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Reca Daetwyler Sarfati

Education

Aug. 2014 - May 2018 **Brown University**, *Sc.B. in Mathematics and Computer Science*, magna cum laude.
Phi Beta Kappa, Sigma Xi

- *Senior Capstone:* "Strategic Bidding and Querying in Ascending Combinatorial Auctions."
  I derive probabilistic performance bounds on strategies for bidding and value querying in ascending combinatorial auctions, empirically assessing performance via simulations of Canadian Spectrum Auction.

Fall 2018 - Spring 2019 **New York University**, *Graduate Coursework.*
Microeconomics I (PhD), *final grade 2/21 in cohort*; Analysis II: Lebesgue Integral and Measure Theory (MSc), *highest final grade in cohort*; Advanced Econometric Modeling (MSc).

Federal Reserve Bank of New York, *Bayesian Macroeconometrics.*
Class taught at the New York Fed by Marco Del Negro, following his PhD course at Columbia (GR6413). (Non-)Linear state-space models, BVARs, filters (Kalman, particle), simulation smoothers, shock decomposition, Gibbs sampler, MCMC methods. Applications to time-varying parameter models, stochastic volatility, dynamic factor models.

Personal

Citizenship United States, Switzerland.

Interests Macroeconomics, Theory, Inequality, Labor, Development, Market Design, Computation.

Papers Accepted and Under Revision

Mar. 2020 **Online Estimation of DSGE Models**, *conditionally accepted to* ***The Econometrics Journal***, with Michael Cai, Marco Del Negro, Edward Herbst, Ethan Matlin, and Frank Schorfheide.

This paper illustrates the usefulness of sequential Monte Carlo (SMC) methods in approximating DSGE model posterior distributions. We show how the tempering schedule can be chosen adaptively, explore the benefits of an SMC variant we devise termed generalized tempering for "online" estimation, and provide examples of multimodal posteriors well-captured by SMC methods. We then use our online estimation technique to compute pseudo-out-of-sample density forecasts of DSGE models with and without financial frictions, documenting the benefits of conditioning DSGE model forecasts on nowcasts of macroeconomic variables and interest rate expectations.

- *Presented*: European Seminar on Bayesian Econometrics (St. Andrews, Scotland, Sep. 3-4), System Committee on Econometrics (Philadelphia Fed, Sep. 25-26), Forecasting at Central Banks Conference (Bank of Canada, Oct. 3-4).

Working Papers

Mar. 2019 **Estimating HANK: Macro Time Series and Micro Moments**, with Sushant Acharya, Michael Cai, Marco Del Negro, Keshav Dogra, and Ethan Matlin.

We show how to use sequential Monte Carlo methods to estimate a heterogeneous agent New Keynesian (HANK) model featuring both nominal and real rigidities. We demonstrate how the posterior distribution may be specified as the product of the standard macro time series likelihood and a prior enforcing several steady state distributional moments, including the average marginal propensity to consume (MPC) and fraction of agents with zero liquid wealth. Using this framework, we ask whether there exists a tension between fitting macroeconomic time series and distributional moments of interest, ultimately finding there is none. For instance, even after relaxing the prior, the posterior based solely on macro time series features an MPC well below one, broadly in line with existing micro evidence.

- *Presented*: 20th IWH Macroeconometric Workshop (Halle, Germany on Oct. 29-30), New York Fed/Hong Kong Monetary Authority Conference on "Monetary Policy and Heterogeneity" (Hong Kong, May 23-24).

Jan. 2019 **Learning Correlated Equilibria in Extensive Form Games**, with Amy Greenwald.

We formalize an efficient class of counterfactual regret minimization algorithms exploiting the "sequence form" to compute "Φ-equilibria" – a generalized class of equilibrium concepts defined within general-sum extensive form games of imperfect information. We develop increasingly strong notions of no-regret, mapping those notions directly onto concepts of interest, such as agent- and extensive-form correlated and coarse correlated equilibria.

- *Presenting*: 20th AAAI Conference on Artificial Intelligence, *Reinforcement Learning in Games* (Feb. 7-8, 2020).

Blog Articles

Dec. 20, 2019 **Liberty Street Economics**, *The New York Fed DSGE Model Forecast: December 2019*, with William Chen, Marco Del Negro, Ethan Matlin, and Andrea Tambalotti.

Sep. 30, 2019 **Liberty Street Economics**, *The New York Fed DSGE Model Forecast: September 2019*, with Ozge Akinci, William Chen, Marco Del Negro, and Ethan Matlin.

Sep. 4, 2019 **Liberty Street Economics**, *Online Estimation of DSGE Models*, with Michael Cai, Marco Del Negro, Ethan Matlin, and Frank Schorfheide.

Jun. 21, 2019 **Liberty Street Economics**, *The New York Fed DSGE Model Forecast: June 2019*, with Sushant Acharya, Michael Cai, Marco Del Negro, and Ethan Matlin.

Feb. 8, 2019 **Liberty Street Economics**, *The New York Fed DSGE Model Forecast: January 2019*, with Marco Del Negro, Michael Cai, and Ethan Matlin.

Oct. 24, 2018 **Liberty Street Economics**, *The New York Fed DSGE Model Forecast: October 2018*, with Marco Del Negro, Argia Sbordone, Michael Cai, and Ethan Matlin.

Research Experience

Jun. 2018 - Present **Federal Reserve Bank of New York**, *Senior Research Analyst*.
Assisting the dynamic stochastic general equilibrium (DSGE) team with research, policy analysis, forecasting, and model development. Developing and maintaining the DSGE.jl package (in the Julia programming language) for solving, estimating, and forecasting DSGE models. (Julia, MATLAB, Fortran, Stata)

- Coauthoring two academic papers with NY Fed economists which explore the application of sequential Monte Carlo (SMC) methods to the estimation of representative and heterogeneous agent New Keynesian (HANK) models.
- Studying and developing code for insertion of Hamiltonian Monte Carlo sampling in the place of random-walk Metropolis-Hastings during the "mutation" step of SMC, with an eye toward the efficient estimation of DSGE models with many state variables.
- Under Andrea Tambalotti, Giorgio Primiceri, and Florin Bilbiie, extending baseline model from Justiano, Primiceri, Tambalotti (2009) to include two agents switching between a "hand-to-mouth" and unconstrained state, as in Bilbiie (2019), so as to study the cyclicality of inequality and risk in an estimated DSGE-HANK model.

Aug. 2017 - Present **Brown University Computer Science Department**, *Research Assistant*.

- With Prof. Amy Greenwald, coauthoring paper in which we derive no-regret learning algorithms for efficient computation of various Bayes correlated equilibrium concepts in extensive-form imperfect information games.
- Researched application of innovations in reinforcement learning to the computation of correlated equilibria, wrote package for running simulations, derived proofs of empirical convergence.
- Participated in and led sessions for algorithmic game theory reading group among PhD computer science students.

Sep. 2017 - May 2018 **Brown University Economics Department**, *Research Assistant*.
Under Prof. Jesse Shapiro, developed quantitative index of national freedom of assembly. We conjectured that in states with heavily restricted freedom to protest, protests against the state would either come as a surprise or likely not occur. On this premise, we built a model of strategic interaction between a regime and its opposition, hypothesizing the relative "unpredictability" of state-targeted civil unrest could be used as an instrument for state suppression.

- Explored use of machine learning classifiers (SVM, Naïve Bayes, and logistic regression) to construct implied measures of "predictability." (Python)
- Designed Python algorithm to web-scrape tens of thousands of news articles to match, augment, and re-classify protest data in Social Conflict Analysis Database (SCAD). Constructed relational database in SQL of Bloomberg sovereign bond time series data. Studied effects of protests against the state on average bond mid prices in Egypt, Mexico, and South Africa. (Python, Stata, SQL)

May 2016 - Sep. 2017 **Brown University Social Science Experimental Laboratory**, *Research Assistant*.
Under Prof. Louis Putterman, implemented 24-subject game in z-Tree to model social incentives for civic engagement in a setting with moral hazard. Administered sessions, cleaned and interpreted the collected data. Results from implementation culminated in the working paper Kamei, Putterman, and Tyran (2019). (z-Tree)

- Extended base z-Tree functionality to handle thread-safe distributed computation, enabling greater complexity of interactive experiment design without subjects perceiving a lag.
- Designed graphical user interface enabling inter-player messaging (modeled after social media platforms) and dynamic graphics for interactive games used to simulate civic engagement.

May. 2015 - Aug. 2015 **U.S. Consulate Guangzhou, China**, *Summer Analyst in Foreign Commercial Service, Consular Sections*.

- Constructed and cleaned database of over 60,000 observations of past visa applicants. Performed logistic regression analysis to discern attributes correlated with future visa fraud. (SQL, MATLAB)
- Compiled and analyzed summary statistics of high-tech direct investment trends from major Guangdong businesses.

Speaking and Presentations

Jun. 2019 **JuliaCon 2019**, *Heterogeneous Agent Dynamic Stochastic General Equilibrium (DSGE) Models in Julia at the Federal Reserve Bank of New York*, University of Maryland, Baltimore.
▶ Watch
Invited to deliver 30-minute presentation at annual conference for developers in the Julia programming language, on work implementing tools for the solution and estimation of heterogeneous agent models.

Jul. 2019 **Federal Reserve Bank of New York**, *Intro to Git and Version Control; Intro to Database Management and SQL; Coding Best Practices; Intro to Julia.*

Authored Software

Summer 2019 **Sequential Monte Carlo**, *Package (Julia).*
Coauthored Julia-licensed package, SMC.jl, implementing sequential Monte Carlo sampling methods for the approximation of posterior distributions. Optimized memory allocation to rival Fortran speeds for distributed computation.

Spring 2019 **Sparse Automatic Differentiation**, *Package (Julia).*
Wrote extension to Julia package, ForwardDiff.jl, to exploit sparsity of data structures during forward automatic differentiation (useful for differentiation of functions $f : \mathbb{R}^n \to \mathbb{R}^m$ when $n << m$). This modification more than halves the runtime of solution algorithms for various continuous-time HANK models.

Spring 2018 **Extensive Form Games**, *Library (Python).*
Developed library in Python for specification and conversion of games between normal, extensive, and sequence form representations. Implemented reinforcement learning algorithms to compute various correlated equilibrium concepts.

Summer 2017 **Tempered Particle Filter**, *Package (Julia).*
Implemented self-tuning tempered particle filter from Herbst and Schorfheide, (2017) for likelihood evaluation of non-linear models with non-Gaussian innovations. Integrated code into the NY Fed's package of filtering and smoothing routines for state-space models, StateSpaceRoutines.jl.

Teaching Experience

Fall 2017 **Design and Analysis of Algorithms**, *Teaching Assistant*, Brown Computer Science Department.
CSCI 1570 : Led sections, held office hours, and graded projects, exams, and homework assignments for advanced proof-based course spanning data structures, linear programming, optimization, online and competitive analysis, dynamic programming, NP-Hardness, information theory, parallel computing, and graph algorithms.

Spring 2017 **Algorithms and Data Structures**, *Teaching Assistant*, Brown Computer Science Department.
CSCI 0160 : Taught section of 20 students, held office hours, wrote assignment stencil code in Java, and implemented auto-grading functionality for programming assignments. Course spanned complexity analysis, data structures, sorting, and search algorithms, as well as fundamental Python and Java.

Summer 2016 **{Statistics, Economics} for Public Policy (MPA)**, *Economics Tutor*, Brown Economics Department.
PLCY 2455, 2460 : Tutored masters students in quantitative methods and microeconomics for public policy.

Honors and Grants

Mar. 2019 **National Science Foundation**, *XSEDE Research Allocation Grant, SES #190003.*
- "Estimating Heterogeneous Agent Dynamic Stochastic General Equilibrium Models using Sequential Monte Carlo."

Mar. 2019 **Vault Recognition Award**, *Federal Reserve Bank of New York.*

May 2018 **Phi Beta Kappa**, *Brown University.*
- 1/136 inducted from graduating class of 1,696.

May 2018 **Magna Cum Laude**, *Brown University.*
- Highest honors awarded at graduation, to no more than the top 20% of the class by GPA.

May 2018 **Sigma Xi**, *Brown University.*
- 1/99 inducted to nomination-only scientific research honors society. 1/17 to receive all three honors (ΦBK, ΣΞ, *magna cum laude*) from class of 1,696.

Jun. 2016 - May 2018 **JPMorgan Chase Research Assistantship Award for Research in Economics**, *Brown University.*
- Salaried funding for two research projects, spanning two years.

Dec. 2017 **Women of Computer Science '84 Undergraduate Teaching Assistant Award**, *Brown University.*

May 2017 **The Ratcliffe Hicks Prize for Excellence in Debate**, *Brown University.*
- Awarded annually for extraordinary performance in and commitment to collegiate debate. (val. $2,500)

Other Awards and Experience

May 2018 **4th Place, American Parliamentary Debate National Championships**, *Johns Hopkins University*.
Ranked 4th in the nation at the National Championships for American parliamentary debate.

Jan. 2018 **Top 6% Speaker, World Universities Debating Championships**, *Mexico City, Mexico*.
Ranked 36/629 (top 6%) globally for individual speaker performance in the world's largest, most prestigious debating tournament.

Dec. 2014 - May 2018 **Brown Debating Union**, *Vice President of Operations, Vice President of Finance, Varsity Debater*.

- Managed logistics and budget of over $20,000 for 2nd-ranked (2016-2018) debating union in the nation.
- Extensively researched and edited 1500-word arguments for use on the national circuit.
- Competed weekly at tournaments across the country. (35+ hours/week)

Select Coursework

- Computer Science: Advanced Probabilistic Algorithms (PhD), Data Science (MSc), Machine Learning, Design and Analysis of Algorithms, Design and Implementation of Programming Languages, Computer Systems, Object-Oriented Programming, Intro to Algorithms and Data Structures.
- Math: Intro Analysis II: Lebesgue Integral and Measure Theory (MSc), Analysis: Functions of Several Variables, Analysis: Functions of One Variable, Abstract Algebra, Graph Theory, Ordinary Differential Equations, Dynamics and Vibrations, Discrete Structures and Probability, Statistical Inference I, Linear Algebra, Multivariate Calculus, Logic.
- Economics: Microeconomics I (PhD), Advanced Econometric Modeling (MSc), Algorithmic Game Theory (MSc), Advanced Macroeconomics: Monetary, Fiscal, and Stabilization Policies, Econometrics I (Adv.), International Trade, Economic Development, Intm. {Macroeconomics, Microeconomics}, International Political Economy, Comparative Politics of Finance.

Technical Skills

- **Programming Languages:** *Expert:* Julia, MATLAB, Python, Java, SQL, z-Tree. *Extensive Use:* C/C++, Fortran, R, Stata, Lisp, Racket. *Familiar:* Visual Basic, x86-64.
- **Scripting/Typesetting Languages:** Shell Script, JavaScript (incl. D3.js, Node.js), HTML, Pyret, Markdown, LaTeX.
- **Computing Skills:** High performance distributed computing and parallel processing (OpenMP, MPI, SGE, Slurm, sparse grids), GPU programming, Git, Arduino Robotics.
- **Clusters:** NY Fed Research Access Network, UT Dallas BigTex, Bridges PSC, Indiana/TACC Jetstream (XSEDE).
- **Operating Systems/Software:** Linux, Mac OS, Windows, Maya, SolidWorks, CAD.

Personal

- **General Interests:** Oration, programming language design, classical violin, oil painting, modernist literature, rugby.
- **Places Lived:** Seoul, South Korea; Manila, Philippines; Vienna, Austria; Kingston, Jamaica; Düsseldorf, Germany; Guangzhou, China; Sydney, Australia.

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