Sheet 4 - Answers

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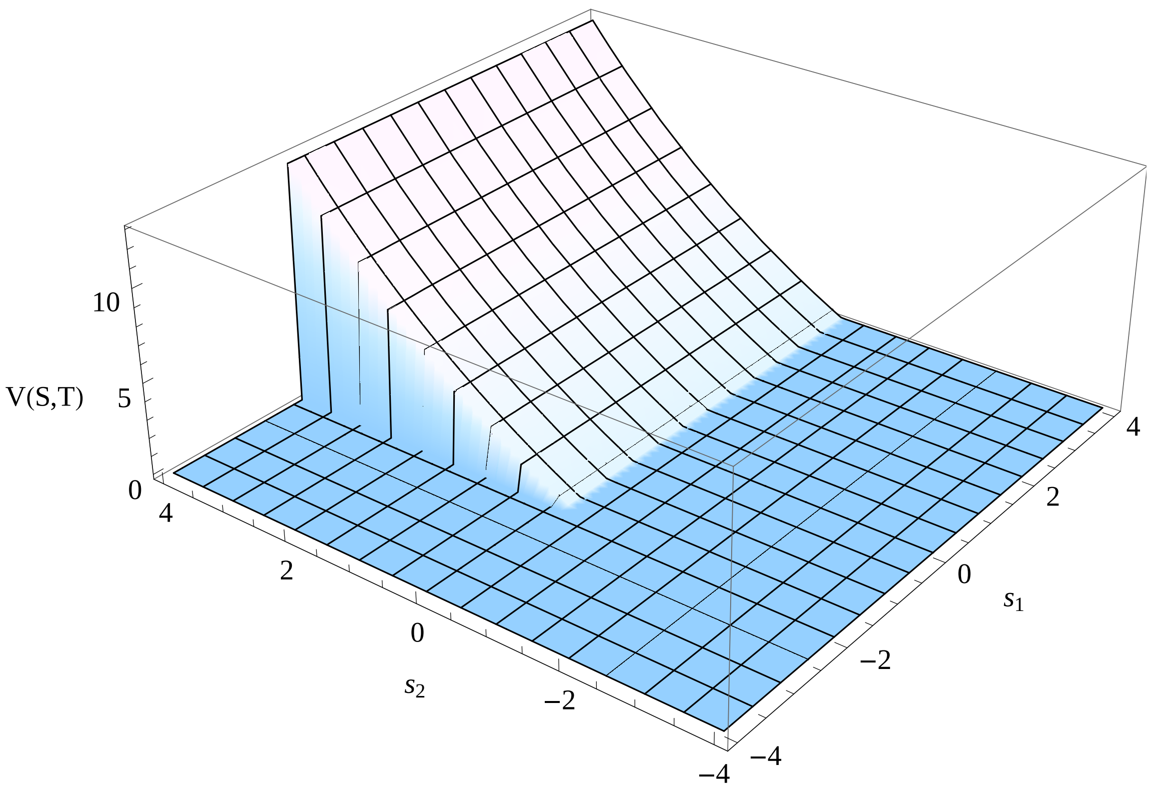
Task: 1

Plot for the integrand of a two-dimensional Down-Out Call option with barrier B.

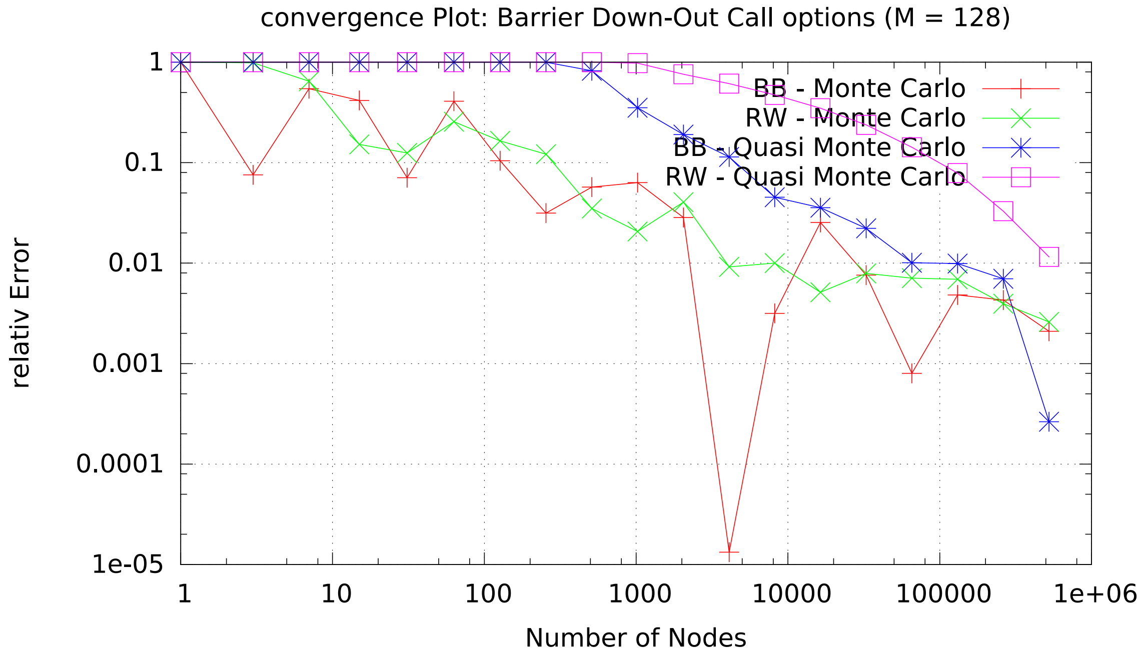


Integrand of 2-dimensional Down-Out Call option.

Task: 2

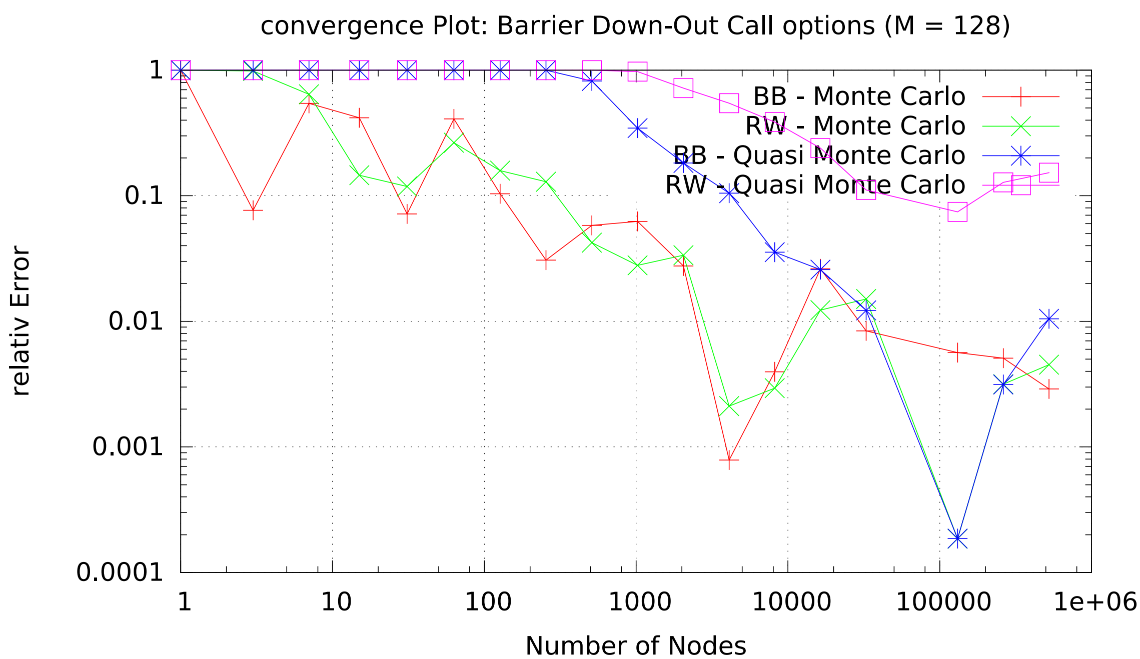
Part 1

Convergence Plot of a Brownian Bridge and Random Walk construction for a Barrier Down Out Call option with Monte Carlo and Quasi Monte Carlo.

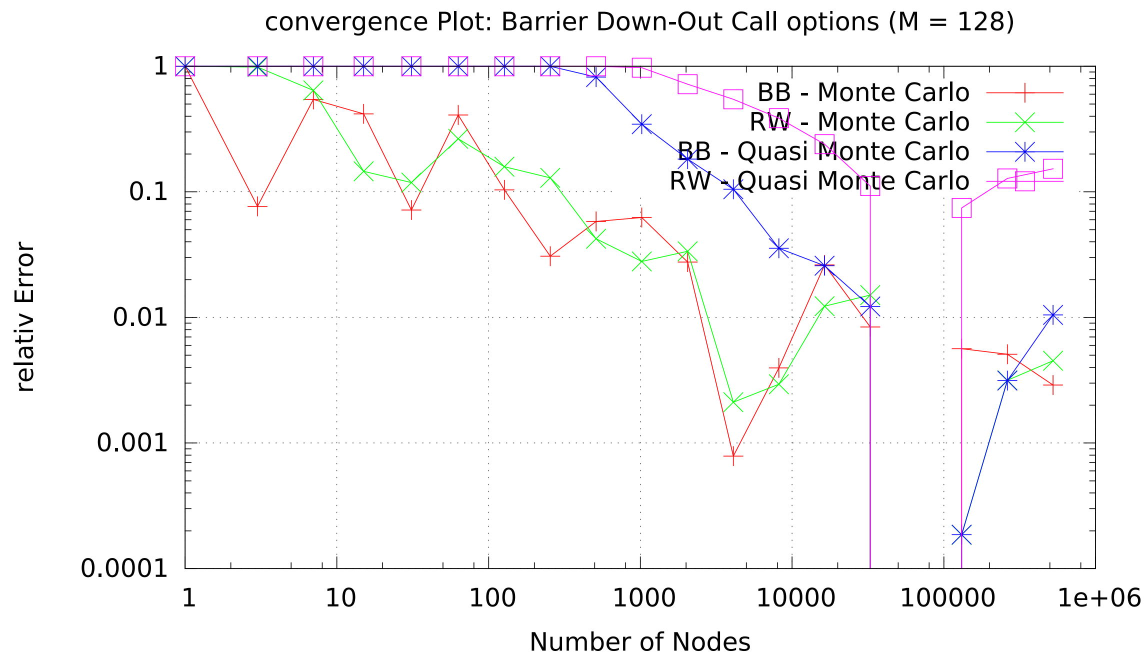


Part 2

This Plot illustrates the error for a not sufficiently big reference value. Here is $l \leq 20$, but the reference value is only $l = 16$.

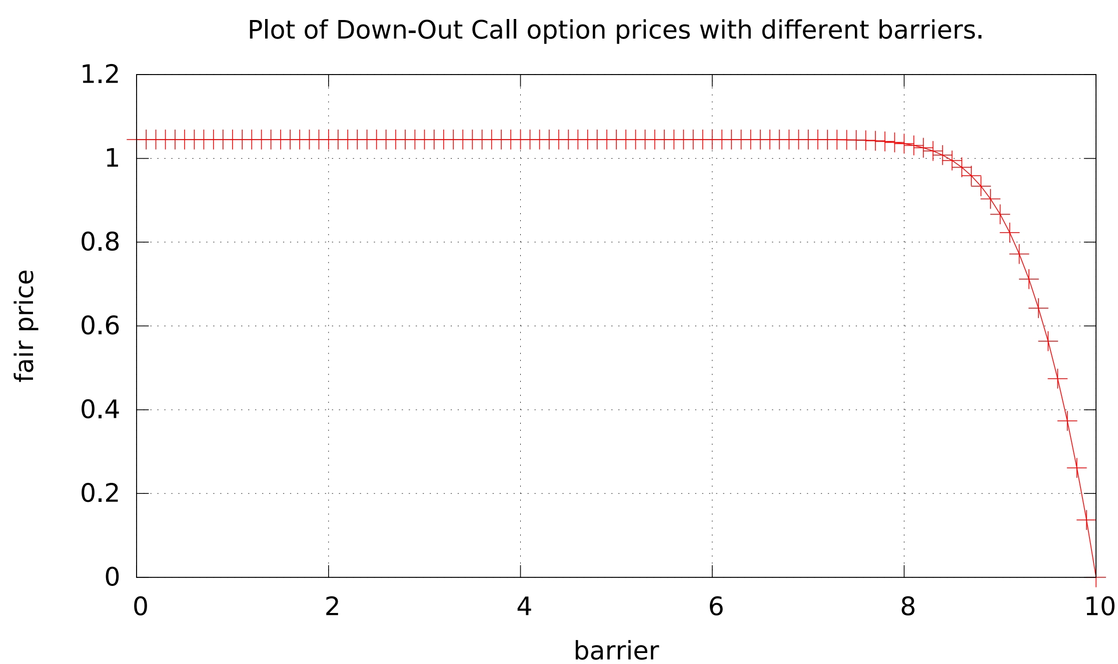


This is an alternative, where the missing zero value for $l = 16$ is not left out.



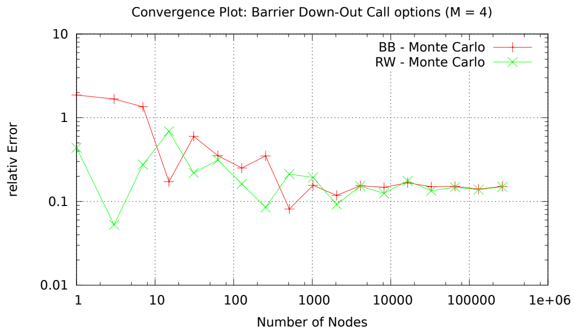
Task: 3

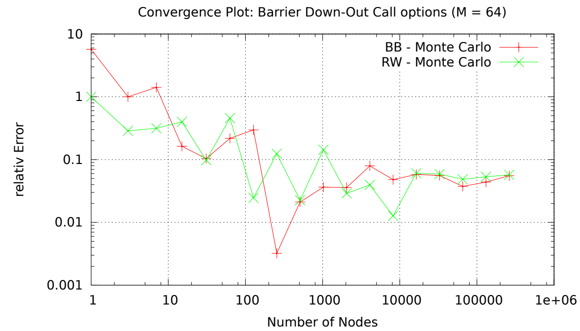
Plot of the Black Scholes formula for a Down-Out call option.

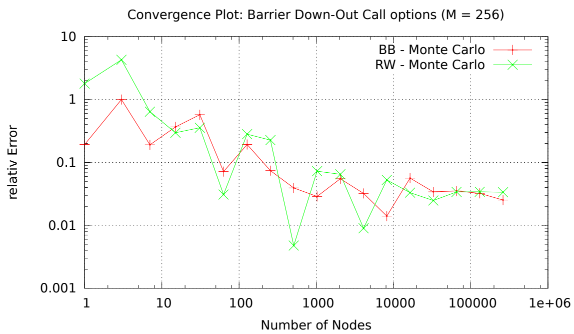


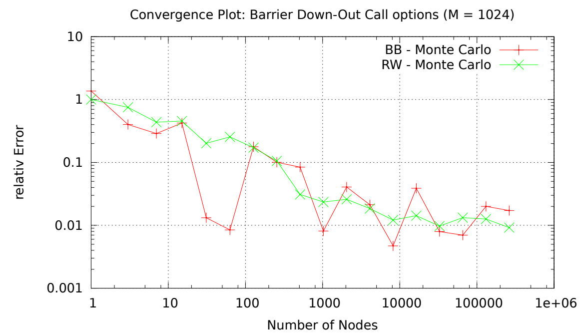
Task: 4

This is also a convergence Plot of a Brownian Bridge and Random Walk construction for a Barrier Down Out Call option. But this time only for Monte Carlo (no QMC) and with different M = {4, 64, 256, 1024}.



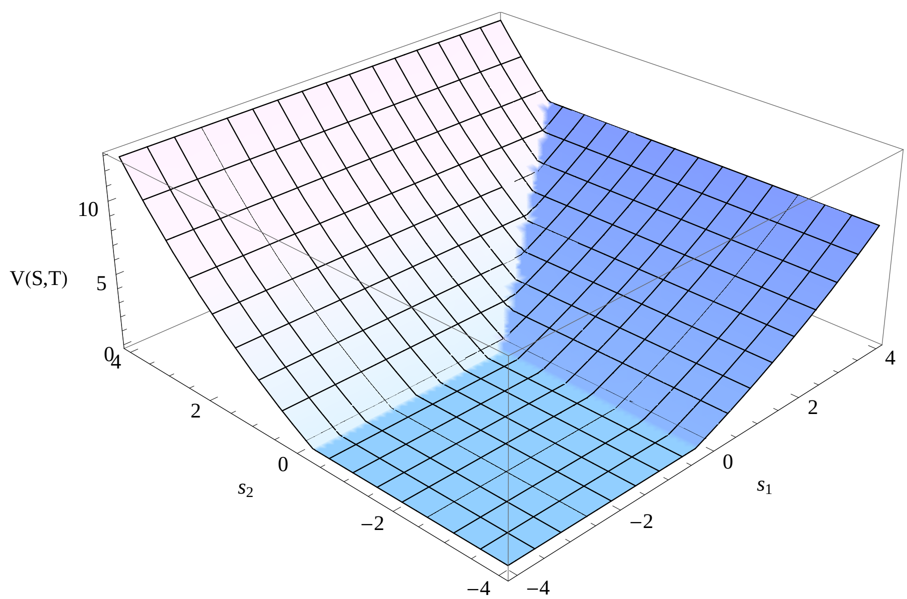






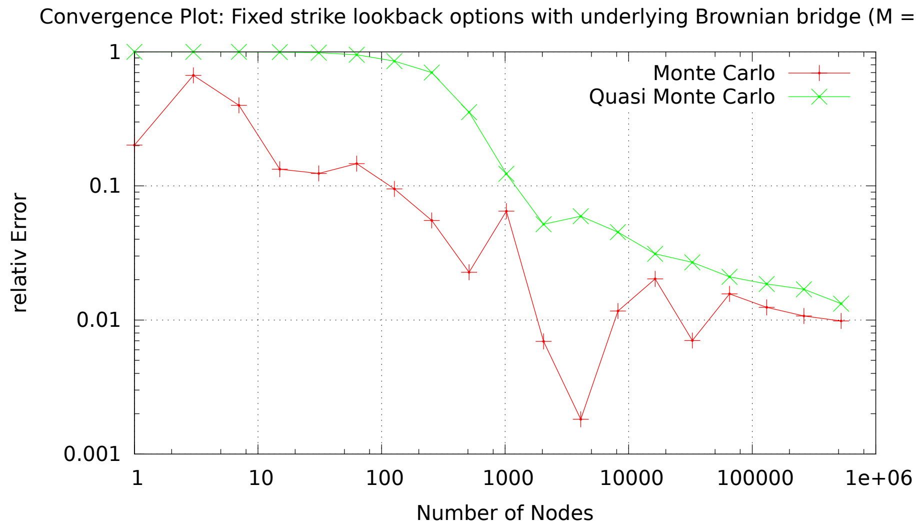
Task: 5

Plot of the discrete time integrand (for Lookback option with fixed strike) for M = 2 with the usual parameters.



Task: 6

This is a convergence plot for for MC and QMC for a discrete time Lookback option with M = 128. The path discretization is done with Brownian Bridge.



Task: 7

Call option implied volatilities computed with Newton-Raphson algorithm with different start values σ_0 and for different actual σ $(2V/(\sqrt{T}S(0)) = 0.0975412)$:

actual σ \ σ_0	0.0975412	0.0100000	1.0000000	10.0000000	0.1000000
0.0010000	0.0091670	0.0091670	nan	nan	0.0091670
0.0100000	0.0100000	0.0100000	nan	nan	0.0100000
1.0000000	1.0000000	nan	1.0000000	nan	1.0000000
9.0000000	9.0000000	nan	9.0000000	9.0000000	9.0000000

Put option implied volatilities computed with Newton-Raphson algorithm with different start values σ_0 and for different actual σ $(2V/(\sqrt{T}S(0)) = 0)$:

actual σ \ σ_0	0.0000000	0.0100000	1.0000000	10.0000000	0.1000000
0.0010000	0.0091670	0.0091670	nan	nan	0.0091670
0.0100000	0.0100000	0.0100000	nan	nan	0.0100000
1.0000000	1.0000000	nan	1.0000000	nan	1.0000000
9.0000000	9.0000000	nan	9.0000000	9.0000000	9.0000000

One observed cause for the divergence of the algorithm is that the quotient σ_0/σ diverges too far from one (either is too large or too near to zero).

Task: 9

We looked up some values from "www.onvista.de". We used values of a Gold stock and European call options of UBS with same time of maturity.One can observe the smile and one runaway value.