Persons and Particles
The Microdynamics of Opinion Formation

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Overview

Analogical Models of Social Systems

- Transferring models from physics to social science, in particular economics, has a long tradition. (Rickles, 2007)
- In recent decades, there seems to be a new surge of exporting models.
- Interestingly, this doesn't only happen to economics, but also sociological/social psychological phenomena, in particular opinion dynamics. (c. f. Lallouache et al. (2010); Biswas (2011); Stauffer and Meyer-Ortmanns (2004))
- How do such models fare in a normative evaluation?

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- How do such models fare in a normative evaluation?
- Not the smallest point: Social Epistemologists have a first level interest in social systems!

Trouble on the Way?

On observation are some worrying features of current sociophysics:

1. The literature seems isolationist, in the sense that physicists are referencing almost exclusively other physicists and respond to the papers of other physicists.

2. Social scientists (e. g. (Gallegati et al., 2006)) have expressed various worries with the current development of econophysics.

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N. B. Of course some sociophysical models are mostly beyond the doubts raised here, like the mechanism of preferential attachment (Barabási and Albert, 1999).

1. Identify an example that has been published, cited, and is simple enough to avoid misunderstanding.
2. Analyze the model with respect to its assumptions, its empirical content and its connections to theory.
3. Argue for the defectiveness of the model under both a data-driven and a theory-driven research perspective.
4. Suggest *a* first step in the direction to improve the model.

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N. B.: This is a case study, with all the advantages and disadvantages.

Overview

Model

The LCCC-model (Lallouache et al., 2010) can be largely described by the appropriate exchange equation:

$$O_i(t+1) = \lambda O_i(t) + \epsilon \lambda_j O_j(t) \tag{1}$$
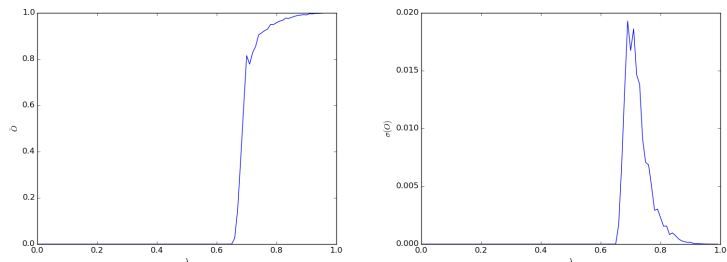
where

$O_i(t)$ is i's opinion at time t.

λ_i is i's *conviction*.

j is i's interaction partner at t, chosen uniformly at random.

ϵ is a random number, drawn uniformly at random from $[0, 1]$.

Main assumptions: $\forall i \forall j \lambda_i = \lambda_j$.

Behavior

For a system consisting of agents described by Equation 1, λ operates as an order parameter, providing the following macro-level behavior:

Figure : Results from the kinetic exchange model, expressed by opinion mean (left) and standard deviation (right)

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Data Driven Approach

Fit-to-Data Reading

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N. B. This seems at least close to the view of econophysicist modelers of inequality – and also sounds similar to an instrumentalist view more general. Does it fit the kinetic-exchange model?

Problems

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- An additional difficulty is the homogeneity assumption. It implies that a researcher would have to aggregate conviction into a single number for a whole society.
- The qualitative results conflict with known facts about opinion distribution. In particular, the model *cannot* generate a sustainable bi-polarization.

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Theory-oriented Reading

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N. B.: This perspective is related to standard scientific realism, but the crucial point is the relationship to theory.

Problems I

- The random interaction structure of the model is well-known to be incorrect, and there are compelling arguments that network structure is relevant for the qualitative features of opinion formation (Flache and Mäs, 2015)

- While it does not require a precise measurement of conviction, this reading has to give a consistent explication of conviction – for example, which real-world features of agents are part of his or her conviction?

- The microdynamics are extremely implausible under this reading. Some examples:
    - $O_i, O_j \approx 1$, $\lambda < 0.5$: Agents converge to 0. *Did they actually hold extreme opinions?*
    - $O_i, O_j \approx 0.1$, $\lambda \approx 1$: Agents converge to 1. *High conviction implies polarization, thus moving away from one's opinion?*
    - $O_i = -O_j \approx 0$, $\lambda \approx 1$: Agents converge to 0 quickly. *If we are both strongly convinced, we end up indifferent?*

Problems II

This counter-intuitive consequences are likely an outcome of the conflation of influence and influentiability for mathematical simplicity.

- If the equations are to be interpreted in the terms of a theory, what does the factor ϵ refer to?

Problems Summarized

1. A quasi-instrumentalist reading seems impossible due to the immeasureability of the construct of conviction and the conflict with well-known empirical results.

2. The alternative reading suffers from the complete lack of theoretical meaning attached to the variables in the model, as well as the absence of connections to existing theory.

Problems Summarized

1. A quasi-instrumentalist reading seems impossible due to the immeasureability of the construct of conviction and the conflict with well-known empirical results.

2. The alternative reading suffers from the complete lack of theoretical meaning attached to the variables in the model, as well as the absence of connections to existing theory.

The model seems to be a mere mathematical toy, both theoretically unintelligible and devoid of empirical meaning –**what to do?**

Overview

Basic Strategy

1. Find or develop an intelligible theory to interpret the variables of the model.
2. Very likely, such a connection to theory will also allow us to separate influence from influentiability.
3. Ideally, this strategy will also result in more (qualitative) empirical adequacy.

Basic Strategy

1. Find or develop an intelligible theory to interpret the variables of the model.
2. Very likely, such a connection to theory will also allow us to separate influence from influentiability.
3. Ideally, this strategy will also result in more (qualitative) empirical adequacy.
4. In this spirit: Let's include homophily (McPherson et al., 2001)!

Homophily

Homophily

Homophily denotes the phenomenon that social ties are more likely between individuals who are similar with respect to certain properties like race, gender, age, ethnicity, but notably also opinion (in particular, political opinion).

Idea: Use a variable controlled by opinion similarity to calculate j's influence on i.

Modified Model

Let $\delta_{ij}(t) =_{def} |O_i(t) - O_j(t)|$

$$O_i(t+1) = \lambda_i O_i(t) + \epsilon(1 - \frac{\delta_{ij}(t)}{2})O_j(t) \qquad (2)$$

That implies that j's influence on i approaches 0 with increasing difference in opinion. But what about negative influence?

$$O_i(t) = \lambda_i O_i(t) + \epsilon(1 - \delta_{ij}(t))O_j(t) \qquad (3)$$

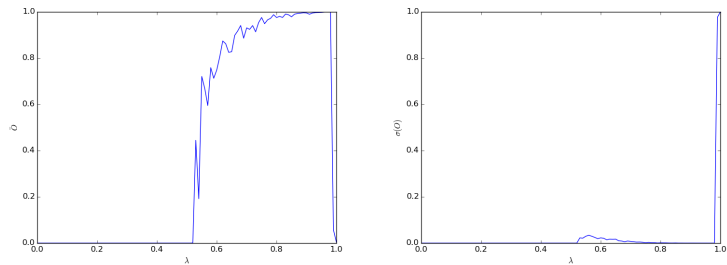Theoretically interesting: Difference between types of influence is only a constant in the model!

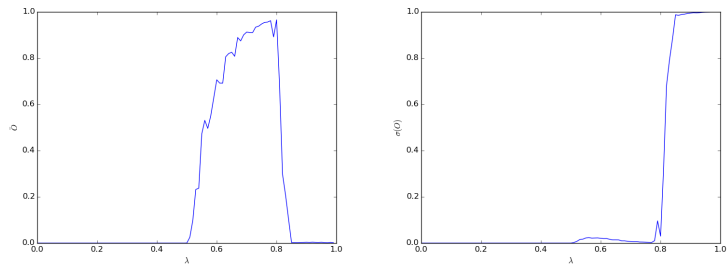Figure : Results from the modified model without negative Influence.

Figure : Results from the modified model with negative influence.

Overview

Summary

- There is a worrying tendency in sociophysics to develop and explore models that are devoid of theoretical content.
- The kinetic exchange model of opinion formation, moreover, isn't even apt to an instrumentalist reading.
- One solution is to connect the model with existing theory, provide interpretations of the variables, and face refutation, even if it comes only from the armchair.
- This route also implies to interact with social scientists. In particular, opinion formation is traditionally a part of sociology and social psychology, which is a different audience than economists.

- My claim rests for the most part on the analysis of a single case study, and a comparison with other model's would be required for generalization.
- For the model itself, there is a lot of unexplored space in the form of unquestioned assumptions; it will be interesting from a philosophical point, too, to see how robust the model is against relaxations of more and more assumptions.
- A question I did not dive into here is, which kind of idealization fits sociophysical opinion formation models the best. The realist reading is likely connected to a minimalist interpretation.

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Questions

- There is a tendency in sociophyics to develop unintelligible models.
- A striking example is the kinetic exchange model of opinion formation.
- Two possible readings of the model are both impossible:
  1. Data-oriented: Measurement problems, conflict with data.
  2. Theory-oriented: Meaningless Variables, consistent explication difficult, randomness unexplained.
- A possible solution is to connect the model to existing theory, e. g. attitudinal homophily.
- The mathematical analogy can be a useful heuristic for model development, but does not free the researcher from the burden to provide a meaningful model.