Assignment 3

Submission deadline: January 18, 2022 (submission via OPAL or alternatively via email to torsten.heinrich@wiwi.tu-chemnitz.de).

Background

It is conjectured that firm growth follows the Kesten process

$$x_{t+1} = \alpha_t x_t + \beta_t,$$

where x_t is the firm's size (in terms of capital stock in Euro) at time t and α_t and β_t are independent sequences of i.i.d. random variables with

$$\alpha_t = \mathcal{U}(0.8, 1.2)$$

$$\beta_t = \mathcal{U}(0, 10000).$$

$\mathcal{U}$ denotes the uniform distribution.

To understand this growth process it is to be applied to a population of $n = 10000$ hypothetical firms with identical initial size $x_0 = 10000$.

Problem

1. Please write a Python script for performing this experiment.
   Hint: *There are many different ways to implement this script. Some are object-oriented and agent-based and more illustrative, others are more abstract, more computationally efficient, and operate only with arrays instead of agent objects. They are all equally correct as long as they implement the problem correctly.*

2. Please visualize the resulting distribution in an appropriate way and conjecture which of the following statistical distributions could potentially describe firm size distribution resulting from your script:

   - Gaussian (normal)
   - Uniform
   - Log-normal
   - A skewed distribution with the right tail following a Pareto distribution.

   Hint: *You do not need to perform statistical tests; visual inspection is sufficient. Also consider plotting the data in semi-log and/or log-log plots. It is possible that more than one distribution might fit the data.*

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.