Lecture 22: Diffusion and Individual Choice

1 Introduction

In this lecture, we return to the concept of diffusion. We first encountered diffusion in our discussion of standing ovations. Now, we'll take a deeper look. We'll use the basic model laid out in Lave and March's Chapter 7 as a benchmark and from there we will consider some fun examples (no really they are fun). Some fit their model nicely. Others do not. In the next lecture, we'll look at networks.

2 Lave and March's Model

The Lave and March model has five basic assumptions:

1. People must be linked
2. The object of diffusion must be transmitted by the person who has it. (whether they know it or not)
3. The object must be accepted by the person who does not have it (whether they know it or not)
4. Each person either has or does not have the object (no shades of gray here)
5. Once you've got the object you keep it indefinitely (this can be relaxed)

Now, let's consider some examples:

Example	**A1**	**A2**	**A3**	**A4**	**A5**
Flu	Y	Y	M	Y	N
HIV	Y	Y	M	Y	Y
New Word	Y	Y	Y	Y	M
Religion	Y	Y	Y	M	M
Computer Virus	Y	Y	Y	Y	M
TiVO	Y	M	Y	Y	M
Activism	Y	Y	Y	M	M

What we see from these examples is that the world may not be as clean and simple as the assumptions that they would like to make in their model. Let's now look at some particular cases in depth. In the past twenty years more sophisticated models have revealed subtleties not captured by this stark framework. There has been lots of work on network structure for example.

2.1 Diffusing Ideas and technologies

Over the past forty years, there have been massive sustained efforts by groups ranging from the Peace Corps, Save the Children, the Catholic Church, and the United States government to diffuse ideas and technologies in developing countries. These ideas and technologies have touched upon birth control, general health and nutrition, education, irrigation systems, plant rotation, herd management, and so on. The success rates of these programs have varied. Why they have failed is an interesting story. You would think that if something were "better" that anyone would accept it. That may not be true if the evidence that the outcome is better is not *immediate, recognizable,* and *consistent* with the belief system of the people that are being asked to adopt it.

2.2 A Bad Disease

Diseases, like the flu and HIV, have periods in which they are symptomatic and periods in which they are contagious. If the contagious period and the symptomatic period are simultaneous then the disease will not spread very fast because people with the disease will limit contact with others. If the contagious period begins several days (or years) prior to any symptoms, then the disease may spread quickly through the population. This is one of the concerns with small pox.

The general theory for disease transmission relies on three characteristics of a disease: *contagiousness*, *duration*, and *number of people who are susceptible*. The more we increase any one of these, the more sick people. For example, AIDS does not spread as fast as colds due to how they spread. The spreading mechanism matters a great deal as well. Is it rats, water, or human contact? The number of people who are susceptible is really tricky to determine in some cases. There is more and evidence for genetic susceptibility - some people are just not likely to get some diseases. Also, some behavior may not be known so people who do not think they are at risk may be, such as is the case with heterosexual women and the spread of AIDS.

2.3 Discrete Signals and Information Cascades

In this example, we show how the diffusion of knowledge may lead to the wrong outcome. Suppose that each person gets a signal as to the worth of a stock. The true value of the stock is $100. The signals have mean $100 and standard deviation $2. If investors are offered the stock sequentially, and if people know the actions of previous investors, then an information cascade can occur. Here's how. Suppose that stock is for sale at $99, (a bargain price). Let the values of the investors be (in order) $98, $99, $100 $101. $100, $102. On average the investors have a value of 100. Four of them get signals of $99 or greater, so three or four of them should buy the stock.

Let's think about what would happen. The first investor will say no. The second, being indifferent, will learn from the first investor and also say no. The third, fourth, and fifth, investors might say no as well because they think that they got high signals based on the other people saying no. The lesson to take from this is that we could get a cascade where the wrong decision is being made. This happens because the signals are discrete. If the people said "no, my value is $98" instead of just saying no, then there would not be any cascade.

This example begs the question: when would we see cascades? Or, of more current interest, could we see a cascade in our models of class choice? The answer of course is yes, but we'd think that they are far more likely among frosh at orientation than among seniors because the former do not have as good of information and they would be more likely to take a class based on rumor.

2.4 Guerrilla Marketing

The movie *Blair Witch Project* was one of the first highly successful applications of guerrilla marketing. The producers of the film paid people to go to bars and coffee shops and talk about the movie and to implicitly suggest that it was a true story. Word of the movie spread just as in the standard model. If we apply the concepts for the disease model, we see that the rumor was contagious "*people died making the movie*", the rumor lasted until people saw the movie, and many people were susceptible. The Blair Witch Project was like smallpox, people spread the disease without knowing that they were spreading it.

2.5 Y2K

There was a building concern that at the start of the year 2000 that many computer systems would shut down or become unstable because the year was coded as 00. This meant, for instance, that the year 1999 would be 99 years in the future as opposed to one year in the past. This is one reason why banks were so concerned about Y2K. The Y2K problem was interesting because it was a case where the government was concerned about diffusion at two levels. The first level was the diffusion of failures in networks. Would phone, gas, water, electric, and financial networks fail. The second was the diffusion of panic among citizens if there was failure on the networks.

One of the government's concerns was how to respond to prevent possible riots or mass panics. One immediate question is how much and what information the government should provide people. To analyze this question, we need to think about what sort of failures there could be. Let's break these into three types: *regional failure*, *sector failure*, or *complete failure*. In the case of the last of these, the government's response is pretty clear: bring out the armed forces and take control of the country until people are safe and have power, food, and heat. In the case of the other two types of failures, it was not clear what to do. Suppose that there was a failure in the financial markets, or even a whiff of one. You might get a run on the banks. Alternatively, a failure in the natural gas network might lead to many homes without heat. Panic might take the form of runs on gasoline or firewood.

Regional failure was the most likely outcome and the most troubling from a policy standpoint. Lack of power and heat and no access to money could lead to riots. The government would have to prevent riots by quickly getting resources to people and it might be in the government's interest to less than fully disclose the severity of problems.

2.6 Feedback

The models so far consider contagious people who spread some idea or disease. But in some cases, the more often that you run into someone who has the disease the more contagious you become. This feedback is especially important in the spread of new words or phrases. The more we hear a word, the more we spread it. It may well be that before I spread something I have to hear it several times.

3 Summary

Diffusion models are used to describe fads, fashions, the spread of language, and diseases. What we can learn from constructing simple models is that the potential for something to diffuse depends upon

- Strength of belief system (culture)
- Discrete versus continuous signals: information cascade
- Awareness that you're spreading: Blair Witch Project, smallpox
- Duration of contagious period: small pox
- Number of susceptible people: genetics
- Structure of social network: see homework and next class

Homework Due Wednesday: Construct a model or models for the spread of silly jokes and for offensive jokes. You should have fun with this. Based on your models, which would spread faster?