**Lecture Notes**: Social Networks: Models, Algorithms, and Applications
**Lecture 13**: Feb 28, 2012
**Scribes**: Rahil Sharma and Vivek Sardeshmukh

# 1 Framingham Heart Study

The results in [1] are due to mainly 3 causes

1. Homophily
2. Contagion/influence
3. Confounding factors

Homophily and Contagion are difficult to distinguish (since they used direction of friendship). Cosma Rohilla Shalizi has written a review about the above results on his blog[1]. In this lecture, we will discuss the arguments given on this blog. He tries to answer the question - "Can we nonetheless tell whether bridge-jumping (a particular trait) spreads by (some form) of contagion, or rather is due to homophily, or, if it is both, say how much each mechanism contributes?"

## 1.1 Graphical Model

If Joey is obese, does her friend Irene obese too ? Let answer this question by drawing relevant graphical model (see Figure 1). Denote,

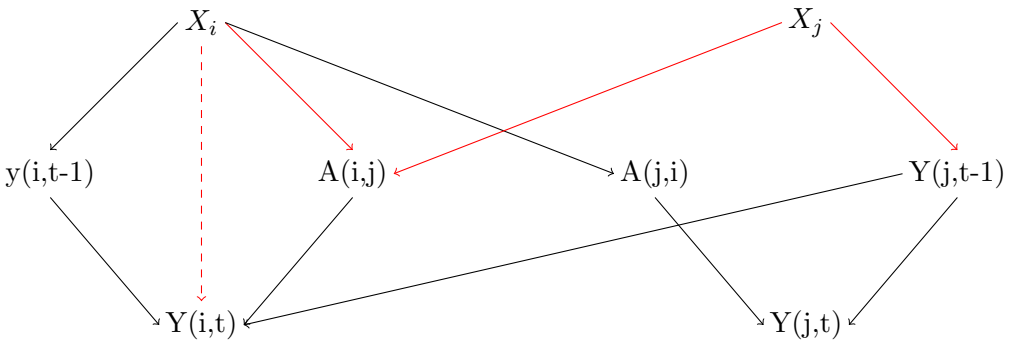


**Figure 1:** Graphical Model for factors affecting traits of friends

- i for Irene and j for Joey
- Y(i,t)=1, if Irene obese at time t
- Similarly Y(i,t-1)=1, if Irene was obese at time t-1
- Similarly define Y(j,t) and Y(j,t-1)

[1] `http://cscs.umich.edu/~crshalizi/weblog/656.html`

- A(i,j)=1, if Irene regards Joey as a friend

We want to know whether the later variable influences the former.

See link y(j,t-1) to y(i,t). Its called an inspirational link. that is Joey gets inspiration to become obese at time t from Irene who was obese at time t-1.

### 1.2 Logical Regression

The above result can be explained with logical regression also. A logical function is a function of form $f(x) = \frac{1}{1+e^{-wx}}$, where $w$ is some kind of weight. Here we can assign weight to be traits of a person and define the probability of a person being obese given trait X as

$$P(obese|X) = \frac{1}{1 + e^(w_0 + \sigma w_i k_i)}$$

To hold the axioms of probability, define

$$P(\neg obese|X) = \frac{e^(w_0 + \sigma w_i k_i}{1 + e^(w_0 + \sigma w_i k_i)}$$

Now if the ratio $\frac{P(\neg obese|X)}{P(obese|X)} > 1$ classify this as not obese.

## References

[1] N.A. Christakis and J.H. Fowler. The spread of obesity in a large social network over 32 years. *New England Journal of Medicine*, 357(4):370–379, 2007.