

## Assignment 5

*Submission deadline: February 22, 2022 (submission via OPAL or alternatively via email to [torsten.heinrich@wiwi.tu-chemnitz.de](mailto:torsten.heinrich@wiwi.tu-chemnitz.de)).*

### Background

This problem is not directly related to economics, but more to population biology. However, similar models (with a more complicated backstory) have been suggested for modeling macroeconomic dynamics, specifically labor, wages, and employment. See, e.g., Richard Goodwin (1967, 1982), 'A growth cycle', [https://dx.doi.org/10.1007/978-1-349-05504-3\\_12](https://dx.doi.org/10.1007/978-1-349-05504-3_12).

### Setting

Consider the following setting:

- Populations of rabbits and cats share the same ecosystem.
- The rabbit population multiplies at a constant rate 0.1.
- Cats feed on rabbits. This results in 1 in 2000 (0.0005) rabbits being taken (dying) per cat, but is important for cat population growth. The cat population grows 0.1 for each rabbit being taken by a cat ( $0.1 \times 0.0005$  per rabbit and cat).
- Both populations are threatened by cars (i.e. they face a chance of 0.05 to be run over).
- Table 1 summarizes all aspects and environmental factors impacting the two populations.




	Rabbit population 	Cat population 
Variable (index $t$ indicating time)	$R_t$	$C_t$
Rabbit population growth rate	0.1	
Interaction (and cat population growth rate)	$-0.0005R_tC_t$	$0.1 \times 0.0005R_tC_t$
Cars 	$-0.05R_t$	$-0.05C_t$
Initial population size	$R_0 = 400$	$C_0 = 50$

Tabelle 1: Influences on the system.

## Problem

1. Write a Python script to model the setting outlined above. Make sure the dynamic is visualized in an appropriate way. Simulate the setting for at least 1000 time steps.

*Hint:* Since the dynamic is defined in terms of populations, it is in this case, not convenient to use agent-based modeling.

*Please submit your solution including the .py script and a very brief explanation in .pdf format. The script should be well-structured and well-commented. The explanation should be brief and should explain how to use the script and show the results.*

*Please be sure to include your name in the submission.*

*If you do not receive a confirmation email, assume that the transmission of your solution did not work and resubmit/resend. I will send a confirmation email in response to any submissions made via email, OPAL sends confirmation emails automatically.*

*Good luck.*