R3 Model - Description

Benjamin Ortiz Ulloa

2/20/2020

Abstract

We propose a stochastic network-based model to represents the movement of addicts in and out of rehab facilities. The model takes advantage of a temporal bipartite network to create a system we can manipulate and observe. We seek to better classify rehabs and rank rehab facilities according to their effectiveness in preventing the relapse of recovering addicts.

Structure

Bipartite

The two node types that create the bipartite structure are **People** nodes and **Location** nodes. The edges connecting the two node types represent where a person is located.

The **People** nodes contain a boolean attribute of *stable* which represents whether a person is a recovering addict and is not using drugs (TRUE) or if a person is a relapsed addict and is using drugs (FALSE).

The **Location** nodes are subdivided into two types: *Rehab Facilities* and *Post-Rehab Locations*. Rehab facilities are locations where people go to when they relapse and start using drugs again. Post-Rehab facilities are locations where people go to when they either recover or are no longer able to stay at the rehab. Each location contains a *rate* attribute which is a number between 0 and 1. The meaning of rate depends on a location's subtype. For rehab facilities, the rate represents the probability that a connected person will recover and stop using drugs. For post-rehab locations, the rate represents the probability that a connected person will relapse and start using drugs again.

Temporal

The temporal element of the network consists of a controlled update of the *stable* attribute of **People** nodes and a controlled rewiring of the edges. Time steps are arbitrary, but consistent, lengths of time.

At each time step we choose a random number between 0 and 1 for each **People** node. If the person is connected to a *Rehab Facility*, then we change the person's *stable* attribute to TRUE if the random number is below the corresponding location's rate. If the person is connected to a *Post-Rehab Location*, then we change the person's *stable* attribute to FALSE if the random number is below the corresponding location's rate.

At each time step we rewire the edges according to the attached **People** nodes' new *stable* attribute and the attached **Location** nodes' subtype. If a person connected to a *Post-Rehab Location* has a new *stable* status of FALSE, then we randomly choose a *Rehab Facility* to reconnect the person to. If a person is connected to a *Rehab Facility*, then we randomly choose a *Post-Rehab Location* to reconnect the person to despite the person's *stable* status (we assume a finite amount of time spent at a rehab facility).