

# Bounded rationality in macroeconomics: Adaptive learning, experiments, agent-based modeling

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## Course description

The course will introduce the concept of bounded rationality. We will present empirical evidence showing that the behavior of economic agents generally deviates from perfect rationality. We will also discuss how relaxing the rational expectations hypothesis has major consequences for the dynamics of macroeconomics models and may alter their policy implications.

The course will be both theoretical and applied. We will present different approaches to model bounded rationality and we will provide students with the programming tools required to replicate the main findings.

A non-exhaustive list of topics includes: learning-to-forecast experiments in macroeconomics and related policy implications; univariate and multivariate models with adaptive learning; introduction to agent-based models as complex adaptive systems; heuristic micro-behavior and emergent macro-dynamics.

## Course structure

The course will be structured as follows:

**Lecture 1** Introduction to the course. Description of bounded rationality and empirical evidence. Overview of macroeconomic experiments with human subjects. (Assenza et al., 2011; Hommes et al., 2005, 2015a,b)

**Lecture 2** Introduction to Matlab programming.

**Lecture 3** Adaptive learning in macroeconomics: theory and applications. (Evans and Honkapohja, 2001; Bullard and Mitra, 2002; Milani, 2007; Eusepi and Preston, 2011)

**Lecture 4** Adaptive learning with Matlab. (Carceles-Poveda and Giannitsarou, 2007)

**Lecture 5** Introduction to agent-based models for macroeconomic analysis. (Delli Gatti et al., 2011, 2018; Hommes and LeBaron, 2018)

**Lecture 6** Programming agent-based models with Matlab.

Total amount of hours: 15.

## References

- ASSENZA, T., P. HEEMELJER, C. HOMMES, AND D. MASSARO (2011): “Individual Expectations and Aggregate Macro Behavior,” CeNDEF Working Paper 2011-1, University of Amsterdam.
- BULLARD, J. AND K. MITRA (2002): “Learning about Monetary Policy Rules,” *Journal of Monetary Economics*, 49, 1105–1129.
- CARCELES-POVEDA, E. AND C. GIANNITSAROU (2007): “Adaptive Learning in Practice,” *Journal of Economic Dynamics and Control*, 31, 2659–2697.
- DELLI GATTI, D., , G. FAGIOLO, M. GALLEGATI, M. RICHIARDI, AND A. RUSSO (2018): *Agent-based Models: A Toolkit*, Cambridge University Press.
- DELLI GATTI, D., S. DESIDERIO, E. GAFFEO, P. CIRILLO, AND M. GALLEGATI (2011): *Macroeconomics from the Bottom-up*, Berlin: Springer.
- EUSEPI, S. AND B. PRESTON (2011): “Expectations, Learning, and Business Cycle Fluctuations,” *American Economic Review*, 101, 2844–2872.
- EVANS, G. W. AND S. HONKAPOHJA (2001): *Learning and Expectations in Macroeconomics*, Princeton University Press.
- HOMMES, C. AND B. LEBARON, eds. (2018): *Handbook of Computational Economics*, vol. 4 of *Handbook of Computational Economics*, Elsevier.
- HOMMES, C., D. MASSARO, AND I. SALLE (2015a): “Monetary and Fiscal Policy Design at the Zero Lower Bound - Evidence from the Lab,” CeNDEF Working Papers 15-11, Universiteit van Amsterdam, Center for Nonlinear Dynamics in Economics and Finance.
- HOMMES, C., D. MASSARO, AND M. WEBER (2015b): “Monetary Policy under Behavioral Expectations: Theory and Experiment,” Tinbergen Institute Discussion Papers 15-087/II, Tinbergen Institute.
- HOMMES, C., J. SONNEMANS, T. TUINSTRA, AND H. VAN DE VELDEN (2005): “Coordination of Expectations in Asset Pricing Experiments,” *Review of Financial Studies*, 18, 955–980.
- MILANI, F. (2007): “Expectations, Learning and Macroeconomic Persistence,” *Journal of Monetary Economics*, 54, 2065–2082.