DEPARTMENT OF MATHEMATICS
Spring 2012 Semester

MATH-GA 2840.003 Advanced Topics in Applied Mathematics:
(Dynamic computational statistical models for socio-economic and geo-political systems)
Tuesdays ,9:30-11:20 am, Room 1302 Warren Weaver Hall (251 Mercer Street)
Instructor: David K.A. Mordecai

Prerequisites: A genuine interest in computational statistical modeling of social phenomena is expected. Some foundation or background in theory or applications of mathematical statistics, matrices, PDEs/finite difference methods, Markov Chain numerical methods, and/or network theory is suggested, but not required. The class will be suitable for students with appropriate backgrounds from areas such as Economics, Epidemiology, Finance, Marketing, Management, Politics, Public Policy, or Sociology, as well as for students of Mathematics or Computer Science.

Description: A comparative multi-disciplinary survey of the developments and application of computational statistics models to the simulation, measurement, and analysis of evolutionary dynamics underlying social and institutional structures, as applied to the following phenomena: cultural and technological propagation and adoption; information dissemination and aggregation; search, matching, intermediation; and network effects across populations within geo-political, socioeconomic, financial systems. Areas of application to be considered will include: financial, labor, housing, consumption, and trade effects of consumer behavior, as well as global population, immigration, socio-political conflict, environmental, epidemiological, aging, and health trends. A extensive list of suggested texts and articles will be provided to participants.

Required texts: Aoki, Masanao and Hiroshi Yoshikawa ,*Reconstructing Macroeconomics*; Bueno de Mesquita, Bruce, *Predicting Politics*; Epstein, Joshua M., *Nonlinear Dynamics, Mathematical Biology, and Social Science*; Gros, Claudius, *Complex and Adaptive Dynamical Systems: A Primer*; Schelling, Thomas, *Micromotives and Macrobehavior*.

Supplementary texts: Aoki, Masanao, *Modeling Aggregate Behavior and Fluctuations in Economics: Stochastic Views...*; Aoki, Masanao, *New Approaches to Macroeconomic Modeling: Evolutionary Stochastic Dynamics, ...*; Foellmi, Reto, *Consumption Structure and Macro- economics: Structural Change and the Relationship...*; Kollman, Ken, John H. Miller, and Scott E. Page, *Computational Models in Political Economy*; Sargent, Thomas J., *Bounded Rationality in Macroeconomics*; Verhulst, Ferdinand, Voit, Johannes, *The Statistical Mechanics of Financial Markets*; Weibull, J. W., *Evolutionary Game Theory*.

Grading: To be based upon in-class discourse and small group activities (paper, project, or problem set).

Course syllabus and semester calendar are found on the reverse side of this page

A syllabus (including references for background reading) will be available well before the start of the Spring 2012 semester.

Week 1:   Diffusion Models of Information Aggregation; Sorting and Mixing Models of Segregation

Week 2:   Bounded Rationality, Search, Information Dissemination and Adoption; Game Theoretic Fundamentals

Week 3:   Fundamental Combinatorial Principles of Stochastic Dynamics in Macroeconomics

Week 4:   Punctuated Equilibria and Applications to Immigration, Regime Changes, Phase Transitions, and Cluster Formation in Financial Markets

Week 5:   Nonlinear Dynamics and Mathematical Biology Models Applied to Socio-Political Conflict: Crime, Combat, Civil Unrest, Arms Races and Combat

Week 6:   Social Norms, Social Networks, Technology Adoption, Voting and Computational Model of Electoral Competition

Week 7:   Guest Lecture - TBA

Week 8:   Guest Lectures - TBA

Week 9:   Guest Lectures - TBA

Week 10:   Group Project/Paper/Problem Set Presentations

Week 11:   Group Project/Paper/Problem Set Presentations

Week 12:   Group Project/Paper/Problem Set Presentations

Week 13:   Group Project/Paper/Problem Set Presentations

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Calendar: First day of the spring 2012 semester: January 23
            Last day of the spring 20112 semester: May 7
            Spring Break: March 12-18
            Final examination period: May 9-15