

Electoral engineering via simulation

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 - ▶ A submission to the NZ Electoral Commission on proposed changes to the current MMP electoral system.
 - ▶ A response (in progress) to the paper “The Electoral Sweet Spot”, by John M. Carey and Simon Hix, *American Journal of Political Science*, 2011.

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- ▶ Electoral Commission materials contained much information about the various systems, much of it purely qualitative.
- ▶ Having been unsatisfied by the level of public debate over the Alternative Vote referendum in UK, we wanted to show voters the likely consequences of changing to these systems.

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- ▶ SM: hybrid of FPP and proportional system; some representatives elected as in FPP, others proportionally.

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- ▶ No changes to some special (Maori or South Island) district seat distribution principles.
- ▶ SM will have 90 district and 30 list seats.
- ▶ (not a hard constraint) Under STV, “It is likely the 120 MPs would be divided between 24 and 30 districts, each with 3 to 7 MPs.”

Basic features of the simulator

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- ▶ Calculator outputs seat distributions in a 120-seat Parliament for each party under each of the 5 systems.
- ▶ For MMP, user can also adjust some parameters: the threshold (default 5%) and whether threshold is waived for district winners (default yes).
- ▶ Important: **no district- or candidate-specific information is part of the input.** There are good reasons for this, in terms of complexity.

Challenge: voter behaviour?

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- ▶ Our simulator avoids this part by leaving most of it up to the user.

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- ▶ The way this done affects the result for all the systems except MMP.

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- ▶ There is some evidence that this is reasonable, at least for MMP elections:

<i>National Party</i>	1999	2008
Total party vote	629932	1053398
<i>comprising:</i>		
Mangere	0.45%	0.39%
Mt. Albert	1.08%	1.18%
Nelson	1.50%	1.46%
Clutha-Southland	2.04%	1.92%

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- ▶ Downscaling is widely used for election forecasting in FPP elections. We also compared our results to the real seat allocations in historical UK and Canadian elections, and they were reasonably close.

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- ▶ Is there a standard way to test quality of performance of such an algorithm?

Year	NAT sim	LAB sim	others sim	NAT	LAB	others
1993	54	45	0	50	45	4
1990	71	26	0	67	29	1
1987	50	47	0	57	40	0
1984	37	58	0	37	56	2
1981	48	44	0	47	43	2
1978	48	44	0	51	40	1
1975	55	32	0	55	32	0
1972	33	54	0	32	55	0
1969	47	37	0	45	39	0
1966	47	33	0	44	35	1
1963	47	33	0	45	35	0
1960	48	32	0	46	34	0
1957	41	39	0	41	39	0
1954	43	37	0	45	35	0

Table : Real and simulated seat distributions in NZ Parliament.

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- ▶ NZ currently has 70 districts: 63 general and 7 Maori.
- ▶ We need to be able to disaggregate the 2008 party vote into our new districts, for downscaling purposes.

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 - ▶ It's a lot of work! (5604 polling places, counting multiplicities).

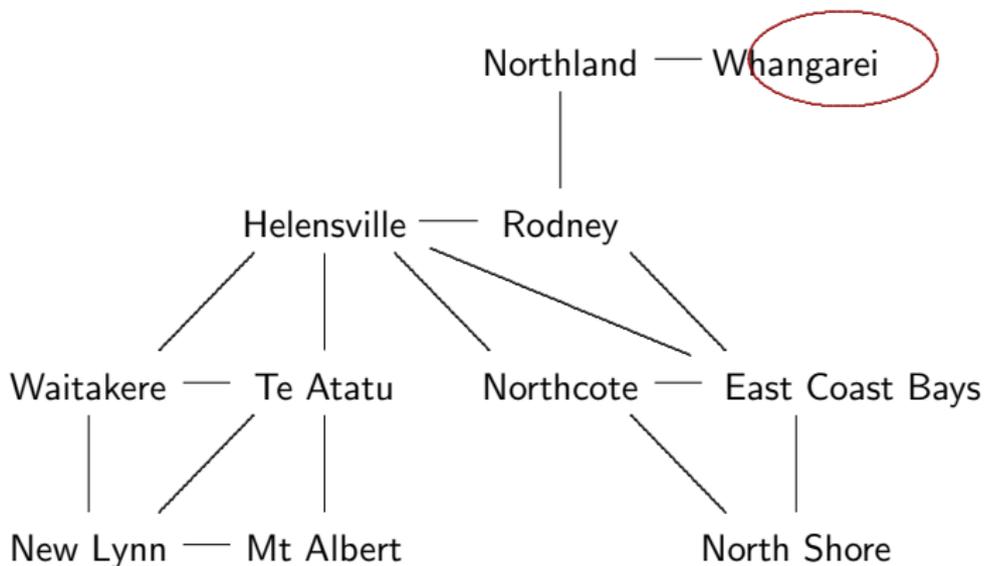
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 - ▶ It's a lot of work! (5604 polling places, counting multiplicities).
 - ▶ About 20% of votes are not traceable to a polling place, but only to a district. (Advance votes, special votes, overseas votes, etc.)
- ▶ Instead: define each new district as a convex combination of contiguous current districts.

Turn 70 old districts into 120 new ones:



Challenge: preference-order votes

- ▶ For PV and STV we must infer voter preference orders over candidates, given only the voter's first choice.
- ▶ Asking the user to enter preference orders leads to an infeasible burden of data entry.

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- ▶ We have separate collections of preference orders for the general and Maori rolls.

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- ▶ We made concrete choices based on our judgment and documented them.
- ▶ Specifically, we created virtual districts with 3–7 representatives per district. We used Wright's method with above-the-line voting (preference order on parties, not on individual candidates).

Results: poll 3 months before referendum

One News/Colmar Brunton poll 21/8/2011:

	Vote	MMP	FPP	PV	STV	SM
National	56%	70	101	98	71	95
Labour	30%	37	19	22	45	21
Green	6.0%	7	0	0	1	2
NZF	2.3%	0	0	0	0	1
ACT	1.7%	2	0	0	0	1
Maori	1.4%	2	0	0	3	0
United	0.5%	1	0	0	0	0
Mana	0.9%	1	0	0	0	0
Total		120	120	120	120	120

(MMP district seats: Maori 2; ACT, United, Mana 1 each.)

Results: 2011 general election party vote

	Vote	MMP	FPP	PV	STV	SM
National	47.31%	59	99	86	67	90
Labour	27.48%	34	21	34	46	24
Green	11.06%	14	0	0	4	4
NZF	6.59%	8	0	0	0	2
ACT	1.07%	1	0	0	0	0
Maori	1.43%	3	0	0	3	0
United	0.6%	1	0	0	0	0
Mana	1.08%	1	0	0	0	0
Conservative	2.65 %	0	0	0	0	1
Total	99.27	122	120	120	120	120

(MMP district seats: Maori 3; ACT, United, Mana 1 each.)

NZES hypothetical FPP vote

The 2008 NZES survey also included a question:

Imagine that the 2008 election had been held under the old first past the post system, and you had only ONE vote for one of the candidates who stood in your electorate. Which party's candidate would you have voted for?

Results: 2008 hypothetical FPP vote

	Vote	FPP	SM
National	44.8%	76	70
Labour	37.6%	37	40
Green	3.5%	0	1
NZF	2.5%	0	1
ACT	0.7%	0	0
Maori	5.0%	7	8
United	0.4%	0	0
Progressive	0.6%	0	0
Total seats		120	120

(For SM, we use the same vote-shares for both votes.)

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- ▶ We have not yet tested it on very different electoral systems (e.g. STV in Australia).

Year	CON sim	LAB sim	OTHER sim	CON	LAB	OTHER
2010	291	258	96	306	258	81
2005	196	331	118	198	355	93
2001	186	391	68	166	413	62
1997	186	407	66	165	418	76

Table : Real and simulated seat distributions in UK House of Commons using FPP popular vote as input

Year	CON sim	LIB sim	OTHER sim	CON I	LIB	OTHER
2011	154	95	59	166	103	39
2008	144	97	67	143	77	88
2006	144	97	67	124	103	81
2004	111	128	69	107	135	66

Table : Real and simulated seat distributions in Canadian House of Commons using FPP popular vote as input

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- ▶ Interacting with the public is hard work. We documented everything and all source code was available. However, attacking the results of the simulation because they are emotionally unsatisfying seems much easier than criticizing assumptions or implementation.
- ▶ This work got more publicity, even among academics, than anything else I have been involved in.
- ▶ Public outreach work can lead to interesting and mathematically nontrivial research questions.

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- ▶ After over 4000 initial submissions, they produced a Proposal Paper that proposed only the following changes: reduce party vote threshold to 4%; remove one district seat threshold; remove the “overhang” seats.
- ▶ <http://mmpreview.org.nz/> contains much information on the process.

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- ▶ We focused on the value of the party vote threshold, assuming the other proposals are adopted.
- ▶ We were not convinced by the Commission's arguments for the optimality of this value.
- ▶ We aimed to compute measures of overall system quality under various assumptions on voter preferences.
- ▶ We investigated values of threshold from 0 to 8%, and interpret our results as showing that 4% is considerably too high.

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- ▶ If we can agree on measures for these desiderata, we can at least compare electoral systems under a given distribution of votes.
- ▶ From the perspective of designing a mechanism, we must consider many (all?) possible distributions of votes.
- ▶ We do not consider strategic behaviour at all in this analysis.

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- ▶ There are many **disproportionality indices** in the literature. Many relate strongly to an **apportionment** method. Each is computed using the vote fraction v_i and seat fraction s_i awarded to each party, i .
- ▶ We use the **Loosemore-Hanby index** (related to Hamilton's method),

$$L = \frac{1}{2} \sum_i |v_i - s_i|$$

and the **Gallagher index**,

$$G = \left(\frac{1}{2} \sum_i (v_i - s_i)^2 \right)^{1/2}.$$

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- ▶ It makes sense to us also to use a modified version that takes into account power, rather than just presence in Parliament. We replace the fraction s_i above by the **Shapley-Shubik power index** σ_i . This index has an interpretation in terms of a noncooperative bargaining model.

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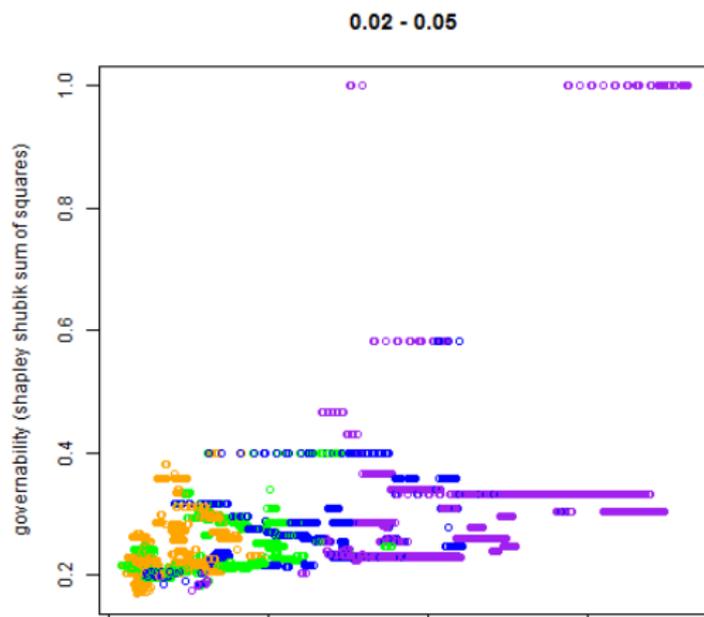
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- ▶ We assume that each voter moves its 2nd preference to its 1st, or its 3rd to its 1st, with probabilities determined by reported probabilities from the NZ Election Surveys of the relevant years.
- ▶ This is done at the national level, then disaggregated to districts using the same method as in the referendum simulator.

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- ▶ We started with the voting data from MMP elections since 2002.
- ▶ For each real election we generated a cluster of neighbouring hypothetical elections, using the above assumptions and a simple model of preference change.
- ▶ We assume that each voter moves its 2nd preference to its 1st, or its 3rd to its 1st, with probabilities determined by reported probabilities from the NZ Election Surveys of the relevant years.
- ▶ This is done at the national level, then disaggregated to districts using the same method as in the referendum simulator.
- ▶ We assume no difference in strategic voter behaviour, or party behaviour.

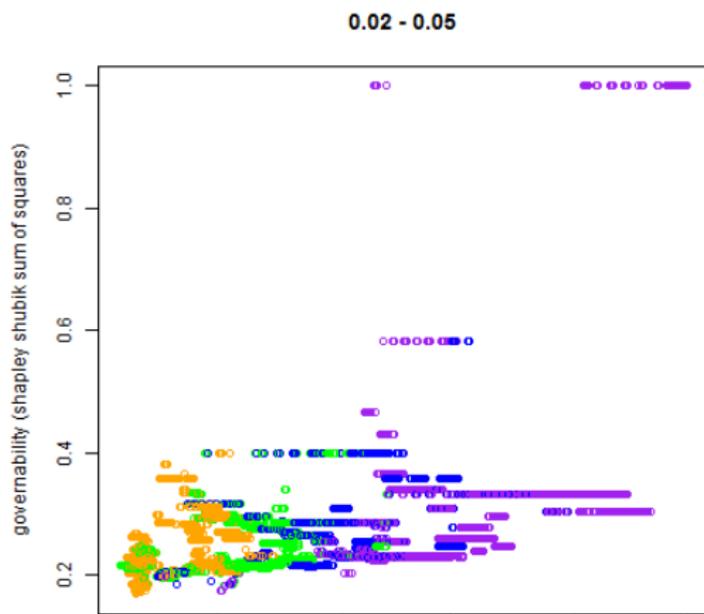
Results: Loosemore-Hanby/Shapley-Shubik

Figure : 2% (orange), 3% (green), 4% (blue), 5% (purple)



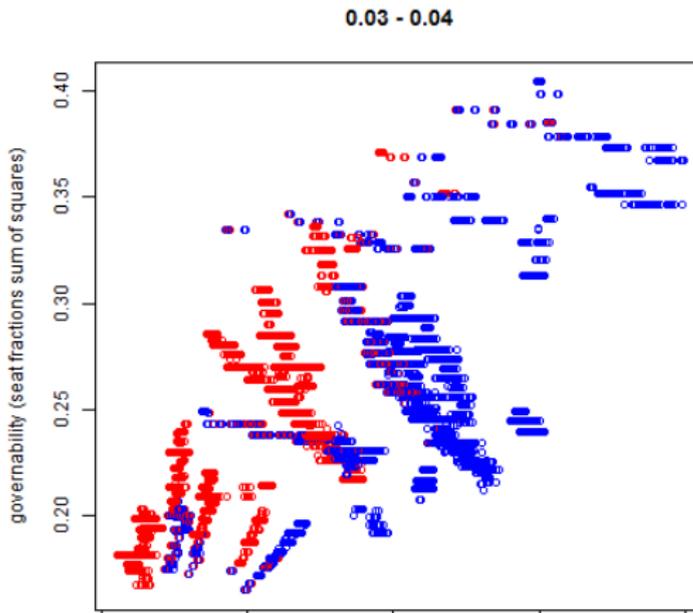
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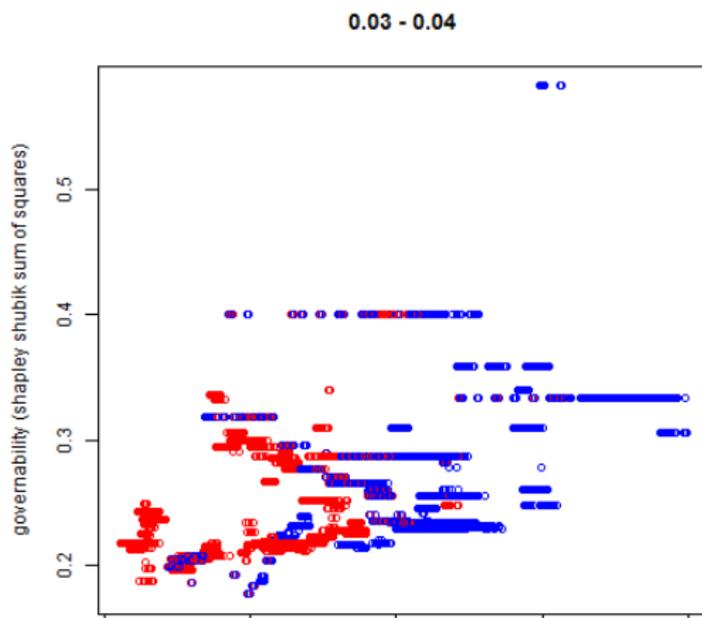
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Figure : 3% (red) versus 4% (blue)



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- ▶ It was the only submission to receive this treatment.
- ▶ However, the Commission stuck with their recommendation of a 4% threshold.
- ▶ This is perhaps disappointing, but at least they didn't recommend an increase (a large number of submitters did favour that).

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- ▶ They try to control for some electoral system factors, such as thresholds, and many socioeconomic factors.
- ▶ Difficulties: what if the district magnitude is not constant? isn't 609 a rather small number?

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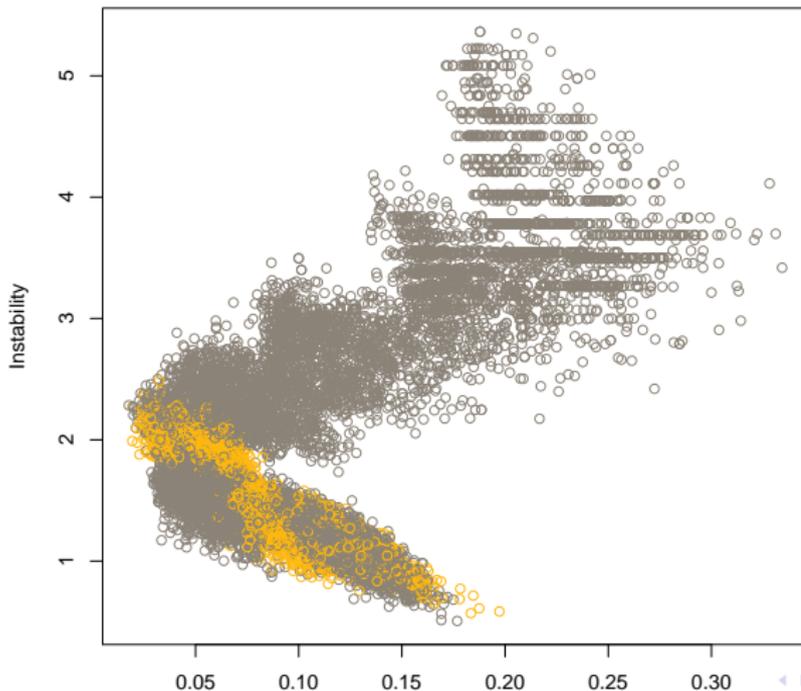
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- ▶ We aim to distinguish between competitive and clearly Pareto-suboptimal parameter settings.

Example of results - “NZ-like societies”

Simulated Elections



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- ▶ However, it seems that the Carey-Hix qualitative description is borne out by our simulations. District magnitude 1 appears to be clearly suboptimal, but the optimal size depends on the type of system used.
- ▶ What are the “right” statistical methodologies to use here?
- ▶ Questions and comments welcome!