Network Science	
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Social Network Dynamics

28.1 Network Dynamics

28.1.1 Introduction

1. Contagion
   - Physical
   - Psychological
2. Cascades
   - Information cascades
   - Cascading behavior

- [Herding] Bayesian Learning ([1] and Chapter 16 in [2])
- [Diffusion] Coordination Game (Pan's Dissertation[3] and Chapter 19 in [2])
- [Epidemic] Model (Chapter 21 in [2])
  - Characteristics of disease, e.g., incubation, respiratory, elementary
  - Network structure

28.1.2 SIR

Definition 1 SIR
Susceptible - Infectious - Removed(Recovered)

1. **Directed Graph** of Contact Graph (can be two ways of contact), can be arbitrarily complex.

Figure 28.1: Two-way contact

2. **Basics**: remain in **I** for a fixed period of time. Fixed prob. of transmission $P_{v,w}$.
3. **Expansion**: heterogeneous $P_{v,w}$, recovery rate q. We can further divide **I** period into several stages; we have other epidemic models such as **SIS**, **SIRS** for different diseases.

28.1.3 Branching Process

A *branching process* is the simplest model of contagion.

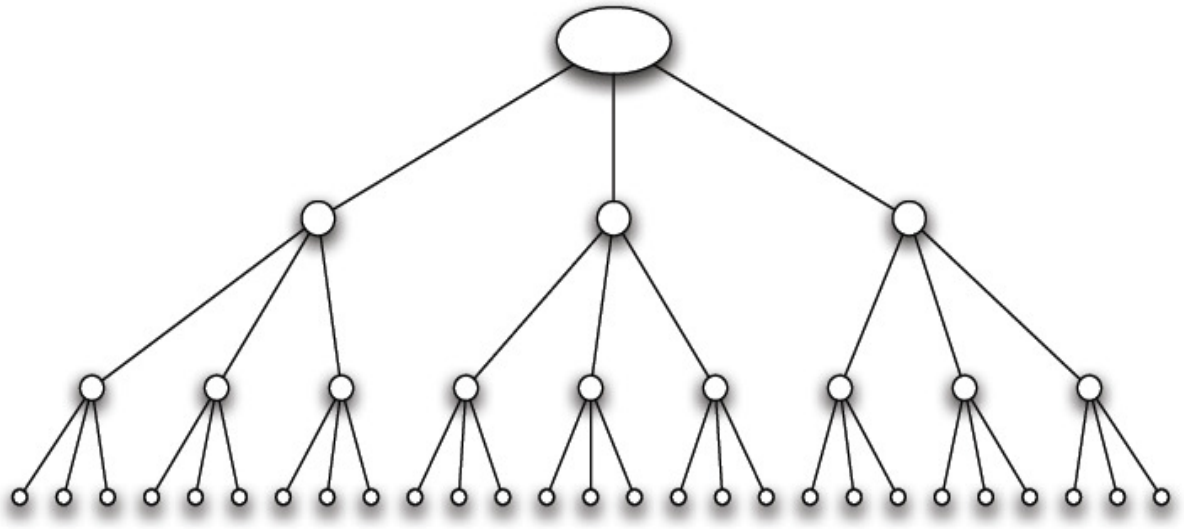

Figure 28.2: Branching process. (The copyright of this figure belongs to those of the book [2])

1. Once it fails to infect anyone during a wave, a disease dies out.
2. Or, it has to infect someone during every wave.

1. p: probability for an infectious person to transmit disease to a person he meets.
2. k: number of new persons each person meets in the current wave.
3. R_0: basic reproductive number, i.e., the expected number of new cases of the diseae caused by a single individual. $R_0 = pk$.
4. X_n: number of infected individuals at level n. $\mathbf{E}(X_n) = (pk)^n$.
5. q_n: probability of epidemic survives for the nth wave.

$$\lim_{n\to\infty} q_n = q^* \begin{cases} q^* > 0, \text{ if } R_0 > 1; \\ q^* = 0, \text{o/w.} \end{cases}$$

28.1.4 Jackson and Rogers, 2007 [4]

In the paper, they present a dynamic model of network formation where nodes find other nodes with whom to form links in two ways: some are found uniformly at random, while others are found by searching locally through the current structure of the network (e.g., meeting friends of friends).

Please refer to their slides(in file:JacksonRogersAER07.pdf).

References

[1] V. Bala and S. Goyal, "Learning from neighbors," *Review of Economic Studies*, vol. 65, pp. 595–621, 1998.

[2] D. Easley and J. Kleinberg, *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*. Cambridge University Press, 2010.

[3] Z. Pan, "Learning, game play, and convergence of behavior in evolving social networks," Ph.D. dissertation, Virginia Tech, 2009.

[4] M. O. Jackson and B. W. Rogers, "Meeting strangers and friends of friends: How random are social networks?" *American Economic Review*, vol. 97, pp. 890–915, 2007.