

COMPLEXITY ECONOMICS AND AGENT-BASED MODELING (075 240)

COURSE OUTLINE WINTER 2021 / 2022

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CONTENT

This module provides an introduction into complexity thinking and complexity economics. Complexity economics is a modern school of thought that differs strongly from neoclassical economics. The economy is conceived as a complex adaptive system. Agents are typically not fully rational and there is no a-priori assumption that equilibria exist. Complexity economics is well suited to study innovation and societal transformation processes. Examples of such transformations are the sustainability transition and the effect of digitalization. Complexity thinking provides a new understanding of societal challenges and of economic policy.

There are different approaches to analyze complex systems, for instance network analysis, system dynamics and narrative research. We briefly introduce these methods, but mostly focus on agent-based computer models. Agent-based models are an extremely flexible research tool that can be applied to many different topics and for many purposes. We present examples of agent-based models and show how that can be used for theoretical and policy analyses.

The module covers technical aspects of agent-based modeling and simulation such as how to set up a model, how it can be analyzed and how it can be implemented on a computer. After finishing the course, you will be able to program your own small model for a research project or the master's thesis.

MODULE OBJECTIVES

- You understand what a complex system is and how the complexity view differs from other economic approaches.
- You learn how to apply complexity thinking to get a better understanding of the economy and economic policy.
- You learn how to work with ABM and how to interpret their results.
- You acquire basic knowledge to implement your own agent-based models.
- You will learn how to use the ABM programming platform NetLogo.

PREREQUISITES

You will need very good skills in written and spoken English. Some affinity to computer programming would be helpful.

ORGANIZATION AND ASSESSMENT

This module is designed as blended learning course. It provides a mix of online education materials and opportunities to interact with your instructors. Here, the instructors will guide you

through the materials, they answer questions and they give you structure and orientation. Accordingly, it is important that you study the material on your own and ask questions. The material is available on Moodle.

The lectures and tutorials are designed as an open dialogue. It is therefore important that you prepare the material provided via Moodle.

You will learn how to develop and program an agent-based model in which the sentiment of agents affects their economic behavior and hence has macroeconomic effects.

Your task to get credit will be to extend a basic model presented in class. This will be the topic of your term paper. You are expected to make the simple model more realistic and to apply it to answer a research question. The term paper will be group work by teams of 2 – 3 members, depending on the total number of participants.

You can only write the term paper and get credit for this module if you pass weakly ungraded assignments (“Studienleistungen”) during the semester. Further details will be available in the Moodle course.

Deadline for the term paper: 7.3.2022

Participants:	20
Assessment:	Term paper (Hausarbeit): 100% ungraded assignments that must be passed
Time:	Thursday 14:15 – 15:45 h Friday 14:15 – 15:45 h For details see schedule below!
Place:	Online via Zoom
Start:	Thursday, 14.10.2021

REGISTRATION

It is necessary to register for this module in FlexNow **and at the chair**, because the number of places is limited to 20.

The **registration procedure at the chair** consists of two steps:

- 1 You have to sign in to the Moodle course by 12.00h on October 14, 2021.
- 2 You have to show up at the first lecture (14.10.21).

If there are more than 20 applications, we will choose participants randomly.

If there are free places available, you can join the course after the first round of registrations.

The registration phase in FlexNow is: 13.12.2021 – 7.1.2022.

MOODLE

There is a Moodle course for this module (Complexity economics and agent-based modeling WiSe 21/22). No password is required for the registration. **The Moodle course is a key element of the module as the course material is provided there. Please register to the Moodle course and read the provided information as soon as possible!**

SCHEDULE

Lecture/Seminar meeting

Meeting	Topic	Lecturer
14.10.	Introduction, Complexity and complexity concepts	Roos
15.10.	Feedback	Roos
22.10. (10:15h)	Parking fees model	Roos
4.11.	Infection, diffusion, SIR	Roos
11.11.	From SD to ABM: Predator-prey model	Roos
18.11.	ABM: opinion mill and infection model	Roos
25.11.	Emergence	Roos
10.12.	Self-organization	Roos
16.12.	Basic model	Roos
13.1.	Uncertainty	Roos
20.1.	Sense-making and mental models	Roos
27.1.	Narratives	Roos
3.2.	Policy implications	Roos

Tutorials

Meeting	Topic	Lecturers
21.10.	Introduction to Vensim, Tutorial	Siegmann
29.10.	Predator prey model	Siegmann
5.11.	Diffusion/Bass model	Siegmann
12.11.	Introduction to ABM	Alfers/Banning
19.11.	Coding exercises	Alfers/Banning
26.11.	Coding exercises	Alfers/Banning
2.12.	Coding exercises	Alfers/Banning

3.12.	Coding exercises	Alfers/Banning
9.12.	Coding exercises	Alfers/Banning
17.12.	Discussion of basic model	Alfers/Banning
14.1.	Pitch on project ideas	Alfers/Banning
21.1.	Work on model for term paper / feedback	Alfers/Banning
28.1.	Work on model for term paper / feedback	Alfers/Banning
4.2.	Work on model for term paper / feedback	Alfers/Banning

This schedule is preliminary and subject to change. Potential changes will be announced via Moodle.