Computational Modeling of Social Behavior

Coding Challenges – Day 4

Let's play with network models!

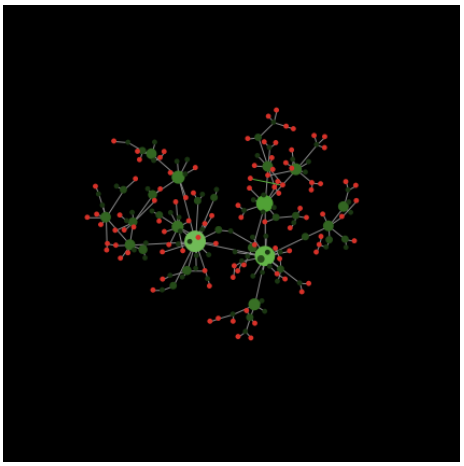
1. Founder Effects in Preferential Attachment

The preferential attachment algorithm is a model for how social networks form. We can use the baseline model to explore how the order in which individuals enter the network influences their potential for influence. Open the Preferential Attachment sample model (Models Library -> Sample Models -> Networks -> Preferential Attachment) and re-save it with whatever name you like.

Exploring the baseline model
Run the simulation with default settings until you have around 400 nodes. What does the degree distribution of this network look like? What is the degree of the node with the highest degree? Click on "resize nodes". Right click on nodes of different size and use the inspector. Each turtle's (node's) "who" number reflects the order in which it was created (starting with zero). What relationship do you see between degree and the "age" of the nodes?

Adding a second wave
Modify your code so that clicking "resize nodes" turns all existing nodes green (bonus challenge: vary the shade of green by size/degree). All subsequently created nodes will still be red. The green nodes will be those that entered the network before you clicked the button. (You can use any two colors you like – you may want to do so especially if you have trouble distinguishing red and green.) Next, modify your interface display so that there are two new plots, each plotting a histogram of degree distributions: one for green nodes and one for red ones. Also add monitors that will tell you the highest degree of any red or green node.

Once you have successfully modified the model code, run a new simulation for around 400 ticks (so you have about 400 nodes). Then click "resize nodes." Then, without restarting, click "go" again and run the model until you have a total of around 800 nodes. You should have roughly the same number of red and green nodes. The red nodes are your new nodes, and the green are your old ones. How do these two sets of nodes differ in degree? What is the degree of the red and green nodes with the highest degree? Examine your plots. How do the two degree distributions compare? What is the implication for systems where "the rich get richer" applies?



2. Spreading Ideas on a Network

Consider a simple epidemiological model of agent communication in which one agent has an idea, and spreads it to other agents. That is, the model will start with one agent "infected" with the idea, and this idea will be transmitted to other agents, who can in turn transmit the idea to even more agents, and so on. Think about what we did on Day 2. Build a new model with 300 agents on a random network. For the code for four different random network formation algorithms, see code in the Models Library: IABM Textbook -> chapter 5 -> Random Network for connection algorithms – you can use any of them you like. Make sure to save your model.

Once the agents are formed on a network, some small number of agents will start out as "infected" with the idea, and this idea will be transmitted to other agents, who will in turn transmit the idea to even more agents, and so on. Specifically, the idea will spread from infected agents to any agents they are connected to on the network. Have infected agents change color, and plot the number of agents who are infected over time. Think about how network topology affects the spread of infection.

3. Challenge: Complex Contagion

Modify your contagion model so that an agent only becomes infected if it encounters multiple infected agents. The idea here is that some ideas or behaviors will only spread if an individual receives affirmation of the idea from several people, as in the cases of high-risk social movements, avant garde fashions, and unproven technologies. How does the number of infectees required for adoption affect diffusion dynamics?

3. Challenge: Games on graphs

Put the cooperation model of Nowak and May onto a random graph. How does the connectivity (average degree) of the network influence the evolution of cooperation?