# Introducing the Econ-ARK: Economics "Algorithmic Repository and toolKit"

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# Goal: Tool like DYNARE for Models With Heterogeneity

State-of-the-art set of tools for:

1. Solving dynamic stochastic optimization problems
   - 'Hard' Bellman problems with uncertainty, 'kinks,' nonconvexities
2. Simulate behavior of populations of agents
3. Finding equilibria for markets/economies populated by such agents

# Why Have We Created It?

1. HA Modeling 2017 $\approx$ Econometrics circa 1970
   - 1970 econometrics: Write your own matrix inversion package!
   - 2017 structural: Write your own numerical convergence alogrithms
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 (with hands-on, problem-set-assignable exercises)
- 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

- Summers (2011), Yellen (2016), Blanchard (2016), Coeure (2013), 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
- $\rightarrow$ 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: 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
- ...

# 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 code at http://github.com/econ-ark/PARK

Install 'econ-ark' on your computer:

- If you don't have Python 2.7 on your computer, get either:
  - Python 2.7 only
    - On Mac or Linux to download and install it
    - On Windows
  - Anaconda which adds many packages useful for scientific computing
- Make sure you have `pip` installed
- Install the 'econ-ark' package:

Run notebooks on your own computer:

- Install Jupyter

Run our demonstration notebooks using MyBinder

# References I


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