UPPSALA UNIVERSITY
DEPARTMENT OF MATHEMATICS
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Assignment 3
Spring 2022

Lab 3: Spread of memes on a network

The deadline for this sheet is midnight 16th of May.

Please submit hand-ins on studium. All code should be included or uploaded to github. Please feel free to submit videos illustrating your results where appropriate, via studium or uploaded elsewhere such as vimeo or youtube. You may work in groups of size 1-5, and only one group member needs to submit the assignment. State clearly the members of the group. This exercise will be covered in lab session on 4th of May.

Spread of memes

Consider the following model of the spread of Internet memes. There are three states: resting (R), sharing (S) and bored (B). We will consider various rules for how memes spread between individuals. Use discrete time steps in the model.

1. Lets first assume the following rules for spreading of memes for each time step of the model.

   Resting With probability p a resting person will discover a new meme by themselves and become a sharer.

   Sharer With probability q a sharer will pick one person completely at random from the population. If that person is resting then they will now become a sharer. However, if the person they pick is bored, then the sharer will lose interest and become bored too.

   Bored With probability r a bored person will pick one person completely at random from the population. If that person is resting then the bored person will now become resting, otherwise they will continue to be bored.

   Write a simulation of this model and run it with $N = 1000$ people of whom only one is bored (i.e. $B(0) = 1$) and only one who is sharing ($S(0) = 1$). Simulate this model for different parameter values and describe the types of dynamics that can arise. Start by choosing a very small value of p. (e.g. $p = 0.001$ and $q = 0.01$). For repeated simulations of the model for these parameter values and show the mean change in number of sharers over time. Plot how the number of sharers changes in this model. **(4 points)**

2. Implement the same model as the one above, but on (a) a two dimensional lattice (either square lattice, or another lattice of your choosing) and (b) a real network with at least 100 vertices (you may choose to modify a real network you find, or choose a subset of it - e.g. the largest connected component). When individuals pick people to interact with, they pick (still randomly) only from their nearest neighbours and not from the whole population. For the lattice use periodic boundary conditions, so that cells interact over the left and right and the top and bottom boundaries. Investigate properties of this model and write a short report, including pictures and/or film, explaining the patterns the model generates and explaining how different network structures effect the model outcome. **(6 points)**