INTRODUCTION

Thanks to your great job with network analysis, DBBA Bank decided to assign a new task to you. Specifically, **given the continuous rises in interest rates**, DBBA Bank's investment division wants you to run an agent-based simulation to analyse their clients' **future demand** for bond and stock investments. To achieve this, your simulation will cover several scenarios of stock and bond expected returns. DBBA Bank wants to do this only for their loyal long-term investors, for which it has an **extensive dataset of all prior investments and allocations.**

KEY INFORMATION

We want to assess future demand

We have all data we might need to model agents

Assumptions

You can assume the following:

- All stocks have the same expected yearly return **s**.

- Stocks are risky and therefore there is a probability **p** that their return will be **−s** instead.

- All bonds have the same expected yearly return **b**.

- Bonds cannot be sold before maturity

- The time horizon for the investments is T=10 years.

QUESTION 1

Describe the agents that will be used in the model, following the first three of the four steps that have been covered both in class and in the textbook.

QUESTION 1

ANSWER

Nature of agents

List of variables

List of actions

QUESTION 1

POSSIBLE ANSWER

Nature of agents - Investors with prospect theory function

List of variables - Prospect theory variables (risk attitude and loss aversion coefficient)

List of actions - We could assume they invest, so the only action is to decide whether to invest in bonds or stocks

QUESTION 2

Briefly describe the procedure you would follow to calibrate the model.

QUESTION 2

POSSIBLE ANSWER

Since we only have one type of agent, the only values that we can calibrate are risk attitude and loss-aversion coefficient.

We could use the standard values found from empirical economics literature as a means of input validation, but since we have the data available from DBBA Bank's dataset, we can use that to calibrate our model. The best way to do so is to assume these parameters follow a given distribution and fit the distribution with past data.

QUESTION 3

Briefly describe the procedure you would follow to validate the model.

QUESTION 3

ANSWER

Input validation is implicitly done by assuming agents follow prospect theory.

Output validation could be done by calibrating the model on only a portion of the dataset and validate it on the rest of it. The validation variable(s) could be related to the proportion of agents investing all their wealth in bonds or stock.

QUESTION 3

You now want to improve the model by assuming that investors do not fix their expected bond return **b**, but form an opinion about this based on discussion with their peers.

Explain in detail how you would model this.

QUESTION 3

POSSIBLE ANSWER

Deffuant model, small-world or scale-free network.

QUESTION 4

Good job! DBBA Bank's CEO wants you to present the model at the next Board meeting. However, most of the members of the Board are not experts in this field and are skeptical about your results. **Briefly describe your model** and explain the **advantages** of agent-based modelling over other possible methodologies (for instance, machine learning) **for this specific case**. Do so in simple terms and without using technical terminology unless necessary. Maximum five sentences.

QUESTION 4

POTENTIAL ANSWER

This model can be used to simulate investors' wealth allocations in the future based on potential scenarios.

Considering the heterogeneity of the decision-making function's parameters would be rather difficult (if possible at all) to do with mathematical models. A machine learning model could be potentially trained to forecast the allocation, but would not have the flexibility to simulate what-if scenarios and updated the model with new forecasts for b, s, and p.