Problem Introduction

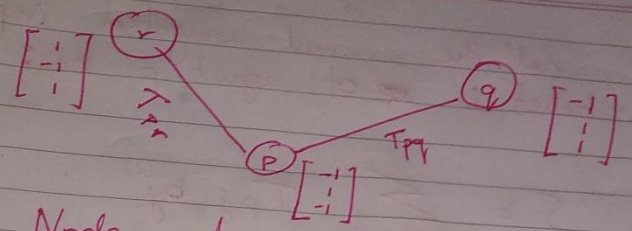
This proposal aims to address the question – 'does social media contribute to political polarization?' For our purposes I define polarization as the phenomenon by virtue of which a large group of individuals for whom multiple disparate, sometimes unrelated, political issues are relevant tend to categorize themselves into one of two antagonistic groups, such as 'liberals' and 'conservatives'. Such clustering of beliefs suggests that people might not update their beliefs about a particular issue independent of other issues. The phenomenon of **homophily** (one's tendency to be attracted to people similar to themself) is implicated in homogenization and polarization.

Much has been said and written about the influence of social media on political polarization. Social media have democratized the ability to broadcast information, beliefs and opinions. This proposal aims to study the implications of increasing the broadcasting ability of individuals on polarization.

Network Model

Every agent has a finite non-zero number of beliefs that can take on binary values. A particular belief of an agent changes when the summed weighted belief of its neighbourhood is opposite to its own, and exceeds a threshold. The weights themselves are a function of how similar the set of beliefs of the two nodes are.

The mathematical treatment is as follows:



Node p has neighbours q and r. Say each node has 3 beliefs, as shown above. The weights represent the level of trust or homophily between nodes.

Let,

$$T_{pq} = \frac{\sum_{i=1}^{k} b_p^{(i)} b_q^{(i)}}{k}$$

where k is the number of beliefs (here 3), $b_p^{(i)}$ and $b_q^{(i)}$ are the i^{th} beliefs of agents p and q respectively. $b_a^{(b)} \in \{-1, 1\}$ and T_{pq} is the homophily between p and q.

It can be seen that

$$T_{pr} = -1 \; ; \; T_{pq} = 0.\dot{3}$$

Updating Rule:

$b^{(i)}$ for any agent can take on +1 or -1 at a time. It will switch its i^{th} belief if the input beliefs (from its neighbours) swing far enough in the opposite direction after weighting by homophily and normalization.

Let the summed weighted input for belief i of agent p be:

$$S = \sum_{j \in \{\text{neighbouring nodes}\}} T_{pj}\, b_j^{(i)}$$

Update Rule: • If $S\, b_p^{(i)} < \gamma$

Then set,

$$sgn(b_p^{(i)}) \Leftarrow sgn(S)$$

Where γ is a threshold parameter. For simplicity $\gamma = 0$.

This proposal aims to look at the influence of social media, as opposed to traditional media, on polarization. This can be modelled as follows:
Let there be two types of nodes: **media houses** and **individuals**. Individuals behave exactly as the nodes described above, and media houses behave like individuals except for two aspects: (a) the beliefs of media houses are immutable, and (b) every media house has a link to every individual.

Let us define for a node its **Broadcasting Power (BP)** as the fraction of individuals it has a link to. Media houses thus have BP = 1. Let us define **Individual Broadcasting Power (IBP)** as the mean BP of individuals.

Analysis

To address the question, we must look at polarization at equilibrium as a function of IBP.

Polarization is defined here as the formation of two antagonistic clusters in the belief space, as opposed to homogenization or dispersion, at equilibrium. As of the time of writing this I am unsure of what metric to use as an index of polarization. One way to do it perhaps is to apply a clustering algorithm in the belief space and derive a measure of polarization based on the number of clusters obtained.

Limitations

- IBP is assumed to be uniformly distributed across agents.
- Agents are assumed to be broadcasting all their beliefs at all time points. This is not true in reality. Broadcasting ability is limited in both space and time for individuals as opposed to media houses.
- There are alternate mechanisms by virtue of which polarization may occur, such as the existence of moral primitives that may have a common effect on multiple beliefs (for example, if one is averse to government interference, they may have correlated beliefs on taxation and environmental regulation). The model assumes homophily can account for all polarization.