FE 620: Pricing and Hedging
Spring 2022: Course Project

Introduction

For your course project, you will work in teams (of 3-4 people) to go through the process of pricing and risk managing a simple derivative.

Broadly your project will consist of three inter-related topics:

1. Expository part: introduction to the financial derivative chosen, explaining the payoff, economic rationale, markets where it is traded.

2. Build a valuation algorithm for pricing this derivative, and test the algorithm on appropriate limit and test cases;

3. Data collection and analysis. Download real market data and use it to calibrate your model.

In this project you will implement models and techniques discussed in class or from *Hull* [1] on real data (from, e.g., *Yahoo Finance*).

With this project you will replicate the real life experience of a desk quant, working in a bank to build valuation and risk management models for the derivative chosen. This is a great learning experience.

Important Dates

Milestone	**Data**	**Deliverables**
Team Formation	2/18	Submit as text on Canvas. One per group. Include the names for the members of the team.
Project Proposal	3/11	Submit **pdf** on Canvas. One per group.
Final Report	Tue 5/5	Submit **pdf** on Canvas. One per group.
Project Presentation	5/4 [in class]	One per group.

Project Components

Application of Derivatives

Choose a derivative from the following list. More details can be found in *Hull* [1] (Ch. 26).

- American options;
- Asian options;
- Barrier options;

Think about when your chosen derivative might be used in practice. Research the literature about your chosen derivative.

Valuation Algorithm

Use a numerical technique to price your derivative on fictitious data. Consider, for instance, Binomial Trees or Monte Carlo simulation of the Black-Scholes model. Compute valuations and sensitivities with respect to market parameters. Consider the errors produced by numerical approximations and simulations in your pricing.

Data Collection and Analysis

In this step your team will download financial data on a liquidly traded asset (equity or commodity future) and option prices from *Yahoo Finance* or other sources (e.g. *Bloomberg*). You will need to estimate market parameters from financial data. Consider historical and implied volatilities, find the volatility smile, forward curve of your asset, etc... Use your valuation algorithm to price the derivative under consideration. Think about how to hedge the derivative using the underlying asset and perform a Delta hedging analysis (similar to Delta hedging analysis which will be covered in class for European options).

Deliverables

Deliverable #1: Team Formation

You will submit your choices for teams for projects. Teams should consist of **4 students**. If you have trouble forming a group for any reason (whether that means you are a single individual or have a partial group of 2 or 3 students), please submit that by the deadline. With your team submission, provide also the proposed derivative to study.

Deliverable #2: Project Proposal

You will submit a formal proposal for your project. This should give as much detail as possible about what specifically you will consider the full breadth of your project. To help with project management you may consider including a project timeline in the form of a Gantt chart[1] detailing the activities necessary to complete your project, timelines for start and end dates of each task, and teammate assignments to each task.

Deliverable #3: Final Report

You will submit your final write-up, which should include all of the information detailed below. This should be presented in roughly the order given, but your write-up need not have corresponding sections or bullet points. The write-up should be about 15 double-spaced pages, Times New Roman 12pt font. This does not include any appendices (of, e.g.,

[1]Named for Henry Gantt, who received a Masters of Engineering degree in mechanical engineering from the Stevens Institute of Technology. He is considered one of the fathers of scientific project management.

your *python* code) you may wish to include. Any external resources used should have clear citations and a reference page at the end of your work. All group members should contribute to the analysis and write-up as detailed in your Gantt Charts. The report should include an appendix describing the contributions of each team member.

1. **General description** of the derivative: payoff, rationale for trading and possible economic use.

2. Detailed description of the **pricing algorithm** chosen for the derivative considered, and sample results obtained with dummy data. This includes test results, sensitivity to inputs and parameters of the numerical algorithm (e.g. sensitivity to the choice of the time step).

3. **Data analysis**: explain the financial data used, and the details and results of the analysis performed. Mention any data cleaning if required.

4. The results obtained by running the pricing algorithm for the **derivative using real data** as inputs.

5. **Hedging analysis**: principle and test results. What are the main risks of the derivative, and how can they be hedged?

6. **Next steps**: What else could be done with the data collected and pricing algorithm, but time did not permit?

Project Presentation

On the last day of class, your group will give a 10 minute prepared presentation. Every team member should present on their contributions to the work. An additional 2-3 minutes will be used for questions from the audience. Order of presentations will be settled the week before and may be either random or based on a sign-up sheet on first-come first-serve basis [TBD].

References

[1] John C. Hull, Options, Futures and Other Derivatives, Pearson, 10th Edition, 2018