**Problem Set 6B (due 11:59 pm, 3 December 2023)**

**Simulation of the Minority Game**

Write a Python program of the Minority Game. The state update is endogenous. The updates of the virtual and real scores are linear scores (that is, the magnitude of the score updates is the excess demand divided by ). Fix and

Outline of the Endogeneous Minority Game simulation:

* Define the parameters: memory size , number of strategies per agent number of agents number of iterations number of iterations before reaching steady state number of samples
* Generate the strategies of all agents.
* Initialize the virtual scores of all 𝑁𝑠 strategies to 0.
* Initialize the real scores of all 𝑁 agents to 0.
* Initialize the input state to 0 at 𝑡 = 0.
* The strategy choices of the agents are randomly chosen at 𝑡 = 0.
* During each iteration of the trading period, each agent chooses the strategy with the highest virtual score. If the two strategies of an agent have the same virtual score, one of the two is randomly chosen.
* Compute the excess demand. It is sufficient to count the number of buyers, since the other agents must be sellers.
* Update the virtual scores and real scores using the linear score.
* Update the state of the game.
* Iterate the game for 200 steps. During this period, no statistics will be collected.
* Iterate the game from steps to steps. Compute the variance of the number of buyers. (np.var() is useful.)
* Repeat the simulation for 10 samples at each value of and compute the average of the variance and its standard deviation.
* Repeat the simulation for the range of *N* between and using 10 to 20 data points. Then plot versus . Include error bars for For your convenience, the plots can be done in Excel or Python.
* In this model, theory predicts that there is a minimum at (slide 27 of lecture notes, see also slide 19). Compare your result with the theory.

Additional comments:

* The requirement of 1,000 iterations and 10 samples should produce reasonable results, but students are welcome to increase the number of iterations and samples if they wish. However, increasing the number of agents to a large value may not provide more information about the game behavior.
* Students may find that the minimum is closer to This is fine if we take into account the finite size effect of the simulations.