Simulation Methods for Finance

Barrier and Look-back Options

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Introduction

- Create a module for the core task: random variable generation, European option.
- Barrier option: price and greeks.
- Look-back option: price and greeks.
- Document the code and create a user manual.

Outline

Random Variable Generation - Task

Random Variable Generation - Analysis

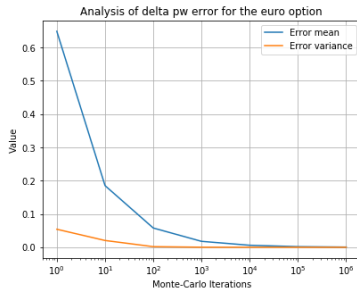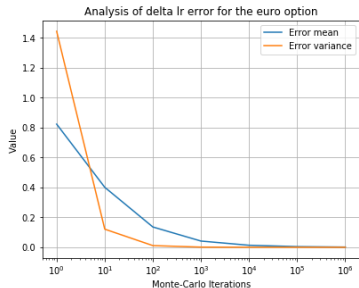# Random Variable Generation - Results

European Call Option - Task

With the usual conventions, recall our model.

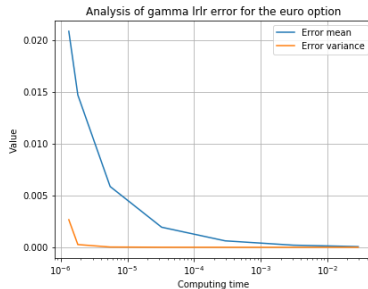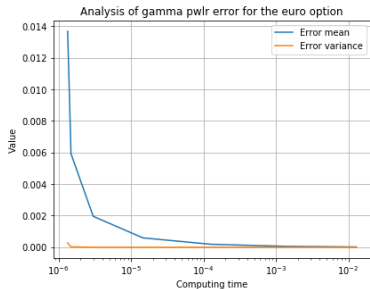$$dS_t = rS_t dt + \sigma S_t dW_t, \ 0 \leq t \leq T$$

$$C_t = E[e^{-r(T-t)}(S_T - K)^+ | F_t]$$

- Create a module to simulate the results for the European option.
- Compute the Greeks (delta, gamma, vega) using different methods.
- Analyse the error compared to the theoretical result.

European Call Option - Analysis

European Call Option - Analysis

European Call Option - Results

- There is a significant accuracy gap beyond 1,000 simulations.
- We based our conclusions on the industry standard: 100,000 simulations.
- There is a trade-off computation time/accuracy.

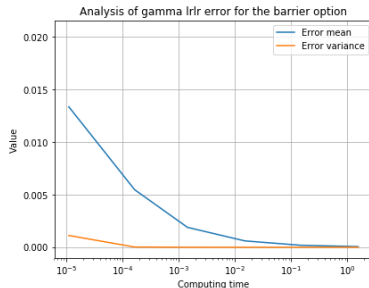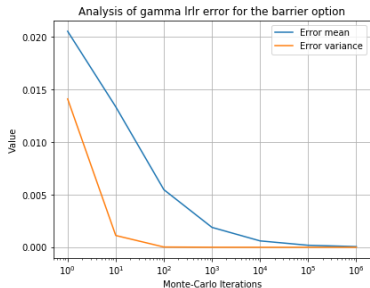|	Error Mean	Error Variance	Time
Delta LR	Worst	Worst	Best
Delta PW	Best	Best	Worst
Gamma PWLR	Worst	Best	Best
Gamma LRPW	-	Worst	Best
Gamma LRLR	-	-	Worst
Vega LR	Worst	-	Worst
Vega PW	Best	-	Best

Barrier Option - Task

Barrier Option - Analysis

Barrier Option - Analysis with a New Method
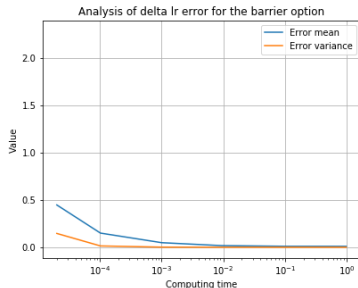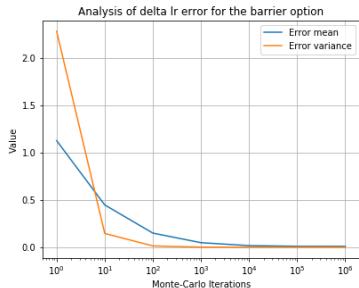
Barrier Option - Analysis with a New Method

Barrier Option - Results

Look-back Option - Task

Look-back Option - Analysis
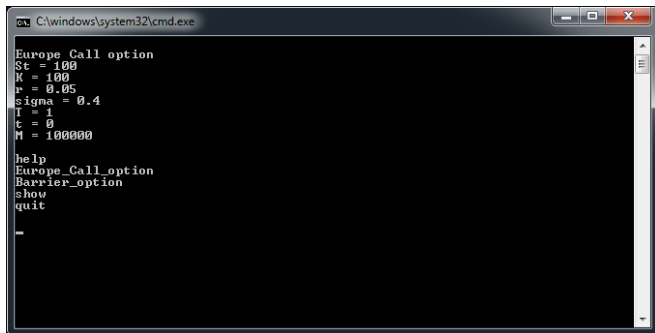
Look-back Option - Results

Using our Code - C++ Package

- We have created a package for C++ users.
- Uses industry standards with dynamic library files.
- Package is very intuitive.

```cpp
#include "BarrierLookBackOptions.h"



european_option call(S_t, K, r, s, T, t, iterations);

double price = call.price();
double gamma = call.gamma("lrlr");
double vega = call.vega("lr");

```

Using our Code - "Code Free" terminal

- We have created an intuitive interface.
- This is suitable for users who do not code: you just have to type the command and there is a help mode.
- It supports european call option, barrier option and the look-back option price and delta.

Conclusion

- We have created a module with the core task.
- The module also can also compute elements related to the barrier option and the look-back option.
- Our package is user-friendly and has a "code-free" interface.

Thank you!

github.com/tjespel/barrier-and-look-back-options