Syllabus

Statistics 218

"Statistical Analysis of Networks"

The table below lists topics and readings. The weeks are approximate and will be adjusted during the quarter.

Textbooks

[K] Eric Kolaczyk "Statistical Analysis of Network Data" (2009). Springer.

Available electronically via UCLA.

[KCR] Eric Kolaczyk and Gabor Csardi "Statistical Analysis of Network Data with R" (2014). Springer. *Available electronically via UCLA.*

[EK] David Easley and Jon Kleinberg "Networks, Crowds, and Markets: Reasoning about a Highly Connected World" (2010). *Available free online.*

Week	Topic	Reading	Homework
1	**Introduction** Social science is the study of relationships and relationships can be represented via social networks	**K**, Ch 1 **KGR**, Ch 1 **EK,** Ch1 Radcliffe-Brown (1940): On Social Structure	Homework 1: Fundamentals of Network Descriptives
	Graph Concepts and Notation Nodes, ties (directed/undirected), sociomatrix, edge list, graph types (bipartite, affiliation).	**K**, Ch 2 **KGR**, Ch 2	
	Manipulating and Visualizing Graphs R network data types, sna and network packages reading and manipulating networks, plotting	**K**, Ch 3 **KGR**, Ch 3	
2	**Describing Graphs and Networks** degree, connectedness, cycles, centrality, betweenness, etc. Computing descriptive statistics	**K**, Ch 4 **KGR**, Ch 4 Sunbelt handout	Homework 2: Network descriptives
	Elementary Stochastic Models for Networks Model 1: Reney-Erdos: p(tie) is constant, independent: joint distribution model, logistic model Model 2: Different types of nodes with different probabilities of ties	**K**, Ch 6.1-6.2 **KGR**, Ch 5.1-5.2	

	Model 3: Vertex covariates model (logistic regression) Inference for models		
3	**Motivation** Overview of the use of social networks to model social structure important for understanding the spread of HIV.	Local Acts, Global Consequences: Networks and the Spread of HIV	
	Modeling Cohesive Subgroups arbitrary mixing groups known a priori likelihood inference	**K**, Ch 6.3 **KGR**, Ch 6.3	
4	**Modeling Cohesive Subgroups continued** multiple groups unknown (latent class model)	Nowicki, K. and Snijders (2001). Estimation and prediction for stochastic block models.	

Week	Topic	Reading	Homework
5	**Models for Fundamental Social Forces** 1. Centrality (degree centrality, eigenvalue centrality) 2. Sociality (undirected) 3. Prestige (directed) 4. Mutuality (directed)	W&F Chapter 5	Homework 4 Example Renyi-Erdos, vertex attributes, mixing
6	**Modeling Cohesive Groups in Social Space** Network position (latent social space, probability of a tie proportional to distance) 1-dimensional continuous observed 2-dimensional continuous observed 2-dimensional continuous unobserved latent space cluster models Additive and multiplicative effects models	Hoff, Raftery, & Handcock (2001) Hoff, P.D. (2018) "Additive and multiplicative effects network models". arXiv:1807.08038.	Homework 5 a) Latent class model b) centrality model
7	**Introduction to general ERGM framework** general form conditional independence models: Markov models, Hammersley-Clifford Tapered ERGM 1. Simulation of network via MCMC 2. Likelihood-based inference 3. Maximum likelihood and Bayesian inference	Hunter (2003)	Homework 6 Latent space models
8	**Structure of triads: Triad Census (Davis-Holland-Leinhardt)** transitivity balance model (Heider) Simmel model	W&F Chapter 14	

	Mores sophisticated structural forms cycles, triangles, gwsp, dsp, esp, stars	Snijders et al (2006)	Homework 7 ERGM theory and MCMC, simulation of graphs
9	**Latent Order Logistic (LOLOG) Models**	Fellows (2018)	
10	**Goodness of fit of ERGMs and LOLOG**	Hunter, Goodreau, & Handcock (2006)	
	Inference for partially observed networks	Handcock and Gile (2010), Gile and Handcock (2017)	
11	**Sampling of networks (design)** ego-centered, link tracing	Gile and Handcock (2008); Frank (2004) Chapter 4	Homework 8 Triad census Heider vs. Simmel More sophisticated models
Extra	**Network Dynamics** **Summary**		Homework 9 Goodness of fit sampling examples