VRIJE UNIVERSITEIT AMSTERDAM, FACULTY OF SCIENCES, DEPARTMENT OF MATHEMATICS
BUSINESS SIMULATION (X_401006) 2018-2019, BACHELOR BUSINESS ANALYTICS

Final Assignment Business Simulation

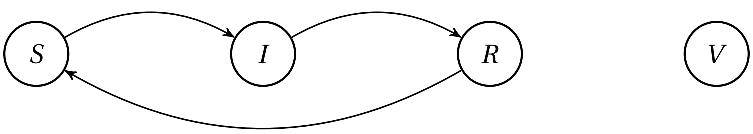
January 21, 2019

This simulation assignment should be carried out in groups of at most two students. Every group has to choose one of the two final assignments stated on Canvas.
Deadline: Friday February 1, 2018 at 23:59
Hand in the following:

- A written report of at most six pages in which you present your findings to the questions asked in the assignment.
- The compiled version of your Business Simulation project (*.jar file). See Canvas for instructions on the .jar file.

VARIANT 2: MODELLING EPIDEMICS

Consider a network in which the nodes are people and the links represent friendships between these people. Imagine that this network consists of all inhabitants of a particular country and the authorities want to find out if they can immunize the entire population from an epidemic spreading by vaccinating a small percentage of the population. The spreading of the disease through the network can be modeled using a SIRS-epidemic model. In this model, every person can be in three states: Susceptible (S) to the epidemic, Infected (I) by the epidemic and Recovered (R) from the epidemic. To these states, we add the Vaccinated (V) state. A schematic picture of the transitions between these states is given in the figure below.



A social network dataset with edges and links can be found on Canvas. Note that not all user ID's in the range from 0 to 999 are used in this dataset. Note that some ID's are missing and will not be included in the network.

ASSUMPTIONS:

- The infection can only spread through the network via the edges in the network.
- We start the simulation with one randomly chosen infected individual.
- We consider the spread of an infection through the network in discrete time.
- At each time-step, Infected individuals infect each of their neighbors with probability $\beta = \frac{1}{3}$.
- At each time-step, an Infected individual becomes Recovered with probability $\gamma = \frac{1}{8}$.
- At each time-step, a Recovered individual becomes Susceptible again with probability $\alpha = \frac{1}{20}$.
- Vaccinated individuals will always remain in the Vaccinated (V) state and will not transition between states.

QUESTIONS BY THE HEALTH ORGANIZATION:

1. What is the impact on the spread of the epidemic (the fraction of sick nodes in the network) if we vaccinate 5% of the population, chosen uniformly at random?
2. Are there better ways to vaccinate people in order to stop the epidemic from spreading than vaccinating randomly?
3. How many people do we need to vaccinate randomly if we want a maximal spread of the epidemic of 10%?
4. How many people do we need to vaccinate according to the earlier found rules in 2. if we want a maximal spread of the epidemic of 10%?
5. Suppose we may wait ten time-steps before we choose the people who are vaccinated. How does this change the vaccination strategy? What is the maximal spread of the epidemic in this case?