

Political evolution

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There has been much interest over the last few years in applying mathematical methods to socioeconomic systems [1]. This project seeks to formulate a model for the evolution of political opinions in an extremely simple network model of a society. This research is timely, given the rise of social, political and economic stress in Europe. We seek a description that is sufficiently rich to allow us to ask simple questions about the role of Media influence and the structure of social connectivity, now quite different following the adoption of new social media.

We will assume that the political outlook of the i^{th} person can be quantified by a scalar variable ϕ_i measuring the position on the left/right spectrum; $\phi = 0$, $\phi = 1$ correspond to ultra-left (“communist”) and ultra-right (“fascist”), respectively. This one-dimensional mapping of political views, although simplistic, has some justification in the literature [2]. The context is that there might be occasional elections in which a (small) number of political parties, each with positions p_k , compete for votes from these individuals. A simple model for these could be that the i^{th} individual votes for the party j that minimises $|p_j - \phi_i|$, leading to a government with a political outlook $P \in [0, 1]$. As a first approximation we will neglect this electoral dynamics entirely, fix $P = 1/2$ and examine the evolution of ϕ_i .

The individual’s outlook might evolve according to an equation of the form

$$\frac{1}{\tau} \frac{\partial \phi_i}{\partial t} = \sum_{ij} G_{ij}(\phi_j, \phi_i) + \sum_l M_l(\phi_i) + f(\phi_i, P) + \eta_i \quad (1)$$

Here τ is a characteristic relaxation time for an individual to change political outlook. In what follows we can choose time units such that $\tau = 1$ without loss of generality. The kernel G_{ij} reflects the network structure ($G_{ij} = 0$ for non-connected individuals) and has a functional form describing the influence exerted by a connected individual with outlook ϕ_j on one that has ϕ_i . In the simplest case an analogy with interacting magnetic moments might be

used to describe the form of individual interactions. In pre-21st century societies G_{ij} would tend to be rather local (off-diagonal elements mostly zero); new media has given rise to a more non-local structure. The M_l are media outlets that apply influence towards a particular opinion $\in [0, 1]$ (like like a field influencing microscopic magnets). For simplicity, we first consider all media companies to have the opportunity to be exposed equally to all individuals. Refinements in which media companies and/or individuals couple according to their political *distance* are possible but are probably beyond the scope of this mini-project. The function f describes the *contentment* that an individual with outlook ϕ_i has with the current political administration P . Qualitatively we expect f to drive opinion towards P when broader social and economic conditions are good, away from it when times are bad. We do not propose to attempt a full description of the underlying socio-economic conditions, rather merely to invoke a change in the form of f to mimic a transition content \rightarrow discontent(\rightarrow content). Finally η_i describes an uncorrelated white noise with adjustable strength.

The mini-project will address the following:

- Carry out a short literature review, including on analogous magnetic systems embedded in networks. Are any general results known about the magnetic ordering, e.g. as a function of temperature (noise)?
- Write code to perform a computer simulation of this system in which network connectivity and the media field are adjustable
- Examine when and how political opinions become more extreme as an effect of the content \rightarrow discontent transition. Study how this depends on the network structure and the distribution of the media fields.
- Could we expect this to involve a corresponding dialogue shift from the comparison between left & right (and the use of those terms in the mainstream media) to the comparison between mainstream & extreme (and their use). Could we test this?
- Is there a second phase of coarsening from a state in which there are substantial populations in both left and right (magnetic domains), to a state in which one of these gradually dominates opinion? If so, how long does this transition take? Study how this depends on the network structure and Media field.

References

- [1] Philip Ball. The Physical Modelling of Human Social Systems. *ComplexUS*, 1(11):587–644, 2011.
- [2] G. Grendstad. Comparing political orientations: Grid-group theory versus the left-right dimension in the five Nordic countries. *European Journal of Political Research*, 42:1–21, 2003.