

Agent-Based Modeling (Master SIED)

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Unit 5

Designing an Agent-Based Model and Analyzing its results

Three Major Steps in ABM

- 1) Design the Model
- 2) Run the Model
- 3) Analyze the Results

Two Design Methods

- Phenomena-Based Modeling
 - When you know characteristic / reference pattern you want to model
- Exploratory Modeling
 - Starting with a basic set of mechanisms and then exploring what those mechanisms generate

Top-Down vs. Bottom-Up Design

- Almost all ABMs are bottom-up in terms of the model
- But Design can be approached from either a bottom-up or top-down approach:
 - Top-Down: Start with the components and the design and then put them together
 - Bottom-Up: Conceptual model and code co-evolve to create the model
- It is rare that a designer uses any of these methods exclusively

Design Principles

- Start Simple and Build Toward the Question You Want to Answer.
- “The supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience.” - Albert Einstein
- “Do not multiply entities unnecessarily” - William of Ockham
- “Keep It Simple, Stupid” - Robert Axelrod

Advantages of Simplicity

- Helps confirm that all mechanisms are necessary
- Easier to understand
- Facilitates verification and validation
- Allows you to more easily examine components

Build Toward a Question

- “All models are wrong, but some models are useful.” - George Box
- Do not add content that does not help you answer the question at hand, even if it would make the model “more realistic”.

Analyzing a Model

- Once we have a model, we would like to analyze its results
- For instance, we might ask, “If we hold parameter x constant, what is the effect of different values of parameter y on some observable emergent (= macro) variable z ?”
- Whenever a model has stochastic components, you must do multiple runs
- You also want to be able to systematically alter an input parameter

Analysis of Results

- You want to take the data produced by the model and analyze them
- Behavior Space
- It doesn't take much to output data on a log file
- You can then use any statistical package to analyze the data output by Mesa
 - Excel, SAS, R, ...
- Or you can also use Python itself