

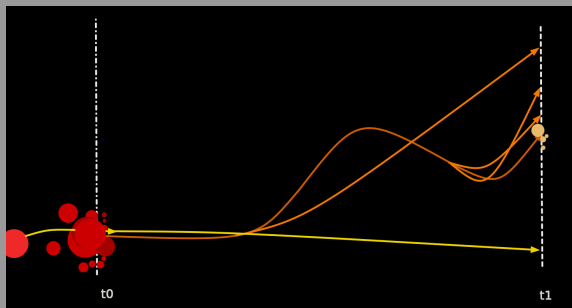
MACHINE LEARNING SIMULATES AGENT-BASED MODEL TOWARDS POLICY-MAKING

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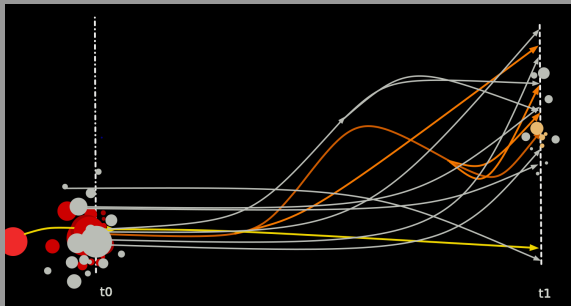
inverse Generative Social Sciences Workshop
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Possible errors in describing the social phenomena

- ▶ Given a social phenomena, can we sufficiently describe an initial and target point?
- ▶ Given an observed trajectory, can we guarantee that a slightly different starting point would not lead to a different pathway and end-target?



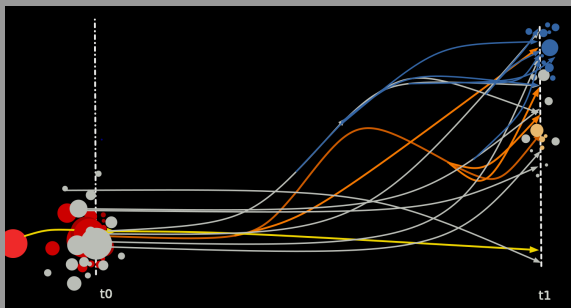
ML can expand the space of possible trajectories



Motivational iGSS questions

- ▶ Question: Independent of the observed, real or possible trajectories, is there a space of parameters/policy alternatives that are socially optimal? Or consistently superior, despite the imperfections and incompleteness of both description and trajectories?

Can we distinguish optimal social trajectories?



What? An Ongoing Project

- ▶ Freshly out-of-the-oven complex spatial-economic-empirical ABM: PolicySpace2 [1]
- ▶ 7 parameter-based rules and 27 actual parameters
- ▶ Configuration JSON parameters associated to 5,573 runs' results
- ▶ A larger, more flexible, sensitivity analysis: 1,000,000 runs

Objective Research Question

- ▶ Check robustness + of results
- ▶ Can we identify a superior dominant dense policy space to design a policy normative framework?
- ▶ Could we test omitted structures as configuration parameters?

Procedures

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2. Associate them with results of the model
3. Design a socially optimal target: +production,
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5. Train machine learning algorithms
6. Generate a more variable $\sigma = 3$, larger set of parameters configuration (X). Truncated
7. Fit new parameters
8. Compare relative results

Some preliminary results

- ▶ More precise when compared to one-parameter sensitivity, max 2-2, analysis
 - ▶ Most differences small magnitude, but suggesting ML more precise
 - ▶ Most results were known from plot analysis
 - ▶ Nuances of some results had not been identified. New and informative
 - ▶ For example: Policy Quantile. Policy Days.

Random Forest Classifier

▶ Score: 0.9842

▶ Confusion Matrix: $\begin{bmatrix} 1148 & 3 \\ 19 & 224 \end{bmatrix}$

Policy Test. Confirm, reinforce previous analysis

Policies	Sample size	Non-optimal	Optimal
Housing	0.2500	0.2382	0.0118
No Policy	0.2500	0.1982	0.0518
Rental vouchers	0.2498	0.0609	0.1889
Monetary Aid	0.2501	0.0437	0.2065
		0.5410	0.4590

Insights into Metropolitan Regions comparisons

Metropolitan Areas	Sample size	Non-optimal	Optimal
Belo Horizonte	0.0346	0.0010	0.0336
Fortaleza	0.0342	0.0103	0.0239
Porto Alegre	0.0345	0.0138	0.0206
Campinas	0.0347	0.0167	0.0180
Brasília	0.0345	0.0239	0.0106

Future work

- ▶ Use full set of results. 66 indicators
- ▶ Vary distributions configuration parameters
- ▶ Use full ML algorithms availability
- ▶ Enrich original sample (cities) for comprehensive results
- ▶ Test non-existent parameters aka omitted rules using historic data: validation

References

- [1] B. A. Furtado, “Policyspace2: modeling markets and endogenous housing policies.” Submitted. Preprint available on <https://arxiv.org/abs/2102.11929>, 2021.

Thank you! Questions? Collaborations?

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