Arnav Sood

February 8, 2022

NBER Graduate Student Workshop on Heterogeneous-Agent Macroeconomics
NBER Conference Department
1050 Massachusetts Avenue
Cambridge, MA 02138-5398

Dear Professors Auclert, Rognlie, and Straub:

My name is Arnav Sood, and enclosed are my application materials for the Workshop.

I should first note that I'm applying on the basis of communication with Elisa Pepe, who explained that applications from some first-year students are welcome. I have taken second-year PhD courses in macro during undergrad, and have a work and publication history which I believe prepares me well for the material.

This history includes a particular emphasis on computation. Most recently, I was an invited panelist at the ASSA's "What Can AI Do in Economics?" session. One of my PhD courses from undergrad was John Stachurski's seminar on economic computing, and later I went on to become a Lead Developer at the QuantEcon organization. I also worked as a predoctoral fellow with Jesse Perla at UBC, where we coauthored this working paper on high-dimensional dynamic programming.

Writing that paper (and working on our other projects, such as the codebase for Perla, Tonetti, and Waugh (AER 2020)) required us to experiment with a variety of economic settings and solution methods. This helped me get a sense of the current research frontier, and of the tractability and theoretical implications of heterogeneity.

Overall, I believe my academic background and practical experience enables me to make the most of the Worskhop. Thank you for your consideration.

My referring faculty member is Professor David Childers (dchilder@cmu.edu).

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Yours Sincerely,

Arnav Sood

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overview

I am a first-year economics Ph.D. student at Carnegie Mellon University (Tepper School of Business.) My general interests are in computational macroeconomics, and especially high-dimensional models with heterogeneity in information.

employment

Predoctoral Fellow, Univeristy of British Columbia, 2018–2020.
▶ Supervised by Jesse Perla. Member of CAIDA.

Lead Developer, QuantEcon, 2019–2020.

Prior Experience, 2014–2018.
Research Assistant to Laura Veldkamp
Economics Research Intern, Office of the Comptroller of the Currency
Intern, Morgan Stanley Bank, N.A.

education

(In-Progress) Ph.D. Economics, Carnegie Mellon University.
▶ PhD Macro Courses: Macro I, Macro II, Macro III[1]

Economics Coursework, University of British Columbia, 2018–2020.

B.A. Mathematics, New York University, 2018.
▶ PhD Macro Courses: Topics in Computational Economics (`course link`), Advanced Macroeconomics (`syllabus`), Macro I, Macro II

working papers

Exploiting Symmetry in High-Dimensional Dynamic Programming. NBER
With Mahdi Ebrahimi Kahou, Jesús Fernández-Villaverde, Jesse Perla.
Presented: ASSA 2022; Minnesota Macro Conference (Minneapolis MN, August 2–4, 2021); VSE Econometrics Lunch (Vancouver BC, April 16, 2021); VSE Lunch Seminar (Vancouver BC, December 1, 2020)

software

Expectations.jl
Efficient expectation operators for univariate distributions, using Gaussian quadrature.
Presented: JuliaCon 2020 (Virtual, July 29–31, 2020)

InstantiateFromURL.jl
Allows Julia notebooks to refer to online, versioned dependency information.
Presented: JuliaCon 2020 (Virtual, July 29–31, 2020)

other writing

Optimal Stopping and Linear Complementarity. QuantEcon Notes
With Jesse Perla. Computational Appendix.

activities

Volunteer Tech Support, Free Geek Vancouver

Volunteer Teacher, Splash! (Various Universities)
▶ Taught free one-hour classes to high-school students. Subjects included information economics, mathematical statistics, group theory, philosophy of mind, and Play-Doh.

[1] Macro II is ongoing, and Macro III will start in our fourth quarter.

Personal Statement

My main goals for the Workshop are to explore how heterogeneity complicates policymakers' problems, and to learn more about the implementation, calibration and estimation of these models.

For example, one of my research goals is studying how heterogeneity can help us understand so-called "systemic" or "endogenous risk." This refers to the tendency of certain economic models to exhibit extreme outcomes (such as "stock market crashes, banking crises, runs on the repo, [etc.]") without a commensurate aggregate shock. (Zigrand, 2014)

The natural question for that work is how the social planner can dampen volatility. But it's becoming increasingly clear that policy effects can't be sharply anticipated without the machinery of heterogeneity. Perhaps the canonical example is furnished by Nakamura and coauthors for monetary policy, but heterogeneity is becoming an important channel for bank regulation, optimal taxation, and labor markets, among other areas. I hope that after the Workshop, I have more intuition for the nonlinearities and feedback behavior that social planners need to account for in these models.

The computational side of the Workshop will be immensely valuable for me. From my own experience with QuantEcon and my predoc, I know that (for example) Aiyagari models can take hours to solve even for reasonable state spaces, and every computational optimization counts. While I have some familiarity with the standard solution methods (for example, the perturbation approach of Ben Moll and coauthors, or the projection methods of Den Haan and coauthors), and some of the usual "tricks" (such as heavily exploiting sparsity in continuous-time state transitions, using endogenous grids, or trying autodifferentiation), I wish to deepen this knowledge and build a better understanding of these methods. The opportunity to get practical experience with experts in this area will be invaluable.

As for econometrics, one question I wish to explore during my PhD is whether the "sufficient statistic" approach made famous in Krusell and Smith can be applied to a wider class of models. In the working paper I mention above, we find that many common economic models exhibit symmetries (such as agent exchangeability) which can be used to sharply reduce the number of parameters required to approximate equilibrium objects.

What I hope to take away from the Workshop on this score is a granular knowledge of how these models are actually tuned and estimated. There are a myriad of questions, from which structural parameters to tune, which moments and impulse responses to match, and which optimization routines to use (with which shortcuts and what kind of manual pre-heating), that are often glossed over in the literature in favor of the economic implications. By interacting with leading scholars in this area, I hope that I can acquire this critical information and use it in my own research.

In sum, I think that this Workshop is a fantastic fit for my research goals and academic preparation, and I hope that I can join you in June.