

Using Big Data to Solve Economic and Social Problems

Professor Raj Chetty

Stanford University, Spring 2017

Format: This course consists of eleven (11) one hour and twenty minute lectures delivered at Stanford University in Spring 2017 (Economics 45).

Description: This introductory course shows how "big data" can be used to understand and solve some of the most important social and economic problems of our time. The course gives students an introduction to frontier research in applied economics and social science that does not require prior coursework in Economics or Statistics. Topics include equality of opportunity, education, health, the environment, and criminal justice. In the context of these topics, the course provides an introduction to basic statistical methods and data analysis techniques, including regression analysis, causal inference, quasi-experimental methods, and machine learning.

When taught at Stanford in 2017, the course also included guest lecturers David Leonhardt, Alex Laskey, Jini Kim, Sendhil Mullainathan, and Matthew Gentzkow, who discussed real-world applications of data science; these guest lectures are not included in the online version.

Goals: The course has three principal learning objectives: 1) to introduce students to frontier social science research on key social and economic issues in the United States, 2) to teach students how to understand and analyze quantitative data, and 3) to show students to how practitioners use "big data" to analyze social problems.

Prerequisites: None. Some prior background in statistics is recommended but not required.

Acknowledgements: I am indebted to Rebecca Toseland, the Head Section Leader for the course, for her assistance in helping prepare course materials and organize the class and to the Equality of Opportunity Project research team for developing much of the content in these lectures.

Course Outline

Part I: Equality of Opportunity

- 1 Introduction and the Geography of Upward Mobility
- 2 Policies to Improve Upward Mobility
- 3 Opportunity, Innovation, and Economic Growth

Part II: Education

- 4 Higher Education
- 5 Primary Education
- 6 Do Charter Schools Work?

Part III: Health

- 7 Improving Health Outcomes
- 8 The Economics of Health Care and Insurance

Part IV: Environment

- 9 Social Costs of Climate Change and Pollution
- 10 Policies to Mitigate Climate Change

Part V: Justice

- 11 Criminal Justice and Discrimination

Reading List

Part I: Equality of Opportunity

1 - Introduction and the Geography of Upward Mobility

- *Einav, Liran, and Jonathan Levin. 2014. “Economics in the Age of Big Data.” *Science* 346 (6210): 715.
- *Leonhardt, David. 2013. “[In Climbing Income Ladder, Location Matters.](#)” *The New York Times*.
- *Leonhardt, David, Amanda Cox, and Claire Cain Miller. 2015. “[An Atlas of Upward Mobility Shows Paths Out of Poverty.](#)” *The New York Times*.
- *Aisch, Gregor, Eric Buth, Matthew Block, Amanda Cox, and Kevin Quealy. 2015. “[The Best and Worst Places to Grow Up: How Your Area Compares.](#)” *The New York Times*.
- *Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. 2014. “Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States.” *Quarterly Journal of Economics* 29 (4): 1553–1623. [Non-technical summary](#)
- * [Non-technical summary](#) “The Impacts of Neighborhoods on Intergenerational Mobility ”

Optional Reading

- Badger, Emily and Christopher Ingraham. 2016. “[The Striking Power of Poverty to Turn Young Boys into Jobless Men.](#)” *The Washington Post*.
- Chetty, Raj, Nathaniel Hendren, Frina Lin, Jeremy Majerovitz, and Benjamin Scuderi. 2016. “Childhood Environment and Gender Gaps in Adulthood.” *American Economic Review Papers and Proceedings* 106 (5): 282–88. [Non-technical summary](#)
- Chetty, Raj, and Nathaniel Hendren. 2016. “The Impacts of Neighborhoods on Intergenerational Mobility I: Childhood Exposure Effects.” NBER Working Paper No. 23001.
- Chetty, Raj, and Nathaniel Hendren. 2016. “The Impacts of Neighborhoods on Intergenerational Mobility II: County-Level Estimates.” NBER Working Paper No. 23002.

2 - The Geography of Upward Mobility cont'd and Policies to Improve Upward Mobility

*Chetty, Raj, Nathaniel Hendren, and Lawrence F Katz. 2016. “The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment.” *American Economic Review* 106 (4): 855–902. [Non-technical summary](#)

*Davis, Bob. 2016. “[Barely Half of 30-Year-Olds Earn More Than Their Parents.](#)” *The Wall Street Journal*.

*[Non-technical summary](#) “The Fading American Dream: Trends in Absolute Income Mobility Since 1940.”

Optional Reading

Chetty, Raj, David Grusky, Maximilian Hell, Nathaniel Hendren, Robert Manduca, and Jimmy Narang. 2016. “The Fading American Dream: Trends in Absolute Income Mobility Since 1940.” NBER Working Paper No. 22910.

3 - Opportunity, Innovation, and Economic Growth

*Cimpian, Andrei and Sarah-Jane Leslie. 2017. “[Why Young Girls Don’t Think They Are Smart Enough.](#)” *The New York Times*.

*Bian, Lin, Sarah-Jane Leslie, and Andrei Cimpian. 2017. “Gender Stereotypes about Intellectual Ability Emerge Early and Influence Children’s Interests.” *Science* 391 (6323): 389–91.

Optional Reading

Alex Bell, Raj Chetty, Xavier Jaravel, Neviana Petkova, John Van Reenen. 2016. “The Lifecycle of Inventors.” Working Paper.

Part II: Education

4 – Higher Education

* Aisch, Gregor, Larry Buchanan, Amanda Cox, and Kevin Quealy. 2017. “[Some Colleges Have More Students From the Top 1 Percent Than the Bottom 60. Find Yours.](#)” *The New York Times*.

*Leonhardt, David. 2017. “[America’s Great Working Class Colleges.](#)” *The New York Times*.

*Chetty, Raj, John N Friedman, Emmanuel Saez, Nicholas Turner, and Danny Yagan. 2017. “Mobility Report Cards: The Role of Colleges in Intergenerational Mobility.” Working Paper. [Non-technical summary](#)

*Hoxby, Caroline Minter, and Christopher Avery. 2013. “The Missing ‘One-Offs’: The Hidden Supply of High-Achieving, Low Income Students.” *Brookings Papers on Economic Activity*, 1–66.

Optional Reading

Hoxby, Caroline Minter, and Sarah E. Turner. 2015. “What High-Achieving Low-Income Students Know About College.” *American Economic Review: Papers & Proceedings* 105 (5): 514–17.

Hoxby, Caroline, and Sarah Turner. 2013. “Expanding College Opportunities for High-Achieving, Low Income Students.” *Stanford Institute for Economic Policy Research Discussion Paper*, no. 12-014: 1–57.

5 - Primary Education

*Porter, Eduardo. 2015. “[Education Gap Between Rich and Poor is Growing Wider](#).” *The New York Times*.

*Leonhardt, David. 2010. “[The Case for \\$320,000 Kindergarten Teachers](#).” *The New York Times*.

*Chetty, Raj, John N. Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan. 2011. “How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project STAR.” *Quarterly Journal of Economics* 126 (4): 1593–1660. [Non-technical summary](#).

*[Non-technical summary](#) “Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates.”

*Reardon, Sean. 2016. “School Segregation and Racial Academic Achievement Gaps.” *Russell Sage Foundation Journal of the Social Sciences* 2 (5): 34–57.

Optional Reading

Lowrey, Annie. 2012. “[Big Study Links Good Teachers to Lasting Gain](#).” *The New York Times*.

Chetty, Raj, John N Friedman, and Jonah E Rockoff. 2014. “Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates.” *American Economic Review* 104 (9): 2593–2632.

Chetty, Raj, John N Friedman, and Jonah E Rockoff. 2011. “Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood.” *American Economic Review* 104 (9): 2633–79.

Fredriksson, Peter, Björn Öckert, and Hessel Oosterbeek. 2013. “Long-Term Effects of Class Size.” *The Quarterly Journal of Economics* 128 (1): 249–85.

Reardon, Sean, Demetra Kalagrides, and Kenneth Shores. 2016. “The Geography of Racial/Ethnic Test Score Gaps.” *CEPA Working Paper*, no. 16.

Guest Lecture #1: David Leonhardt, Columnist & Founding Editor of The Upshot, The New York Times

[David Leonhardt](#) is an Op-Ed columnist for The New York Times. David was previously the Washington bureau chief and the founding editor of [The Upshot](#), a Times website covering politics and policy. In 2011, he received the [Pulitzer Prize](#) for commentary, for his columns on the financial crisis and its aftermath. As a staff writer for The Times Magazine, he won the Gerald Loeb Award in 2009 for the story, [“Obamanomics.”](#) He is the author of the best-selling [e-book](#), “Here’s the Deal: How Washington Can Solve the Deficit and Spur Growth.”

6 – Do Charter Schools Work?

*Leonhardt, David. 2016. [“Schools That Work.”](#) *The New York Times*.

*Chabrier, Julia, Sarah Cohodes, and Philip Oreopoulos. 2016. “What Can We Learn From Charter School Lotteries?” *Journal of Economic Perspectives* 30 (3): 57–84.

Optional Reading

Abdulkadiroğlu, Atila, Joshua D. Angrist, Susan M. Dynarski, Thomas J. Kane, and Parag A. Pathak. 2011. “Accountability and Flexibility in Public Schools: Evidence from Boston’s Charters and Pilots.” *Quarterly Journal of Economics* 126 (2): 699–748.

Dobbie, Will, and Roland G. Fryer. 2011. “Are High-Quality Schools Enough to Increase Achievement among the Poor? Evidence from the Harlem Children’s Zone.” *American Economic Journal: Applied Economics* 3 (3): 158–87.

Baude, Patrick, Marcus Casey, Eric A Hanushek, and Steven G Rivkin. 2014. “The Evolution of Charter School Quality.” NBER Working Paper 20645.

Part III: Health

7 – Improving Health Outcomes

- *Irwin, Neil and Quoc Trung Bui. 2016. “[The Rich Live Longer Everywhere. For the Poor, Geography Matters.](#)” *The New York Times*.
- *Chetty, Raj, Michael Stepner, Sarah Abraham, Shelby Lin, Benjamin Scuderi, Nicholas Turner, Augustin Bergeron, and David Cutler. 2016. “The Association Between Income and Life Expectancy in the United States, 2001-2014.” *Journal of the American Medical Association* 315 (16): 1750–66. [Non-technical summary.](#)
- *Ginsberg, Jeremy, Matthew H Mohebbi, Rajan S Patel, Lynnette Brammer, Mark S Smolinski, and Larry Brilliant. 2009. “Detecting Influenza Epidemics Using Search Engine Query Data.” *Nature* 457:1012-4

Optional Reading

- Lazer, David, Ryan Kennedy, Gary King, and Alessandro Vespignani. 2014. “The Parable of Google Flu: Traps in Big Data Analysis.” *Science* 343 (6167): 1203–5.

8 - The Economics of Health Care and Insurance

- *Leonhardt, David. 2017. “[The New Study that Shows Trumpcare’s Damage](#)” *The New York Times*.
- *Quealy, Kevin and Margot Sanger-Katz. 2015. “[The Experts Were Wrong About the Best Places for Better and Cheaper Health Care.](#)” *The New York Times*.
- * [Non-technical summary](#) “Subsidizing Health Insurance for Low-Income Adults: Evidence from Massachusetts and Implications for Future Health Reforms”
- * [Non-technical summary](#) of research on the Oregon Health Insurance Experiment.
- *Cooper, Zack, Stuart Craig, Martin Gaynor, and John Van Reenen. 2015. “The Price Ain’t Right? Hospital Prices and Health Spending on the Privately Insured.” *NBER Working Paper*. NBER Working Paper No. 21815.
- *Baicker, Katherine, Sarah L. Taubman, Heidi L. Allen, Mira Bernstein, Jonathan H. Gruber, Joseph P. Newhouse, Eric C. Schneider, Bill J. Wright, Alan M. Zaslavsky, and Amy N. Finkelstein. 2013. “The Oregon Experiment — Effects of Medicaid on Clinical Outcomes.” *New England Journal of Medicine* 368: 1713–22.

Optional Reading

Data resource: The Dartmouth Atlas of Health Care. <http://www.dartmouthatlas.org/>

Finkelstein, Amy, Nathaniel Hendren, and Mark Shepard. 2017. “Subsidizing Health Insurance for Low-Income Adults : Evidence from Massachusetts.” Working Paper.

Finkelstein, Amy N, Sarah L Taubman, Heidi L Allen, Bill J Wright, and Katherine Baicker. 2016. “Effect of Medicaid Coverage on ED Use - Further Evidence from Oregon’s Experiment.” *The New England Journal of Medicine* 375 (16): 1505-1507.

Finkelstein, Amy N, Matthew Gentzkow, and Heidi Williams. 2016. “Sources of Geographic Variation in Health Care: Evidence from Patient Migration.” *Quarterly Journal of Economics* 131 (4): 1681–1726.

Taubman, Sarah L, Heidi L Allen, Bill J Wright, Katherine Baicker, and Amy N Finkelstein. 2014. “Medicaid Increases Emergency-Department Use: Evidence from Oregon’s Health Insurance Experiment.” *Science* 343 (6168): 263–68.

Wherry, Laura R, Sarah Miller, Robert Kaestner, and Bruce D Meyer. 2017. “Childhood Medicaid Coverage and Later Life Health Care Utilization.” Forthcoming in *Review of Economics and Statistics*.

Guest Lecture #2: Jini Kim, Founder & CEO, Nuna

Jini Kim is the Founder and CEO of [Nuna](#), a healthcare technology startup that works with both public and private sector partners to understand and improve how people use healthcare. She took a leave of absence from Nuna to participate in the “tech surge” that saved the Healthcare.gov site, work that led to a [TIME magazine cover story](#) by Steven Brill. Kim was previously a product manager at Google Health, tasked with determining Google’s strategy in genomics. Her work led to the funding of research labs and startups in genetic sequencing and large database work on genotypic/phenotypic associations. In addition, Kim was the product manager of the Go team, Google’s first programming language. She was also responsible for helping to launch Google Public Data, which fostered her deep understanding of how to create tools for people who have little to no experience with data analytics or visualization.

Part IV: Environment

9 – Social Costs of Climate Change and Pollution

*National Climate Assessment. <http://nca2014.globalchange.gov/>
—Skim the report/highlights for background knowledge—

*Carleton, T. A., and S. M. Hsiang. 2016. “Social and Economic Impacts of Climate.” *Science* 353 (6304): 1112.

*Isen, Adam, Maya Rossin-Slater, and W Reed Walker. 2014. “Every Breath You Take - Every Dollar You’ll Make: The Long-Term Consequences of the Clean Air Act of 1970.” Forthcoming in the *Journal of Political Economy*. [Non-technical summary](#).

Optional Reading

Greenstone, Michael. 2017. “[What Financial Markets Can Teach Us About Managing Climate Risks](#).” *The New York Times*.

Currie, Janet, Lucas Davis, Michael Greenstone, and Walker Reed. 2015. “Environmental Health Risks and Housing Values: Evidence from 1,600 Toxic Plant Openings and Closings.” *American Economic Review* 105 (2): 678–709.

Giglio, Stefano, Matteo Maggiori, and Johannes Stroebel. 2015. “Very Long-Run Discount Rates.” *Quarterly Journal of Economics* 130 (1): 1–53.

Keiser, David A and Joseph S Shapiro. 2017. “Consequences of the Clean Water Act and the Demand for Water Quality.” NBER Working Paper 23070.

10 – Policies to Mitigate Climate Change

*Gardiner, B. 2014. “[Energy Efficiency May Be the Key to Saving Trillions](#).” *The New York Times*.

*Schultz, P. Wesley, Jessica M. Nolan, Robert B. Cialdini, Noah J. Goldstein, and Vidas Griskevicius. 2007. “The Constructive, Destructive, and Reconstructive Power of Social Norms.” *Psychological Science* 18 (5): 429–34.

*Allcott, Hunt, and Todd Rogers. 2014. “The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation.” *American Economic Review* 104 (10): 3003–37.

*Doyle, Joseph J., and Krislert Samphantharak. 2008. “\$2.00 Gas! Studying the Effects of a Gas Tax Moratorium.” *Journal of Public Economics* 92 (3-4): 869–84.

*Ito, Koichiro. 2014. “Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing.” *American Economic Review* 104 (2): 537–63.

Optional Reading

Allcott, Hunt. 2011. “Social Norms and Energy Conservation.” *Journal of Public Economics* 95 (9–10): 1082–95.

Allcott, Hunt, and Michael Greenstone. 2012. “Is There an Energy Efficiency Gap?” *Journal of Economic Perspectives* 26 (1): 3–28.

Davis, Lucas W, and Lutz Killian. 2011. “Estimating the Effect of a Gasoline Tax on Carbon Emissions.” *Journal of Applied Econometrics* 26: 1187–1214.

Gallagher, Kelly Sims, and Erich Muehlegger. 2011. “Giving Green to Get Green? Incentives and Consumer Adoption of Hybrid Vehicle Technology.” *Journal of Environmental Economics and Management* 61 (1):1–15.

Li, Shanjun, Joshua Linn, and Erich Muehlegger. 2014. “Gasoline Taxes and Consumer Behavior.” *American Economic Journal: Economic Policy* 6 (4): 302–42.

Guest Lecture #3: Alex Laskey, Founder, Opower and VP, Utilities Solutions, Oracle

*Alex Laskey’s [keynote](#) at TED's annual conference.

*Case Study: *Game Changers: Opower’s Quest to Make Everyone in the World Care about Energy*

Alex Laskey is Vice President of Utilities Solutions for Oracle Utilities. He was previously the President and Founder of Opower, which was acquired by Oracle in 2016. Alex grew Opower from a two-person startup to a publicly-traded global business serving more than half of the largest electric and gas utilities in the world. At Oracle, Alex is a strategic consultant to those clients, and also speaks frequently on trends in energy and technology. Alex delivered a [keynote](#) at TED's annual conference, was named to [Fortune’s 40 under 40 list](#), and was a Technology Pioneer at the Davos World Economic Forum. Alex serves on the board of the Conservation Lands Foundation and received his B.A. from Harvard College.

Part V: Criminal Justice, Discrimination, and Political Polarization

11 – Criminal Justice and Discrimination

*Hvistendahl, Mara. 2016. [Can ‘Predictive Policing’ Prevent Crime Before It Happens?](#) *Science News*.

*Bertrand, Marianne, and Sendhil Mullainathan. 2004. “Are Emily and Greg More Employable Than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination.” *American Economic Review* 94 (4): 991–1013.

Optional Reading

Abrams, David S, Marianne Bertrand and Sendhil Mullainathan. 2012. “Do Judges Vary in Their Treatment of Race?” *Journal of Legal Studies* 41 (2): 347–83.

Danziger, S., J. Levay, and L. Avnaim-Pesso. 2011. “Reply to Weinshall-Margel and Shapard: Extraneous Factors in Judicial Decisions Persist.” *Proceedings of the National Academy of Sciences* 108 (42): E834–E834.

Edelman, Benjamin, Michael Luca, and Svirsky Dan. 2017. “Racial Discrimination in the Sharing Economy: Evidence from a Field Experiment.” *American Economic Journal: Applied Economics* 9 (2): 1–22.

Goldin, Claudia, and Cecilia Rouse. 2000. “Orchestrating Impartiality: The Impact of ‘Blind’ Auditions on Female Musicians.” *American Economic Review* 90 (4): 715–41.

Kleinberg, Jon, Himabindu Lakkaraju, Jure Leskovec, Jens Ludwig, and Sendhil Mullainathan. 2017. “Human Decisions and Machine Predictions.” NBER Working Paper 23180.

Mohler, George, Martin Short, P. Jeffrey Brantingham, Frederick Schoenberg, and George Tita. 2011. “Self-Exciting Point Process Modeling of Crime.” *Journal of the American Statistical Association* 106 (493): 100–108.

Guest Lecture #4: Sendhil Mullainathan, Professor of Economics, Harvard University

*Kleinberg, John, Jens Ludwig, and Sendhil Mullainathan. 2016. [A Guide to Solving Social Problems with Machine Learning](#). *Harvard Business Review*.

* Mullainathan, Sendhil, and Jann Spiess. 2017. “Machine Learning: An Applied Econometric Approach.” *Journal of Economic Perspectives* 31 (2): 87–106.

Sendhil Mullainathan is the Robert C. Waggoner Professor of Economics at Harvard University. He has done research on poverty (such as how [poverty impedes](#) cognitive function), discrimination (using [fictitious resumes](#) to measure it) and other areas of behavioral economics, especially as they inform policy or important social problems. His current work focuses on machine learning. Mullainathan is a recipient of the MacArthur “genius” Award, has been designated a “Young Global Leader” by the World Economic Forum, labeled a “Top 100 Thinker” by Foreign Policy Magazine, and named to the “Smart List: 50 people who will change the world” by Wired Magazine (UK).

Guest Lecture #5: Matthew Gentzkow, Professor of Economics, Stanford University

*Thompson, Derek. 2016. “[Why Democrats and Republicans Literally Speak Different Languages](#).” *The Atlantic*.

*Allcott, Hunt, and Matthew Gentzkow. 2017. “Social Media and Fake News in the 2016 Election.” *Journal of Economic Perspectives* 31 (2): 211–36.

* Gentzkow, Matthew, and Jesse M. Shapiro. 2011. “Ideological Segregation Online and Offline.” *Quarterly Journal of Economics* 126 (4): 1799–1839.

Optional Reading

Boxell, Levi, Matthew Gentzkow, and Jesse M Shapiro. 2017. “Is the Internet Causing Political Polarization? Evidence From Demographics.” Working Paper.

Gentzkow, Matthew, Jesse Shapiro, and Matt Taddy. 2016. “Measuring Polarization in High-Dimensional Data: Method and Application to Congressional Speech.” Working Paper.

Matthew Gentzkow is Professor of Economics at Stanford University. He studies empirical industrial organization and political economy, with a focus on media industries. He received the 2014 John Bates Clark Medal, given by the American Economic Association to the American economist under the age of forty who has made the most significant contribution to economic thought and knowledge. He is a fellow of the American Academy of Arts and Sciences and the Econometric Society, a senior fellow at the Stanford Institute for Economic Policy Research, and a former co-editor of *American Economic Journal: Applied Economics*. He was educated at Harvard University, where he earned a bachelor's degree in 1997, a master's degree in 2002, and a PhD in 2004.

Probability, Statistics, and Econometrics References

Angrist, Joshua D. and Jörn-Steffen Pischke. *Mastering 'Metrics: The Path from Cause to Effect*. Princeton: Princeton University Press, 2015.

Stock, James H. and Mark W. Watson. *Introduction to Econometrics*. 3rd Ed. Boston: Pearson, 2014. (Earlier editions work too)

Wackerly, Dennis D., William Mendenhall III, and Richard L. Scheaffer. *Mathematical Statistics with Applications*. 7th Ed. Pacific Grove, CA: Duxbury, 2008. (Earlier editions work too)

Wooldridge, Jeffrey M. *Introductory Econometrics: A Modern Approach*. 5th Ed. Mason, OH: South-Western, 2012. (Earlier editions work too)

Stata Resources

Stata's Base Reference Manual: <http://www.stata.com/bookstore/base-reference-manual/>

UCLA's IDRE Stata Modules: <http://stats.idre.ucla.edu/stata/modules/>

UW-Madison SSCC <http://www.ssc.wisc.edu/sscc/pubs/sfs/home.htm>