CF963-SP Computational Models in Economics and Finance

Assignment Brief, 2022/23

Lecturer: Maria Kyropoulou

- Answer all (four) questions below. Submit your answers to FASER. You need to submit:
  - one report with your answers to all questions. This should be a word or pdf document named according to 'CF963_RegNumber_Report'. No pictures/screenshots of handwritten answers are allowed.
  - the MATLAB (.m) files that you created in the context of this assignment (task 1 and task 2), named according to 'CF963_RegNumber_TaskX.m'.

  Submit them separately (do not .zip). Make sure that your code is easy to follow, and copy and paste your code in the report as requested in the specific task.
- Your assignment will be assessed on the quality of the files you submit –correctness, work quality and quality of presentation. Aim for precise and concise answers and explanations. Good luck!

Task 1 [20%]

Consider the following moving average trading strategy:

Let 7^{MA} be the 7-days moving average, and let 14^{MA} be the 14-days moving average. If the 7^{MA} crosses the 14^{MA} from below, then buy your entire budget. If the 7^{MA} crosses the 14^{MA} from above, then sell your entire portfolio.

Your task is to implement the above strategy and test it with MATLAB on the JustEat6M stock's daily closing prices that are provided on the moodle page of the module (Unit 1). Assume you have £1M available to invest and that only integer quantities of the asset can be traded.

In particular:

a. (2%) Your code should import data from the JustEat6M file that is provided on the moodle page of the module (Unit 1). Make sure that your code runs if the JustEat6M file is in the same folder as the .m file that you submit, without the need to rename the JustEat6M file or make any other amendments.

b. (8%) Your code should implement the above strategy by identifying for which days the trading conditions hold and adapting the budget and portfolio variables accordingly.

c. (4%) Your code should output when your algorithm buys or sells.

d. (3%) Your code should output the profit/loss at each deal.

e. (3%) Your code should be adequately commented to pinpoint the parts where the above calculations are performed.

Copy and paste your code and present the requested outputs in the report, in addition to uploading the (.m) matlab file on FASER.

Task 2 [30%]

Consider a double auction market where identical copies of a single item are being sold/bought.

At each round, every buyer/seller places their limit order. The bids of the buyers are raked in descending order and the asks of the sellers are ranked in ascending order. Each bid is compared with the corresponding ask and if the bid is at least as high as the ask, a match of the corresponding traders is made and a trade is performed between them for a price that is equal to the half-way point between the two. The profit of a seller from a trade is equal to the corresponding price of that trade minus his cost. The same process is repeated until no other match is possible, while each trader can only participate in at most one trade at each round.

Consider 20 traders in the market. Trader $i = 1, \ldots, 20$ is randomly allocated the role of buyer or seller. Buyers own 0 items at the beginning, while sellers own/can construct any number of items for a cost of 80 each. The bid/ask of each trader at each round is selected uniformly at random from the range $[1, \ldots, 200]$.

a. (15%) Program the agent-based simulator in MATLAB for the above setting and run your simulation for 10 rounds.

b. (5%) Calculate the profit of each seller at each round and overall. Note that based on the definition above, the profit can be negative.

c. (5%) Compute how many units of the item were traded in total.

d. (5%) Replicate your simulation 50 times and output the histogram of the answer of part c.

Copy and paste your code and present the requested outputs in the report (in addition to uploading the matlab file on FASER).

Task 3 [20%]

a. (13%) Consider the Cournot duopoly model where the inverse demand function and the cost functions are given by

$$P = 185 - 3(q_1 + q_2), \qquad c_1 = 9 + 23q_1, \qquad c_2 = 4 + 23q_2,$$

where

q_i is the production quantity of firm i, for $i = 1, 2$. Give the profit functions of the firms and compute the Nash equilibrium defined by the quantity each firm chooses to produce. Compute the profit of each firm, the consumer surplus, and the total surplus at equilibrium. After presenting your calculations, present your answers in a table of the following form:

q_1	...
q_2	...
$\pi_1(q_1, q_2)$	...
$\pi_2(q_1, q_2)$	...
CS	...
TS	...

b. (7%) Consider the leader-follower duopoly model with the inverse demand function and the cost functions as defined in Part a. Let the reaction function of firm 2 be

$$r_2(q_1) = 5 + \frac{q_1}{6}.$$

Give the profit function of firm 1 and find the equilibrium strategies (production quantities) of the firms. After presenting your calculations, present your answers in a table of the following form:

q_1	...
q_2	...
$\pi_1(q_1, q_2)$	...

No MATLAB code is required.

Task 4 [30%]

Pick one of the following papers and provide

a. (10%) a concise summary that reveals the main points addressed in the paper, and

b. (20%) a critical assessment of the paper that includes how this paper compares to previous related work.

Focus on the real life setting that is considered, the modelling choices that were made in an attempt to abstract it and analyse it, and elaborate on the particular computational modelling technique that is applied to it.

Suggestions for points to address: What simplifying assumptions are made? How does computational thinking help us analyze this particular situation? Are the assumptions made and/or the methodology used appropriate? How could this analysis be extended, e.g. can you think of an adaptation to the model that would be meaningful?

Length guide: Your answer should not exceed an A4 page overall. Aim for half page summary of the paper and another half page for criticism on the approach. There is no need to focus on the technical details (mathematical proofs).

Papers:

- *Stylized Facts and Agent-Based Modeling*, by Simon Cramer and Torsten Trimborn. [link]
- *Optimality Despite Chaos in Fee Markets*, by Stefanos Leonardos, Daniël Reijsbergen, Barnabé Monnot, and Georgios Piliouras. [link]
- *Forgiving Debt in Financial Network Games*, by Panagiotis Kanellopoulos, Maria Kyropoulou, and Hao Zhou.
- *Firms Default Prediction with Machine Learning*, by Tesi Aliaj, Aris Anagnostopoulos, and Stefano Piersanti. [link]
- *A Model of Dealer Networks*, by Daniele Condorelli, Andrea Galeotti, and Ludovic Renou. [link]

Please refer to the Student's handbook on the Departmental Policy on Plagiarism and Late Submission