Modeling Influence in a Social Network: Metrics and Evaluation

1 Background

Social recommender systems use social networks to propagate information which significantly affects customers’ decision making. Since customers tend to get recommendation from the people they trust rather than automated recommender systems, we are motivated to use social recommender systems. Viral Marketing is a way of using customers to promote products in a market. We are looking for optimal marketing plan in which we find a set of most valuable nodes in the network which has the highest influence on their friend to infect the network.

2 Quantifying Influence

The probability of infection of a node $w$ from $v$ is given by:

$$Pr(Ret(w, i) | Ret(v, i)) = \lambda \times Interest(w, i) + \beta \times RepsharingRate(w) + \gamma \times trust(w, v)$$

The influence rank is defined as:

$$IR(v) = \frac{(1 - \alpha) \sum_{v' \in F(v)} IR(v')} {F(v)} + \alpha \times MOI(v)$$

$$MOI(v) = \sqrt{\frac{\sum_{v' \in F(v)} (ROA(v, v'))^2} {P(v)}}$$

Since the calculation of this rank is non-polynomial, we adapted the PageRank algorithm to calculate the influence rank in $O(n^2m)$.

3 Approximating Influence Rank

The PageRank Algorithm iteratively calculates the following equation until the error decreases to a defined threshold.

$$PR_{i+1} = \frac{1}{N} + \alpha \left( \frac{l(p_i, p_1)} {l(p_i, p_N)} \right) PR_i$$

4 Results

Spearman’s Correlation Pearson Correlation Relative Error

0.90 0.95 0.13

5 Conclusions

- Formal model for influence proposed.
- Influence Rank (IR) is recursive.
- Modified PageRank algorithm can accurately compute IR.

6 Future Work

- Consider a probabilistic diffusion model of information in a social network.
- Incorporation of semantics of proposed topics of transmission.
- Finding users with the highest capability for diffusion of information in a network.
- Using models in crisis predication and management.

7 References