Epidemics on Time-Varying Empirical Networks

Carl A. B. Pearson, Thomas J. Hladish
Emerging Pathogens Institute, University of Florida, Gainesville, FL

Introduction

Contact networks are intrinsically temporal, but we often analyze them as aggregated over time. This simplifies both analytical and simulation approaches, but with simulation approaches we may dis-aggregate with minimal additional complexity when the simulation is based on strictly empirical networks.

We have a large population, multi-year dataset for geo-temporal co-location, based on anonymized access to a municipal WiFi system. We use that data to explicitly consider compare the time evolution of network measures when aggregating on shorter time scales up to aggregating over the entire period. We then use the network as a time-varying, empirical backbone for simulating infection spread.

Placeholder

Image

Figure 1: The first figure should be a series of comparisons of network measures (e.g., degree distribution) for the totally aggregated network vs averaged values of the network aggregated at different time periods - 1 year, 1 month, 1 week, 1 day. May also want to do some heat charts of those measures through time, since the averages might hide neat insights like seasonality.

Materials

Should describe the data set here. Collection times, number of data points, assorted other counts, etc.

Methods

The network measures are derived in the standard way, with the edges aggregated on co-temporal, co-location within the varying windows.

The epidemic simulation is based on conventional network Susceptible-Infectious-Recovered simulation. We established the reference transmission probabilities by fitting to final sizes for typical influenza outbreaks in the associated city.

When simulating the epidemics, we randomly select an iniital infective. Infectives are uniformly infectious for a period of days τ, and while infectious spread the infection with transmission probability p to each of their suspectible neighboors each day. Who is in their neighboorhood, however, changes each day according to the empirical contact network.

Important Result

Comparison of the epidemic final size distribution and time evolution across some parameters, and in comparison to the same, with the same parameters, for the fully aggregated network.

Mathematical Section

Probably not relevant. Maybe restate the network measures? Diagram SIR flow?

Results

Placeholder

Image

Figure 2: This should be the figure showing the simulation results for aggregation on whole network vs having day-by-day networks. Probably should be two figures, one for final sizes and one for trajectories. If we have time, multiples of these for some parameter variation.

Conclusion

The aggregation of empirical observations has important implications for simulation results.

Additional Information

Maecenas ultricies feugiat velit non mattis. Fusce tempus arcu id ligula varius dictum.

- Curabitur pellentesque dignissim
- Eu facilisis est tempus quis
- Duis porta consequat lorem

References

[1] J. M. Smith and A. B. Jones.
Book Title.
Publisher, 7th edition, 2012.

[2] A. B. Jones and J. M. Smith.
Article Title.
Journal title, 13(52):123–456, March 2013.

Acknowledgements

Thank the data source + ARO grant that's paying for CABP to attend.

Contact Information

- Web: http://github.com/pearsonca/epidemics-4talk
- Email: cap10@ufl.edu, thladish@ufl.edu

PLACEHOLDER LOGO

PLACEHOLDER LOGO