

# Assignment for Module 3

April 2025

**Instructions:** This is a mini project on the use of the Monte Carlo scheme to price various call options, to be completed using Python. C++ is also allowed, but Excel/VBA is not permitted. As this is the half way point of the CQF, this assessment is designed for delegates to show independence and maturity in interpretation of a slightly open ended problem. It will test

- finding and understanding the relevant lectures, Python labs and tutorials in module 3; as well as the Python primer.
- ability to experiment and demonstrate initiative in mathematical and numerical methods.
- willingness to work outside narrow instruction that are typical of maths based tests/exams.

Queries to **Riaz Ahmad at zendesk**

## Task

Use the expected value of the discounted payoff under the risk-neutral density  $\mathbb{Q}$

$$V(S, t) = e^{-r(T-t)} \mathbb{E}^{\mathbb{Q}} [\text{Payoff}]$$

for the appropriate form of payoff, to consider **European and binary** options.

Use the **Euler-Maruyama scheme**, **Milstein scheme** and **closed form solution** for simulating the underlying stock price. As an initial example you may use the following set of sample data

$$\begin{aligned} \text{Today's stock price } S_0 &= 100 \\ \text{Strike } E &= 100 \\ \text{Time to expiry } (T - t) &= 1 \text{ year} \\ \text{volatility } \sigma &= 20\% \\ \text{constant risk-free interest rate } r &= 5\% \end{aligned}$$

Then vary the data to see the affect on the option price. Your completed assignment should centre on a report to include:

- Introduction - outline of the finance problem and numerical procedure used. [20%]
- Results - appropriate tables, error analysis and comparisons. [40%]
- Any interesting observations and problems encountered. [15%]
- Conclusion. [20%]
- References. [5%]

**For a Python Jupyter Notebook, a detailed notebook will become the complete report (write-up, code, results). No other format of Python will be accepted.**

**Note: There is no additional credit for calculating the greeks.**

**Score key**

60-65	Pass
66-70	Good
71-79	Very Good
80-89	Excellent
90-95	Outstanding
96+	Exceptional

**Note:** An assessment of this form differs from mathematical exercises that can attract full marks. The key above is provided for this reason.