University of Wisconsin - Madison
ECON899 - Computational Methods
Instructor Q1: Dean Corbae, email: dean.corbae@wisc.edu, Office: SS7438,
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Web: http://sites.google.com/a/wisc.edu/deancorbae/home.

Quarter 1, Fall 2021 Syllabus

Course Overview: This class is co-taught with J.F. Houde, who will teach Quarter 2. The course covers techniques to compute and estimate structural models. Q1 will focus on dynamic models with heterogeneous agents to understand such issues as wealth inequality and the firm size distribution. Q1 will run until approximately October 27, 2021.

Evaluation: There will be Julia, Matlab or Fortran computer assignments almost every week in Q1 that can be done in groups. A final project for the entire class must be done individually associated with either quarter's material. The final project for Q1 can be to replicate the computational results in an existing paper not covered in-class. Some suggestions for replication papers are listed at the bottom of this syllabus. Successful completion of the weekly problem sets are a necessary (but not sufficient) condition for a grade of AB while successful completion of the final project is a necessary (but not sufficient) condition for a grade of A.

Problem Set Tools: Each problem set is intended to introduce you to a different method.

1. PS1: Infinite Horizon Dynamic Programming in Matlab, Fortran, Julia. How to parallel process.

2. PS2: Operators and Nested Fixed Points: Application to finding a price which clears a market.

3. PS3: Finite Time dynamic programming: Application to Life Cycle Models.

4. PS4: Computing Transitions: Application to a change in social security tax

5. PS5: Approximating sequences of distributions: Application to heterogeneous agent problems with aggregate uncertainty (both household (Krusell-Smith) and firm (Weintraub, et. al.))

6. PS6: Entry and Exit: Application to competitive firm dynamics.

7. PS7: Simulated Method of Moments, Parameter sensitivity, Bootstrapping.

Credits: This is a 3 credit course. The class meets for two 75 minute periods. The expectation is that students will work on course learning activities (reading, problem sets, writing a final project, etc) for about 5 hours out of classroom for every class period.

Learning Outcomes: At the end of this course, students are expected to be able to apply computational methods to solve and estimate models in macroeconomics, labor economics, public finance, international, and industrial organization.

Textbooks: No textbook is required. Some books that might prove useful are:

Atkinson, K. 1989. An Introduction to Numerical Analysis, New York: John Wiley.

Judd, K. 1998. Numerical Methods in Economics, Cambridge: MIT Press.

Press, W., S. Teukolsky, W. Vetterling, B. Flannery. 1996. Numerical Recipes in Fortran 90, Cambridge: Cambridge University Press.

Stokey, N. and R. Lucas. 1989. Recursive Methods in Economic Dynamics. Cambridge: Harvard University Press.

Outline and Readings:

Part 1a. Understanding the U.S. Distribution of Wealth ("$*$" denotes papers covered in class or problem sets)

Aiyagari, R. 1994. "Uninsured Idiosyncratic Risk and Aggregate Saving", *Quarterly Journal of Economics*, 109, p. 659-84.

Athreya, K. 2002. "Welfare Implications of the Bankruptcy Reform Act of 1999", *Journal of Monetary Economics*, 49(8), p. 1567-1595.

Budria Rodriguez, S., J. Diaz Gimenez, V. Quadrini, V. Rios-Rull. 2002. "Updated Facts on the U.S. Distributions of Earnings, Income, and Wealth", *Federal Reserve Bank of Minneapolis Quarterly Review*, Summer, p. 2-35.

Chatterjee, S., D. Corbae, M. Nakajima, and V. Rios-Rull. 2007. "A Quantitative Theory of Unsecured Consumer Credit with Risk of Default", *Econometrica*, 75(6), p. 1525-1589.

Chatterjee, S., D. Corbae, K. Dempsey, and V. Rios-Rull. 2020. "A Quantitative Theory of the Credit Score", mimeo.

*Conesa, J. and D. Krueger (1998) "Social Security Reform with Heterogeneous Agents", *Review of Economic Dynamics*, Vol. 2, p. 757-795.

Corbae, D. and E. Quintin. 2015. "Leverage and the Foreclosure Crisis", *Journal of Political Economy,* 123, p. 1-65.

*Diaz Gimenez, J., A. Glover, and V. Rios-Rull. 2011. "Facts on the Distributions of Earnings, Income, and Wealth in the United States: 2007 Update", *Federal Reserve Bank of Minneapolis Quarterly Review*, February, p. 2-35. (DGR uses 2007 SCF)

Heathecote, J., K. Storesletten, and G. Violante. 2009. "Quantitative Macroeconomics with Heterogeneous Households", Federal Reserve Bank of Minneapolis Research Department Staff Report #420.

*Huggett, M. 1993. "The risk-free rate in heterogeneous-agent incomplete-insurance economies", *Journal of Economic Dynamics and Control*, 17, p. 953-69.

*Huggett, M. 1996. "Wealth distribution in life-cycle economies", *Journal of Monetary Economics*, 38, p. 469-94.

*Krussell, P. and A. Smith. 1998. "Income and Wealth Heterogeneity in the Macroeconomy," *Journal of Political Economy*, 106, p. 867-96.

Miao, J. 2006. "Competitive equilibria of economies with a continuum of consumers and aggregate shocks," *Journal of Economic Theory*, 128, p. 274-98.

Rios-Rull, V. 1997. "Computation of Equilibria in Heterogeneous Agent Models", *Federal Reserve Bank of Minneapolis Staff Report 231.*

*Tauchen, G. 1986. "Finite state Markov-chain approximation to univariate and vector autoregressions", *Economics Letters*, 20, p. 177-81.

Part 2a. Understanding Entry, Exit, and Firm Dynamics

*Andrews, I., M. Gentzkow, and JM Shapiro. 2017 "Measuring the Sensitivity of Parameter Estimates to Estimation Moments", *Quarterly Journal of Economics*, 132 (4), p.1553-92.

Clementi, G. and D. Palazzo. 2016. "Entry, Exit, Firm Dynamics, and Aggregate Fluctuations", *American Economic Journal: Macroeconomics,* 8, 1-41.

Corbae, D. and P. D'Erasmo. "Reorganization or Liquidation: Bankruptcy Choice and Firm Dynamics", forthcoming *Review of Economic Studies.*

Davis, S., J. Haltiwanger, S.Schuh. 1996. *Job Creation and Destruction.* Cambridge:MIT Press. See also http://www.bsos.umd.edu/econ/haltiwanger/download.htm

Hansen, L. 1982. "Large Sample Properties of Generalized Method of Moments Estimators", *Econometrica,* 50, p. 1029-54.

*Hopenhayn, H. 1992. "Entry, Exit, and Firm Dynamics in Long Run Equilibrium", *Econometrica*, 60, p. 1127-50.

*Hopenhayn, H. and R. Rogerson. 1993. "Job Turnover and Policy Evaluation: A General Equilibrium Analysis", *Journal of Political Economy*, 101, p. 915-38.

*Lee, B.S. and B. Ingram. 1991 "Simulation estimation of time series models", *Journal of Econometrics*, 47, p. 197-205.

*Michaelides, A. and S. Ng. 2000. "Estimating the rational expectations model of speculative storage: A Monte Carlo comparison of three simulation estimators", *Journal of Econometrics*, 96, p. 231-66.

Part 2b. Strategic Interactions among Firms

Corbae, D. and P. D'Erasmo, "Capital Buffers in a Quantitative Model of Banking Industry Dynamics", forthcoming *Econometrica.*

Egan, M., A. Hortascu, G. Matvos (2017) "Deposit Competition and Financial Fragility: Evidence from the US Banking Sector", *American Economic Review*, 107, p. 169-216.

*Ericson, R. and A. Pakes. 1995. "Markov-Perfect Industry Dynamics: A Framework for Empirical Work", *Review of Economic Studies*, 62, p. 53-82.

Pakes, A. 2000. "A framework for applied dynamic analysis in I.O.", NBER wp #8024.

Rust, J. 1987. "Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher", *Econometrica*, 55, p. 999-1033.

Weintraub, G.Y., C.L. Benkard, and B. Van Roy. 2008. "Markov Perfect Industry Dynamics with Many Firms", *Econometrica*, Vol. 76, No. 6 (November, 2008), 1375–1411.

Weintraub, G.Y., C.L. Benkard, and B. Van Roy. 2008. "Computational Methods for Oblivious Equilibrium", mimeo. See also Weintraub's website http://www.columbia.edu/~gyw2105/GYW/Main_Page.html.

Weintraub, G.Y., C.L. Benkard, and B. Van Roy. 2009. "Industry Dynamics: Foundations for Models with an Infinite Number of Firms", mimeo.

Final Project: Reproduce the results in a paper which uses heterogeneous agent computation techniques of your choice. Some examples are:

(International Trade) Melitz, M. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity", *Econometrica*, 71, p.1695-1725.

(Sovereign Debt) Arellano, C. 2008. "Default Risk and Income Fluctuations in Emerging Economies", *American Economic Review*, 98(3), p. 690-712.

(Corporate Finance) Hennessy, C. and T. Whited. 2005. "Debt Dynamics", *Journal of Finance*, 60, p. 1129-1165.

(Search Models of Money) Molico, M. 2006. "The Distribution Of Money And Prices In Search Equilibrium," *International Economic Review*, 47(3), p. 701-722.

(Private Information) Williamson, S. 1998. "Payment Systems with Random Matching and Private Information", *Journal of Money, Credit, and Banking*, 30(3), p. 551-569.

Other Information

Academic Conduct:

Academic integrity is a fundamental and critical value on the UW-Madison campus, in the Wisconsin Business School, and in the MBA program. The links below offer general guidance on academic conduct:

https://conduct.students.wisc.edu/misconduct/academic-integrity/

https://docs.legis.wisconsin.gov/code/admin_code/uws/14.pdf

To follow the general guidance in these documents, you need to know the appropriate academic conduct for the activities and deliverables in our class:

- Credit for team problem sets requires your involvement in that teamwork. Team code must be new: copying code from previous years' answers to problem sets is not allowed.
- The final project is strictly individual effort.

Conflict Between Academic Requirements and Religious Observance:

If there is a conflict between an academic requirement of this course and your religious observance, contact me within the first two weeks of the course and we will determine an alternative for meeting that requirement.

Accommodations for Students with Disabilities:

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Faculty will work either directly with the student or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA." http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

Accommodations are your right under ADA. But please know that I welcome us meeting to determine the accommodations that make most sense for you. Please reach out to me at the beginning of our part of the semester.

Diversity & Inclusion:

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu

Student Mental Health:

"As a student you may experience a range of issues that can cause barriers to learning. These might include strained relationships, anxiety, high levels of stress, alcohol/drug problems, feeling down, or loss of motivation. University Health Services is here to help with these or other issues you may experience. You can learn about the free, confidential mental health services available on campus by calling 608-265-5600 or visiting www.uhs.wisc.edu. Help is always available."