

IT 606 Social Networks and Epidemiology

Constructed vis-a-vis realized networks. Examples: Transportation, Communication, Biology, Health, Economics, Finance, Sociology; Basic Properties of networks: Degree, Clustering, Assortativity, Centrality, Modularity; Simple models of networks: Erdos-Renyi model (Random graphs), Watts-Strogatz model (Small-world networks), Barabasi-Albert model (Scale-free networks); Temporal networks and Multiplex networks: Examples: Economics, Finance, Sociology, Health, Disease spreading, Dynamical processes on networks: Diffusion on networks, Epidemiological models; Theoretical lectures to be followed by hands-on workshops on: (i) network simulations using R/Python, (ii) empirical data -- network construction, and (iii) network analyses using packages (Cytoscape, Gephi, etc.).

Classical epidemiological model (multi-compartmental models): SIR, SEIR and their extended models; Renormalization theory of infectious disease; Deterministic and stochastic analytical and computational methods of solving the epidemiological models: Equilibrium states, endemic properties, Oscillating properties, disease transmission; Epidemic waves: first, second etc and detection method/s; Immunity during infection; Reproduction number: method of calculation (from data and models); Epidemic forecasting: Malthus, Logistic, Gompertz, Winsor growth laws as means of forecasting; Epidemiological data: Data mining, Data analysis, Parameter estimation, Model fitting and forecasting; Epidemic model simulation: deterministic and stochastic simulation methods/software, Data modeling for intervention.

Recommended books:

1. *Data science and complex networks: real case studies with Python*. Guido Caldarelli and Alessandro Chessa (Oxford University Press, 2016)
2. *Network Science*. Albert-László Barabási (Cambridge University Press, 2016)
3. *A First Course in Network Science*. Filippo Menczer, Santo Fortunato, Clayton A. Davis (Cambridge University Press, 2020)
4. M. J. Keeling and P. Rohani. *Modeling infectious diseases in humans and animals* (Princeton University Press, 2011).
5. Anderson, R. M. & May, R. M. *Infectious Diseases of Humans* (Oxford Univ. Press, 1991).