47951: Doctoral Seminar in Information Systems I

Structural Network Analysis

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***Timing of the class will be decided after discussion with students who register for the class. Class will meet two times per week.

This seminar is intended as a theoretical and analytical introduction to structural network analysis. Social Network analysis is an up and coming area in Information Systems research and other business areas such as marketing and finance. The focus in business has been on analyzing the causes and consequences of social relationships. With respect to causes, the focus is on how individual incentives, demography, and homophily, and structural properties affect the formation of network ties. From a consequence perspective, the focus is on how social relationships affect economic outcomes such as performance, output and adoption and diffusion of products, information and practices. After taking this class, you would be able to conduct in-depth social network analysis of communities such as customer networks, peer to peer networks, open source developer networks, knowledge sharing communities.

The tools and theoretical foundation of social networks analysis have been developed in sociology. Essentially, network analysis focuses on patterns of relations between actors. Both relations and actors can be defined in many ways, depending on the substantive area of inquiry. For example, network analysis has been used to study the structure of affective links between persons, flows of commodities between organizations, shared members between social movement organizations, shared needles between drug users, the citation structure in academic disciplines, and the world wide web. What is central is an emphasis on the structure of relationality, which serves to link micro- and macro-level processes. We will spend the early part of the course becoming familiar with the theoretical foundations of structural network analysis, including principles of balance and transitivity, homophily, the implications of connectivity and density, the relationship between categories and networks, the nature of exchange structures, and power and centrality. The rest of the course will be devoted to specific substantive applications of the network approach. Though the focus of the course is on theory, it is impossible to make progress without paying attention to some of the technical innovations in network analysis. Thus we will also address methodological issues in passim along the way.

Requirements

There are three requirements of this course:

1. For each class a student has to present a pre-assigned paper to the class (15-20 minutes presentation, 4-5 slides). The student will be graded on the clarity with which he/she presents the paper and the questions that he/she raises and answers for others. There will be some papers which will be assigned to the whole class. we will discuss them in class. Students will be graded on their understanding of the papers. Both these things will account for 20% of the class grade.

2. The second requirement of this course is to write a seminar paper (15-20 pages) that explores some aspect of network theory. Ideally this paper will serve as the background for empirical study of some phenomenon you are interested in. I will ask for updates on your topic and progress throughout the quarter. Please talk to me if you are at loss in terms of what to write about; I can help you find a topic. This accounts for 40% of the class grade.

3. The third requirement of this course is writing a critique of a working paper. This assignment would be take home. The students would be graded on theoretical aspect of their critique. This accounts for 40% of the class grade.

Of course active participation in this seminar is expected!!

READINGS AND SOFTWARE

The basic reference for this class is Wasserman and Faust's book, Social Network Analysis (1994, Cambridge University Press). It is readily available at trade bookstores and through on-line booksellers including Barnes and Noble (www.bn.com) and Amazon (www.amazon.com). I strongly encourage you to buy it; it is a good book to have on your shelf. Other readings can be found in book chapters or journal articles. For many of these you will be able to download the text from JSTOR (www.JSTOR.org), ProQuest, or another electronic full-text service. Photocopies of other assigned readings will be made available. I have put a great deal of reading on the preliminary syllabus, in part to introduce you to the traditions and diversity of structural analysis. However, we will identify the key readings for each week in advance. In addition to Wasserman and Faust, you might want to pick up a copy of John Scott's book, Social Network Analysis: A Handbook (1991, Sage Press) which is a very readable introduction to networks and a useful guide. I can also recommend other good reference books that will help you become familiar with social network analysis.

The reading list is provided. As you will note that there are very few Information Systems papers in the list. It is due to two reasons. One the seminar papers in this area have been published in Sociology. Second, it is an up and coming area in Information Systems and other disciplines such as Finance, and Marketing and most of the papers in these areas are still unpublished. I will point you to interesting working papers in business throughout the course. I have also provided a list of recent social networks work in IS, marketing and finance after the reading list.

COURSE OUTLINE

N.B. I consider this outline a work-in-progress. I will revisit it regularly and modify as necessary to take into consideration the substantive interests of members of the seminar.

Reading List

Week 1: Lecture 1

Social Network Notation & Basic Definitions

Wasserman and Faust Chapter 2 and 4. in Wasserman and Faust, Social Network Analysis. Cambridge University Press.

Centrality

Wasserman and Faust Chapter 5. in Wasserman and Faust, Social Network Analysis. Cambridge University Press.

Freeman, Linton. 1979. Centrality in Social networks: conceptual clarification. *Social Networks*. 1:215-240.

Bonacich, P. 1987. Power and Centrality: A Family of Measures. *American Journal of Sociology* 92:1170-1182.

Borgatti, S.P. 2005. Centrality and network flow. *Social Networks*. 27(1): 55-71.

Week 1: Lecture 2

Cohesive Subgroups

Wasserman and Faust Chapter 6 and 7.

Frank, K. A. and J. Y. Yasumoto. 1998. Linking Action to Social Structure Within a System: Social Capital Within and Between Subgroups. *American Journal of Sociology* 104:642-86.

Week 2: Lecture 1

Roles and Categories

Wasserman and Faust. 1994. Chapters 9, 10, and 11 in Wasserman and Faust, Social Network Analysis. Cambridge University Press.

White, Harrison, Scott Boorman, and Ron Breiger. 1976. Social Structure from multiple networks. I. Blockmodels of roles and positions. *American Journal of Sociology* . 81:730-779.

Baker, Wayne and Robert Faulkner. 1991. Role as Resource in the Hollywood Film Industry. *American Journal of Sociology*. 97:279-309.

Week 2: Lecture 2

Social Capital

James Coleman. 1988. Social Capital in the Creation of Human Capital. *American Journal of Sociology* 94:S95-S120.

Ron Burt. Structural Holes versus Network Closure as Social Capital.
http://faculty.chicagobooth.edu/ronald.burt/research/SHNC.pdf

Joel Podolny, Toby E. Stuart, and Michael T. Hannan. 1996. Networks, Knowledge, and Niches: Competition in the Worldwide Semiconductor Industry, 1984-1991, *American Journal of Sociology* 102: 659-89.

Joel Podolny. Networks as the Pipes and Prisms of the Market. *American Journal of Sociology* 107 (1) 33-60

Ray E. Reagans, Bill McEvily, Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly*, 2003

Ray E. Reagans, Bill McEvily, Ezra Zuckerman. How to Make the Team: Social Networks vs. Demography as Criteria for Designing Effective Projects. *Administrative Science Quarterly* 2004.

Week 3: Lecture 1

Embeddedness

Granovetter, Mark S. 1985. Economic Action and Social Structure: The Problem of Embeddedness. *American Journal of Sociology* 91:481-510.

Peter Moron. Structural vs. Relational Embeddedness: Social Capital and Managerial Performance. *Strategic Management Journal* 26(12) 1129-1151

Rajdeep Grewal, Gary L. Lilien, and Girish Mallapragada. Location, Location, Location: How Network Embeddedness Affects Project Success in Open Source Systems *Management Science*, July 2006; 52: 1043 - 1056.

Kollock, Peter. 1994. The Emergence of Exchange Structures: An experimental study of uncertainty, commitment, and trust. *American Journal of Sociology* 100: 313-345.

Jungpil Hahn, Jae Yun Moon, and Chen Zhang. Emergence of New Project Teams from Open Source Software Developer Networks: Impact of Prior Collaboration Ties. *Information Systems Research*, September 2008; 19: 369 - 391.

Lin, M., N. Prabhala, S. Vishwanathan. Judging borrowers by the company they keep: Social networks and adverse selection in online peer-to-peer lending.
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1355679

Week 3: Lecture 2

Diffusion I

David Strang and Nancy Tuma. 1993. Spatial and temporal heterogeneity in diffusion. *American Journal of Sociology*, 99: 614-639

Greve, H. 2005. Interorganizational learning and heterogeneous social structure. *Organizational Studies* 26 1025-1049

Leenders, R. 2002. Modeling social influence through network autocorrelation: Constructing the weight matrix. *Social Networks* 24, 21-47.

Week 4: Lecture 1

Diffusion II

Strang and Soule. 1998. Diffusion in organizations and social movements: From hybrid corn to poison pills. *Annual Review of Sociology.*

Wejnert, B. 2002. Integrating Models of Diffusion of Innovations: A Conceptual Framework. *Annual Review of Sociology*

Knoke, D. 1982. The Spread of Municipal Reform: Temporal, Spatial, and Social Dynamics. *American Journal of Sociology* 87 pp1314-1339.

Myers, D.J. 2000. The diffusion of collective violence: Infectiousness, susceptibility, and mass media networks. *American Journal of Sociology*, 106 173-208.

Param Vir Singh & Corey Phelps (2007) Determinants of Open Source Software Development License Choice: A Social Influence Perspective.

Week 4: Lecture 2

Diffusion III:Adoption of Tetracycline Series

Coleman, James, Elihu Katz, & Herbert Menzel 1957 The Diffusion of Innovation among Physicians. *Sociometry*, 20: 253-270.

Burt, Ron S. 1987 Social contagion and innovation: Cohesion versus structural equivalence. *American Journal of Sociology*, 92: 1287-1335.

Van den Bulte, C. & Lilien, G.L. 2001. Medical innovation revisited: Social contagion versus marketing effort, *American Journal of Sociology*, 106: 1409-1435.

Van den Bulte, C. Opportunities and challenges in studying customer networks. http://marketing.wharton.upenn.edu/documents/research/Opportunities%20and%20challenges%20in%20studying%20customer%20networks.pdf

Week 5: Lecture 1

Diffusion IV: Opinion Leaders and New Product Diffusion

D. J. Watts; P. S. Dodds. Networks, influence, and public opinion formation. *Journal of Consumer Research*, 2007, 4

Christophe Van den Bulte, Yogeh V. Joshi, (2007), New Product Diffusion with Influentials and Imitators, *Marketing Science*, 26 (3), 400-21.

Mauro Bampo, Michael T. Ewing, Dineli R. Mather, David Stewart, and Mark Wallace. 2008. The Effects of the Social Structure of Digital Networks on Viral Marketing Performance. *Information Systems Research*, 19 273 - 290.

Oh, J, A. Susarla, Y. Tan. Examining the diffusion of user-generated content in online social networks. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1182631

Week 5: Lecture 2

Search

Burt, Ronald. 2004. Where good ideas come from. *American Journal of Sociology*

Podolny, Joel and James Baron. 1997. Resources and Relationships: Social Networks and Mobility in the Workplace. *American Sociological Review*. 62:673-693.

Granovetter, Mark. 1973. The Strength of Weak Ties. *American Journal of Sociology*

Bin Gu, Prabhudev Konana, Balaji Rajagopalan, and Hsuan-Wei Michelle Chen. Competition Among Virtual Communities and User Valuation: The Case of Investing-Related Communities. *Information Systems Research*, March 2007; 18: 68 - 85.

Week 6: Lecture 1

Network Formation I

Barabasi, Albert and Reka Albert. 1999. Emergence of Scaling in Random Networks. *Science*. 286: 5909-512.

Lu, Yingda, Kinshuk Jerath, Param Vir Singh. Emergence of Opinion Leaders in Online Review Communities. *Tepper Working Paper*.

Stephen, Andrew and Olivier Toubia, Explaining the Power-Law Degree Distribution in a Social Commerce Network, forthcoming, *Social Networks*.

Cook, Emerson, and Yamagishi, The Distribution of Power in Exchange Networks: Theory and Experimental Results. *American Journal of Sociology* 89(1983):275-305.

Zsolt Katona, *Miklos Sarvary*. 2008. Network Formation and the Structure of the Commercial World Wide Web Marketing Science.27(5) 764-781.

Week 6: Lecture 2

Network Formation II

Miller McPherson, Lynn Smith-Lovin, and James M Cook. 2001. Birds of a Feather: Homophily in Social Networks. *Annual Review of Sociology*. 27:415-444.

Van Alstyne, Marshall and Erik Brynjolfsson 2005 Global Village or Cyberbalkans: Modeling and Measuring the Integration of Electronic Communities. *Management Science* 51(6) 851-868.

Sanjeev Goyal, Marco J. van der Leij, and José Luis Moraga-González. Economics: An Emerging Small World. *Journal of Political Economy*. Volume 114, Issue 2, Page 403–412, Apr 2006.

Scott Feld. 1991. Why Your Friends Have More Friends Than You Do. *American Journal of Sociology* 96:1464-77.

Param Vir Singh, Ray Reagans, Ramayya Krishnan. Forbidden to Simmelian Ties: Dynamics of Online Expertise Sharing Communities. *ILAB working paper*.

Week 7: Lecture 1

Small World and Implications

Watts, Duncan. 1999. Networks, Dynamics, and the Small World Phenomenon. *American Journal of Sociology* 105: 493-527

Travers, Jeffrey and Stanley Milgram. 1969. An Experimental Study of the Small World Problem. *Sociometry*. 32:425-443.

Lauren Cohen, Andrea Frazzini, and Christopher Malloy. 2008. The Small World of Investing: Board Connections and Mutual Fund Returns. *Journal of Political Economy*. 116(5) 951–979.

B Uzzi, J Spiro , Collaboration and Creativity: The Small World Problem. *American Journal of Sociology*, 2005

Melissa A. Schilling and Corey C. Phelps, Interfirm Collaboration Networks: The Impact of Large-Scale Network Structure on Firm Innovation. *Management Science*, July 2007; 53: 1113 - 1126.

Fleming, Lee, Charles King III, and Adam Juda. Small Worlds and Regional Innovation. *Organization Science* (November 2007).

Param Vir Singh (2007) The Small World Effect: The Influence of Macro Level Properties of Developer Collaboration Networks on Open Source Project Success. Forthcoming in *ACM Transactions of Software Engineering and Methodology*.

Week 7: Lecture 2

Econometric Issues in social Network Analysis

Manski, C. 1993. Identification of Endogenous Social effects: The Reflection Problem. *Review of Economic Studies* 60, 531-542.

Bramoulle, Y. H. Djebbari, B. Fortin. 2009. Identification of Peer Effect Social Networks. *Journal of Econometrics* 150, 41-55.

David Krackhardt. 1987. QAP Partialling as a Test of Spuriousness. *Social Networks*, 9 171-186.

Recent Structural Network Applications in Information Systems, Finance and Marketing

Information Systems

Lu, Yingda, Kinshuk Jerath, Param Vir Singh. Emergence of Opinion Leaders in Online Review Communities.

Param Vir Singh (2007) The Small World Effect: The Influence of Macro Level Properties of Developer Collaboration Networks on Open Source Project Success. Forthcoming in *ACM Transactions of Software Engineering and Methodology*.

Param Vir Singh, Yong Tan & Vijay Mookerjee (2007) Network Effects: The Influence of Social Capital on Open Source Project Success. http://ssrn.com/abstract=1111868

Param Vir Singh, Yong Tan(2008) Developer Heterogeneity and Formation of Communication Networks in Open Source Software Projects. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1276098

Param Vir Singh & Corey Phelps (2007) Determinants of Open Source Software Development License Choice: A Social Influence Perspective. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1112860

Param Vir Singh, Ray Reagans, Ramayya Krishnan. Forbidden to Simmelian Ties: Dynamics of Online Expertise Sharing Communities. *ILAB working paper*.

Atip Asvanund, Karen Clay, Ramayya Krishnan, and Michael D. Smith. An Empirical Analysis of Network Externalities in Peer-to-Peer Music-Sharing Networks. *Information Systems Research*, June 2004; 15: 155 - 174.

Bin Gu, Prabhudev Konana, Balaji Rajagopalan, and Hsuan-Wei Michelle Chen. Competition Among Virtual Communities and User Valuation: The Case of Investing-Related Communities *Information Systems Research,* March 2007; 18: 68 - 85.

Jungpil Hahn, Jae Yun Moon, and Chen Zhang. Emergence of New Project Teams from Open Source Software Developer Networks: Impact of Prior Collaboration Ties. *Information Systems Research*, September 2008; 19: 369 - 391.

Mauro Bampo, Michael T. Ewing, Dineli R. Mather, David Stewart, and Mark Wallace. The Effects of the Social Structure of Digital Networks on Viral Marketing Performance. *Information Systems Research*, September 2008; 19: 273 - 290.

Rajdeep Grewal, Gary L. Lilien, and Girish Mallapragada. Location, Location, Location: How Network Embeddedness Affects Project Success in Open Source Systems. *Management Science*, July 2006; 52: 1043 - 1056.

Oh, J, A. Susarla, Y. Tan. Examining the diffusion of user-generated content in online social networks. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1182631

Lin, M., N. Prabhala, S. Vishwanathan. Judging borrowers by the company they keep: Social networks and adverse selection in online peer-to-peer lending. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1355679

Freedman,S., G. Jin, Do Social Networks Solve Information Problems for Peer-to-Peer Lending? Evidence from Prosper.Com http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1304138

Aral, A., E. Brynjolfsson, M. Van Alstyne. Information, Technology and information Worker productivity. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=942310

Aral, A. E. brynjolfsson, M. Van Alstyne. Productivity Impacts of Information Diffusion in Networks. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=987499

Ramaprasad, J. and Dewan, S., Understanding the Impact of Social Influence in an Online Music Community.

Finance

Robert Schonlau, Param Vir Singh (2009) Board Networks and Merger Performance. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1322223

Hochberg, Y., A. Ljungqvist, and Y. Lu. 2007. Whom You Know Matters: Venture Capital Networks and Investment Performance. *Journal of Finance.*

Bizjak, J. M. Lemmon. R. Whitby. 2009. Option Backdating and Board Interlocks. *The Review of Financial Studies.*

Cohen, L. A. Frazzini, C. Malloy. The Small World of Investing: Board Connections and Mutual Fund Returns. *Journal of Political Economy* 116(5) 951-979.

Marketing

Stephen, Andrew, and Olivier Toubia. Deriving value from Social Commerce Networks. *Journal of Marketing Research Forthcoming.*

D. J. Watts; P. S. Dodds. Networks, influence, and public opinion formation. *Journal of Consumer Research*, 2007, 4

Christophe Van den Bulte, Yogeh V. Joshi, (2007), New Product Diffusion with Influentials and Imitators, *Marketing Science*, 26 (3), 400-21.

Mauro Bampo, Michael T. Ewing, Dineli R. Mather, David Stewart, and Mark Wallace. The Effects of the Social Structure of Digital Networks on Viral Marketing Performance. *Information Systems Research*, September 2008; 19: 273 - 290.

Van den Bulte, C. & Lilien, G.L. 2001. Medical Innovation Revisited: Social Contagion versus Marketing Effort, *American Journal of Sociology*, 106: 1409-1435.

Stefan Wuyts, Stefan Stremersch, Christophe Van den Bulte, Philip Hans Franses. 2004. Vertical Marketing Systems for Complex Products: A Triadic Perspective. *Journal of Marketing Research*. 41(4) 479.

Braun, M., A. Bonfrer. 2009. Censoring, Interdependence and Scalability for Dyadic Social Media Data. http://scripts.mit.edu/~braunm/docs/Braun%20Bonfrer%202009%20Dyadic%20Social%20Media%20Data.pdf

Yang, S., V. Narayan. Modeling the formation of dyadic Relationship Between Consumers in online communities. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1027982