

MFE5130 – Financial Derivatives
First Term, 2020 – 21

Group Project

Due date: 11:00 pm, 7-December-2020
(With Relevant Book Sections)

Important Notes:

1. Group Size: At most **4** students.
 2. Submitted Materials must include:
 - a. Written report with the names and student numbers of **ALL** the group members;
 - b. All the data and program files.
 3. Zip all the files in (2) and submit to Blackboard. Each group only needs to submit **ONE** zip file.
 4. Each member of the group must submit the *Peer Evaluation Form* to Blackboard **individually**.
 5. All the notations used in this project are the same as those in the lecture notes.
 6. Plagiarism is a serious issue and will subject to a **severe penalty** (See “Guide to Plagiarism” at the end of this document).
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Let S_t denote the stock price of at time t . Consider a T -year option with the payoff of

$$\begin{aligned} S_T - X & \quad \text{if } \alpha S_T \geq S_T - X \geq 0 \\ \alpha S_T & \quad \text{if } S_T - X > \alpha S_T \end{aligned}$$

where $X > 0$ and $0 < \alpha < 1$.

Things to do

- a. Select a stock from the market as the underlying asset of the option.
- b. Estimate the historical volatility of the stock in (a) from its historical prices. See P. 302 – 305.
- c. Estimate the dividend yield of the stock in (a) and the risk-free interest rate from the market data.
- d. With the estimated values in (b) and (c), use a n -period forward tree to price the option in **both** the European and American cases for different values of n , X , T and α . See Section 10.2 – 10.5.
- e. Give a detailed discussion and comment for your result in (d).
- f. Assume that S_t follows the geometric Brownian motion, derive the analytical pricing formula for the option in the European case. Compare your result in (d) with the formula.

Note: The assumption of the geometric Brownian motion is equivalent to ask your to price the option under the Black-Scholes assumption. The details can see Section 12.1.

- g. Determine/Estimate the delta, gamma and theta for the option in both the European and American cases. Based on the calculated Greeks, discuss on how you design your strategy for this option in order to make profit for different market scenarios. *See Section 12.3 & Appendix 13.B.*
- h. Instead of the historical volatility, we can also use the implied volatility in the forward tree model in (d). Discuss on the way to determine the implied volatility in the tree. *See Section 12.5.*
- i. How do you replicate the option from the existing market products?
- j. Your own additional items (*please highlight them in your report*).

Note: You can make any assumptions if you find necessary. However, you need to state them clearly in your written report.

The written report must

- a. be presented in an essay format. Do NOT present it in a point form or Q&A form.
- b. include all the assumptions that you have made in the project.
- c. include “References” section (*inclusion of others' works or results without citation in the report is also regarded as plagiarism*).

Assessment scheme:

Items	Points
Organization and presentation in the report	10
Contents, programming codes and results	16
Discussion and comments	12
Your own additional items	7
Peer Evaluation	5
Total	50

Guide for Plagiarism

If a student is found plagiarizing, his/her case will be reported to the Program Committee. If the case is proven after deliberation, the student will automatically **fail** the course in which he/she committed plagiarism. The definition of plagiarism includes copying of the whole or parts of reports and/or programming exercises from the others. The penalty will apply to both the one who copies the work and the one whose work is being copied, unless the latter can prove his/her work has been copied unwittingly. Furthermore, inclusion of others' works or results without citation in reports is also regarded as plagiarism with similar penalty to the offender.

End

