Worksheet 4

Practical Lab Numerical Computing

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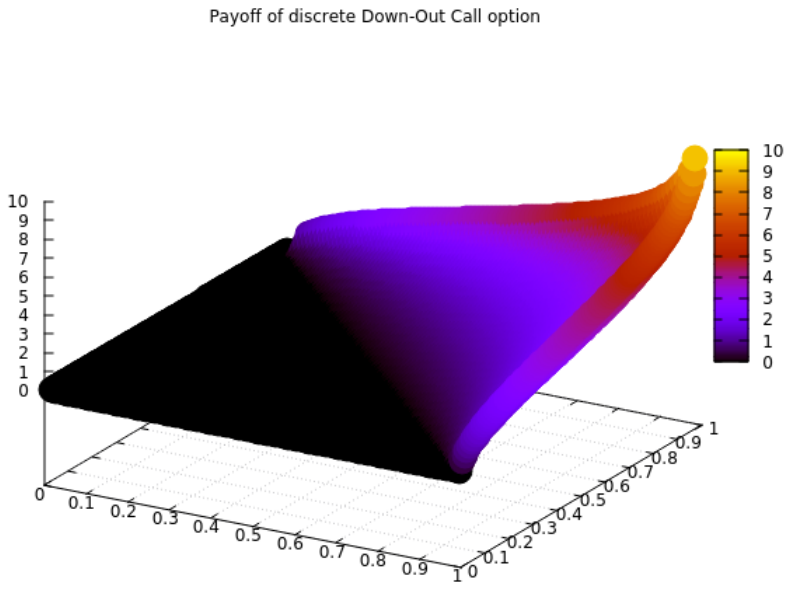
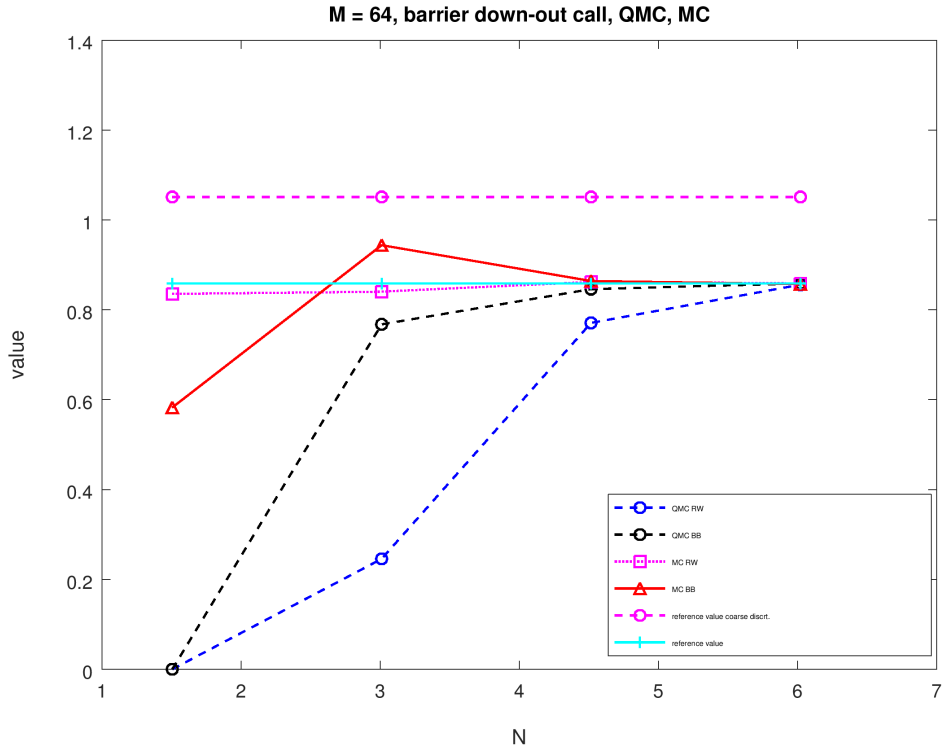
Task 1

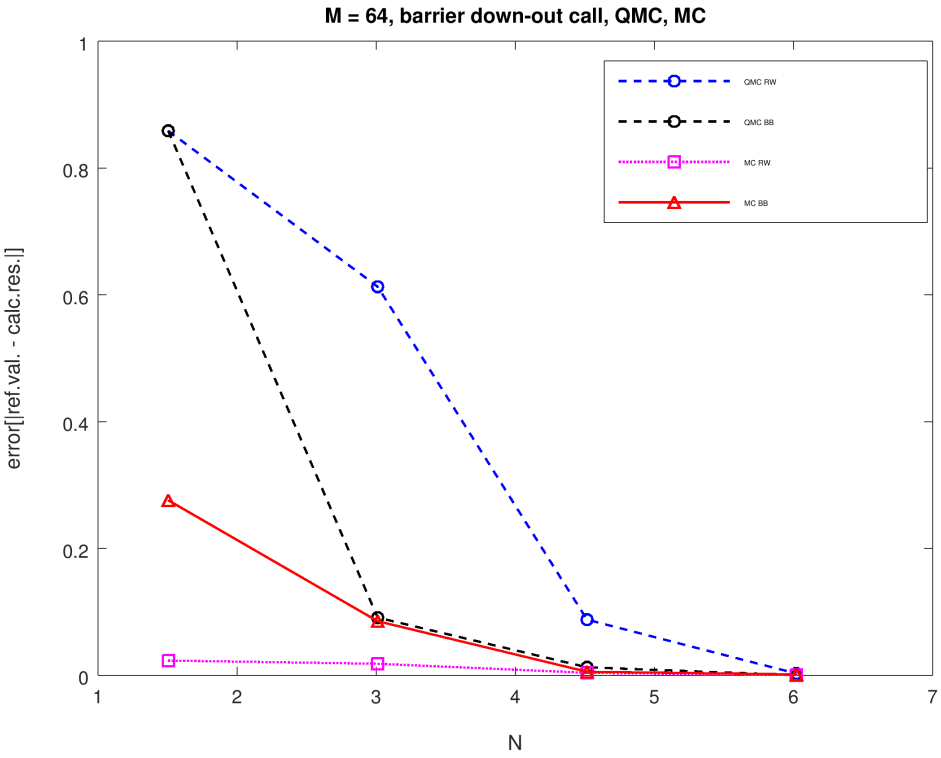


Task 2



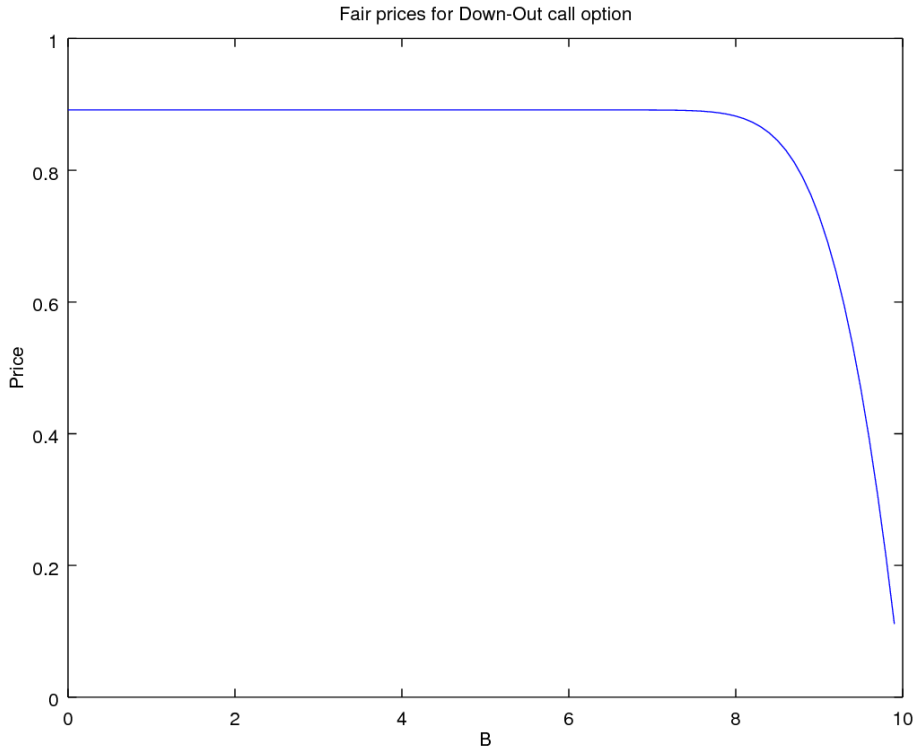
- On this figure value of barrier Down-Out Call option using different methods is plotted against number of used points(10^N).
- Pink dashed line is reference value which you get, if precision is too low. So, if precision is too low then reference value lies above or below the actual price.
- From the plots, one can observe that for QMC Brownian-Bridge shows quicker convergence than Random-Walk, but for MC it is vice verse.

Next figure represents error convergence-rates of the above figure.



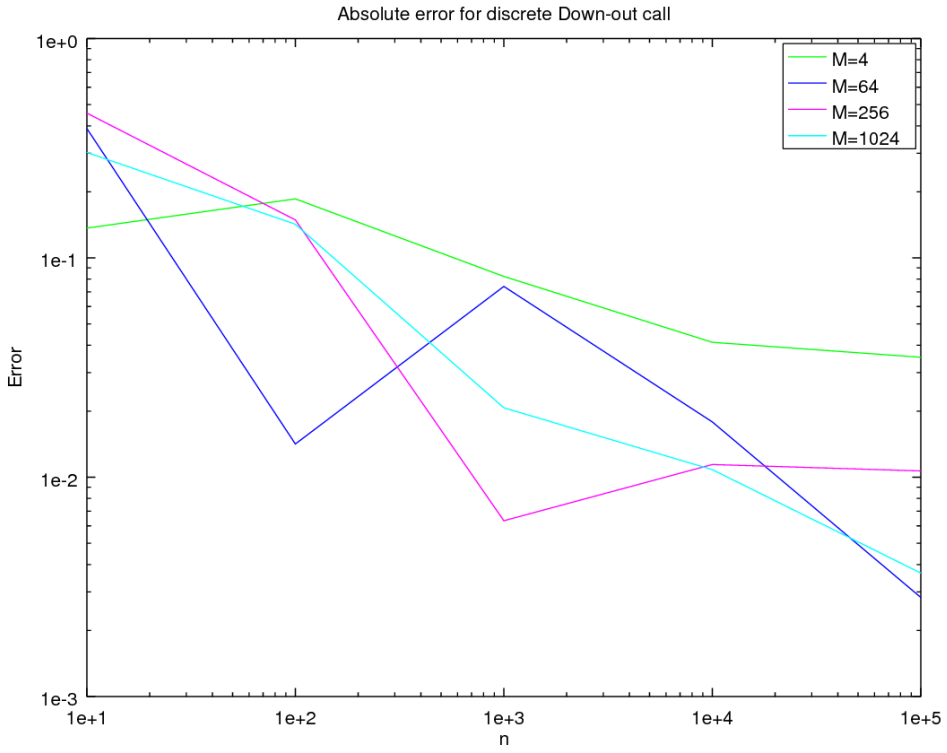
Task 3

The picture below shows the fair price for a Down-Out call option in respect to the barrier B. One can see that the fair price is going down if the barrier is lager then about $B = 8$. This makes sence, because when the barrier has such a high value, the payoff is 0 in many cases (because for this value of B it happens more often that the price of the underlying is under the barrier).

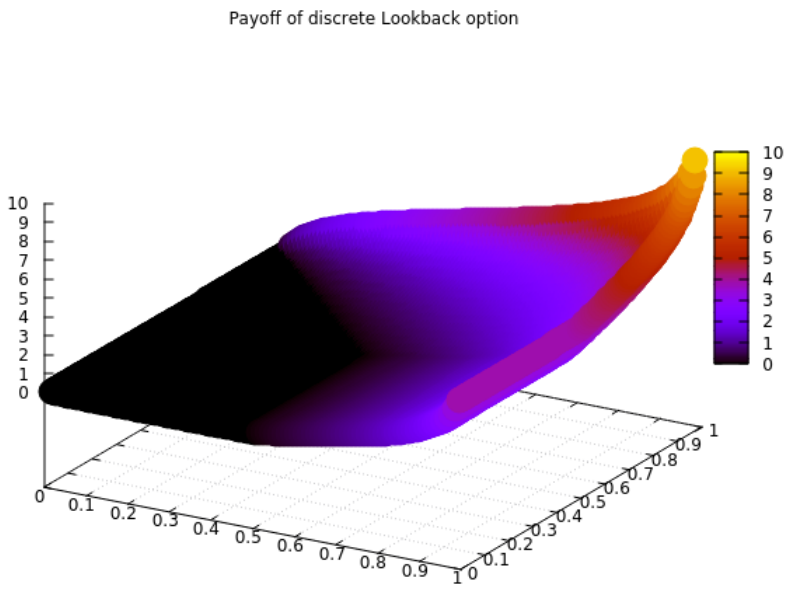


Task 4

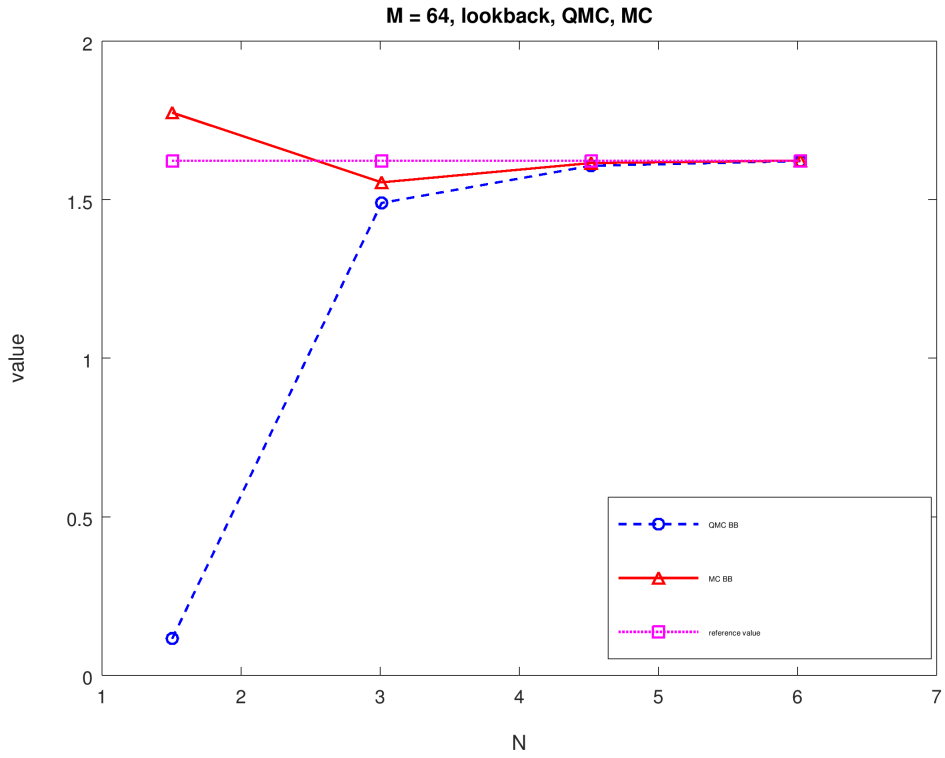
The next plot shows the absolute error for the discrete Down-Out call option for different values of M. One can see that for $M \geq 64$ the convergence is much better then for $M = 4$. Because of Monte Carlo, the error is for $M = 64$ the smallest one in this simulation.


Absolute error for discrete Down-out call
M=4
M=64
M=256
M=1024
1e+0
1e-1
1e-2
1e-3
Error
1e+1
1e+2
1e+3
1e+4
1e+5
n

Task 5

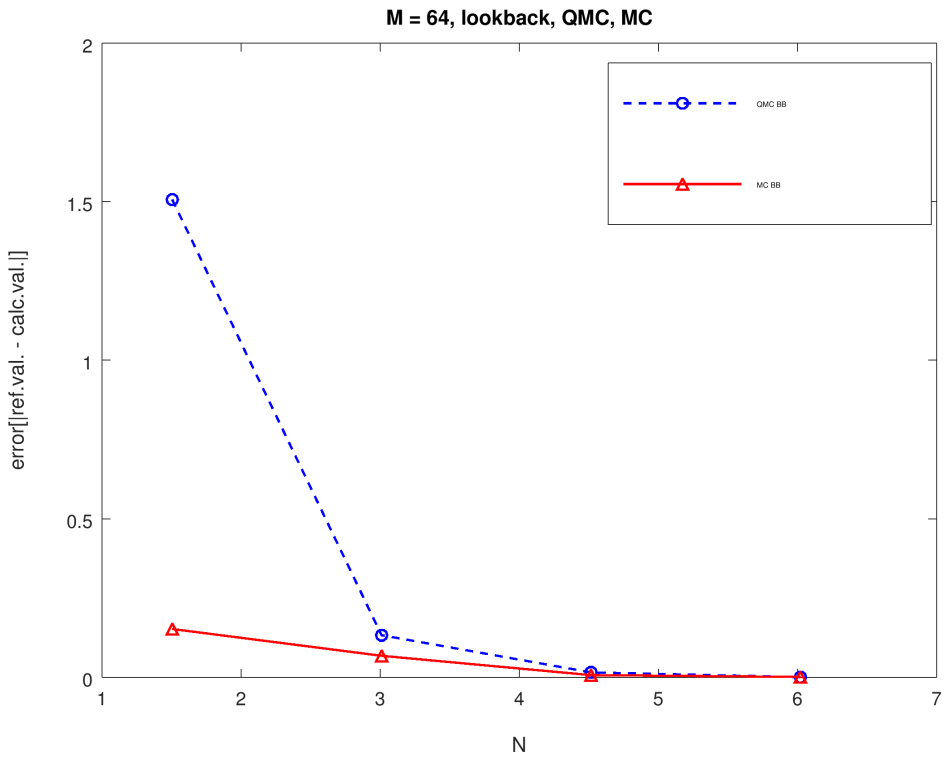

Payoff of discrete Lookback option
10
9
8
7
6
5
4
3
2
1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Task 6

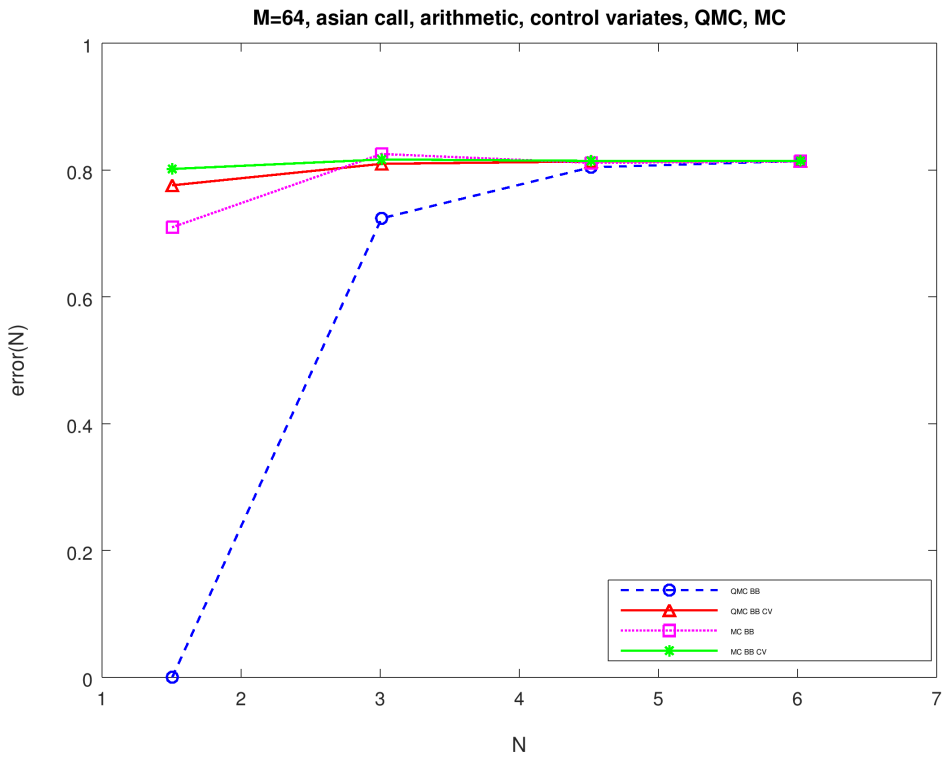


- On this figure value of lookback call option computed with QMC and MC methods using Brownian-Bridge is plotted against number of points.

Here, once more, error between reference value computed numerically and value computed with QMC and MC using Brownian-Bridge against number of points.


M = 64, lookback, QMC, MC
QMC BB
MC BB
error[|ref.val. - calc.val.|]
N
0
0.5
1
1.5
2
1
2
3
4
5
6
7

Task 7



- On this figure, results of **control variates** method are presented. The idea was presented on the worksheet, but we observe, that this method improves slightly the variance in case of an arithmetic Asian call option.