Open Source Economics

A platform for transdisciplinary research and education

The OSE team

September 18, 2020

Open Source
Economics

Public outreach

In a nutshell

*We provide a platform for economists, mathematicians, and computational scientists to facilitate the **transdisciplinary collaboration** in the development, analysis, and application of **computational economic models**.*

*Together, we **expand the set** of possible economic questions that we can address and **improve the quality** of our answers.*

Computational modeling in economics

Motivation

- Facilitate learning

- Study mechanisms

- Predict public policies

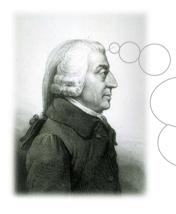# Computational modeling in economics

Motivation

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Transdisciplinary in nature

- Economic model

- Mathematical framework

- Computational implementation

New tooling for an old idea

THE greatest improvement in the productive powers of labor, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the **division of labor**.

– Adam Smith, The Wealth of Nations

Partners

Institute for
Numerical Simulation

DIW BERLIN

LIMES
Life & Medical Sciences Institute

Statistisk sentralbyrå
Statistics Norway

UNIL | Université de Lausanne

What we are doing

Economic models

- **respy**   Finite-horizon discrete Markov decision problem
  Labor economics
- ruspy

- pydsge

What we are doing

Economic models

- respy

- **ruspy**   Infinite-horizon discrete Markov decision problem
                   Industrial organization
- pydsge

What we are doing

Economic models

- respy

- ruspy

- **pydsge**   Dynamic stochastic general equilibrium model
  Monetary economics

What we are doing

Analysis pipeline

- **estimagic**   Numerical optimization
                  Estimating structural econometric models
- econsa

- robupy

What we are doing

Analysis pipeline

- estimagic

- **econsa**   Sensitivity analysis
  Assessing uncertainty of model implications
- robupy

Analysis pipeline

- estimagic

- econsa

- **robupy**   Robust optimization
            Incorporating model ambiguity

What we are doing

Analysis pipeline

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- robupy

$\Rightarrow$ Intellectual arbitrage from work in applied mathematics

What we are doing

Analysis pipeline

- estimagic

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- robupy

$\Rightarrow$ Intellectual arbitrage from work in applied mathematics

$\Rightarrow$ Adapted to the needs of economists

Development

Workflow

- GitHub organization

- Code reviews

- Testing harness

- Continuous integration

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Support

- Documentation

- Chatroom

- Hackathon

- Conferences

OSE Research

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption – savings decision

Eckstein–Keane–Wolpin models

Understanding individual decisions

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- Consumption – savings decision

Predicting effects of policies

- Welfare programs

- Tax schedules

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Mathematical framework and implementation

- Finite-horizon discrete Markov decision problem

- Backward induction algorithm

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$\Rightarrow$ transdisciplinary research on their **economics**, data, and computation

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Economics and data

- **Biased expectations**
- Robust decisions
- Option value

Incorporate subjective expectations
Collaboration with DIW for SOEP-IS data collection
Facilitating development of **soepy** and **respy**

Research projects

Economics and data

- Biased expectations

- **Robust decisions**   Account for ubiquitous uncertainties

Robust decision in light of model misspecification

- Option value   Building on **respy** and **robupy**

Research projects

Economics and data

- Biased expectations

- Robust decisions

- **Option value**   Schooling reform for identification and validation
                           Collaboration with Statistics Norway
                           Extension of **respy** to capture schooling system

Research projects

Computation

- **Uncertainty quantification**

- Global optimization

- HPC implementation

Capture parametric uncertainty
Assess competing policy implications
Need to adapt **econsa** to challenges in economic models

Research projects

Computation

- Uncertainty quantification

- **Global optimization**

- HPC implementation

Explore estimation uncertainty
Acknowledge multiplicity of local minima
Show use-case for **estimagic** features

Research projects

Computation

- Uncertainty quantification

- Global optimization

- **HPC implementation**   Enable increased realism and auditing of economic models
  Exploit large-scale parallelism on supercomputers
  Refactor **respy** to meet needs

Community code

🌊 respy

A research code for the flexible specification, simulation, and estimation of Eckstein–Keane–Wolpin models.

| Anaconda Cloud `2.0.0dev5` | Platforms `linux-64,win-32,noarch,osx-64,linux-32,win-64` | docs `passing` | License `MIT` |

| Continuous Integration Workflow `passing` | codecov `85%` | code style `black` |

Docs   respy.readthedocs.io

Code as research

Ecosystem

- Permissive license

- Online documentation

- Benchmark data sets

- Retreat

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Infrastructure

- Research software engineer

- Pre-doc position

- Lectures

- Courses

OSE Education

Components

Economics

- Motivation

- Interpretation

- Application

Programming

- Simulation

- Exploration

- Visualization

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$\Rightarrow$ Level of difficulty easily adjusted

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Components

Economics

- Motivation

- Interpretation

- Application

$\Rightarrow$ Level of difficulty easily adjusted

$\Rightarrow$ Skills transferable across domains

Programming

- Simulation

- Exploration

- Visualization

Scientific computing for economists

- Basic numerical methods

- Dynamic model of human capital application

- Software engineering

- High-performance computing

- Contributors

Docs ose-scientific-computing.rtfd.io

Exemplary course

Data science for economists

- Methods of causal analysis

- Applications in labor economics

- Python data science ecosystem

- Simulation experiments

- Reproducible workflow

Docs ose-data-science.rtfd.io

Digital infrastructure

NUVOLOS

- Cloud-hosted

- Browser-based

- Identical configurations

- Complete environments

- Scalable workflows

Conclusion

Join us!

 http://bit.ly/ose-github

 http://bit.ly/ose-zulip

 https://twitter.com/open_econ

 https://open-econ.org

Appendix

Contributors

- Professors

- Postdoctoral researchers

- Ph.D. students

- Master students

- Bachelor students

People   37 >