Data Driven Social Analytics: Jordan Harris

**Homework Session VI:**

-Consider the simple Bass model: dF(t) dt = (p + qF(t))(1 − F(t))

-All graphs in the paper seek to illustrate the adoption or infection of a contagion (e.g., a product, disease)

1. Plot the proportion of adoption F(t) as a function of time for p = 0.03 and q = 0.38.

Chart, line chart

Description automatically generated

Note: could not figure out how to get the s-curve with this question

(b) Plot the curve of new adoptions as a function of time. When does it peak?

Chart, histogram

Description automatically generated

As you can see here the number of new additions peaks on the 3rd day.

(c) Repeat the analysis for p = 0.3 and q = 0.1. What differences do you observe, especially in terms of the new adoptions over time? Why?

Chart, line chart

Description automatically generatedChart, line chart

Description automatically generated

In the figure in question A the slope of this graph is dependent of the choice of p and q result in a ‘trade-off’ affect. When the imitation value, q, increases relative to the innovation value, p, the peak may be much sooner or much later, and the slope may be smoothed out depending on p & q. When q is high the time to peak infection also increases while high values of (q/p the time will decrease.

2. Draw a small network of five nodes composed of a single component connected randomly

*Range of edge probabilities depicted: [0.33, 0.61, 0.71, 0.75, 0.82]*

(a) Compare the probability distribution of degrees with the probability that the neighbor of a random node has degree d. *Note: Zoom in for full effect*

Chart, line chart

Description automatically generatedChart, line chart

Description automatically generated

Chart, box and whisker chart

Description automatically generatedA picture containing shape

Description automatically generated

Chart, line chart

Description automatically generatedShape

Description automatically generated with low confidence

Chart, line chart

Description automatically generatedA picture containing polygon

Description automatically generated

Chart

Description automatically generated with medium confidenceA picture containing sky, day

Description automatically generated

(b) What are the implications of their differences in terms of diffusion?

|  |  |  |
| --- | --- | --- |
| Probability of edge creation | Frequency of Node Degree | Probability of Neighbor Degree |
| *0.33* | Degree: 0 Prob: 20%  Degree: 1 Prob: 80% | Degree: 0 Prob: 0%  Degree: 1 Prob: 100% |
| *0.61* | Degree: 2 Prob: 60%  Degree: 3 Prob: 40% | Degree: 2 Prob: 50%  Degree: 3 Prob: 50% |
| *0.71* | Degree: 2 Prob: 20%  Degree: 3 Prob: 80% | Degree: 2 Prob: 15%  Degree: 3 Prob: 86% |
| *0.75* | Degree: 3 Prob: 80%  Degree: 4 Prob: 20% | Degree: 2 Prob: 75%  Degree: 3 Prob: 28% |
| *0.82* | Degree: 4 Prob: 100% | Degree: 4 Prob: 100% |

What the table illustrates is that the ratios between [Node Degree : Neighbor’ degree favors the Neighbors. There is a higher probability for a neighbor to be of a higher and/or max degree than for a source node to be of that same degree. And a lower chance for a Neighbor node to be of a lower degree than a source node. This particular correlation is referred as the *Friendship Paradox.* Which describes the trend that on average your friends have more friends than you do. This paradox in relation to diffusion dynamics, can make it easier for a contagion to spread widely and even exponentially and serves as a great point of focus for prediction the spread of a contagion more so than direct measurement.