Day Trading in the Stock Market

**Description:**

In this assignment, your job will be to use the adversarial framework of bandit algorithms we learned (i.e., experts, adversarial bandit algorithms, OCO) in order to optimize your investment in stocks. The setup of the problem is a VERY simplified version of day-to-day trading

* During the morning of each day, you invest  exactly 1 euro per day on one of K stocks.
* At the end of the day you learn the closing price for this stock, and the percentage (%) of increase or decrease of that stock. You then sell your stock, and you profit exactly that percentage of your 1 euro.
  + e.g. if you invested in stock 3 at day t, and it closed with a gain of 5%, you  get back your 1 euro plus 5 cents.
  + A stock can also lose value during the day. You still must sell, and pick a stock the next morning. E.g. if stock 3 lost 10% then you lose 10 cents (but you will still invest a whole euro the next day).
* The  next day you can invest again 1 euro on any of the K stocks, and so forth, until the end of the horizon.

In this .csv file you will find the day-to-day % changes in 10 real stocks I have compiled from a global stock exchange, for a duration of 2000 days: [Stock price changes](https://www.eclass.tuc.gr/modules/document/file.php/HMMY284/stocks%20%281%29.csv)

* You can load this csv file into your code in various ways (the `delimiter' for the cells is commas). If you are working on Colab, you need to remember to upload the file on the Colab directory first, or to mount your drive.

(**Note:**I might slightly polish this file later and upload a new version but you can already work with this one for now).

You need to complete the following tasks:

**Task 1: Experts Setup)** Assume that at the end of each day you learn the price change percentage for all K stocks (not just the one you invested in). Implement the Multiplicative Weights algorithm to maximize the amount of profit you have collected at the end of the horizon. You should show two separate plots:

* Cumulative regret of your algorithm, from day 1 to the last day.
* Cumulative profits of your algorithm (i.e., how much you've made in total by day 2, day 3, etc.)

**Task 2: Experts with Transactions Fees)**Assume the previous experts setup again (i.e., full feedback) but now each stock n has a fixed transaction cost 𝑐𝑖 , that differs between stocks.

* E.g. imagine you invested again in stock 3. And let's say that stock 3 has a transaction cost 𝑐3=2%, and shows a price increase of 5%.
* Then, at the end of the day, you will have lost 2 cents for the transaction, and gained 5 from the price increase, for an overall gain of 3 cents.
* Assume that the transactions fees are: 0.5%,1%,1.5%,…, for stocks 0 to K, respectively.

Modify your MW algorithm to maximize the accumulated profit (gains minus the transaction costs). Show two plots again, the cumulative regret and the cumulative profit over time, but each one together with the respective plot from the previous scenario with no fees. What do you observe?

**Task 3: Bandits with Transaction Fees)**Assume finally that you have a bandit setup, rather than an experts one. I.e. at the end of day t you only learn the % increase/decrease of the stock you invested in that day (but not the other ones). Modify your previous algorithm to be applicable in this bandit setup and maximize the accumulated profit (minus transactions costs).  Plot the cumulative regret and cumulative profits for this scenario and compare with the respective experts plots.