RUHR UNIVERSITÄT BOCHUM

COMPLEXITY ECONOMICS AND AGENT-BASED MODELING

COURSE OUTLINE WINTER 2020 / 2021

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CONTENT

This modules provide 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.

There are no classical lectures and tutorials. Instead, in the online meetings via Zoom with your instructors you are expected to discuss the materials that you previously studied.

You will learn how to develop and program an agent-based model with the example of an epidemiological model that describes the spread of a virus such as SARS-CoV-2 (Corona).

Your task to get credit will be to implement one of the properties of a complex economic system in an agent-based model. This will be the topic of your term paper. You are expected to apply one of the discussed properties to a specific example and to develop a simple model that illustrates this example. 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 five ungraded assignments ("Studienleistungen") during the semester. Further details will be available in the Moodle course.

Deadline for the term paper: 28.02.2021

Participants:	20
Assessment:	Term paper (Hausarbeit): 100% 5 ungraded assignments that must be passed
Time:	Wednesday 12:15 – 13:45 h Thursday 14:15 – 15:45 h For details see schedule below!
Place:	Online via Zoom
Start:	Thursday, 5.11.2020

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 15.00h on November 2, 2020.
2. You have to show up at the first lecture (5.11.).

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: 14.12.2020 – 15.1.2021.

MOODLE

There is a Moodle course for this module. No password is required for the registration. Study materials will be provided on Moodle. The Moodle course is a key element of the module, because it will replace the normal lectures. Please register to the Moodle course an read the provided information as soon as possible!

SCHEDULE

Meeting	Topic	Lecturers
5.11.	Introduction	Roos
11.11.	Agent-based modeling and NetLogo	Bonakdar / Alfers
19.11.	Complexity and complexity concepts	Roos
25.11.	First steps with NetLogo	Bonakdar / Alfers
3.12.	Non-linearity, feedback, system dynamics	Roos
9.12.	ABMs in virus speading	Bonakdar / Alfers
17.12.	Emergence, self-organization, lock-in	Roos
13.1.	Verification and validation of ABMs	Bonakdar / Alfers
14.1.	Heterogeneity and diversity	Roos
20.1.	Networks and connectedness	Roos
21.1.	Discussion for term papers	Bonakdar / Alfers
27.1.	Discussion for term papers	Bonakdar / Alfers
3.2.	Analysis of ABMs	Bonakdar / Alfers
4.2.	Resilience and vulnerability, policy implications	Roos

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