Epidemic (Models) on Networks

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Yet Another Inadequate Placeholder, at the intersection of epidemic models and network data analysis.

Recommended (big picture):

- István Z. Kiss, Joel C. Miller and Peter L. Simon, *Mathematics of Epidemics on Networks: From Exact to Approximate Models*
- Mark E. J. Newman, "The spread of epidemic disease on networks", *Physical Review E* **66** (2002): 016128, arxiv:cond-mat/0205009

Recommended (close-ups):

- Frank Ball, Denis Mollison and Gianpaolo Scalia-Tomba, "Epidemics with Two Levels of Mixing", *Annals of Applied Probability* **7** (1997): 46–89
- Tom Britton, "Epidemic models on social networks -- with inference", arxiv:1908.05517
- Moez Draief and Laurent Massoulié, *Epidemics and Rumours in Complex Networks*
- Dean Eckles, Elchanan Mossel, M. Amin Rahimian, Subhabrata Sen, "Long ties accelerate noisy threshold-based contagions", arxiv:1810.03579
- Hao Peng, Azadeh Nematzadeh, Daniel M. Romero, Emilio Ferrara, "Network Modularity Controls the Speed of Information Diffusion", arxiv:1910.05870
- Thomas House, Matt J Keeling, "Epidemic prediction and control in clustered populations", *Journal of Theoretical Biology* **272** (2011): 1–7, arxiv:1012.1974
- Eben Kenah and James M. Robins, "Second look at the spread of epidemics on networks", *Physical Review E* **76** (2007): 036113, arxiv:q-bio.QM/0610057
- Seth A. Marvel, Travis Martin, Charles R. Doering, David Lusseau and M. E. J. Newman, "The small-world effect is a modern phenomenon", arxiv:1310.2636
- R. M. May and R. M. Anderson, "The Transmission Dynamics of Human Immunodeficiency Virus (HIV)", *Philosophical Transactions of the Royal Society of London B* **321** (1988): 565–607 [This remarkable paper is the oldest one I can find which works out the consequences for an SIR model of randomly-varying but uncorrelated node degrees (section 4.1). Thus for instance they show that this makes the epidemic threshold $\propto \frac{\text{mean degree}}{\text{mean squared degree}}$. There's a chunk of work in the physics literature from the early 2000s which is just re-discovering this. (More remarkably, May was of course trained as a theoretical physicist.) JSTOR.]
- Xiao-Long Peng, Xin-Jian Xu, Xinchu Fu, and Tao Zhou, "Vaccination intervention on epidemic dynamics in networks", *Physical Review E* **87** (2013): 022813, arxiv:1302.5979 ["Vaccination" here means random movement from a high-susceptibility state (the ordinary S) into a low-susceptibility state, and random movement back.]
- Laura M. Smith, Kristina Lerman, Cristina Garcia-Cardona, Allon G. Percus and Rumi Ghosh, "Spectral Clustering with Epidemic Diffusion", *Physical Review E* **88** (2013): 042813, arxiv:1303.2663
- Didia Vega-Oliveros, Luciano da F Costa and Francisco A. Rodrigues, "Rumor propagation with heterogeneous transmission in social networks", *Journal of Statistical Mechanics: Theory and Experiment* (2017): 023401, arxiv:1610.01012

Recommended, close-ups on "vaccination" / removal of nodes or edges to limit propagation:

- Reuven Cohen, Keren Erez, Daniel ben-Avraham, Shlomo Havlin
  - "Resilience of the Internet to random breakdowns", *Physical Review Letters* **85** (2000): 4626–4628, arxiv:cond-mat/0007048
  - "Breakdown of the Internet under intentional attack", *Physical Review Letters* **86** (2001): 3682–3685, arxiv:cond-mat/0010251
- Zhen Dai, Ping Li, Yan Chen, Kai Zhang, Jie Zhang, "Influential node ranking via randomized spanning trees", *Physica A* **526** (2019): 120625 [This is a purely numerical paper, but I find their centrality measure charmingly simple, and strongly suspect it's a Monte Carlo estimate of something more classical]
- Víctor M. Eguíluz and Konstantin Klemm, "Epidemic Threshold in Structured Scale-Free Networks", *Physical Review Letters* **89** (2002): 108701, arxiv:cond-mat/0205439 [But graphs generated by this model are very weird, and that's really what drives the results --- see Moreno and Vazquez (2003) below]
- Petter Holme, Beom Jun Kim, Chang No Yoon, and Seung Kee Han, "Attack vulnerability of complex networks", *Physical Review E* **65** (2002): 056109, arxiv:cond-mat/0202410
- Q. Nguyen, H. D. Pham, D. Cassi and M.Bellingeri, "Conditional attack strategy for real-world complex networks", *Physica A* **530** (2019): 121561
- N. Madar, T. Kalisky, R. Cohen, D. ben-Avraham, S. Havlin, "Immunization and epidemic dynamics in complex networks", *European Physical Journal B* **38** (2004): 269–276 [Not on arxiv? --- Interestingly, their "acquaintance" immunization strategy, which essentially uses the friendship paradox to preferentially immunize the high-degree nodes without having to know who they are, is the idea I "came up with" for the still-unpublished project code-named "Do not adjust your receiver". Since that idea came to me sometime around 2013, it's entirely possible I was guided by subconscious memories of this paper (hence my scare-quotes around "came up with"). I should finish that project.]
- Yamir Moreno, Alexei Vazquez, "Disease Spreading in Structured Scale-Free Networks", European Physical Journal B **31** (2003): 265–271, arxiv:cond-mat/0210362 [On Eguíluz and Klemm]
- Romualdo Pastor-Satorras and Alessandro Vespignani, "Immunization of complex networks", Physical Review E **65** (2002): 036104, arxiv:cond-mat/0107066
- Christian M. Schneider, Tamara Mihaljev, Shlomo Havlin, and Hans J. Herrmann, "Suppressing epidemics with a limited amount of immunization units" *Physical Review E* **84** (2011): 061911, arxiv:1102.1929 [Their method is to target the nodes (or edges) whose vaccination will result in the largest decrease in the number of susceptible nodes in the resulting connected component. I believe them that this lowers the probability of infection, compared to the Holme et al. strategy of targeting nodes with high betweenness, but the differences are frankly very small for their real-world networks]
- Sebastian Wandelt, Xiaoqian Sun, Daozhong Feng, Massimiliano Zanin & Shlomo Havlin, "A comparative analysis of approaches to network-dismantling", *Scientific Reports* **8** (2018): 13513

Noted without recommendation (and, unfairly, no explanation):

- Giannis Moutsinas, Choudhry Shuaib, Weisi Guo, Stephen Jarvis, "Graph hierarchy and spread of infections", arxiv:1908.04358

Disrecommended:

- Some future time, when I'm feeling meaner.

To read:

- Nino Antulov-Fantulin, Alen Lancic, Hrvoje Stefancic, Mile Sikic, Tomislav Smuc, "Statistical inference framework for source detection of contagion processes on arbitrary network structures", arxiv:1304.0018
- Frank Ball and David Sirl, "An SIR epidemic model on a population with random network and household structure, and several types of individuals", *Advances in Applied Probability* **44** (2012): 63–86
- Romulus Breban, Raffaele Vardavas and Sally Blower, "Linking population-level models with growing networks: A class of epidemic models", *Physical Review E* **72** (2005): 046110
- Fan Bu, Allison E. Aiello, Jason Xu, Alexander Volfovsky, "Likelihood-based Inference for Partially Observed Epidemics on Dynamic Networks", arxiv:1910.04221
- J. G. Caputo, A. Knippel, F. Mouatamide, M. Khaladi, "Analysis of an epidemic model on a network", arxiv:1906.07449
- Hocine Cherifi, Gergely Palla, Boleslaw K. Szymanski, Xiaoyan Lu, "On community structure in complex networks: challenges and opportunities", arxiv:1908.04901
- Kihong Chung, Yongjoo Baek, Daniel Kim, Meesoon Ha, Hawoong Jeong, "Generalized epidemic process on modular networks", arxiv:1312.0573
- Emilie Coupechoux, Marc Lelarge, "Contagions in Random Networks with Overlapping Communities", arxiv:1303.4325
- Leon Danon, Ashley P. Ford, Thomas House, Chris P. Jewell, Matt J. Keeling, Gareth O. Roberts, Joshua V. Ross, Matthew C. Vernon, "Networks and the Epidemiology of Infectious Disease", arxiv:1011.5950
- Xinchu Fu, Michael Small, Guanrong Chen, *Propagation Dynamics on Complex Networks: Models, Methods and Stability Analysis*
- Sergio Gomez, Jesus Gomez-Gardenes, Yamir Moreno, Alex Arenas, "Non-perturbative heterogeneous mean-field approach to epidemic spreading in complex networks", *Physical Review E* **84** (2011): 036105, arxiv:1106.6184
- Jason Hindes, Sarabjeet Singh, Christopher R. Myers, David J. Schneider, "Epidemic fronts in complex networks with metapopulation structure", arxiv:1304.4310
- Petter Holme, "Model versions and fast algorithms for network epidemiology", arxiv:1403.1011
- Thomas House, "Modelling Epidemics on Networks", arxiv:1111.4875
- Brian Karrer and M. E. J. Newman, "Message passing approach for general epidemic models", *Physical Review E* **82** (2010): 016101, arxiv:1003.5673
- Marcelo N. Kuperman, "Invited review: Epidemics on social networks", arxiv:1312.3838
- Hsuan-Wei Lee, Nishant Malik, Feng Shi, and Peter J. Mucha, "Social clustering in epidemic spread on coevolving networks", *Physical Review E* **99** (2019): 062301
- Longzhao Liu, Xin Wang, Yi Zheng, Wenyi Fang, Shaoting Tang, Zhiming Zheng, "Homophily on social networks changes evolutionary advantage in competitive information diffusion", arxiv:1908.05992
- Su-Yu Liu, Andrea Baronchelli, and Nicola Perra, "Contagion dynamics in time-varying metapopulation networks", *Physical Review E* **87** (2013): 032805
- Naoki Masuda, Konstantin Klemm, Víctor M. Eguíluz, "Temporal networks: slowing down diffusion by long lasting interactions", arxiv:1305.2938
- Joel C. Miller, Anja C. Slim, Erik M. Volz, "Edge-Based Compartmental Modeling for Infectious Disease Spread Part I: An Overview", *Journal of the Royal Society: Interface* **9** (2012): 890–906, *arxiv:1106.6320*
- Joel C. Miller, Erik M. Volz
  - "Edge-based compartmental modeling for epidemic spread Part II: Model Selection and Hierarchies", *Journal of Mathematical Biology* **67** (2013): 869–899, arxiv:1106.6319
  - "Edge-Based Compartmental Modeling for Infectious Disease Spread Part III: Disease and Population Structure", *PLoS ONE* **8** (2013): e69162, arxiv:1106.6344
- Sifat Afroj Moon, Faryad Darabi Sahneh, Caterina Scoglio, "Generalized group-based epidemic model for spreading processes on networks: GgroupEM", arxiv:1908.06657
- Géza Ódor, "Spectral analysis and slow spreading dynamics on complex networks", arxiv:1306.3401
- Romualdo Pastor-Satorras and Alessandro Vespignani
  - "Epidemic Spreading in Scale-Free Networks", *Physical Review Letters* **86** (2001): 3200–3203
  - "Epidemic dynamics and endemic states in complex networks", *Physical Review E* **63** (2001): 066117
- Joshua L. Payne, Kameron Decker Harris, and Peter Sheridan Dodds, "Exact solutions for social and biological contagion models on mixed directed and undirected, degree-correlated random networks", *Physical Review E* **84** (2011): 026110
- Prapanporn Rattana, Konstantin B. Blyuss, Ken T. D. Eames, Istvan Z. Kiss, "A Class of Pairwise Models for Epidemic Dynamics on Weighted Networks", *Bulletin of Mathematical Biology* **75** (2013): 466–490, arxiv:1208.6036
- Martin Ritchie, Luie Berthouze, Istvan Z. Kiss, "Beyond clustering: Mean-field dynamics on networks with arbitrary subgraph composition", *Journal of Mathematical Biology* **72** (2016): 255–281, arxiv:1405.6234
- Tim Rogers, "Maximum-entropy moment-closure for stochastic systems on networks", *Journal of Statistical Mechanics* (2011): P05007, arxiv:1103.4980
- Faryad Darabi Sahneh, Caterina Scoglio, Fahmida N. Chowdhury, "Effect of Coupling on the Epidemic Threshold in Interconnected Complex Networks: A Spectral Analysis", arxiv:1212.4194
- Mile Sikic, Alen Lancic, Nino Antulov-Fantulin, Hrvoje Stefancic, "Epidemic centrality and the underestimated epidemic impact on network peripheral nodes", arxiv:1110.2558
- Daniel Smilkov, Ljupco Kocarev, "The influence of the network topology on epidemic spreading", arxiv:1111.3176
- Daniel Smilkov, Cesar A. Hidalgo, Ljupco Kocarev, "Beyond network structure: How heterogenous susceptibility modulates the spread of epidemics", arxiv:1403.2708
- Michele Starnini, Anna Machens, Ciro Cattuto, Alain Barrat, Romualdo Pastor-Satorras, "Immunization strategies for epidemic processes in time-varying contact networks", arxiv:1305.2357
- Francesco Vincenzo Surano, Christian Bongiorno, Lorenzo Zino, Maurizio Porfiri, and Alessandro Rizzo, "Backbone reconstruction in temporal networks from epidemic data", *Physical Review E* **100** (2019): 042306
- Michael Taylor, Timothy J. Taylor, Istvan Z. Kiss, "Epidemic threshold and control in a dynamic network", *Physical Review E* **85** (2012): 016103, arxiv:1110.4000
- L. D. Valdez, L. A. Braunstein, S. Havlin, "Epidemic spreading on modular networks: the fear to declare a pandemic", arxiv:1909.09695
- Erik M. Volz, Joel C. Miller, Alison Galvani and Lauren Ancel Meyers, "Effects of Heterogeneous and Clustered Contact Patterns on Infectious Disease Dynamics", *PLoS Computational Biology* **7** (2011): e1002042
- Huijuan Wang, Qian Li, Gregorio D'Agostino, Shlomo Havlin, H. Eugene Stanley, Piet Van Mieghem, "Effect of the Interconnected Network Structure on the Epidemic Threshold", arxiv:1303.0781
- Damian H. Zanette, Sebastian Risau Gusman, "Infection spreading in a population with evolving contacts", arxiv:0711.0874