ECON7217

Economic Analysis of Social Networks

National Taiwan University, 2nd Semester 2023-2024

Time & Room:
Lecture on Tuesday 9:10AM - 12:10PM at Social Sciences Bldg. 507

Instructor:
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Office Hours:
Mon 1:30 pm to 3:00 pm or by appointment at Social Sciences Bldg.826

Course Overview:
In this course, I will introduce state-of-the-art economic empirical analysis on social networks. Reflected by the rapidly growing number of network studies in different economic fields, including labor, health, development, I.O., international, and financial economics, social (or economic) networks have now become attractive and must-know subjects for graduate students in economics, particularly when network data become widely available in this era.

We will begin this course by learning the characterization of networks. Next, we will discuss various empirical approaches for network data, including network sampling, community (cluster) detection, modeling network (spillover) effects, network formation, etc. Before the end of this course, we will discuss policy implications from a few classic network studies.

Throughout this course, students not only learn statistical models for networks, but also learn how to use the statistical software R to collect, arrange, and analyze network data. Students will also learn graphical software such as Gephi and yEd to visualize network data.

Learning Outcomes:
After completing this course, students should be:

1. Acquainted with basic terminologies in social and economic network analysis.
2. Familiar with the theoretical development of network games
3. Able to perform econometric regressions on network data and provide economic interpretations.
4. Able to use software R to collect data and conduct network analysis.

Requirements:

1. Course participation 20%
   There will be attendance check in every lecture. There will be several on and off-class assignments which exercise the use of R and its network-related packages

2. Course presentation 30%
   Students should present one article from the reference list (or a relevant paper approved by the instructor). There will be peer evaluations.

3. Research proposal 50%
   Students have to hand in one research proposal at the end of the semester. Students should meet and discuss their proposals with the instructor at least once before submission.

Textbook:

No specified required textbooks

Recommended readings:

<u>Books and Surveys</u>

1. Blume, L. E., Brock, W. A., Durlauf, S. N., & Ioannides, Y. M. (2011). Identification of social interactions. In *Handbook of Social Economics* (Vol. 1, pp. 853-964). North-Holland.
2. Borgatti, S. P., Everett, M. G., and Johnson, J. C. *Analyzing Social Networks*, Sage, 2013
3. Bramoulle, Yann, Andrea Galeotti, and Brian Rogers. *The Oxford Handbook of the Economics of Networks*. Oxford University Press, 2016.
4. De Paula (2017). Econometrics of Network Models**,** In B. Honore, A. Pakes, M. Piazzesi and L. Samuelson (Eds.), *Advances in Economics and Econometrics: Theory and Applications*: Eleventh World Congress (Econometric Society Monographs, pp.268-323), Cambridge: Cambridge University Press
5. Goldenberg, A., Zheng, A. X., Fienberg, S. E., & Airoldi, E. M. (2010). A survey of statistical network models. *Foundations and Trends® in Machine Learning*, *2*(2), 129-233.
6. Hsieh, C.S., Lin, X., and Patacchini, E. (2019). Social Interaction Methods. in *Handbook of Labor, Human Resources and Population Economics.*
7. Matthew, Jackson. *Social and Economic Networks*, Princeton University Press, 2008.
8. Matthew, Jackson and Zenou, Yves. *Games on Networks*, Handbook of Game Theory, Vol. 4, Amsterdam: Elsevier, 2014.

9. Kolaczyk, E. D., *Statistical Analysis of Network Data: Method and Models*, Springer, 2009.
10. Kolaczyk, E. D. and Csardi, G., *Statistical Analysis of Network Data with R*, Springer, 2014.
11. Newman, M. (2010) *Networks: An Introduction*, Oxford University Press

Reference Papers:

Social Interactions and Network Effects

I1 Arcidiacono, P., Foster, G., Goodpaster, N., & Kinsler, J. (2012). Estimating spillovers using panel data, with an application to the classroom. *Quantitative Economics*, *3*(3), 421-470.
I2 Ballester, C., Calvó-Armengol, A., & Zenou, Y. (2006). Who's who in networks. Wanted: The key player. *Econometrica*, *74*(5), 1403-1417.
I3 Banerjee, A., Chandrasekhar, A. G., Duflo, E., & Jackson, M. O. (2013). The diffusion of microfinance. *Science*, *341*(6144), 1236498.
I4 Boucher, V., Bramoullé, Y., Djebbari, H., & Fortin, B. (2014). Do peers affect student achievement? Evidence from Canada using group size variation. *Journal of Applied Econometrics*, *29*(1), 91-109.
I5 Calvó-Armengol, A., Patacchini, E., & Zenou, Y. (2009). Peer effects and social networks in education. *The Review of Economic Studies*, *76*(4), 1239-1267.
I6 Cingano, F., & Rosolia, A. (2012). People I know: job search and social networks. *Journal of Labor Economics*, *30*(2), 291-332.
I7 Conti, G., Galeotti, A., Mueller, G., & Pudney, S. (2013). Popularity. *Journal of Human Resources*, *48*(4), 1072-1094.
I8 De Giorgi, G., Pellizzari, M., & Redaelli, S. (2010). Identification of social interactions through partially overlapping peer groups. *American Economic Journal: Applied Economics*, *2*(2), 241-75.
I9 De Giorgi, G., Frederiksen, A., & Pistaferri, L. (2020). Consumption network effects. *The Review of Economic Studies*, *87*(1), 130-163.
I10 Ductor, L. (2015). Does co-authorship lead to higher academic productivity? *Oxford Bulletin of Economics and Statistics*, *77*(3), 385-407.
I11 El-Khatib, R., Fogel, K., & Jandik, T. (2015). CEO network centrality and merger performance. *Journal of Financial Economics*, *116*(2), 349-382.
I12 Engelberg, J., Gao, P., & Parsons, C. A. (2012). Friends with money. *Journal of Financial Economics*, *103*(1), 169-188.
I13 Hsieh, Chih-Sheng, and Lee, Lung fei (2016). "A social interactions model with endogenous friendship formation and selectivity," *Journal of Applied Econometrics*, 31(2), 301-319.
I14 Larcker, D. F., So, E. C., & Wang, C. C. (2013). Boardroom centrality and firm performance. *Journal of Accounting and Economics*, *55*(2-3), 225-250.
I15 Lin, X. (2010). Identifying peer effects in student academic achievement by spatial autoregressive models with group unobservables. *Journal of Labor Economics*, *28*(4), 825-860.

I16 Liu, X., Patacchini, E., & Zenou, Y. (2014). Endogenous peer effects: local aggregate or local average? *Journal of Economic Behavior & Organization*, *103*, 39-59.
I17 Patacchini, E., Rainone, E., & Zenou, Y. (2017). Heterogeneous peer effects in education. *Journal of Economic Behavior & Organization*, *134*, 190-227.

Static Network Formation Models

S1 Caimo, A., & Friel, N. (2011). Bayesian inference for exponential random graph models. *Social Networks*, *33*(1), 41-55.
S2 Graham, B. S. (2017). An econometric model of network formation with degree heterogeneity. *Econometrica*, *85*(4), 1033-1063.
S3 Handcock, M. S., Raftery, A. E., & Tantrum, J. M. (2007). Model-based clustering for social networks. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *170*(2), 301-354.
S4 Hoff, P. D., Raftery, A. E., & Handcock, M. S. (2002). Latent space approaches to social network analysis. *Journal of the American Statistical Association*, *97*(460), 1090-1098.
S5 Hoff, P. D., & Ward, M. D. (2004). Modeling dependencies in international relations networks. *Political Analysis*, *12*(2), 160-175.
S6 Hoff, P. D. (2005). Bilinear mixed-effects models for dyadic data. *Journal of the American Statistical association*, *100*(469), 286-295.
S7 Mele, A. (2017). A structural model of dense network formation. *Econometrica*, *85*(3), 825-850.
S8 Raftery, A. E., Niu, X., Hoff, P. D., & Yeung, K. Y. (2012). Fast inference for the latent space network model using a case-control approximate likelihood. *Journal of Computational and Graphical Statistics*, *21*(4), 901-919.
S9 Rastelli, R., Friel, N., & Raftery, A. E. (2016). Properties of latent variable network models. *Network Science*, *4*(4), 407-432.
S10 Robins, G., Snijders, T., Wang, P., Handcock, M., & Pattison, P. (2007). Recent developments in exponential random graph (p*) models for social networks. *Social Networks*, *29*(2), 192-215.

Dynamic Network Formation Models

D1 Hanneke, Steve; Fu, Wenjie; Xing, Eric P. (2010) Discrete temporal models of social networks. *Electron. J. Statist.* 4 , 585–605.
D2 Han, X., Hsieh, C. S., & Ko, S. I. (2019). Spatial modeling approach for dynamic network formation and interactions. *Journal of Business & Economic Statistics*, forthcoming.
D3 Niezink, N. M., Snijders, T. A., & van Duijn, M. A. (2019). No longer discrete: Modeling the dynamics of social networks and continuous behavior. *Sociological Methodology*, *49*(1), 295-340.
D4 Sewell, D. K., & Chen, Y. (2015). Latent space models for dynamic

networks. *Journal of the American Statistical Association*, *110*(512), 1646-1657.
D5 Sewell, D. K., & Chen, Y. (2016). Latent space models for dynamic networks with weighted edges. *Social Networks*, *44*, 105-116.
D6 Snijders, T. A., Van de Bunt, G. G., & Steglich, C. E. (2010). Introduction to stochastic actor-based models for network dynamics. *Social networks*, *32*(1), 44-60.
D7 Snijders, T. A., Van de Bunt, G. G., & Steglich, C. E. (2010). Introduction to stochastic actor-based models for network dynamics. *Social networks*, *32*(1), 44-60.

Network Sampling

N1 Snijders, T. A. (1992). Estimation on the basis of snowball samples: how to weight?. *Bulletin of Sociological Methodology/Bulletin de Méthodologie Sociologique*, *36*(1), 59-70.
N2 Kossinets, G. (2006). Effects of missing data in social networks. *Social networks*, *28*(3), 247-268.
N3 Gile, K. J., & Handcock, M. S. (2010). 7. Respondent-driven sampling: An assessment of current methodology. *Sociological methodology*, *40*(1), 285-327.

Community Detection in Network Data

C1 Airoldi, E. M., Blei, D. M., Fienberg, S. E., & Xing, E. P. (2008). Mixed membership stochastic blockmodels. *Journal of Machine Learning Research*, *9*(Sep), 1981-2014.
C2 Airoldi, E. M., Blei, D. M., Fienberg, S. E., & Xing, E. P. (2008). Mixed membership stochastic blockmodels. *Journal of Machine Learning Research*, *9*(Sep), 1981-2014.
C3 Blondel, V. D., Guillaume, J. L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment*, *2008*(10), P10008.
C4 Newman, M. E. (2006). Modularity and community structure in networks. *Proceedings of the National Academy of Sciences*, *103*(23), 8577-8582.
C5 Nowicki, K., & Snijders, T. A. B. (2001). Estimation and prediction for stochastic block structures. *Journal of the American Statistical Association*, *96*(455), 1077-1087.

Class Rules:

1. Students are responsible for announcements made in class and via E-mail.
2. We will use NTU COOL as our online course platform. All lecture materials can be downloaded from it.
3. Late submission of the research proposal will result in a grade deduction.

Software:

We will use the statistical software R to learn network analysis. A basic tutorial of R can be found at http://data.princeton.edu/R/. The recommended reading *Statistical Analysis of Network Data with R* provides details of network analysis in R.

Tentative Lecture Schedule:

Week 1 (2/20): Introduction and characterization of social networks

Week 2 (2/27): Regression with network data

Week 3 (3/05): Network interactions

Week 4 (3/12): Network interactions (continued)

Week 5 (3/19): Static network formation

Week 6 (3/26): Static network formation (continued)

Week 7 (4/02): Student Presentation

Week 8 (4/09): Dynamic network formation

Week 9 (4/16): Dynamic network formation (continued)

Week 10 (4/23): Network sampling

Week 11 (4/30): Network sampling

Week 12 (5/07): **No Class**

Week 13 (5/14): Community detection

Week 14 (5/21): Community detection (continued)

Week 15 (5/28): Student Presentation

Week 16 (6/04): Student Presentation