### Valuation Project 2: Monte Carlo Methods

Due Monday, 18 November, 2024

(This is a group assignment. Groups may have up to 3 members.)

The assignment is to: (a) develop and implement a Monte Carlo method to value the financial instrument below or of your choice; (b) select reasonable inputs and estimate the value of the financial instrument; and (c) prepare a short written report documenting your implementation of the valuation model and your result including some kind of sensitivity analysis. The valuation model and documentation must be completed by the deadline.

Grading will be based on both the complexity of the product and/or valuation model, and how well you carry out the implementation of the valuation model. With a Monte Carlo there should ideally be more than one underlying asset, or a path dependent feature.

If you wish to choose your own product (see EDGAR notes at the end) you should select a financial instrument that is interesting (complicated) enough that developing your model is somewhat challenging, but simple enough that developing a valuation model is feasible.

**Very Important Remark for all valuation assignments**. There are many financial instruments that are too difficult for you to value at the moment. For example, some convertible bonds have complicated path-dependent features, and some hybrid securities are exposed to multiple underlying assets, leading to a high-dimensional problem. (You can probably value some of these instruments, but you would not finish before May 1). **I strongly recommend** that you identify your financial instrument and **come and talk to me about it** beforehand, so that I can help you decide whether you have chosen an instrument that is too difficult.

**Product 1: Simple product with one underlying**

<https://www.sec.gov/Archives/edgar/data/1419828/000095017024093837/gs-20240808.htm>

**Key features:**

1. One underlying asset but an **averaging feature** for the payoff.

**Product 2: Three underlying product with standard features**

<https://www.sec.gov/Archives/edgar/data/1419828/000095017024109059/gs-20240924.htm>

**Key features:**

1. Three stocks
2. Standard features that we have seen on Project 1

**Product 3: Five stock indices and a lookback! (Challenging):**

https://www.sec.gov/Archives/edgar/data/1419828/000095017024008871/bskmk164\_final.htm

Key features:

1. Five underlying assets and one is Eurostoxx that makes it a Quanto!
2. Standard payoff at maturity but initial value depends upon a lookback process

**Data:** You will need the risk-free rate in dollars, and the dividend yield and implied volatility for the underlying stock indices – you will need three of them. I can give these. You will also need to estimate the correlations between the stock indices – I would use a simple historical correlation estimate and you can easily get index returns from pretty much any data source.

**Product 4: (From Project 1!) Product with memory feature**

<https://www.sec.gov/Archives/edgar/data/1114446/000183988224030366/ubs_424b2-18282.htm>

Key features:

1. One underlying asset
2. Simple autocall feature (check exactly how many business days after redemption you receive the payment)
3. Complicated (path dependent) coupon calculations at different dates as the size of the coupon payment is path dependent. Here, you will have to consider the different scenarios.

**Product 5: (From Project 1!) Lookback option with a simple payoff**

https://www.sec.gov/Archives/edgar/data/1419828/000095017024010380/spxe1275\_final.htm

Key features:

1. One underlying asset – S&P 500 Index
2. Path dependent feature – a lookback feature
3. Otherwise simple – no coupons, no call features

Data: You will need risk-free rates, and dividend yields and implied volatilities for S&P500. These can be obtained from Bloomberg and other sources.

**Product 6: Contingent Coupon Callable on three stocks (very challenging)**

<https://www.sec.gov/Archives/edgar/data/1666268/000183988224029600/ms3817_424b2-17918.htm>

Key features:

1. Multiple underlying assets.
2. Contingent coupon feature
3. Call feature also – this will require the adaptation of the LSMC method (or equivalent) but only between call dates

**Data:** You will need the risk-free rate in dollars, and the dividend yield and implied volatility for the underlying stocks – you will need three of them. These can be obtained from Bloomberg (see below) and other sources as for Project 1. You will also need to estimate the correlations between the stocks – I would use a simple historical correlation estimate.