Gossips, Gossips

Spreading Rumors in Social Networks

# Abstract

# Background

All humans are active agents in rumor spreading. While we generally think of rumors as high-school gossip or schoolyard trash talk, rumors can have a large impact. In late 2013, rumors regarding how China would react to the rise of Bitcoin greatly affected the price of the currency days before any official statements were made. During the 2008 presidential campaign, rumors about Senator Obama’s place of birth greatly affected the legitimacy of his candidacy. In March 2014, actor Wayne Wright had to publicly declare that he was in-fact not dead after rumors declaring otherwise spread through social networks. However, the spread of rumors is not always harmful. For example, the concept of viral marketing uses the quick spread of rumors through social media to promote goods and services by various companies.

Since the internet boom, the spread of rumors has greatly accelerated. With social products such as Facebook and Twitter, spreading a rumor from a friend halfway around the world is as easy as clicking a “share” button or “retweeting” a status update. Due to their well-defined user relationships, these products allow us to easily analyze the nature of such phenomena in ways we could not before.

# Model Equations

## Model 1

We will begin with an SIR model for Rumor Spreading. Consider a population consisting of N individuals which are subdivided into ignorants (I), spreaders (S), and stiflers (R).

Assumptions:

* The rumor spreads by direct contact of the spreaders with others in the population.
* The population size is constant during the lifetime of a rumor.
* Each person comes into contact with a percentage of the population k.
* Whenever a spreader contacts an ignorant, the ignorant becomes a spreader at a rate .
* When a spreader contacts another spreader or a stifler the initiating spreader becomes a stifler at a rate .

We may simplify the above model by reducing it to two equations since we are assuming the population is constant. We may make the substitution , where is a constant.

In this model, the only steady state is clearly along the line , and it is a stable steady state. This is because Ignorants depend on the presence of Spreaders for their population to change, and if there are no Spreaders, no additional Stiflers may be created.

GRAPH

## Model 2

In Model 1, we assumed that spreaders would become stiflers only if they were themselves stifled by another stifler or spreader. However, spreaders may also spontaneously decide to become stiflers for a variety of reasons. For example, the spreader may realize the rumor isn’t as exciting as it used to be, or the spreader may decide the rumor is harmful to a specific individual or group of people and feel guilty about continuing to spread it. To account for this, we may introduce a parameter to represent the rate at which a spreader may spontaneously decide to become a stifler.

Reducing this to a model of two variables as we did before, we attain the following equations:

Once again, the only steady state occurs along the line S = 0, and it is a stable steady state.

GRAPH

# Agent-Based Model

# Data Set + avg neighbors + size

# Model 3

## Algorithm

## Max\_iterations: why

## Percentage: why

## Avg: why

# Discussion of meaning/choice of parameters

# Results of Graph 0 + observations

We started with our training graph, graph 0. This graph had 334 nodes and an average of 17 friends per node. This graph was conveniently around the median for both number of nodes and average friends per node. For each of our 5 parameters, we ran the simulation with 3 different values per parameter, leading to a total of 243 simulations. From there, we pruned our results. First, we eliminated all stagnant graphs – graphs in which the populations did not change, which was generally caused by extreme values in our parameters. We then grouped various simulations together and sampled them, noting their interesting features and recording their parameter values.

CHART OF OBSERVATIONS

From here, we were able to reduce the parameters for our actual simulations, shown below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Spread Chance** | **Stifle Chance** | **Initial Number of Spreaders** | **Contact Fraction** | **Spontaneous Stifle Chance** |
| **Values** | 0.10, 0.50 | 0.001, 0.10 | 1, 25 | 0.05, 0.50 | 0, 0.20 |

# Discuss why we chose 3 specific graphs

# Results of specific graphs

# Conclusion