A workflow for testing EI

Gabe Schoenbach

MGGG Redistricting Lab | Feb. 2021

Background on EI

- What is EI? What is it used for?
- What are we testing?
- How can we test it?
- What have we found?

What is EI used for?

Q: “In the 2020 Presidential Election, did Native American turnout play a decisive role in President Biden’s wins in GA, AZ, NV, WI, and MI?” *-NCAI to MGGG*

A: Use EI to estimate the ‘?’s a the precinct level, aggregate up to estimate how many Native Americans voted for Biden

	Biden	**Trump**	**Totals**
AMIN CVAP	?	?	2000
non-AMIN CVAP	?	?	3000
Totals	1000	800	

Census data

Election data

EI Settings

- Statewide vs. by-County
- One-phase vs. Two-phase (accounting for turnout)
- How do we account for *problem precincts*?
- ...lots more

One-Phase										
EI Setting	**Precinct**	**CVAP**	**BCVAP**	**HCVAP**	**WOCVAP**	**BUFCVAP**	**Obama**	**Romney**	**totvotes**	**notvotes**
Ground Truth	1	300	50	200	50	-	300	100	400	
Buffer	1	~~300~~ 400	50	200	50	100	300	100	400	0
ScaleVotes	1	300	50	200	50		~~300~~ 225	~~100~~ 75	~~400~~ 300	0
ScalePop	1	~~300~~ 401	~~50~~ 67	~~200~~ 267	~~50~~ 67		300	100	400	1

What are we testing?

There are several different possible answers that “explain” the aggregate values

	C1	C2	Totals
D1	500	300	800
D2	600	800	1400
Totals	1100	1100	

D1 supports C1 62.5%

	C1	C2	Totals
D1	200	600	800
D2	900	500	1400
Totals	1100	1100	

D1 supports C1 25.0%

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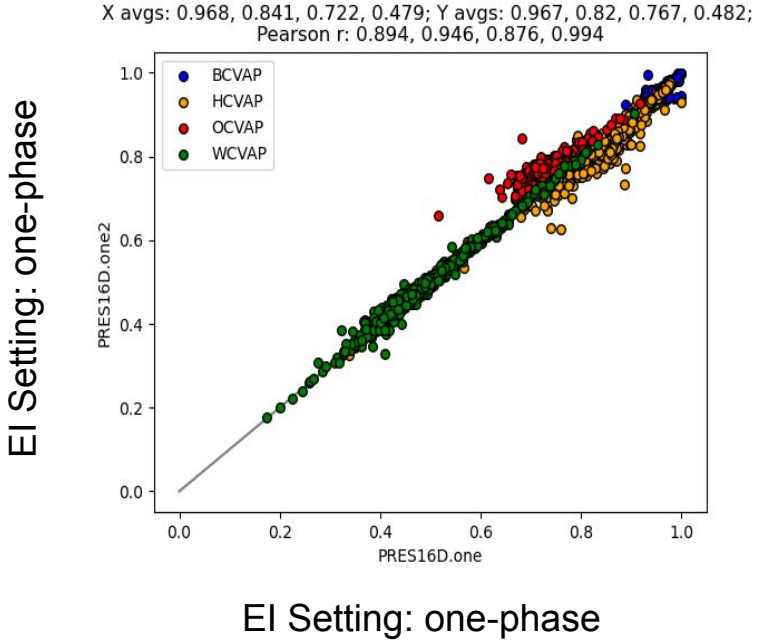
...and different EI settings may affect:

1. The length of time it takes to **converge** to an answer
2. The **answer** itself!

What are we testing?

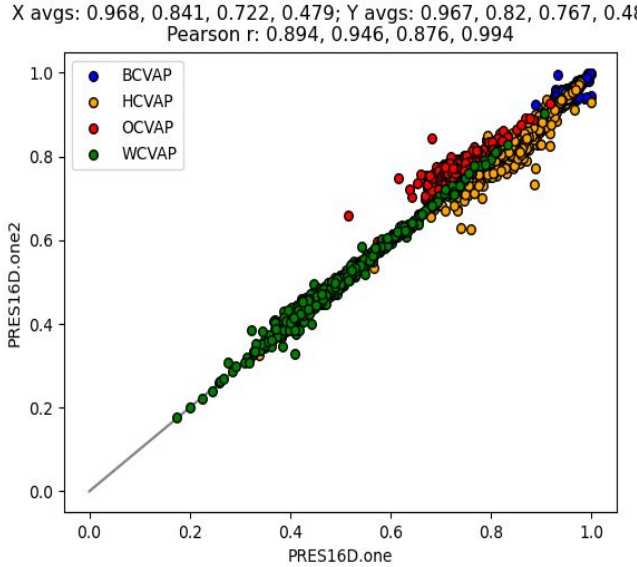
One-phase seems to converge



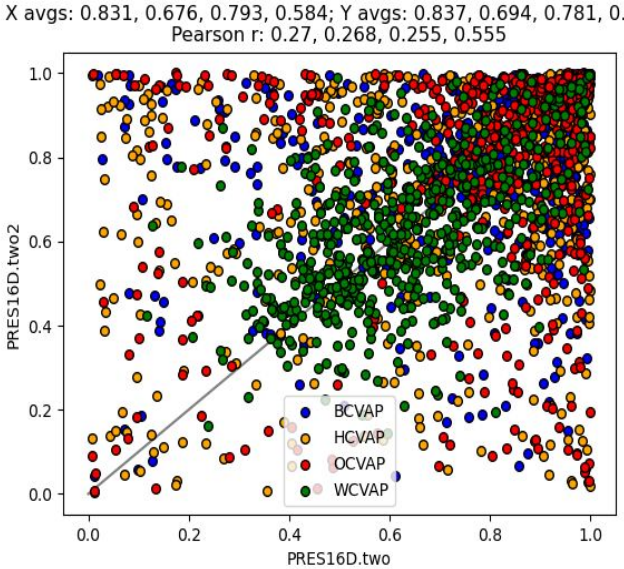
What are we testing?

One-phase seems to converge, but Two-phase has definitely not!

EI Setting: one-phase



EI Setting: two-phase

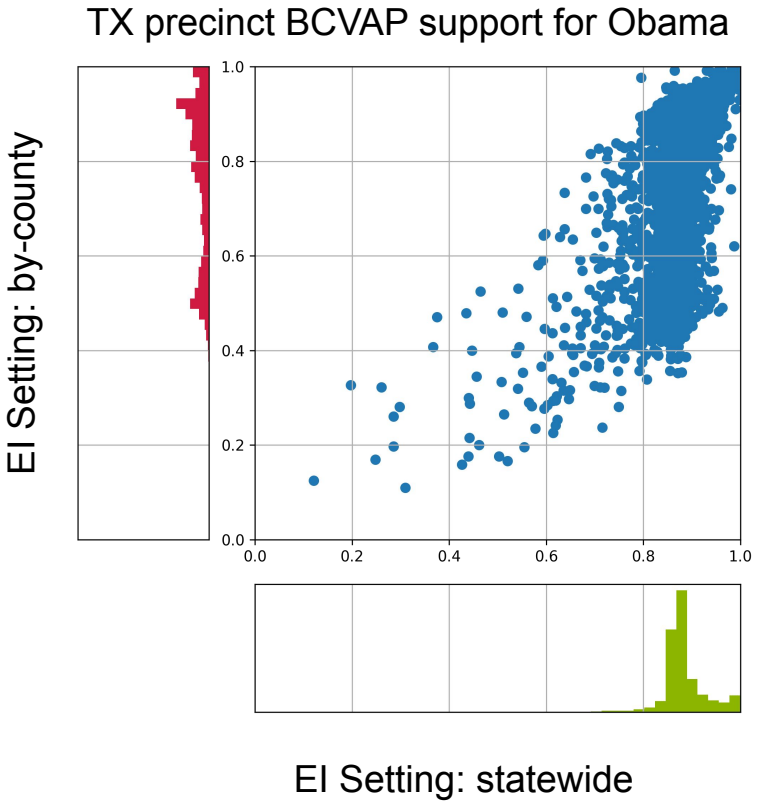


EI Setting: one-phase

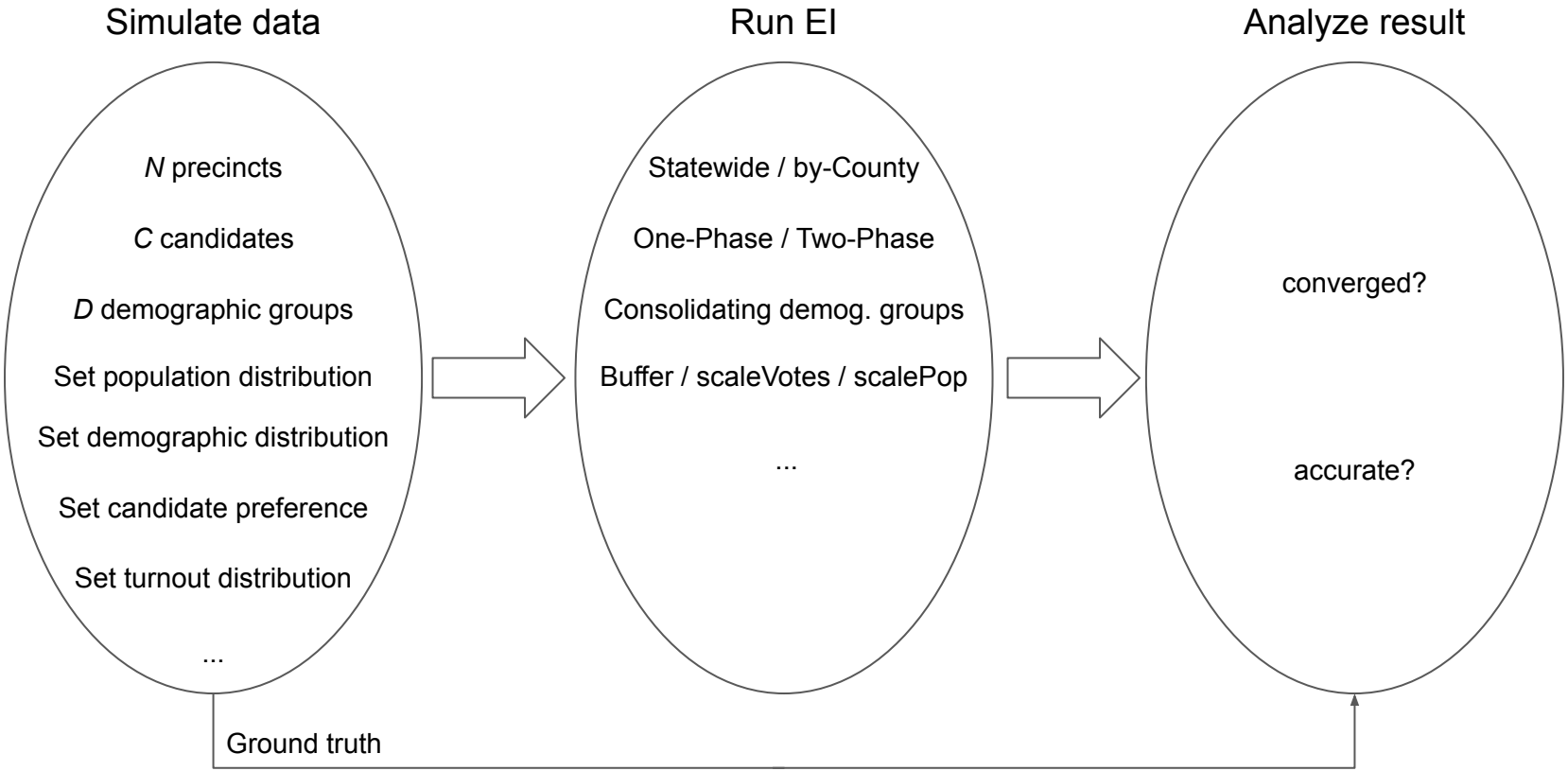
EI Setting: two-phase

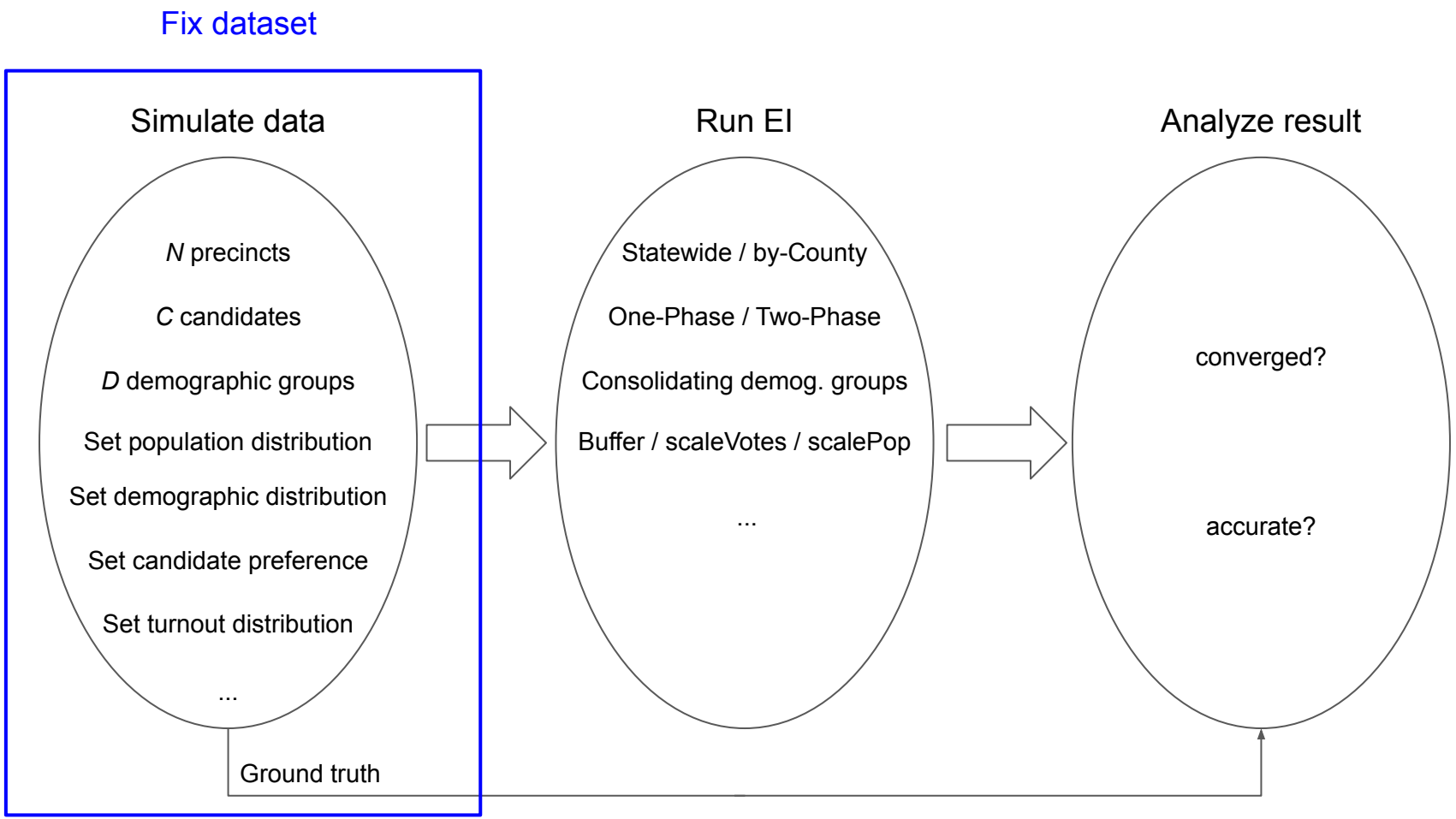
What are we testing?

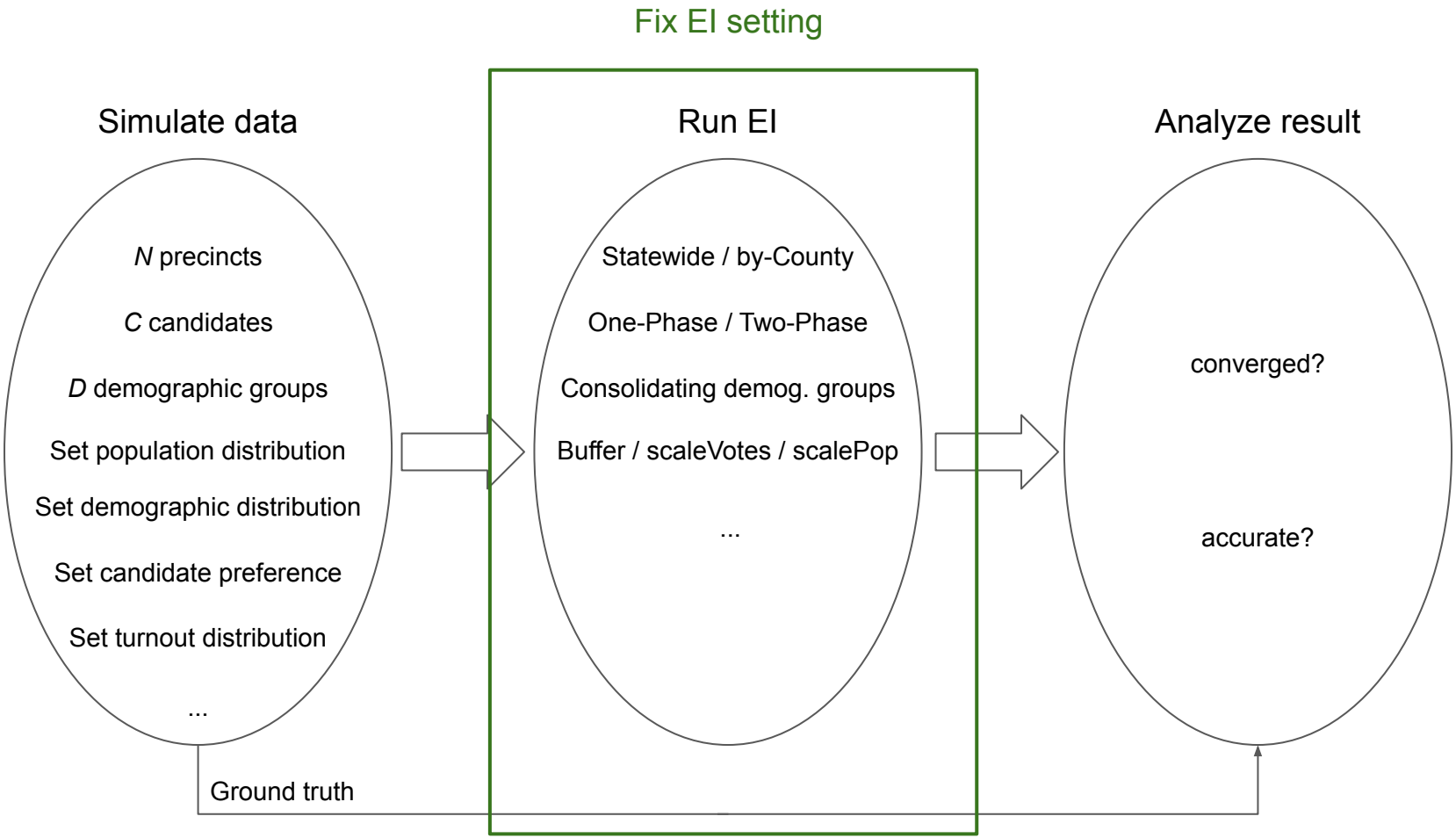
And by-County vs. Statewide give noticeably different answers



Testing EI workflow




Fix dataset
Simulate data
N precincts
C candidates
D demographic groups
Set population distribution
Set demographic distribution
Set candidate preference
Set turnout distribution
...
Ground truth
Run EI
Statewide / by-County
One-Phase / Two-Phase
Consolidating demog. groups
Buffer / scaleVotes / scalePop
...
Analyze result
converged?
accurate?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Ground truth

Results

```
Demographic group D1:
 -- D1 proportion:      67.6%
 -- D1 turnout:         61.0%
 -- D1_C1 preference:   34.9%
 -- D1_C2 preference:   65.1%
```

```
Demographic group D2:
 -- D2 proportion:      32.4%
 -- D2 turnout:         61.1%
 -- D2_C1 preference:   90.9%
 -- D2_C2 preference:   9.1%
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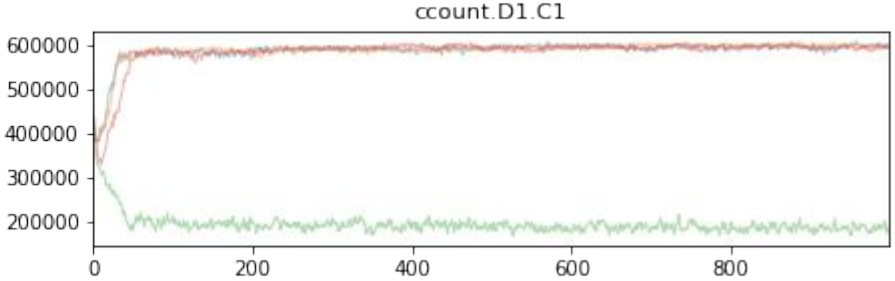
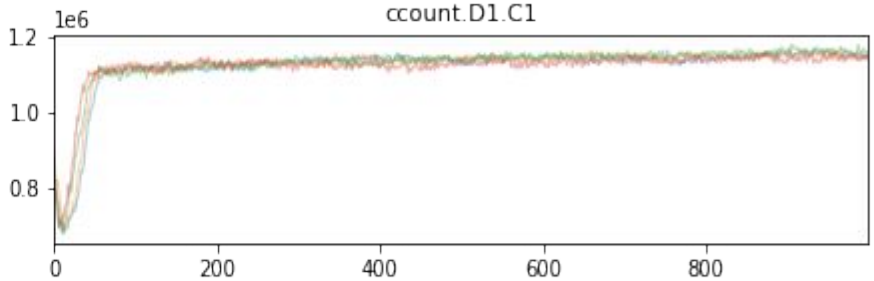
Fix EI setting: *Statewide, one-phase, scalePop* (but no PPs yet)



Dataset: *2x2_uniform_demo_turnout_1k*



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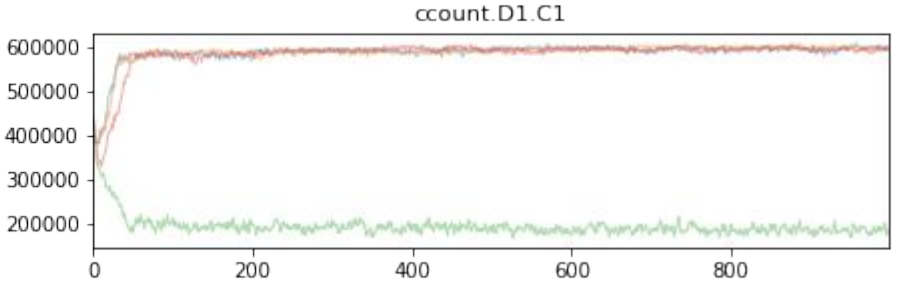

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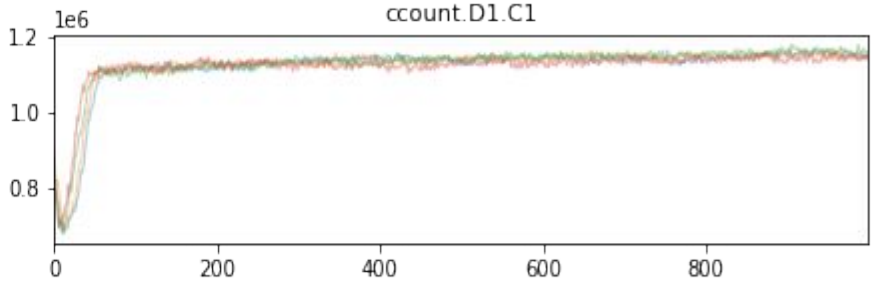

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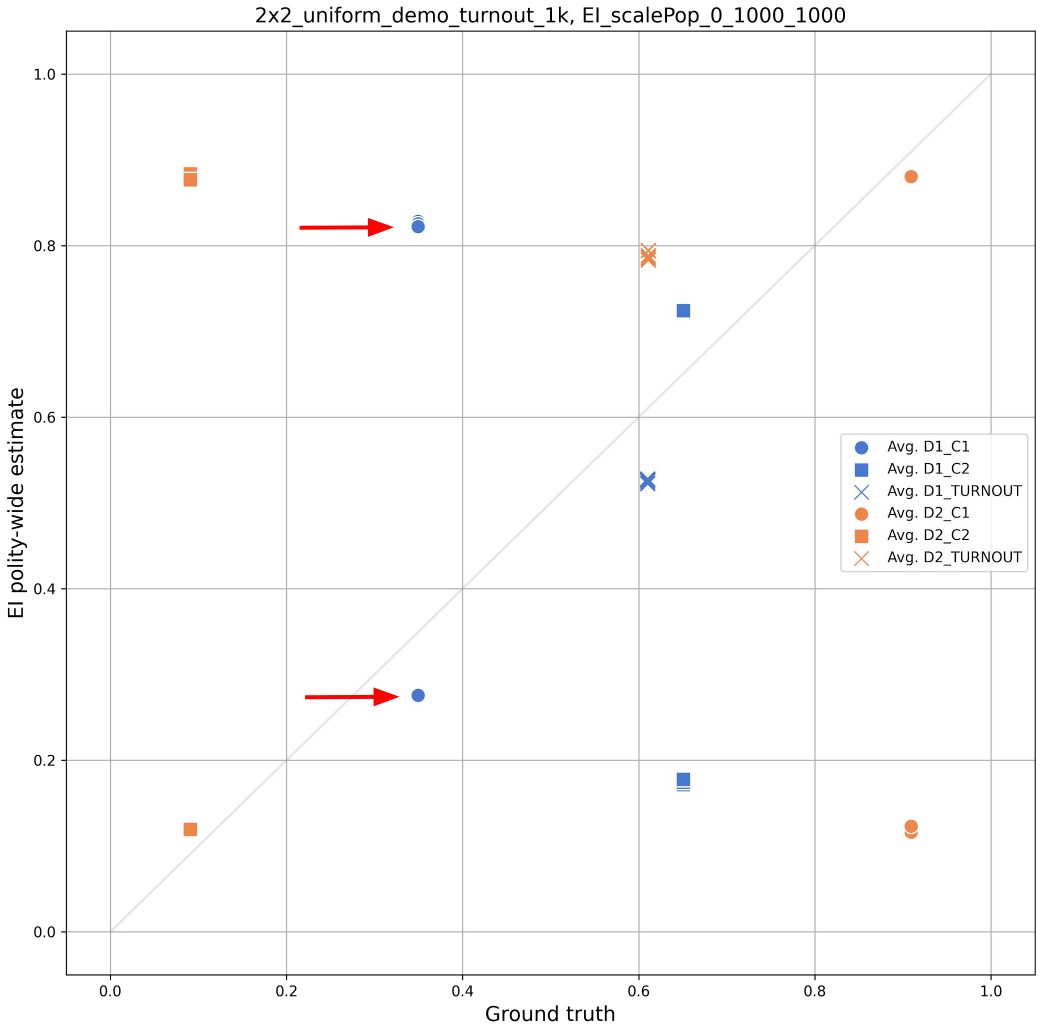
With too few precincts, EI is converging to two distinct answers!




```
*****
Data Summary -- 2x2_uniform_demo_turnout_1k
*****
Simulated data on 1000 precincts...
Num. demographic groups: 2
Num. candidates:         2
*****
Overall turnout:        61.0%
Demographic group D1:
 -- D1 proportion:      67.6%
 -- D1 turnout:         61.0%
 -- D1_C1 preference:   34.9%
 -- D1_C2 preference:   65.1%
Demographic group D2:
 -- D2 proportion:      32.4%
 -- D2 turnout:         61.1%
 -- D2_C1 preference:   90.9%
 -- D2_C2 preference:   9.1%
Overall C1 preference: 53.1%
Overall C2 preference: 46.9%
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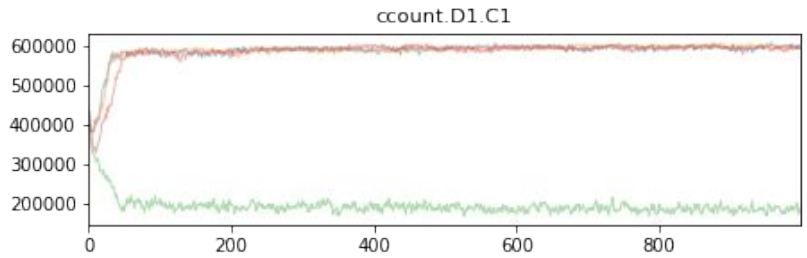
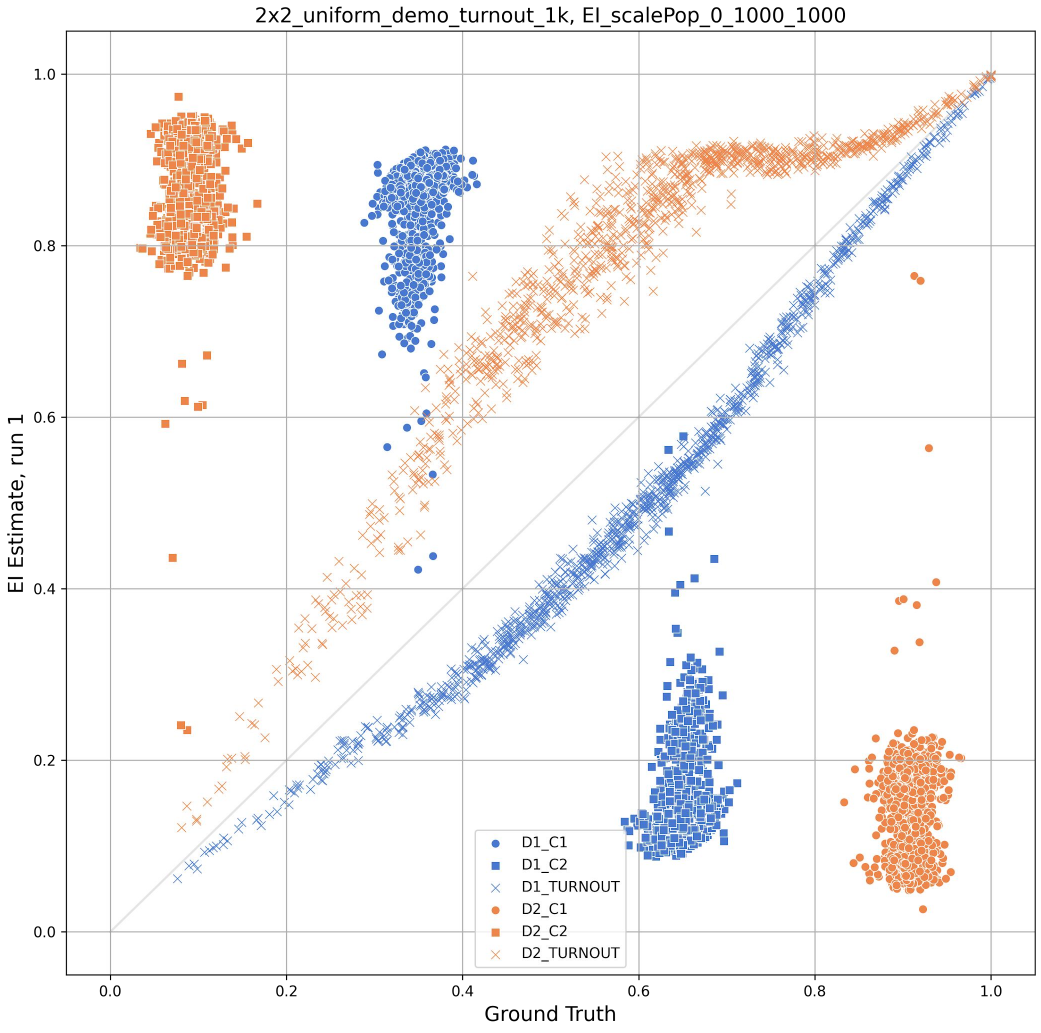
- All runs agree on turnout (X's)
- 3 runs agree on candidate preference, but far from accurate
- 1 run seems close to accurate



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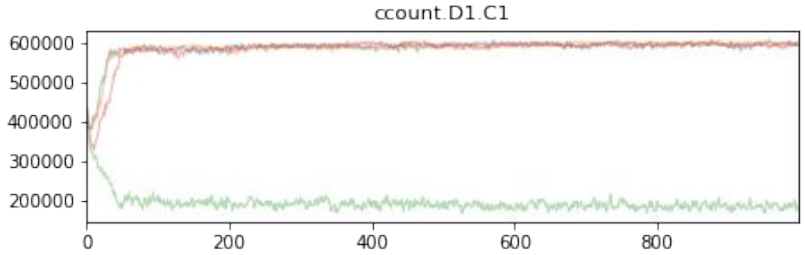

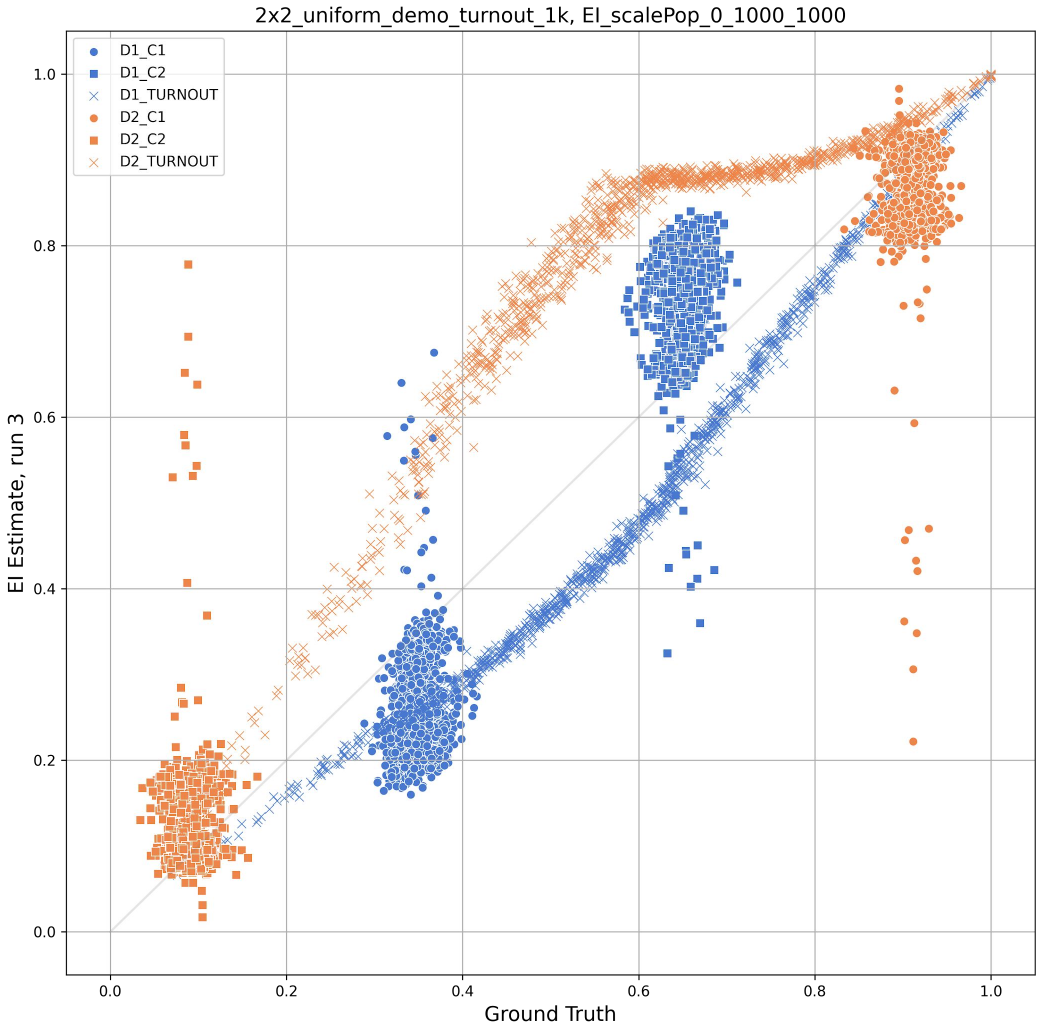


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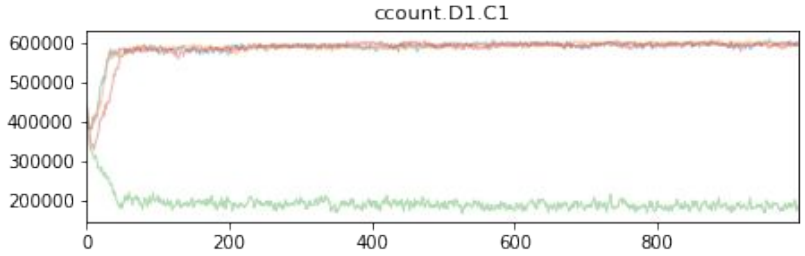

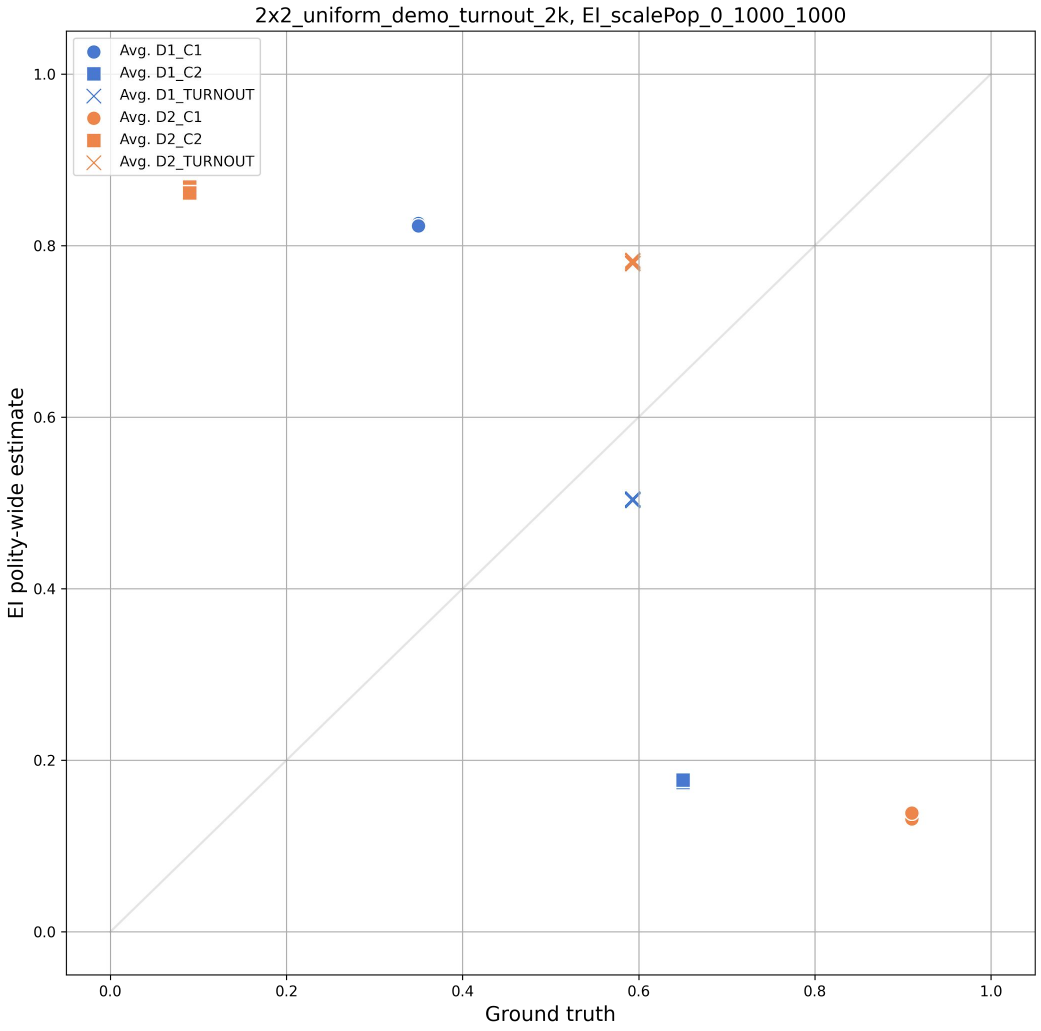


```
*****
Data Summary -- 2x2_uniform_demo_turnout_2k
*****
Simulated data on 2000 precincts...
Num. demographic groups: 2
Num. candidates:         2
*****
Overall turnout:        59.3%
Demographic group D1:
 -- D1 proportion:      67.7%
 -- D1 turnout:         59.3%
 -- D1_C1 preference:   35.0%
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Demographic group D2:
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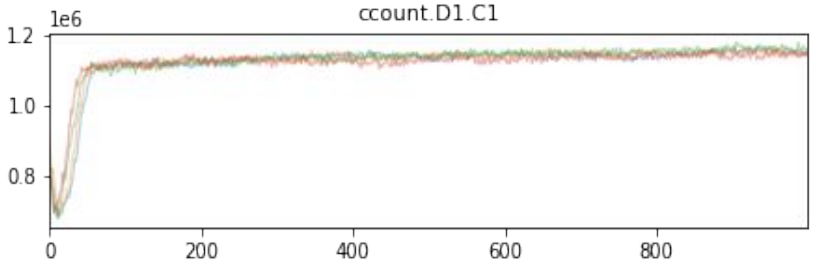

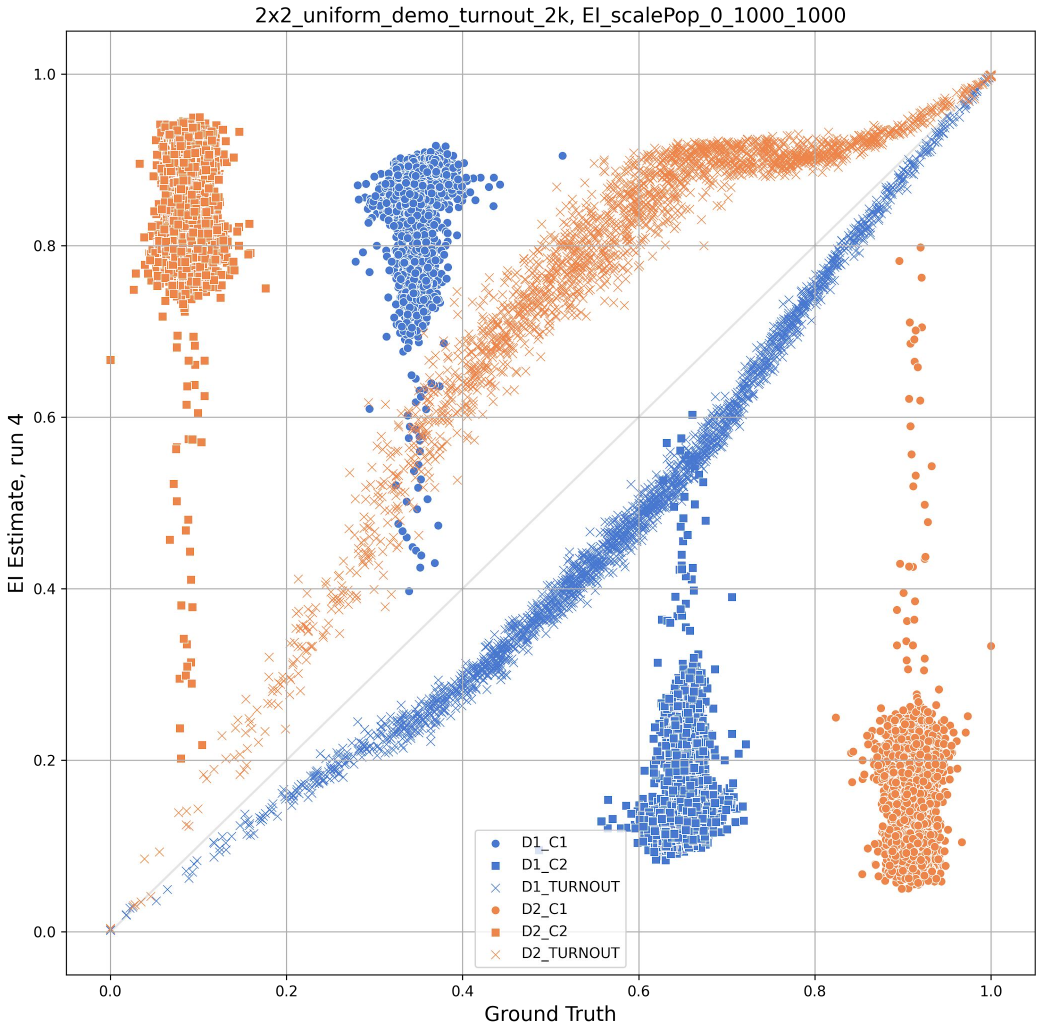


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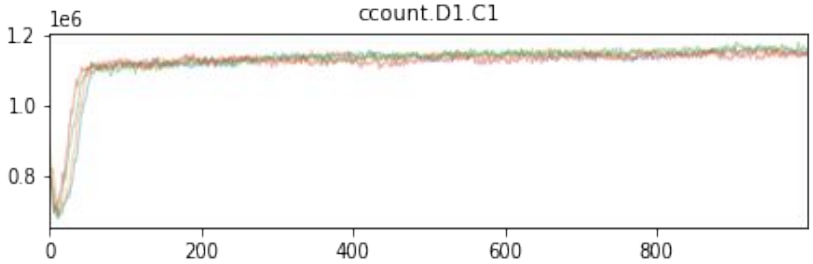

Next steps

1. Understand more about multiple convergence
2. Develop more realistic simulated data
    a. Distribution of demographic makeups should be different
    b. Turnout is probably more complicated
    c. Can we look at real datasets to understand better how turnout and demographic data should be distributed?
    d. Find a smart way to add in problem precincts
    e. Datasets of different *types* of precincts
3. Test a wider array of different EI settings (so far one setting has been confusing enough!)