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Assignment for Module 3

June 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 $\mathbb{Q}$

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

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.