Topics on Microeconomic Theory:

Learning and Evolution in Economics

by

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This course attempts to give preliminary and selective introduction on <u>Evolutionary Game Theory and Learning in Games.</u> The main textbook is: *Individual Strategy and Social Structure—An Evolutionary Theory of Institute*, by Peyton Young.

Course Arrangements: A series of lectures on evolutionary game theory and paper presentations by participants.

Outlines of Lectures

1. Overview
2. Varieties of Learning Behavior
3. Fictitious Play
4. Brief Introduction on Markov Processes
5. Dynamic and Stochastic Stability
6. Adaptive Learning and Small Games
7. Variations on the Learning Process
8. Local Interaction
9. Equilibrium and Disequilibrium Selection in General Games
10. Bargaining
11. Contracts
12. Reinforcement and Regret (*optional !*)
13. Conditional No-Regret Learning (*optional !*)

Evaluation: (1) Paper presentations/Lecture (50%) and (2) End of Term Report: Reports/Comments on presentation given by one of your classmates >>> **NOT YOUR OWN** (50%).

References

I. Evolutionary Game Theory

(1) Books

Boyd and Peter Richerson (1985): Culture and the Evolutionary Process

Boyd and Peter Richerson (2005): Not by Genes Alone: How Culture Transformed Human Evolution

Boyd and Peter Richerson (2005): The Origin and Evolution of Cultures

Cressman (2003): Evolutionary Dynamics and Extensive Form Games

Fudenberg and Levine (1998): *The Theory of Learning in Game*

Fudenberg and Tirole (1991): *Game Theory*

Hart and Mas-Colell (2012): *Simple Adaptive Strategies: From Regret-Matching to Uncoupled Dynamics*

Maynard Smith (1982): *Evolution and the Theory of Games*

Weibull (1995): *Evolutionary Game Theory*

Young (1998): *Individual Strategy and Social Structure*

Young (2004): *Strategic Learning and its Limits*

(2) Papers (*The Reading List for Paper Presentation will be given in due course*)

Arieli, I. and Young, P. (2011) "Fast Convergence in Population Games," *Oxford Economics Discussion Paper* 570, 2011.

Borgers and Sarin (1997): "Learning Through Reinforcement and Replicator Dynamics," *Journal of Economic Theory* **77**, 1-14.

Eddie Dekel, Jeffrey C. Ely, and Okan Yilankaya (2007): "Evolution of Preferences," *Review of Economic Studies*, **74**, 685-704.

Ellison and Fudenberg (1993): "Rules of Thumb for Social Learning," *Journal of Political Economy*, **101**, 612-643.

Ellison and Fudenberg (1995): "Word-of-Mouth Communication and Social Learning," *Quarterly Journal of Economics*, **110**, 1, 93-125.

Ely and Yilankaya (2001): "Nash Equilibrium and the Evolution of Preferences," *Journal of Economic Theory*, **97**, 255-272.

Feri, F., Meléndez-Jiménez, M., Ponti, G. and Vega-Redondo, F. (2011) "Error cascades in observational learning: an experiment on the Chinos Game," *Games and Economic Behavior* 73, 136–146.

Foster, D., Stine, R. and Young, P. (2011) "A Markov Test for Alpha," *Wharton Financial Institutions Center Working Paper* 11-49, and *Oxford Economics Discussion Paper* 568.

Foster, D. and Young, P. (2011) "A Strategy-Proof Test of Portfolio Returns," *Wharton Financial Institutions Center Working Paper* 11-50, and *Oxford Economics Discussion Paper* 567.

Heller (2004): "An Evolutionary Approach to Learning in a Changing Environment," *Journal of Economic Theory*, **114**, 31-55.

Hart, S. (2005): "Adaptive Heuristics," *Econometrica* **73**, 5, 1401-1430.

Hart, S. and Mansour, Y. (2010): "How Long to Equilibrium? The Communication Complexity of Uncoupled Equilibrium Procedures," *Games and Economic Behavior* **69**, 1, 107-126.

Hart, S. and Mas-Colell, A. (2001): "A Reinforcement Procedure Leading to Correlated Equilibrium" in *Economic Essays*, Gerard Debreu, Wilhelm Neuefeind and Walter Trockel (editors), Springer, 181-200.

Hart, S. and Mas-Colell, A. (2003): "Regret-Based Continuous-Time Dynamics," *Games and Economic Behavior* **45**, 2, 375-394.

Hart, S. and Mas-Colell, A. (2003): "Uncoupled Dynamics Do Not Lead to Nash Equilibrium," *American Economic Review* **93**, 5, 1830-1836.

Juang (2001): "Learning from Popularity," *Econometrica*, **69**,735-747.

Juang (2002): "Rule Evolution and Equilibrium Selection," *Games and Economic Behavior*, **39**, 71-90.

Kandori, M., Mailath, R., and Rob, R. (1993): "Learning, Mutation and Long Run Equilibria in Games," *Econometrica*, **61**, 29-56.

Kandori, M., and Rob, R. (1995): "Evolution of Equilibria in the Long Run: A General Theory and Applications," *Journal of Economic Theory*, **65**, 383-414.

Kreindler, G. and Young, P. (2013) "Fast Convergence in Evolutionary Equilibrium Selection," *Games and Economic Behavior* 80, 39-67.

Kreindler, G. and Young, P. (2013) "Rapid Innovation Diffusion in Social Networks," *Oxford Economics Discussion Paper* 626.

Lambson and Probst (2004): "Learning by Matching Patterns," *Games and Economic Behavior*, **46**, 398-409.

Marden, J., Pao, L. and Young, P. (2011) "Achieving Pareto Optimality Through Distributed Learning," *Oxford Economics Discussion Paper* 557.

Pradelski, B. and Young P. (2011) "Learning Efficient Nash Equilibria in Distributed Systems," *Oxford Economics Discussion Papers* 480.

Robson, A. J., and Vega-Redondo, F. (1996): "Efficient Equilibrium Selection in Evolutionary Games with Random Matching," *Journal of Economic Theory* **70**, 65-92.

Wallace, C. and Young, P. (2014) "Stochastic Evolutionary Game Dynamics,"

in H.P. Young and S. Zamir, eds, *The Handbook of Game Theory*, vol. IV, 327-380, Elsevier.

Young, P. (1993) "The Evolution of Conventions," *Econometrica*, **61**, 57-84.

Young, P. (2011) "The Dynamics of Social Innovation," *the Proceedings of the National Academy of Sciences*, 21285–21291.

II. Preferences/Reciprocity (optional)

Bolton and Ockenfels (2000): "ERC: A Theory of Equity, Reciprocity, and Competition," *American Economic Review*, **90**, 166-193.

Charness and Rabin (2002): "Understanding Social Preferences with Simple Tests," *Quarterly Journal of Economics*, **117**, 817-869.

Dwfwenberg and Kirchsteiger (2004): "A Theory of Sequential Reciprocity," *Games and Economic Behavior*, **47**, 268-298.

Engelmann and Strobel (2004): "Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments," *American Economic Review*, **94**, 857-869.

Fehr and Schmidt (1999): "A Theory of Fairness, Competition, and Cooperation," *Quarterly Journal of Economics*, **114**, 817-868.

Rabin (1993): "Incorporating Fairness into Game Theory and Economics," *American Economic Review*, **83**, 1281-1302.

III. Networks (optional)

Allen, F. and D. Gale (2000), "Financial Contagion," *Journal of Political Economy*, 108, 1-33.

Bala, V. and Goyal, S. (2000a) "A non-cooperative model of network formation," *Econometrica*, 68, pp 1181-1230.

Broom, M., Rychtá˘r, J., Stadler, B. (2011), "Evolutionary dynamics on graphs-the effect of graph structure and initial placement on mutant spread," J. Stat. Theory Pract. 5 (3), 369–381.

Calvó-Armengol, A. (2004), "Job Contact Networks," *Journal of Economic Theory* 115, 191-206.

Calvó-Armengol, A. and M.O. Jackson (2004), "The Effects of Social Networks on Employment and Inequality," *American Economic Review*, 94(3), 426-454.

Calvó-Armengol, A. and M.O. Jackson (2009), "Like Father, Like Son: Network Externalities, Parent-Child Correlation in Behavior, and Social Mobility," *American Economic Journal: Microeconomics* 1(1), 124-150.

Demange, G. (2004), "On group stability in hierarchies and networks," *Journal of Political Economy*.

Dutta, B., S. Ghosal, and D. Ray (2005), "Farsighted Network Formation," *Journal of Economic Theory* 122(2), 143-164.

Dutta, B., and Mutuswami, S. (1997), "Stable Networks," *Journal of Economic Theory*, 76, 322-344.

Ellison, G. (1993), "Learning, Local Interaction, and Coordination," Econometrica, 61, 1047-1071.

Ellison, G. and Fudenberg, D. (1995), "Word-of-Mouth Communication and Social Learning," *The Quarterly Journal of Economics*, 110, 93-126.

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Haller, H. and Sarangi, S. (2005), "Nash Networks with Heterogeneous Links," *Mathematical Social Sciences*, 50, 181-201.

Jackson, M.O. (2004), "A Survey of Model of Network Formation: Stability and Efficiency," in *Group Formation in Economics*; *Networks, Clubs and Coalitions*, edited by Gabrielle Demange and Myrna Wooders, Cambridge University Press: Cambridge U.K.

Jackson, M.O. (2006), "The Economics of Social Networks," Chapter 1 in Volume I of *Advances in Economics and Econometrics, Theory and Applications: Ninth World Congress of the Econometric Society,* edited by Richard Blundell, Whitney Newey, and Torsten Persson, Cambridge University Press.

Jackson, M.O. (2010), *Social and Economic Networks*, Princeton University Press.

Jackson, M.O. and Watts, A. (2002a), "The Evolution of Social and Economic Networks," *Journal of Economic Theory*, 106(2), 265-295.

Jackson, M.O. and Watts, A. (2002b), "On the Formation of Interaction Networks in Social Coordination Games," *Games and Economic Behavior*, 41(2), 265-291.

Jackson, M.O. and Wolinsky, A. (1996), "A Strategic Model of Social and Economic Networks," *Journal of Economic Theory*, 71(1), 44-74.

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http://www.stanford.edu/~jacksonm/diffusionchapter.pdf

Lieberman, E., Hauert, C., Nowak, M.A. (2005), "Evolutionary dynamics on graphs," Nature 433 (7023), 312–316.

Morris, S. (2000), "Contagion," *Review of Economic Studies*, 67: 57-78.

Ohtsuki, H., Pacheco, J., Nowak, M. (2007), "Evolutionary graph theory: breaking the symmetry between interaction and replacement," *Journal of Theoretical Biology*, 246, 681–694.

Schelling, T. (1971), "Dynamic Models of Segregation," *Journal of Mathematical Sociology*, 1, 143-186.

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http://www.sciencedirect.com/science/article/pii/S0303264711001675

Shakarian, P., Roos, P., Johnson, A. (2013), "A novel analytical method for evolutionary graph theory problems," Biosystems, 111, 136–144.

Vega-Redondo, F. (2006), "Building up Social Capital in a Changing World," *Journal of Economic Dynamics and Control*, 30(11), 2305-2338.

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