Economics and Complexity

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November 26, 2014
1 Introduction

Economics and Complexity is an introductory course for researchers and graduated economic students who wish comprehend the complex approach applied in economics and learn how to build agent based models. The curse aims to introduce ontological concepts and definitions, set out examples of what is a complex system and how these systems works and evolve in time. In a more pragmatic way the course aims to introduce two specific tools used to build up economic agent based models: the Laboratory of Simulation and Development (LSD) and Netlogo. Some economic and social models will be built by using intensively computational resources. Massive attention will be spent in theoretical questions in economics and programming practices applied in developing agent-based models (ABM).

2 Charge

The course account for 60 hours distributed in fifteen meeting lasting 4 hours each one.

3 Program

What is complexity. What is evolution. Interactions, creativity, variety, mutations, selections, chaos and order, and emergence concepts. Agent-based models. Evolutionary theory of firm. Evolutionary approach of consumer’s behavior. Tools: Laboratory of Simulation and Development (LSD) and NetLogo. Some micro-macro economic models with LSD. An wide research agenda in economics.

Class A1 - Introduction and overview on General Theory of Complexity

The aim of the first class is to introduce the general theory of complexity as a hole and bring out a diversified literature. This include some philosophical and ontological concepts and different mathematical and computational methods used to access the complexity of word in many dimensions. The maths approach includes: graphs theory, dynamic systems based on non linear differential equations; random networks, cellular automata and self-organized systems, and evolutionary theory. The computational methods include: Laboratory of Simulation and Development-LSD (which will be thoroughly used in this course), NetLogo, Swarm, Maple or MatLab, NetworkX, Graphviz and others. These first class is only an overview about many approaches and methods used to access the complexity and has no intention to deep each topic.

- Background and history → Mitchell (2009, Cap. 1 a 7), Érdi (2008)
- Complexity in Social World → Miller and Page (2007, Cap. 1)
- Foundations → Auyang (1998, Cap. 1)
- Theory of Composite Systems → Auyang (1998, Cap. 2)
- Dynamic Complex Systems → Bar-Yam (1997, Cap. 0)
- Emergence: from caos to order → Holland (1998)
• Mathematical Approaches → Gros (2008); Boccara (2004)

Class A2 e A3 - Complexity and Evolution in Economics Science

*** This classes will be expanded! ***

The aim of the second class is to bring up an overview about how the economics science has used the complex theory to address a diversified bunch of social and economic problems going beyond the general equilibrium analysis.

• Complexity and the Economy → Arthur et al. (1997); Arthur (1999, 2005), Tesfatsion and Judd (2006); Durlauf (1997)
• Evolutionary foundations of economics → Dopfer (2004), Tesfatsion and Judd (2006)
• Self-organization → Witt (1997); Foster (1997), Tesfatsion and Judd (2006)
• On the methodology of ABM → Ormerod (2004), Tesfatsion and Judd (2006)
• Agent-based models in economics ..........

Class A4 to A5 - Simulations using NetLogo

These two classes contemplates the structure of the software, language and programming techniques with NetLogo and some social and economics models implemented in the literature. Its are practical classes using personal computer. Practical exercises will be implemented by the students as home works.

• Netlog’s Language and programming techniques
• Model 1 to be defined...
• Model 2 to be defined...
• Model 3 to be defined...

Class A6 to A8 - Simulations using Laboratory for Simulation and Development - LSD

These three classes teaches how to use the software LSD, developed by Marco Valente, to build micro-macro models with heterogeneous agent interacting. Its are practical classes using personal computer including: how to install LSD, concepts and structure of the software, programming language and functions, implementation of simple examples. Practical exercises will be implemented by the students as home works.

• Thesis LSD → Valente (2000);
• LSD introduction → Valente (2008a);
• LSD documentation;
Class A9 - ABM(LSD) - Competing Technologies, Increasing Returns, and Lock-In - Brian Arthur

This class presents one of the famous models in agent-based model where interactions between agents where the aggregated pattern that emerge is different than the simple aggregation mechanism. The model is useful to study how interactions between consumers can produce other results than that embodied in constant scale returns.


Class A10 - ABM(LSD) - Nelson & Winter adapted model

This class presents in details an model built by Nelson & Winter where firms adapt their strategy (innovate or immitate) according its own performance and the environment state. The model will be handled and modified two study other dynamics properties no present in the original paper.


Class A11 - ABM(LSD) - Financial Regime, Innovation and Business Cycle

This class presents different economic models implemented in LSD. After a brief discussion about the theoretic properties of the models, some changing in specific parts of the model will be implemented as exercises.

Higachi et al. (2013)

Class A12 - ABM(LSD) - Structural Change, Growth and Distribution

This class presents different economic models implemented in LSD. After a brief discussion about the theoretic properties of the models, some changing specific parts of the model will be implemented as exercises.

Structural Change, Growth and Distr → Ciarli et al. (2008); Ciarli and Lorentz (2010)

Class A13 - Consumption Theory with Agent-based models 1

A model of consumer behavior using Netlogo.

Fernandes et al. (2013)
Class A14 - Consumption Theory with Agent-based models 2

This class addresses the consumption decision and its interaction with supply side of an economy and inquire its role and consequences in economic growth and personal distribution, using a micro-macro model developed in LSD.

Ciarli et al. (2010a,b); Ciarli and Lorentz (2010)

Class A15 - ABM(LSD) NK and Pseudo-NK models

This class presents different economic models implemented in LSD. After a brief discussion about the teoretic properties of the models, some changing specific parts of the model will be implemented as exercises.

Kauffman and Levin (1987); Kauffman and Weinberger (1989); Valente (2008b, 2013)

4 Appraisal

The appraisal process and final note will be conquered by many partial deliveries and its respective points according to table 1. There will be two short survey in the initial classes, two programming exercise, one test and one draft article at the end of the course.

The subject of draft article will be suggested by professor and must be delivered on 30/07/2014 in electronic form. All the surveys and the drafts article must be written using an Latex editor. Each delivery must contain three files attached: TEX, PDF, BIB and sand off to joabasilio@ufpr.br until midnight of date, according to table 1.

<table>
<thead>
<tr>
<th>Class</th>
<th>Delivery</th>
<th>Points</th>
<th>Date</th>
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<tbody>
<tr>
<td>A1</td>
<td>Survey paper about Complexity</td>
<td>1.0</td>
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<tr>
<td>A2 and A3</td>
<td>Survey paper about Complexity in Economics</td>
<td>1.0</td>
<td></td>
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<tr>
<td>A4 and A5</td>
<td>Programming exercises with NetLogo</td>
<td>1.0</td>
<td></td>
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<tr>
<td>A6 to A8</td>
<td>Programming exercises with LSD</td>
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<td></td>
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<tr>
<td>A9 to A15</td>
<td>Test about the models and complex theory</td>
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<tr>
<td>*</td>
<td>Draft article</td>
<td>4.0</td>
<td></td>
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<td>Total</td>
<td></td>
<td>10.0</td>
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Journals and further readings

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<thead>
<tr>
<th>Journal</th>
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<tr>
<td>Journal of Evolutionary Economics</td>
<td>Structural Changes and Dynamics Economic Complexity (since 1995)</td>
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<tr>
<td>Complex Adaptive Systems Modeling</td>
<td>Metroeconomica</td>
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<tr>
<td>Journal of Economic Behavior and Organization</td>
<td>...</td>
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<tr>
<td>Evolution</td>
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Some Institutes
Center of Studies of Complex Systems
New England Complex Systems Institute
The Observatory of Economic Complexity
LSE Complexity Group
Santa Fe Institute

References


