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MGMT 8404

Computational Social Science for Organizational Research

Spring 2020

Instructor

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Meeting Times

Section 001 H 12:15 P.m.–3:15 p.m.

Meeting Location

Due to the COVID-19 outbreak, we will be meeting online (likely in a Zoom room) for the foreseeable future. Should we get the all clear to meet in person again, we have CSOM 3-377 reserved for all classes except for March 19 (the first meeting) and April 16. For those sessions, we have CSOM 2-260D.

Course Description

This seminar will provide a general introduction to the field of computational social science, with an emphasis on applications for research on organizations and management. The course will begin with an examination of the benefits of computational methods and their relationship to other, more established research approaches. Subsequently, we will consider several broad categories of topics, theories, and tools, including, for example, social network analysis, simulation, and natural language processing. In addition to providing an overview of the emerging field of computational social science, the course will help you gain hands on experience with using the methods discussed through lab demonstrations and a research project.

Learning Objectives

This course aims to help you...

- gain an overview of the emerging field of computational social science
- understand the relationship between computational techniques and established methods
- learn how to do organizational research using computational techniques

The course materials and assignments are designed to assist you in meeting these objectives.

Course Materials

There is **NO** textbook for the class.

Canvas

Our course will make extensive use of the University of Minnesota's Canvas course management system and therefore it is essential for you to log in and access the class's Canvas page on a regular basis. It is impossible to succeed in this course without using Canvas. You may access Canvas by navigating to `http://canvas.umn.edu`, signing in with your University of Minnesota Internet ID and password, and clicking on the link for our class. Within canvas, you should visit the "Modules" link to access relevant resources (e.g., slide decks) before each class session.

Assignments and Evaluation

Our approach to learning will be organized around several different kinds of activities.

Readings, discussion, and memos. Each session has an associated set of required and optional readings. You should complete the required readings before each class session and come prepared to discuss them. I have done my best to keep the readings relatively limited, with the goal of giving you more time for hands-on exploration. The optional readings consist of background, classic papers, review articles, and more advanced topics that may be of interest for further study.

For **4 class sessions**, you should write a 1 page (typed, singled spaced, 1 inch margins, 11 or 12 point font) critical response memo based on the days readings. You don't need to address every reading, but you should generally aim to discuss two or more, particularly by putting them in dialogue with one another, identifying common themes, strengths and weaknesses, conflicting assumptions, proposing research ideas that combine multiple methods, and so forth. Creativity is encouraged. Please bring a printed copy of the review to class to share with the instructor.

Alternatively, in place of writing a critical response memo, you may also write a "code memo." The purpose of a code memo is to give you an opportunity to get more hands on experience with the methods we learn about in class. The format should generally be similar to the critical response

memos (typed, singled spaced, 1 inch margins, 11 or 12 point font), but may be longer if you include code snippets, figures, or tables (which are encouraged). Jupyter notebooks are also acceptable. For a code memo, you should conduct some application of a method from either day's session or a prior session. The memo should walk the reader through what you did, any interesting findings that emerged, questions or roadblocks encountered, and so on.

No memo is expected for the first week of class. Over the course of the term, you should **aim to do at least 2 code memos.**

Research paper. The goal of this class is to help you learn how to use the methods of computational social science to advance your research. Reading papers will help you get the lay of the land, but the only way to really master the methods is to apply them. With that end in mind, over the course of the semester, you will work on a research paper in which you will conduct an analysis applies a method from the course to a problem in organizational theory, strategic management, or entrepreneurship. Your paper should include the following components (approximately 15 pages).

1. An introduction that positions the paper with respect to prior work (i.e., briefly reviews background knowledge and identifies a puzzle or limitation of existing knowledge), articulates a research question, and proposes a solution that leverages methods from computational social science.
2. A data and methods section that gives an overview of the methods you'll use, your data and so forth.
3. A results section, where you present the findings from your analysis.
4. A discussion section, where you review the implications of your findings and discuss the strengths and weaknesses of your approach.
5. A "next steps" section, where you discuss how you would build out and strengthen the paper and analysis.
6. A section with relevant tables and figures as necessary.

In short, your term paper should more or less include the components of a regular academic article, sans the theory and/or hypothesis development section. More details on the paper and expectations will be given in class. You are encouraged to build off your existing papers, ideas, and/or code memos.

Research paper presentations. To help get feedback on your ideas to share what you've learned with the class, we will carve out time during a few sessions for presentations relating to the research paper. More details will be given in class.

Due Dates and Late Work. Late assignments will not be accepted except in the case of a university approved absence.

Assignment	Points
Readings, discussion, and memos	40
Research paper	50
Research presentations	10
Total	**100**

Course Policies[1]

Student Conduct Code. The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: *Student Conduct Code*. To review the Student Conduct Code, please see: `http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf`.

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

Use of Personal Electronic Devices in the Classroom. Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, students may use laptop computers and/or tablets in class, but cell phones and pagers are not permitted, except in circumstances specifically noted by the instructor. For complete information, please see: `http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html`.

Scholastic Dishonesty. You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: `http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf`) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: `http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html`.

[1]Some policy language taken and adapted from: `http://www.policy.umn.edu/Policies/Education/Education/SYLLABUSREQUIREMENTS_APPA.html`.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: http://www1.umn.edu/oscai/integrity/student/index.html. If you have additional questions, please clarify with me. The instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of this class.

Makeup Work for Legitimate Absences. Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, see: http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html.

Appropriate Student Use of Class Notes and Course Materials. Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html.

Sexual Harassment. "Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult the Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf.

Equity, Diversity, Equal Opportunity, and Affirmative Action. The University of Minnesota provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf.

Disability Accommodations. The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations. If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations. If you are registered with DS and have a current letter requesting reasonable accommodations, please contact me as early in the semester as possible to discuss how the accommodations will be applied in the course. For more

information, please see the DS website, https://diversity.umn.edu/disability/.

Mental Health and Stress Management. As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu.

Academic Freedom and Responsibility. Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.[2] Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact me, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost if you have questions.

[2]Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students."

Course Schedule and Readings

WEEK 1

Thursday, March 19—Introduction

Agenda:

- A new kind of science?
- Roadmap for the course
- Cautionary tales
- Introduction to Python

Required readings:

- Matthes, Eric. (2019) "Getting started," "Variables and simple data types," and "Introducing lists." In *Python crash course, 2nd edition: A hands-on, project-based introduction to programming*: pp. 3-14, pp. 15-32, pp. 33-49. San Francisco: No Starch Press.
- Lazer, David, Alex Pentland, Lada Adamic, Sinan Aral, Albert-László Barabási, Devon Brewer, Nicholas Christakis et al. "Computational social science." *Science* 323(5915): 721-723.
- Bradshaw, Gary F., Patrick W. Langley, and Herbert A. Simon. (1983) "Studying scientific discovery by computer simulation." *Science* 222(4627): 971-975.
- Anderson, Chris. (2008) "The end of theory: The data deluge makes the scientific method obsolete." *Wired*, June 23.
- Halevy, Alon, Peter Norvig, and Fernando Pereira. (2009) "The unreasonable effectiveness of data." *IEEE Intelligent Systems* 24(2): 8-12.
- Lazer, David, Ryan Kennedy, Gary King, and Alessandro Vespignani. (2014) "The parable of Google Flu: Traps in big data analysis." *Science* 343(6176): 1203-1205.
- Evans, James, and Andrey Rzhetsky. (2010) "Machine science." *Science* 329(5990): 399-400.

Optional readings:

- Hey, Tony, Stewart Tansley, and Kristin Tolle (2009) "Jim Grey on eScience: A transformed scientific method." In *The Fourth Paradigm: Data-Intensive Scientific Discovery*: pp. 281-354. Redmond, WA: Microsoft Research.
- George, Gerard, Ernst C. Osinga, Dovev Lavie, and Brent A. Scott. (2016) "Big data and data science methods for management research." 59(5): 1493-1507.
- Salganik, Matthew (2018) "Ethics." In *Bit-by-bit: Social research in the digital age*: pp. . Redmond, WA: Microsoft Research.

Thursday, March 26—Networks

Agenda:

- Introduction to networks
- Foundational network models
- Generative models

Required readings:

- Barabási, Albert-László, and Réka Albert. (1999) "Emergence of scaling in random networks." *Science* 286(5439): 509-512.
- Guimera, Roger, Brian Uzzi, Jarrett Spiro, and Luis A. Nunes Amaral. (2005) "Team assembly mechanisms determine collaboration network structure and team performance." *Science* 308(5722): 697-702.
- Bearman, Peter S., James Moody, and Katherine Stovel. (2004) "Chains of affection: The structure of adolescent romantic and sexual networks." *American Journal of Sociology* 110(1): 44-91.
- Hernandez, Exequiel, and Anoop Menon. (2017) "Acquisitions, node collapse, and network revolution." *Management Science* 64(4): 1652-1671.
- Watts, Duncan J., and Steven H. Strogatz. (1998) "Collective dynamics of 'small-world' networks." *Nature* 393(6684): 440-442.
- Tatarynowicz, Adam, Maxim Sytch, and Ranjay Gulati. (2016) "Environmental demands and the emergence of social structure: Technological dynamism and interorganizational network forms." *Administrative Science Quarterly* 61(1): 52-86.

Optional readings:

- Jackson, Matthew O., and Asher Wolinsky. (1996) "A strategic model of social and economic networks." *Journal of Economic Theory* 71(1): 44-74.
- Hidalgo, César A. (2016) "Disconnected, fragmented, or united? a trans-disciplinary review of network science." *Applied Network Science* 1(1): 6.
- Simon, Herbert A. (1955) "On a class of skew distribution functions." *Biometrika* 42(3/4): 425-440.
- Broido, Anna D., and Aaron Clauset. (2019) "Scale-free networks are rare." *Nature Communications* 10(1): 1017.

Thursday, April 2—Documents and Text

Agenda:

- Corpora
- Vector space model
- Document similarity
- Topic models
- Text networks

Required readings:

- Michel, Jean-Baptiste, Yuan Kui Shen, Aviva Presser Aiden, Adrian Veres, Matthew K. Gray, Joseph P. Pickett, Dale Hoiberg et al. (2011) "Quantitative analysis of culture using millions of digitized books." *Science* 331(6014): 176-182.
- Pechenick, Eitan Adam, Christopher M. Danforth, and Peter Sheridan Dodds. (2015) "Characterizing the Google Books corpus: Strong limits to inferences of socio-cultural and linguistic evolution." *PloS ONE* 10(10): e0137041.
- Kelly, Bryan, Dimitris Papanikolaou, Amit Seru, and Matt Taddy. (2018) "Measuring technological innovation over the long run." Working Paper No. 25266. Cambridge, MA: National Bureau of Economic Research.
- Kaplan, Sarah, and Keyvan Vakili. (2105) "The double-edged sword of recombination in breakthrough innovation." *Strategic Management Journal* 36(10): 1435-1457.
- Rule, Alix, Jean-Philippe Cointet, and Peter S. Bearman. (2015) "Lexical shifts, substantive changes, and continuity in State of the Union discourse, 1790?2014." *Proceedings of the National Academy of Sciences* 112(35): 10837-10844.

Optional readings:

- Blei, David M., Andrew Y. Ng, and Michael I. Jordan. (2003) "Latent Dirichlet Allocation." *Journal of Machine Learning Research* 3: 993-1022.
- Gentzkow, Matthew, Bryan Kelly, and Matt Taddy. (2019) "Text as data." *Journal of Economic Literature* 57(3): 535-74.
- Evans, James A., and Pedro Aceves. (2016) "Machine translation: Mining text for social theory." *Annual Review of Sociology* 42: 21-50.
- Hoberg, Gerard, and Gordon Phillips. (2016) "Text-based network industries and endogenous product differentiation." *Journal of Political Economy* 124(5): 1423-1465.
- Mihalcea, Rada, and Paul Tarau. (2004) "Textrank: Bringing order into text." In *Proceedings of the 2004 Conference on Empirical Methods in Natural Language Processing*: pp. 404-411. Barcelona, Spain: Association for Computational Linguistics.

Thursday, April 9—Language and Words

Agenda:

- Linguistics
- Word embeddings
- Sentiment analysis

Required readings:

- Manning, Christopher D. and Hinrich Schütze. (1999) "Introduction" and "Linguistic essentials." In *Foundations of statistical natural language processing*: pp. 3-36 and pp. 81–115. Cambridge, MA: MIT Press.
- Kozlowski, Austin C., Matt Taddy, and James A. Evans. (2019) "The geometry of culture: Analyzing the meanings of class through word embeddings." *American Sociological Review* 84(5): 905-949.
- Caliskan, Aylin, Joanna J. Bryson, and Arvind Narayanan. (2017) "Semantics derived automatically from language corpora contain human-like biases." *Science* 356(6334): 183-186.
- Goldberg, Amir, Sameer B. Srivastava, V. Govind Manian, William Monroe, and Christopher Potts. (2016) "Fitting in or standing out? The tradeoffs of structural and cultural embeddedness." *American Sociological Review* 81(6): 1190-1222.
- Bollen, Johan, Huina Mao, and Xiaojun Zeng. (2011) "Twitter mood predicts the stock market." *Journal of Computational Science* 2(1): 1-8.

Optional readings:

- Shannon, Claude. (1949) "Discrete noiseless systems." In *The mathematical theory of communication*: pp. 36-64. Urbana, IL: University of Illinois Press.
- Golder, Scott A., and Michael W. Macy. (2011) "Diurnal and seasonal mood vary with work, sleep, and day length across diverse cultures." *Science* 333(6051): 1878-1881.
- Nguyen, Dong, A. Seza Doğruöz, Carolyn P. Rosé, and Franciska de Jong. (2016) "Computational sociolinguistics: A survey." *Computational Linguistics* 42(3): 537-593.
- Kumar, Srijan, William L. Hamilton, Jure Leskovec, and Dan Jurafsky. (2018) "Community interaction and conflict on the web." In *Proceedings of the 2018 World Wide Web Conference*: pp. 933-943. Republic and Canton of Geneva, Switzerland: International World Wide Web Conferences Steering Committee.
- Mikolov, Tomas, Ilya Sutskever, Kai Chen, Greg S. Corrado, and Jeff Dean. (2013) "Distributed representations of words and phrases and their compositionality." *Advances in Neural Information Processing Systems*, 26: 3111-3119.
- Tshitoyan, Vahe, John Dagdelen, Leigh Weston, Alexander Dunn, Ziqin Rong, Olga Kononova, Kristin A. Persson, Gerbrand Ceder, and Anubhav Jain. (2019) "Unsupervised word embeddings capture latent knowledge from materials science literature." *Nature* 571(7763): 95-98.

Thursday, April 16—Geography and Space

Agenda:

- Spatial autocorrelation
- Sociometric badges
- Mobile phone metadata
- Social media and images

Required readings:

- Leenders, Roger Th.A.J. (2002) "Modeling social influence through network autocorrelation: Constructing the weight matrix." *Social Networks* 24: 21-47.
- Dow, Malcolm M. (2007) "Galton's problem as multiple network autocorrelation effects: Cultural trait transmission and ecological constraint." *Cross-Cultural Research* 41(4): 336-363.
- Papachristos, Andrew V. and Sara Batomski. (2018) "Connected in crime: The enduring effect of neighborhood networks on the spatial patterning of violence." *American Journal of Sociology* 124(2): 517-568.
- Onnela, Jukka-Pekka, Benjamin N. Waber, Alex Pentland, Sebastian Schnorf, and David Lazer. (2014) "Using sociometers to quantify social interaction patterns." *Scientific Reports* 4(5604): 1-8.
- Ma, Ruixian, Wei Wang, Fan Zhang, Kyuha Shim, and Carlo Ratti. "Typeface reveals spatial economical patterns." *Scientific Reports* 9(15946): 1-9.
- Wang, Qi, Nolan Edward Phillips, Mario L. Small, and Robert J. Sampson. (2018) "Urban mobility and neighborhood isolation in America's 50 largest cities." *Proceedings of the National Academy of Sciences* 115(30): 7735-7740.

Optional readings:

- Woolley, Anita Williams, Christopher F. Chabris, Alex Pentland, Nada Hashmi, and Thomas W. Malone. (2010) "Evidence for a collective intelligence factor in the performance of human groups." ' *Science* 330(6004): 686-688.
- Henderson, J. Vernon, Adam Storeygard, and David N. Weil. (2012) "Measuring economic growth from outer space." *American economic review* 102(2): 994-1028.
- Naik, Nikhil, Scott Duke Kominers, Ramesh Raskar, Edward L. Glaeser, and Csar A. Hidalgo. (2017) "Computer vision uncovers predictors of physical urban change." ' *Proceedings of the National Academy of Sciences* 114(29): 7571-7576.

Thursday, April 23—Machine Learning

Agenda:

- Unsupervised learning
- Supervised learning
- Data wrangling
- Causal inference
- Model selection

Required readings:

- Mullainathan, Sendhil and Jann Spiess. (2017) "Machine learning: An applied econometric approach." *Journal of Economic Perspectives* 31(2): 87-106.
- Choudhury, Prithwiraj, Dan Wang, Natalie Carlson, and Tarun Khanna. (2019) "Machine learning approaches to facial and text analysis: Discovering CEO oral communication styles." *Strategic Management Journal* 40:1705-1732.
- Li, Guan-Cheng, Ronald Lai, Alexander D'Amour, David M. Doolin, Ye Sun, Vetle I. Torvik, Z. Yu Amy, and Lee Fleming. (2014) "Disambiguation and co-authorship networks of the US patent inventor database (1975?2010)." *Research Policy* 43(6): 941-955.
- Harrison, Joseph S., Gary R. Thurgood, Steven Boivie, and Michael D. Pfarr. (2019) "Measuring CEO personality: Developing, validating, and testing a linguistic tool." *Strategic Management Journal* 40: 1316-1330.
- Lee, Brian K., Justin Lessler, and Elizabeth A. Stuart. (2010) "Improving propensity score weighting using machine learning." *Statistics in Medicine* 29: 337-346.
- Athey, Susan, and Guido Imbens. (2016) "Recursive partitioning for heterogeneous causal effects." *Proceedings of the National Academy of Sciences* 113(27): 7353-7360.
- Varian, Hal. (2014) "Big data: New tricks for econometrics." *Journal of Economic Perspectives* 28(2): 3-28.

Optional readings:

- Kleinberg, Jon, Jens Ludwig, Sendhil Mullainathan, and Ziad Obermeyer. "Prediction policy problems." *American Economic Review* 105(5): 491-495.
- Athey, Susan, and Guido W. Imbens. (2017) "The state of applied econometrics: Causality and policy evaluation." *Journal of Economic Perspectives* 31(2): 3-32.
- Tibshirani, Robert. (1996) "Regression shrinkage and selection via the lasso." *Journal of the Royal Statistical Society: Series B* 58(1): 267-288.
- Molina, Mario, and Filiz Garip. (2019) "Machine learning for sociology." *Annual Review of Sociology* 45: 27-45.

Thursday, April 30—Simulation

Agenda:

- Understanding real world data
- Creating your own worlds
- Best practices

Required readings:

- Schelling, Thomas C. (1978) "Sorting and mixing: Race and sex." In *Micromotives and macrobehaviors*: pp. 137-166. New York: W. W. Norton & Company.
- Bruch, Elizabeth, and Jon Atwell. (2015) "Agent-based models in empirical social research." *Sociological Methods & Research* 44(2): 186-221.
- Smith, Edward Bishop, and William Rand. (2017) "Simulating macro-level effects from micro-level observations." *Management Science* 64(11): 5405-5421.
- Lazer, David, and Allan Friedman. (2007) "The network structure of exploration and exploitation." *Administrative Science Quarterly* 52(4): 667-694.
- Guimera, Roger, Brian Uzzi, Jarrett Spiro, and Luis A. Nunes Amaral. (2005) "Team assembly mechanisms determine collaboration network structure and team performance." *Science* 308(5722): 697-702.

Optional readings:

- Davis, Jason P., Kathleen M. Eisenhardt, and Christopher B. Bingham. (2007) "Developing theory through simulation methods." *Academy of Management Review* 32(2): 480-499.
- Centola, Damon and Michael Macy. (2007) "Complex contagions and the weakness of long ties." *American Journal of Sociology* 113(3): 702-734.
- Levinthal, Daniel A. (1997) "Adaptation on rugged landscapes." *Management Science* 43(7): 934-950.
- Fang, Christina, Jeho Lee, and Melissa A. Schilling. (2010) "Balancing exploration and exploitation through structural design: The isolation of subgroups and organizational learning." *Organization Science* 21(3): 625-642.
- Chu, Johan SG, and Gerald F. Davis. (2016) "Who killed the inner circle? The decline of the American corporate interlock network." *American Journal of Sociology* 122(3): 714-754.
- Bruch, Elizabeth E., and Robert D. Mare. (2006) "Neighborhood choice and neighborhood change." *American Journal of Sociology* 112(3): 667-709.

Final paper DUE by 11:59 p.m. on Friday, May 8.