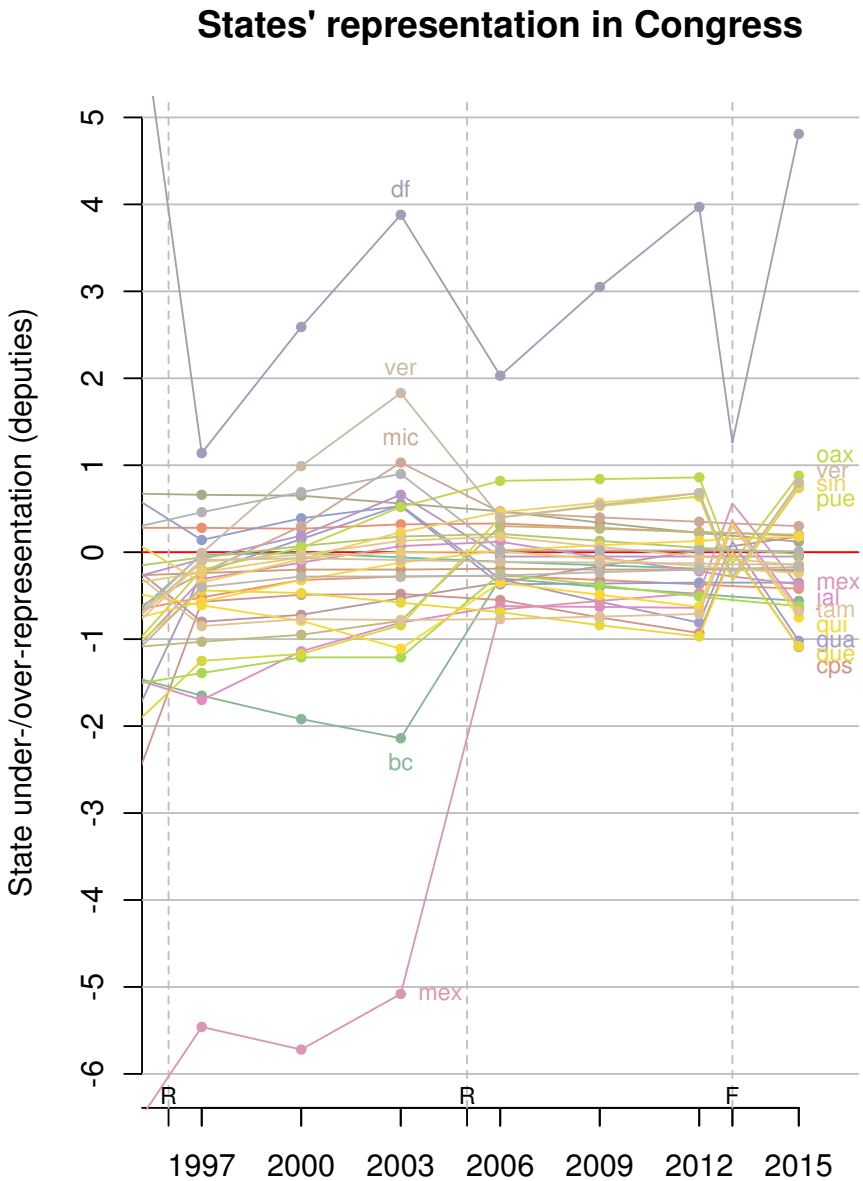
State-level aggregates (average = 9.4 districts, larger N)



PAN
PRI
PRD
Green

State-years above 45° line: PRI $^{3}/_{5}$
PAN $^{2}/_{5}$
PRD $^{1}/_{4}$

States' representation



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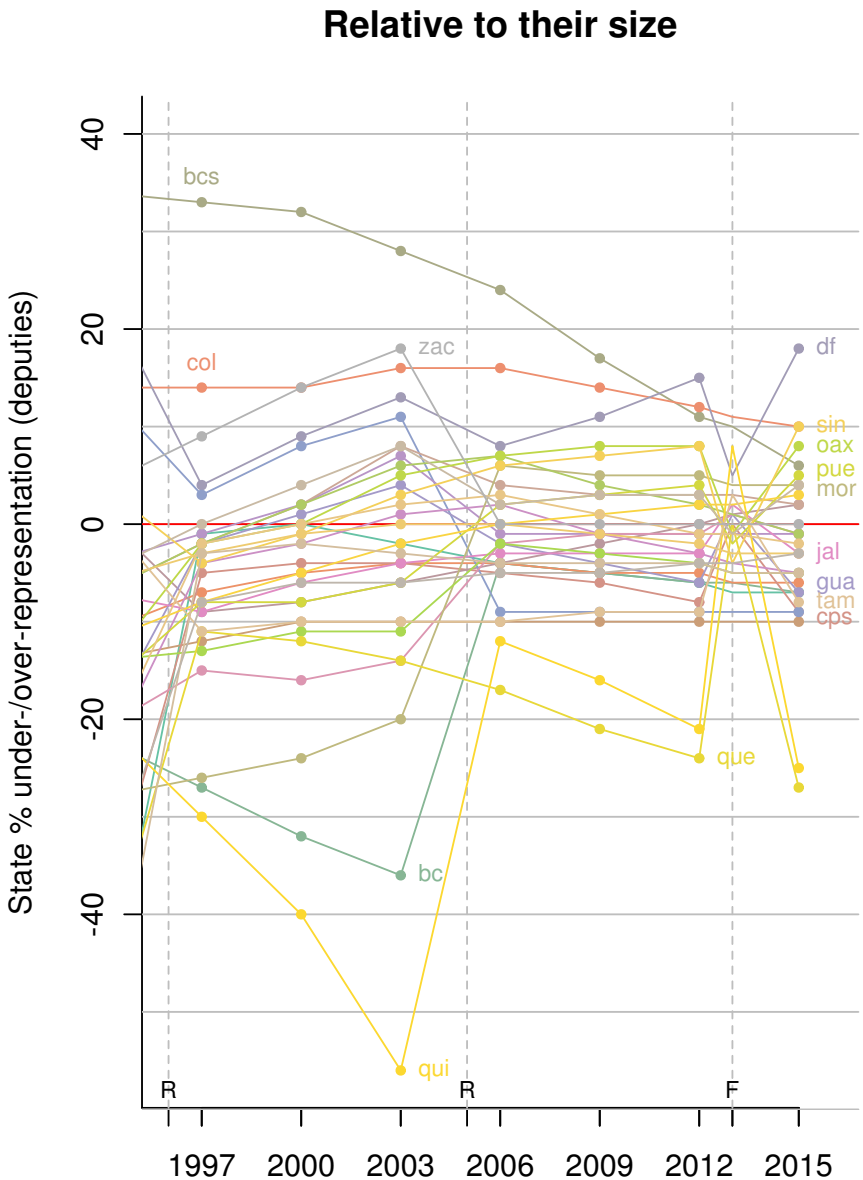


States' representation

Use of population projections reveals unintended malapportionment

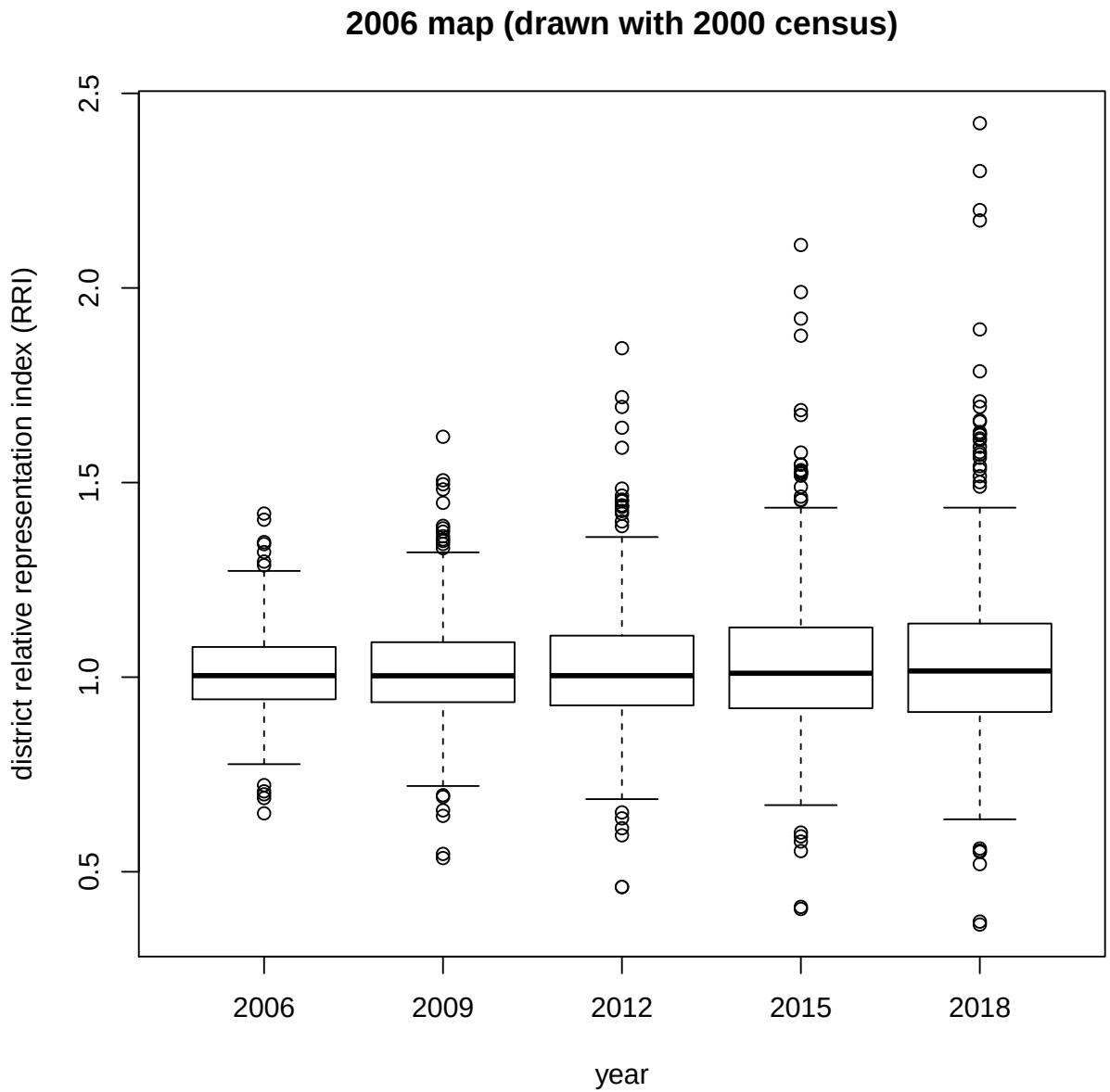
And use of old population estimates introduces distorsions

Relative representation index (Ansolabehere et al. 2002):

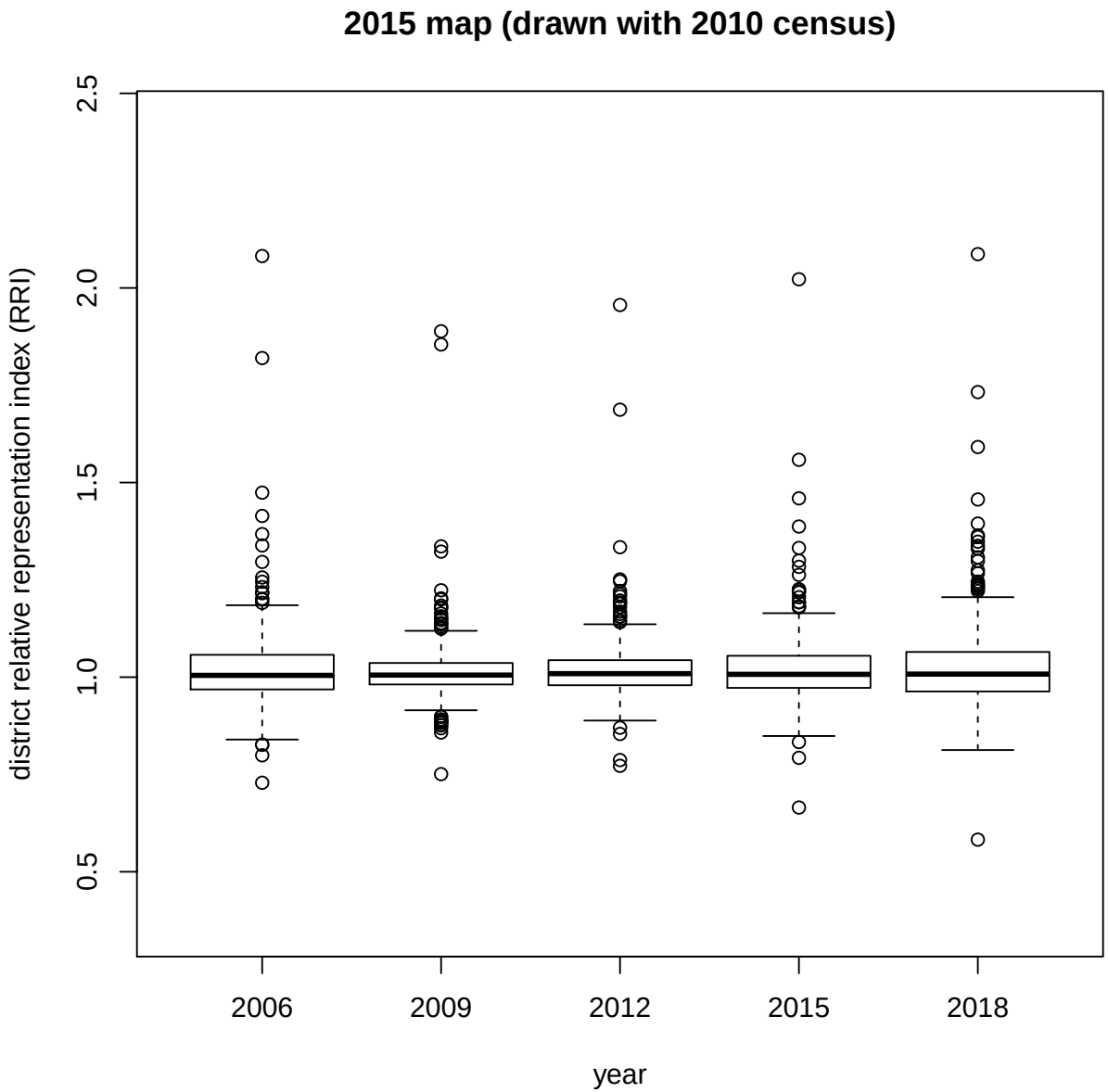
$$RRI_{d,s} = \frac{1/population_d}{apportionment_s/population_s}$$

(Reformers should demand use of fresher population estimates!)

Representation within states



Representation within states



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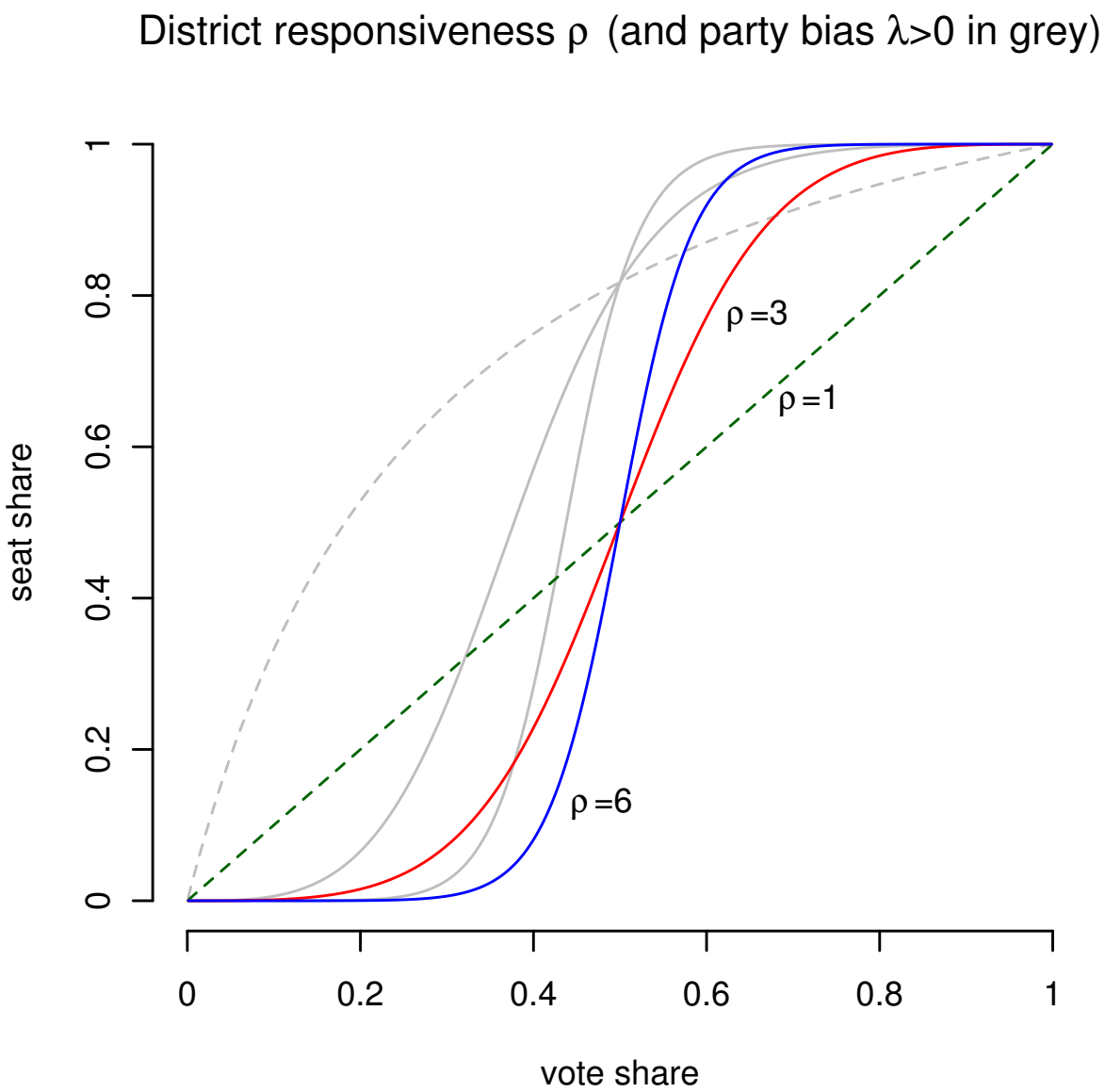
Systemic distorsion: two types

Focus in the votes-to-seats relation
(Rae 1967, Tufte 1973, Lijphart 1994, Taagepera&Shugart 1989)

Two measures of interest:

1. **Party bias** λ:
   helps beneficiary buy seats with fewer votes
   ("packing")
2. **Responsiveness** ρ:
   seat bonus to large parties
   ("microcosm strategy")

Two types of distorsion



Cube Law:

$$\frac{s}{1-s} = \left(\frac{v}{1-v}\right)^3$$

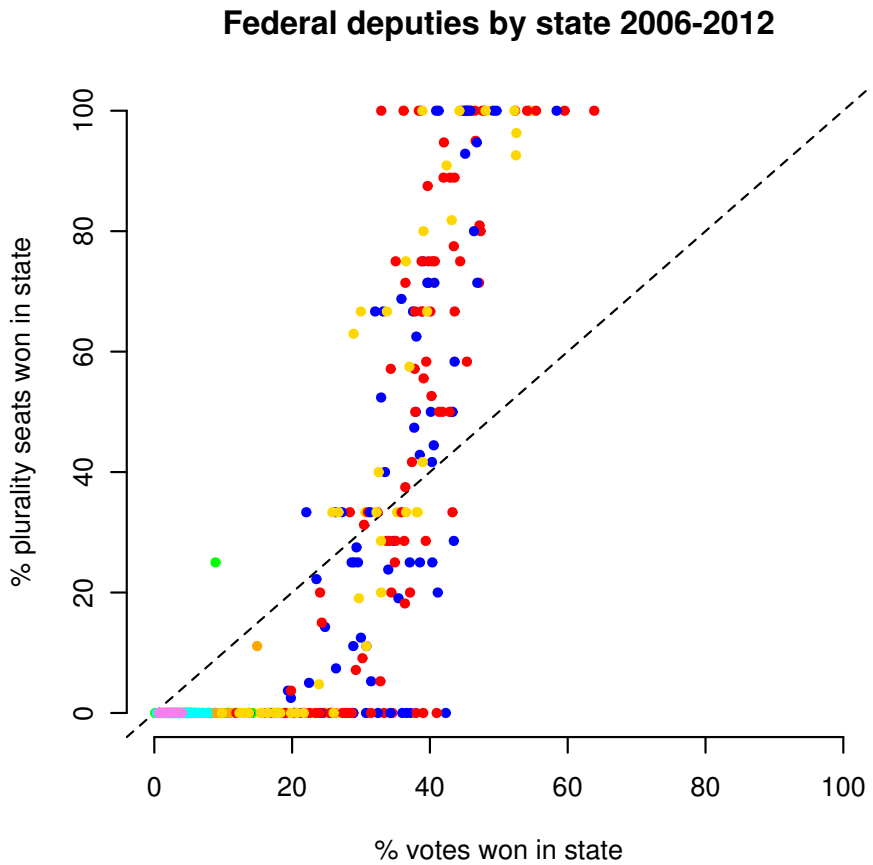
Generalization (King&Browning 1987):

$$\frac{s}{1-s} = e^{\lambda} * \left(\frac{v}{1-v}\right)^{\rho}$$

Multiparty (King 1990, Calvo&Micozzi 2005):

$$E(s_j) = \frac{e^{\lambda_j} * v_j^{\rho}}{\sum_{m=1}^{J} e^{\lambda_m} * v_m^{\rho}}$$

Data



PAN
PRI
PRD
Green

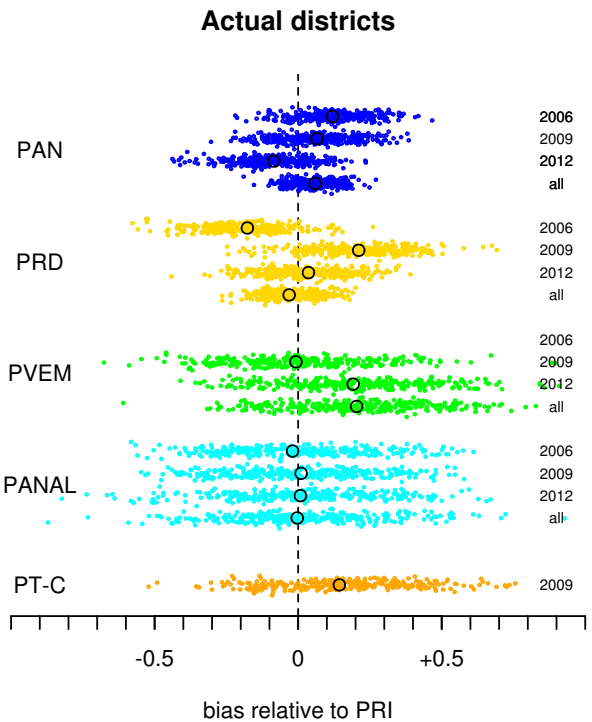
- State-level aggregates (average = 9.4 districts)
- MCMC ($3 \times 10k$ iter., every 100^{th} for post. sample)

Bugs code

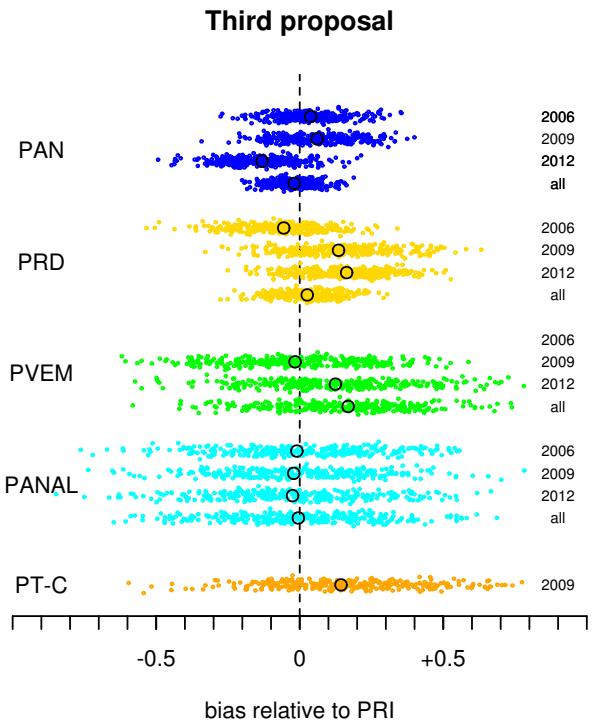
```
for (i in 1:I){     # loop over state-years
    for (j in 1:J){ # loop over parties (dummy selects those who ran that year)
        S[i,j] ~ dbin(pi[i,j], D[i])  # D is number SMD seats in obs. i's state
    }
    numerator[i,1] <- dummy[i,1] * exp( lambda[1] + rho * log(v[i,1]) )
    numerator[i,2] <- dummy[i,2] * exp(             rho * log(v[i,2]) )
    for (j in 3:J){
        numerator[i,j] <- dummy[i,j] * exp( lambda[j-1] ) * v[i,j]^rho
    }
    for (j in 1:J){ # loop over parties (dummy selects those who ran that year)
        d1[i,j] <- dummy[i,1] * exp( lambda[1] ) * v[i,1]^rho
        d2[i,j] <- dummy[i,2]                    * v[i,2]^rho
        d3[i,j] <- dummy[i,3] * exp( lambda[2] ) * v[i,3]^rho
        d4[i,j] <- dummy[i,4] * exp( lambda[3] ) * v[i,4]^rho
        d5[i,j] <- dummy[i,5] * exp( lambda[4] ) * v[i,5]^rho
        d6[i,j] <- dummy[i,6] * exp( lambda[5] ) * v[i,6]^rho
        d7[i,j] <- dummy[i,7] * exp( lambda[6] ) * v[i,7]^rho
        denominator[i,j] <- d1[i,j]+d2[i,j]+d3[i,j]+d4[i,j]+d5[i,j]+d6[i,j]+d7[i,j]
        pi[i,j] <- numerator[i,j] / denominator[i,j]
    }
}
### priors
for (p in 1:6){ # there are 7 party labels in the 3-election data, PRI is reference
    lambda[p] ~ dnorm( 0, tau.lambda )
}
tau.lambda <- pow(.25, -2)
rho ~ dexp(.75) # this has positive range, median close to 1, mean 1.25, max 4.5
```

Results: party bias relative to PRI

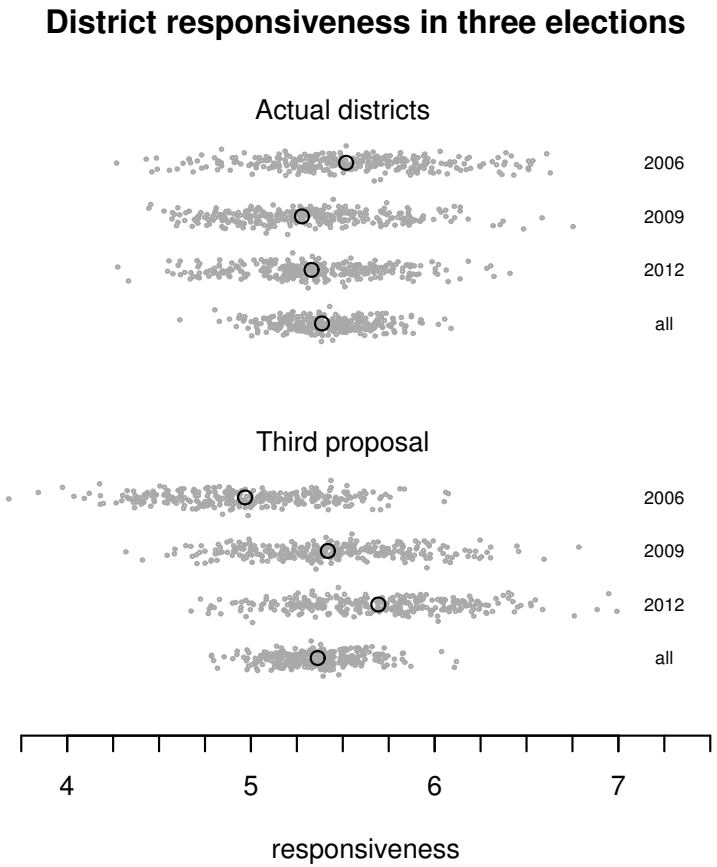
2006 map



2015 map



Results: responsiveness



Approach 2: seats–votes swing ratios (Niemi&Fett 1986)

Swing ratio is the % change in seats associated with a 1 % change in a party's national congressional vote

Party with 10 % natl vote evenly spread v. concentrated in a region

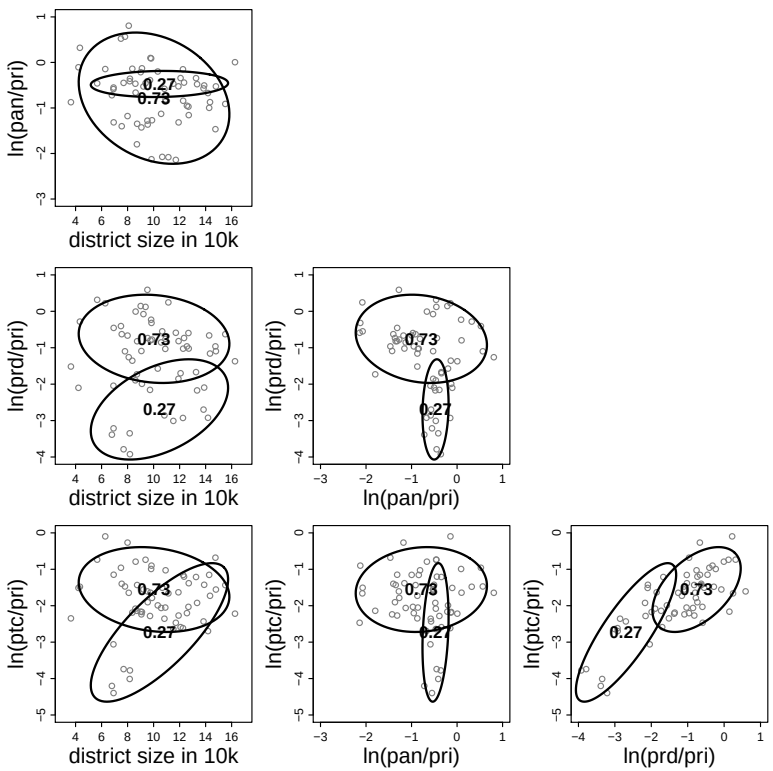
Complication: who loses when party X wins 1 % nationwide? And where?

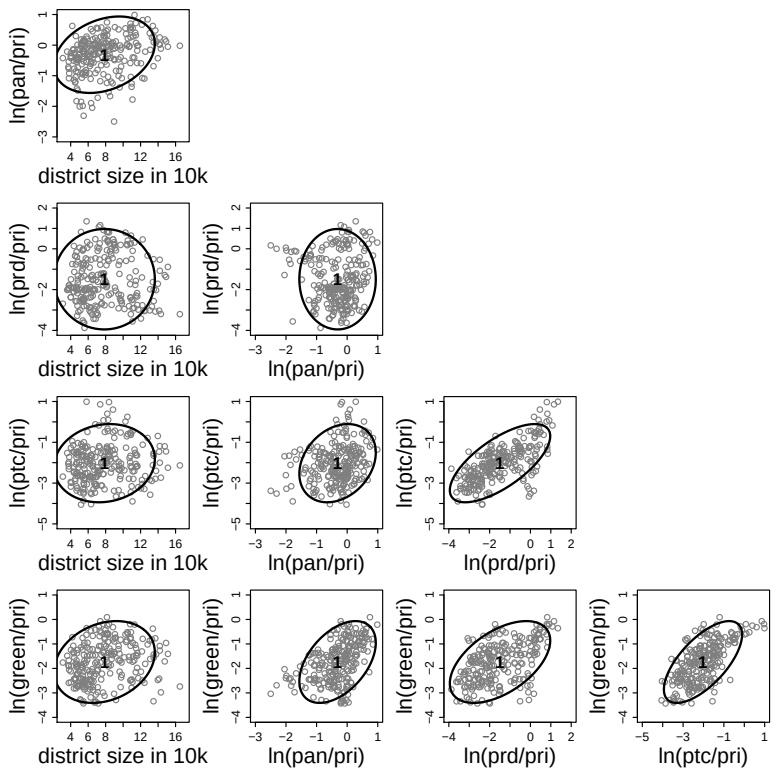
Further complication: two- v. multi-party systems

Linzer (2012): finite mixture model to simulate multiparty dynamics with compositional variable

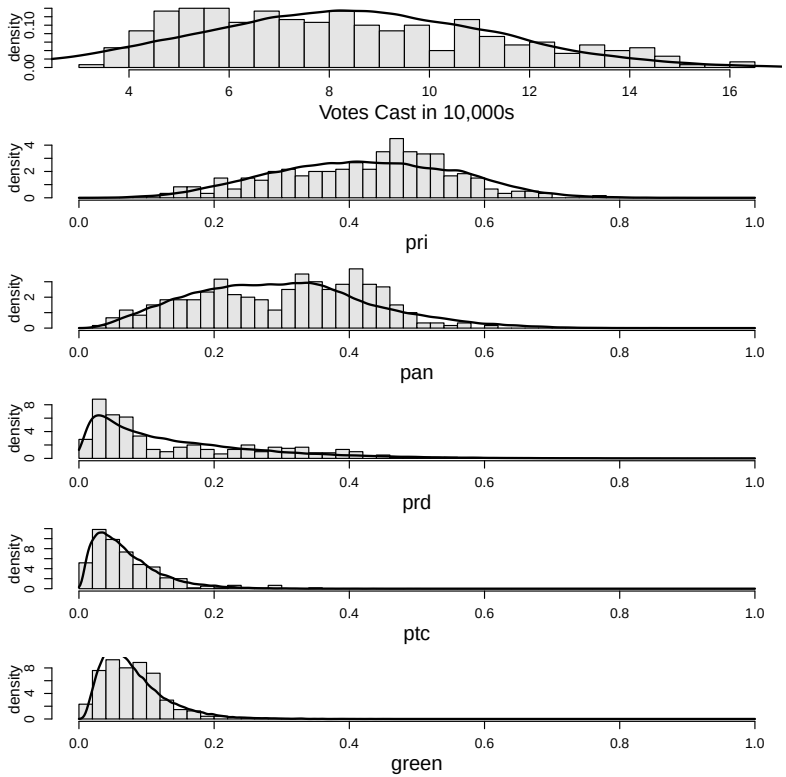
Mixture model

- Combines the properties of two or more prob. density functions: can approximate any arbitrary distribution
- Seek components (multivariate normals) and weights of log-ratio votes shares



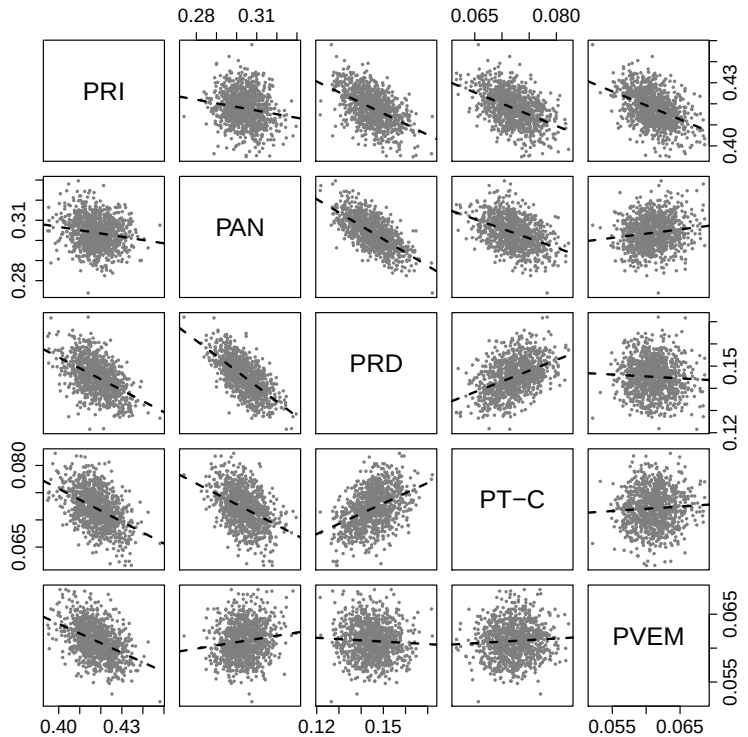


Fit: marginal densities

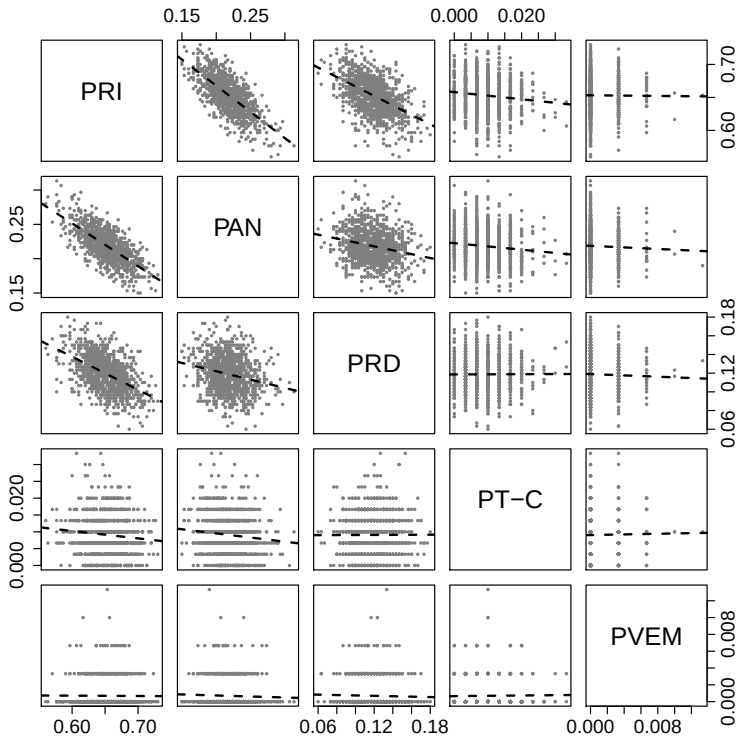


Trade-offs: 1,000 simulated 2009 elections

Vote shares



Seat shares



Use swing ratios to compare two maps

1. Simulate 5k 2009 elections with status quo map for each party
2. Repeat using abandoned map
3. Pool simulations together and regress
4. Coefficient β_3 measures and tests change in party's swing ratio *due to redistricting*

$$S = \beta_0 + \beta_1 V + \beta_2 dis2015 + \beta_3 V \times dis2015 + \texttt{error}$$

	PAN	PRI	Left
2006 election			
V	1.94^{***}	2.27^{***}	1.91^{***}
$V \times$ dis2015	$+.45^{***}$	$-.01$	$-.04$
2009 election			
V	1.95^{***}	2.27^{***}	1.67^{***}
$V \times$ dis2015	$-.13^{***}$	$+.04$	$-.02$
2012 election			
V	2.24^{***}	3.99^{***}	2.39^{***}
$V \times$ dis2015	$+.02$	$+.03$	$-.06^{*}$

$^{***} < .01$, $^{*} < .1$

Findings, next steps

Preliminary analysis reveals that:

1. Malapportionent is substantial
2. Yet no evidence of systematic party bias
3. But **huge** large-party bonus (PRI is small in few states)
4. And boundary changes affect more PAN than PRD, and especially than PRI
5. Study inter-election volatility?
6. Study residuals and relation to malapp.? turnout diff.? geography of support?

Thank you!

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