Assignment 2

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A. **Simulating the Dynamics of Opinions in a Small Social Network**

1. See Figure 1.

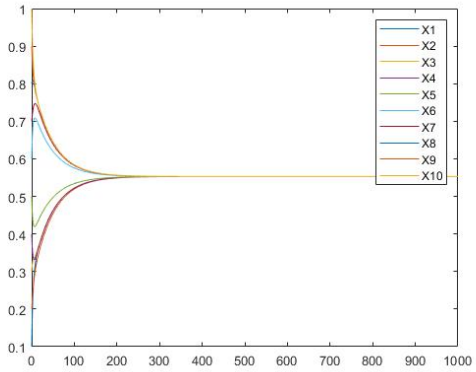
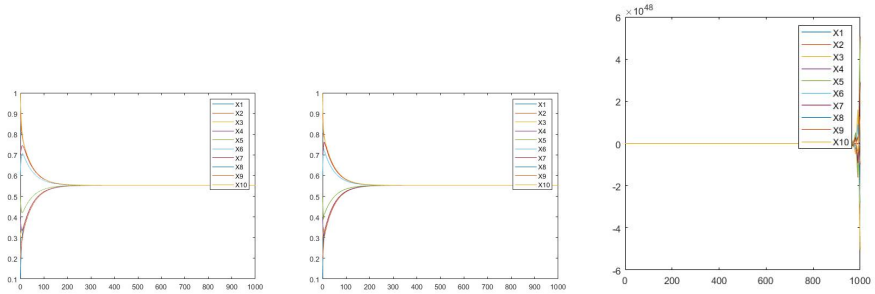


Figure 1: Graph representation for the scenario.

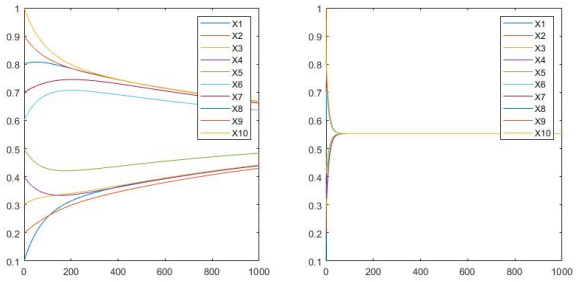
2. In the beginning, the trend in the changes of opinions is faster because the individuals do not have that opinion yet. However, as the opinion is spread, the members have already adopted such opinion and thus the other members of the community do not affect their opinion (as they are similar to their own).
3. The step size refers to the fixed steps of step size second in which the simulation time advances until it reaches the real time. In Figure 9 it is observed how detail of the spread of the opinion is lost with a higher step size (e.g. Figure 2b) when the opinion is changing quickly ($0 \leq t \leq 10$). Thus, rapid changes require small step sizes for accurately capturing these dynamics. It is observed that when the step size is too large (e.g. $dt = 10$), the model looses accuracy.
4. The speed factor describes the speed of change of the opinion state for each individual in the network. This provides a timing of the processes



(a) $dt = 0.05$ (b) $dt = 3$ (c) $dt = 10$

Figure 2: Responses for the change in opinion in the network participants for different step size values.

for a state. It is observed that a small speed factor value (e.g. $ms = 0.01$) represents a much slower change in each individual upon causal impact than a larger one (e.g. $ms = 1.0$). The opinion, therefore, does not become homogeneous by the end of the simulation ($t = 70$) in Figure 3a, whereas in Figure 3b the opinion becomes homogeneous in a much faster rate than in the original scenario.



(a) $ms = 0.01$ (b) $ms = 1.0$

Figure 3: Responses for the change in opinion for different speed factor values.

B. **Communities and Bridge Connections**

1. It is observed in Figure 4 that a very small connection weight between both communities makes the homogenization of the opinion between the two communities significantly slower, even if in each community the opinion of each individual is very similar to the ones of the same members of the group.
2. In Figure 5 we the breakage of the bridge causing each community to

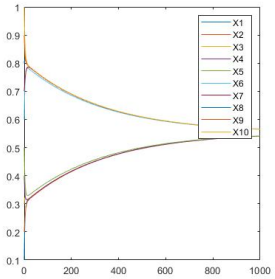


Figure 4: Graph representation for the scenario with $(5, 6) = 0.1$ and $\omega(6, 5) = 0.1$

share an opinion that is different and not influenced by that one of the other community.

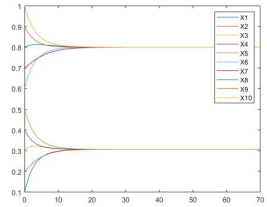


Figure 5: Graph representation for the scenario with $(5, 6) = 0$ and $\omega(6, 5) = 0$

3. Figure 6 shows that a one-directional connection with $(5, 6) = 1$ and $\omega(6, 5) = 0$ causes the opinion of community B (states X_6-X_10) to become similar to those of community A (states X_1-X_5), whereas the opinions of the states in community A remain unaffected by the dynamics in community B.
4. It is observed in Figure 7 that the reduction of the initial values of the members in community A by a factor of 0.1 makes the opinions in community A more homogeneous, with a value close to 0. The value of the opinion, however, increases because of the influence of member X_5, that has a connection with X_6. This connection both increases the rate of change in the beginning and further changes the opinion of the community as t increases.
5. See Figure 8.
6. It is observed in Figure 9a that a rate of response of 0 for X_1 causes this individual to have an unchangeable opinion of 0.1 throughout the simulation, as it is not influenced by any other member. Moreover, both of the community values tend towards 0 as time increases. This is because

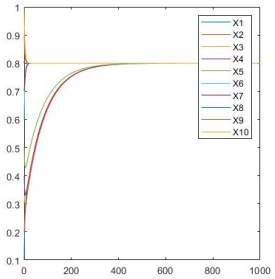


Figure 6: Response rates for a scenario with $(5, 6) = 1$ and $\omega(6, 5) = 0$.

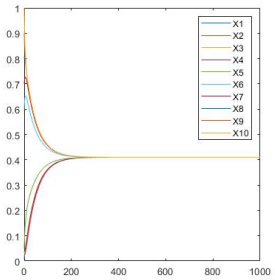
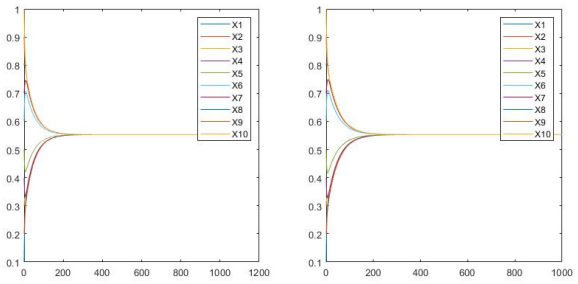


Figure 7: Response rates over time for a scenario with $0.01 < iv < 0.1$.

this member still has an influence (directly or indirectly) on the rest of the members.

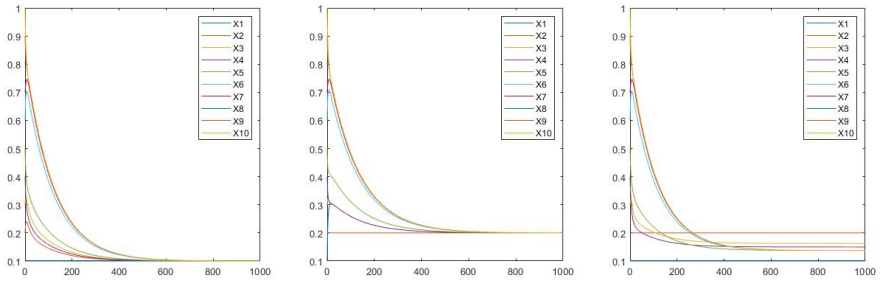
In Figure 9b, the rate of response of 0 of X_2 causes the opinions in community B to be heterogeneous: X_5 opinion increases the average value of the opinions in community A, X_2 constant opinion decreases the average value of community A, and the rest of the members with a high rate of response tend towards the average of the rest of the states. Moreover, the connection of X_5 with community B causes the opinion in this community to be constantly reduced and tend, in the long run, also towards the 0.2 value of X_2.

In Figure 9c, the rate of response of 0 for both X_1 and X_2 causes the opinion of the rest of the members in both communities to speed and tend towards 0.15. The opinions will, in a longer period of time, be divided in $X_1 = 0.1$, $X_2 = 0.2$, and the rest will have an opinion of value 0.15.



(a) $dt = 0.1$ (b) $dt = 1.0$

Figure 8: Response rates for scenarios with different dt values.



(a) X_1 with speed factor 0. (b) X_2 with speed factor 0. (c) X_1 and X_2 both with speed factor 0.

Figure 9: Response rate over time for different scenarios, setting different states speed factors to 0.