Econometric Methods for Social Spillovers and Networks

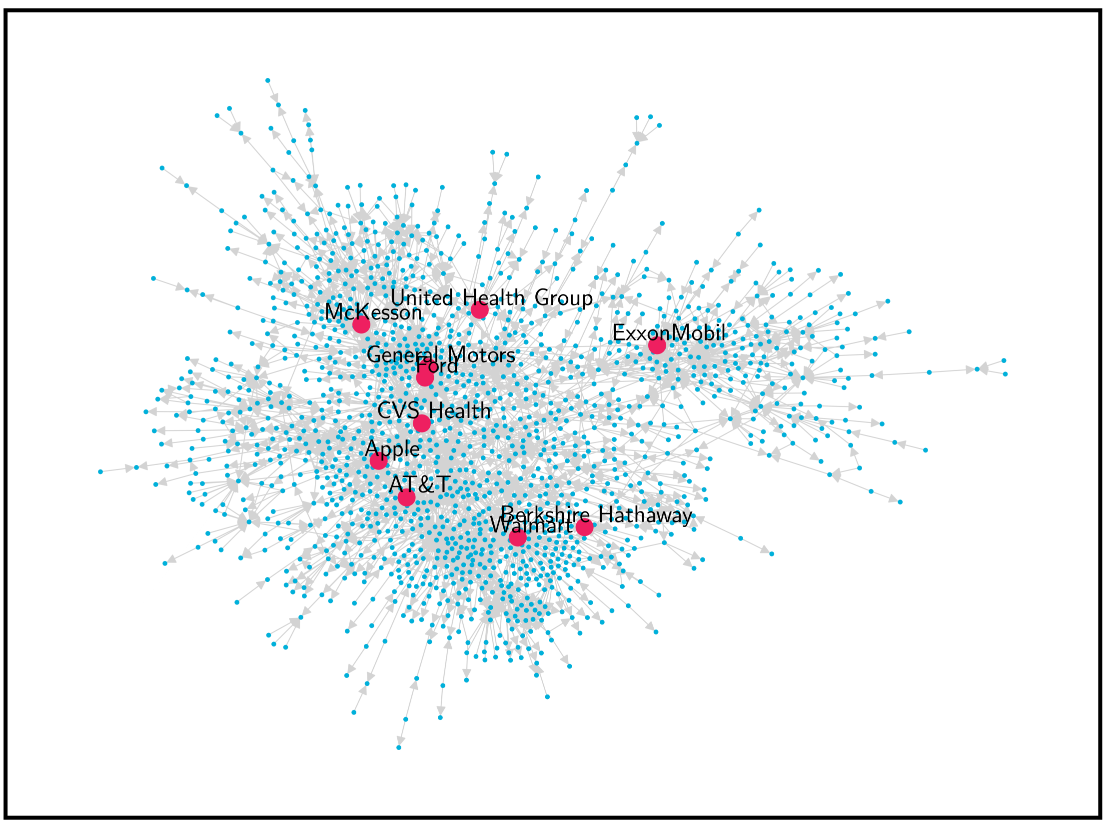
University of St. Gallen

September 28th to October 5th, 2020

"In a real sense all life is inter-related. All men are caught in an inescapable network of mutuality, tied in a single garment of destiny. Whatever affects one directly, affects all indirectly." - Martin Luther King, *Letter from Birmingham Jail*

Course Description

This course will provide an overview of econometric methods appropriate for the analysis of social and economic networks. Many social and economic activities are embedded in networks. Furthermore, datasets with natural graph theoretic (i.e., network) structure are increasingly available to researchers. We will focus on (i) descriptive analysis of network data, (ii) dyadic regression methods, (iii) econometrics models of network formation admitting agent-specific heterogeneity and/or strategic interaction, and (iv) econometrics models of social interaction or peer group effects.



Course Logistics

Instructor: Bryan Graham, Department of Economics, University of California - Berkeley

Email: `bgraham@econ.berkeley.edu`

Time: To be determined. Due to the COVID-19 pandemic class will be held virtually using the ZOOM platform.

Prerequisites: The equivalent of a first year Ph.D. level sequence in econometrics. Specifically an understanding of probability and statistical inference at the level of Casella and Berger (1990, *Statistical Inference*), linear regression analysis at the level of Goldberger (1991, *A Course in Econometrics*) and some exposure to non-linear models (e.g., maximum likelihood, M-estimation, GMM). I will also assume a basic knowledge of applied linear/matrix algebra. Exposure to the theory of U-Statistics is useful, but not required.

Textbook: Readings preceded by a [r] in the course outline are "required" (i.e., should ideally be read prior to class), while those preceded by a [b] are for "background" (i.e., may be useful for students interested in additional material or empirical applications). Students may find the book by Graham & de Paula (2020a) useful (available for purchase here). We will also make extensive use of my recent *Handbook of Econometrics* chapter (Graham, 2020b). This chapter is available in draft form on the arXiv here. Students who anticipate doing research involving networks should consider purchasing the textbooks by Jackson (2006) and Newman (2010), but doing so is not necessary. The survey by Goldenberg et al. (2009) covers much of the technical literature in statistics and machine learning, but is now somewhat dated.

GitHub: Supplemental course materials, including slides, lecture nodes and computer programs, will be made available on GitHub at `https://github.com/bryangraham/short_courses`.

Computation: The bulk of class will be devoted to the formal development of the material, albeit with empirical illustrations as well as ample discussions of the various practicalities of implementation. However I do intend to reserve some class time for actual practice with computation. Computational examples will be done using Python. Python is a widely used general purpose programming language with good functionality for scientific computing. For those wishing to manage a Python environment on their personal computer, the Anaconda distribution, which is available for download at https://www.anaconda.com/distribution/, is a convenient way to get started. Some basic tutorials on installing and using Python, with a focus on economic applications, can be found online at `http://quant-econ.net`. Good books for learning Python, with some coverage of statistical applications, are Guttag (2013), VanderPlas (2017), and McKinney (2017). The code I will provide will execute properly in Python 3.6, which is (close to) the latest Python release.

Grades: Grades will reflect a combination of in class participation and performance on a final take-home assessment. Details of the final assessment will be provided in class.

Course Outline (Tentative/Subject to Revision)

Date	Topic	Readings
9/28	**Describing Networks**	[r] Jackson et al. (2017)
		[b] Goyal et al. (2016)
	Examples of networks	[b] Atalay et al. (2011); Mizuno et al. (2014)
		[b] Apicella et al. (2012); Marotta et al. (2015)
		[b] Seongjoo (2019)
	Small worlds	[b] Milgram (1967)
	Degree distributions	[b] Mitzenmacher (2004)
	Homophily	[b] McPherson et al. (2001)
	Triads	[b] Granovetter (1973); Jackson et al. (2012)
		[b] Holland & Leinhardt (1976)
9/28	**Centrality, Shocks & Diffusion**	[r] Graham & de Paula (2020b)
		[r] Carvalho & Tahbaz-Salehi (2019)
		[b] Jackson & Zenou (2015); König et al. (2019)
		[b] Galeotti et al. (2020)
		[b] Kim et al. (2015), [b] Carvalho et al. (2020)
		[b] Acemoglu et al. (2012, 2016)
9/29	**Dyadic Regression**	[r] Graham (2020b, Sections 3 & 4)Graham et al. (2019)
		[r] Graham (2020a), Menzel (2017)
		[b] Fafchamps & Gubert (2007); Aronow et al. (2017)
		[b]Rose (2004); Santos Silva & Tenreyro (2006)
9/30	**Causal Effects**	[r] Graham (2020b, Sections 5 & 6)
		[r] Santos Silva & Tenreyro (2010)
9/30	**Heterogeneity**	[r] Graham (2017), [b] Chatterjee et al. (2011)
		[b] Dzemski (2018), Jochmans (2018)

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Date	Topic	Readings
10/1	**Network Statistics** *(Estimation & Inference)*	[r] Holland & Leinhardt (1976), [b] Picard et al. (2008) [r] Graham (2020b, Sections 2 & 7) [b] Bickel et al. (2011); Bhattacharya & Bickel (2015)
10/2	**Strategic Interaction:**	[r] de Paula (2020) [r] Graham (2020b, Section 8) [r] Pelican & Graham (2019); Graham & Pelican (2020) [r] Blitzstein & Diaconis (2011); McDonald et al. (2007) [r] Miyauchi (2016); de Paula et al. (2018) [r] Christakis et al. (2020)
10/5	**Peer Effects**	[r] Manski (1993); Bramoullé et al. (2009) [b] Bramoullé et al. (2020); Graham (2018) [b] Angrist (2014), [b] Graham (2008)
10/5	**Sorting & Complementarity**	[r] Graham et al. (2010, 2018) [r] Jochmans & Weidner (2019) [r] Bonhomme et al. (2019) [r] Graham et al. (2020)

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