

Introducing the Econ-ARK: Economics “Algorithmic Repository and toolKit”

Generic Presentation

June 21, 2018

Goals: Like DYNARE's, but for Models With Heterogeneity

State-of-the-art tools for:

- ① Solving microeconomic dynamic stochastic optimization problems
 - 'Hard' Bellman problems with uncertainty, 'kinks,' nonconvexities
- ② Simulating populations of agents
 - Whether or not they are solving DSOP
 - Allows disciplined exploration of deviations from RE
- ③ Finding equilibria for markets/economies populated by such agents

Who Has Produced It?

Name	TLA	Affiliation
<i>Christopher D Carroll</i>	CDC	JHU, CFPB
<i>David C Low</i>	DCL	CFPB
<i>Nathan M Palmer</i>	NMP	OFR
<i>Matthew N White</i>	MNW	UDel, CFPB
<i>Alex Kaufman</i>	ABK	CFPB → Princeton

Nothing herein may be interpreted as reflecting opinions of

- CFPB - United States Consumer Financial Protection Bureau
- JHU - Johns Hopkins University
- IMF - International Monetary Fund
- OFR - Office of Financial Research, U.S. Treasury
- UDel - University of Delaware

Major credit to CFPB

- Hired CDC as Chief Economist with this as a key priority
- Hired NMP as intern to get started
- Hired MNW as Visiting Scholar to work on it
- Hired DCL as new economist last year
- Hired ABK as RA

Big Grant from Alfred P. Sloan Foundation!

Three Years

- Hire Programmers, RA's, Open Source Project Managers, etc etc

What Is It Good For?

- Heterogeneous Agent Macro Models
 - Original name: **H**eterogeneous **A**gent **R**esources and tool**K**it
 - HARK!
- Structural Micro Models (e.g., labor, health)
- IO models with equilibrium between consumer agents and firm agents
 - Unlike Noah's, our ARK can hold more than two of each kind!
 - Ultimate goal: Get examples on the ARK of all types of animal (model)

Why Have We Created It?

- ① Micro Structural Modeling 2017 \approx Econometrics circa 1970
 - 1970 econometrics: Write your own matrix inversion package!
 - 2017 structural: Write your own numerical convergence algorithms
- ② In practice:
 - Each paper is hand-crafted work of art involving years of work
 - Impenetrable spaghetti code; from generations of copy-and-paste
 - Progress very slow
 - Confidence is not very high
 - Papers that could benefit from including theory do not do it

Why: Goals

Make it *much* easier:

- To get started doing structural Heterogeneous Agent modeling
- To teach newcomers how to use such models
- To *compare* models to each other
- To add new capabilities
- To mix-and-match components/modules/agent types

Remove the excuse 'Structural model was not worth the effort'

Why Are Policy Institutions So Interested?

Who?

- Participation: CFPB, OFR, IMF
- Interest From: FRB, ECB, BLS

RA models unable to address key questions in Great Recession

- U.S. NEC Chair Larry Summers (2011), Fed Chair Janet Yellen (2016), former IMF Chief Economist Olivier Blanchard (2016), ECB Governing Board Member Benoit Coeure (2013), Bank of England Chief Economist Andy Haldane (2016), etc etc
- Theme: Heterogeneity desperately needed
 - Borrowers vs lenders
 - Poor, middle class, and rich
 - Homeowners vs renters
 - ...

Policymaking = Applied Theory. Options:

- ① Informal, intuitive, “wetware” theory
- ② Formal, structural, “software” theory

Why? Welfare Analysis With Heterogeneity

Sensible cost-benefit analysis requires:

- Estimates of distribution of heterogeneous outcomes
- Utility or other weighting of those outcomes
- → Structure

How: What Makes Us Think This is Feasible?

- Has been done already in many other scientific/technical fields
 - AstroPy
 - Statistics: 'R' and the Journal of Statistical Software
 - Many open-source resources in other sci/tech fields

How: *The Invention of Science* by David Wootton

Wrong explanations for the Scientific Revolution:

- Invention of 'the experiment'
- Invention of the printing press
- ...

Right explanation:

- Creation of community of scholars
- ... whose methods and results were 'open source'
- ... who criticized and improved and debugged each other

Alchemy → Chemistry

17th and 18th century version of github.com!

How: Github+Python=Gutenberg

Suite of powerful modern tools developed by software engineers:

- Almost-Automatic Integrated Documentation
- Robust Built-In Testing
- Continuous Integration
- Version Control
- Object-Oriented Programming (Python!)
- Integrated Development Environments
- Apache License
- ...

Will We Succeed?

A *lot* of enthusiasm from deep-pocketed policy institutions

- CFPB - Lion's Share of the Credit For Getting Here
 - Hired CDC As Chief Economist
 - On Specific Premise that Toolkit Would Be Priority
 - Hired MNW (leave of absence from UDel) To Create It
- Central Banks
 - So far: Fed (Board and Banks), ECB, BoE, RBA, RBNZ
- IMF
- OFR

Where Is It?

Browse without installing:

- Browse on our webpage at econ-ark.org
- Browse our code at <http://github.com/econ-ark>
- Browse our talks at <http://github.com/econ-ark/PARK>
- Overview paper at <http://github.com/econ-ark/PARK/SciPy2018.pdf>
- Browse our live [notebooks](#)
- Browse our [documentation](#)

Installing It On Your Local Computer

- You Need Python 2.7 (Python 3 target is July)
- If you don't have Python 2.7 on your computer, install either:
 - 1 **Anaconda2** - adds many packages useful for scientific computing
 - 2 Python 2.7
 - On Mac or Linux to download and install it
 - On Windows
 - Install Jupyter
 - Make sure you have **pip** installed
 - 3 Install the 'econ-ark' package:
 - pip install econ-ark
- Get our **our demonstration notebooks** from **DemARK**

References I

- BLANCHARD, OLIVIER (2016): "Do DSGE Models Have a Future?," Discussion paper, Petersen Institute for International Economics, Available at <https://piie.com/system/files/documents/pb16-11.pdf>.
- COEURE, BENOIT (2013): "The relevance of household-level data for monetary policy and financial stability analysis," .
- HALDANE, ANDY (2016): "The Dappled World," Discussion paper, Bank of England, Available at <http://www.bankofengland.co.uk/publications/Pages/speeches/2016/937.aspx>.
- SUMMERS, LAWRENCE H. (2011): "Larry Summers and Martin Wolf on New Economic Thinking," *Financial Times interview*, <http://larrysummers.com/commentary/speeches/brenton-woods-speech/>.
- YELLEN, JANET (2016): "Macroeconomic Research After the Crisis," Available at <https://www.federalreserve.gov/newsevents/speech/yellen20161014a.htm>.