ACM30110 ADVANCED COMPUTATIONAL FINANCE 2024-2025

THE GROUP PROJECT IS DUE ON FRIDAY 25TH APRIL 2025

Assignment

You are a small team of 5 UCD graduates working for the Valuations and Financial Risk Unit at Forvis Mazars. Your team decided to tender for pricing a path-dependent non-dividend paying stock option, in which one of the main clients of your company has invested 1 million of dollars.
If your team gets the job, all the components of the team will deserve a promotion and an extra annual bonus.

The option to price is an exotic barrier option with the following characteristics:

- The underlying stock price must be monitored during all the life of the option (path-dependent option), expiring at the time $T = 1$ year. The barriers are introduced to measure the stock performance (the option is exotic, not a "classical" in-out barrier option).
- Let us denote with H_1 and H_2 two performance thresholds, with $0 < H_1 < H_2$. The conditions to be monitored are:

$$S_t > H_1 \qquad \textit{Condition 1,}$$
$$S_t > H_2 \qquad \textit{Condition 2.}$$

- Let us denote with C_1 and C_2 the variables that count the number of days for which *Condition i* holds. If *Condition i* holds, then you increment C_i of 1, otherwise you do not update its value.

- The option payoff is

$$Payoff = \begin{cases} S_T - K + 30, & \text{if } S_T > K \text{ and } C_2 \geq 150, \\ S_T - K + 10, & \text{if } S_T > K \text{ and } C_1 \geq 100 \quad \text{and} \quad C_2 < 150 \quad \text{and} \quad AVG(C_1, C_2) < 125 \\ S_T - K, & \text{if } S_T > K \text{ and } C_1 \geq 100 \quad \text{and} \quad C_2 < 150, \\ 10, & \text{if } S_T > K \text{ and } C_1 < 100, \\ 0, & \text{if } S_T \leq K, \end{cases}$$

where K is the option strike price and AVG represents the arithmetical average between C_1 and C_2.

The pricing must be done via Monte Carlo Methods and the input data must be:

$$S = 60 \quad K = 50$$
$$H_1 = 65 \quad H_2 = 75$$
$$r = 0.05 \quad T = 1 \quad \sigma = 0.3$$
$$n = 260 \quad nr \geq 1000,$$

where n is the number of time steps and nr is the number of simulations.

Delivery

You have to submit:

(1) The python code for pricing the option with a related documentation (constraint on documentation: max 1 page 11pt).

(2) A diary reporting: the activities done with a detailed schedule, who did what (roles within the group), minutes of the meetings, all kind of problems the group found to prepare the project and the way such conflicts were resolved (constraint on documentation: max 3 pages 11pt).

(3) A 20-minutes PowerPoint presentation for a general (non technical) audience on your proposal. Such presentation must provide:
  - A brief description of what an option is and what a barrier option is (in general). Then you must provide an accurate description of this specific path-dependent exotic option you are pricing. Feel you free to use different means of representation (cartoons, graphs, videos, pictures...),
  - A description of the Monte Carlo Methods you are going to implement,
  - A brief description of the main parts/commands/variables of your code,
  - Numerical results of your code,
  - Goodness of your results, with a justification of the methodologies you have implemented to improve them and how many times you exercise the option.
  - Marketing component: Who are you? Why should I give you the job?

Assessment

I am going to assess:

- Financial, Mathematical and Programming skills (backbone of your project),
- Creativity (each of you must prepare at least one slide, name at the bottom of each slide),
- Communication and Negotiation skills,
- Time management,
- Team working and ability to solve conflicts (to be described in your diary).

Feel you free to exploit your ideas and have fun in working on them!!

Maximum Grade 10%

Code and Documentation	3%
Performing Appropriate Calculations/coding choices	1%
Results Accuracy	1%
Code Descriptions	1%
Diary	3%
Project Management	1%
Resolution of Conflicts/problems	1%
Project Description	1%
Presentation	3.5%
Stating the Problem	0.5%
Explaining the relevant Theory/Model/Approach	1%
Presenting results and Conclusions	0.5%
Team Presentation & Negotiation skills	0.5%
Critical reflections	0.5%
Creativity	0.5%
Other	0.5%