

# Worksheet 4

Practical Lab Numerical Computing

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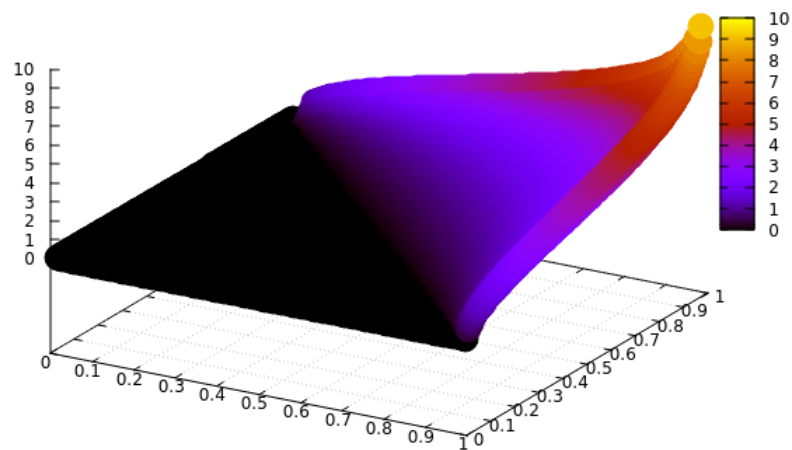
Lars Schleithoff

Hendrik Kleikamp

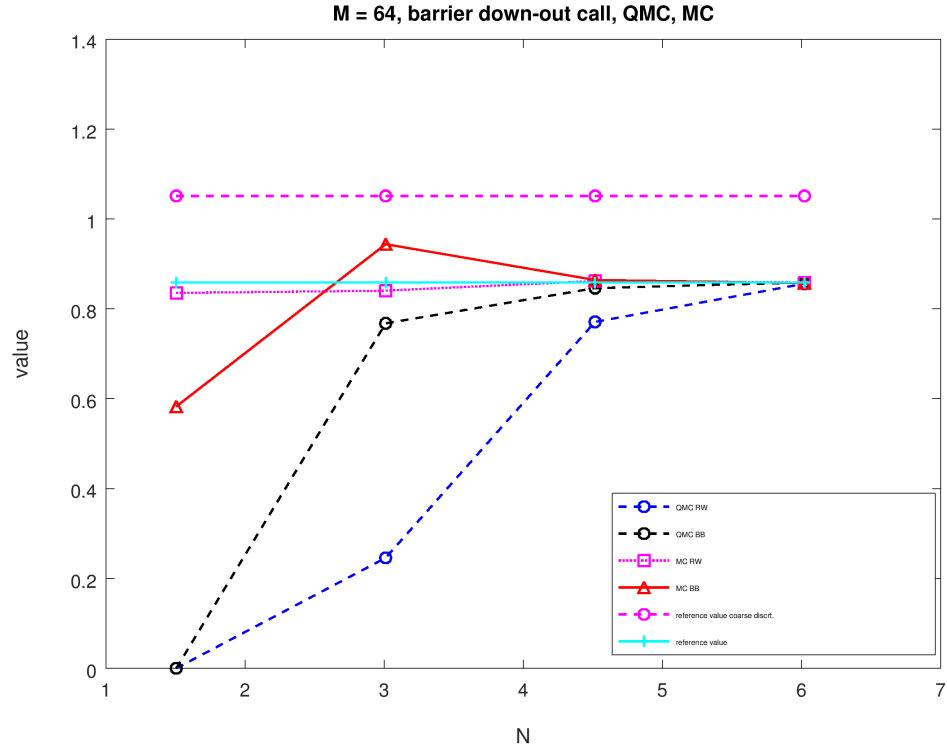
July 10, 2017

## Task 1

Payoff of discrete Down-Out Call option

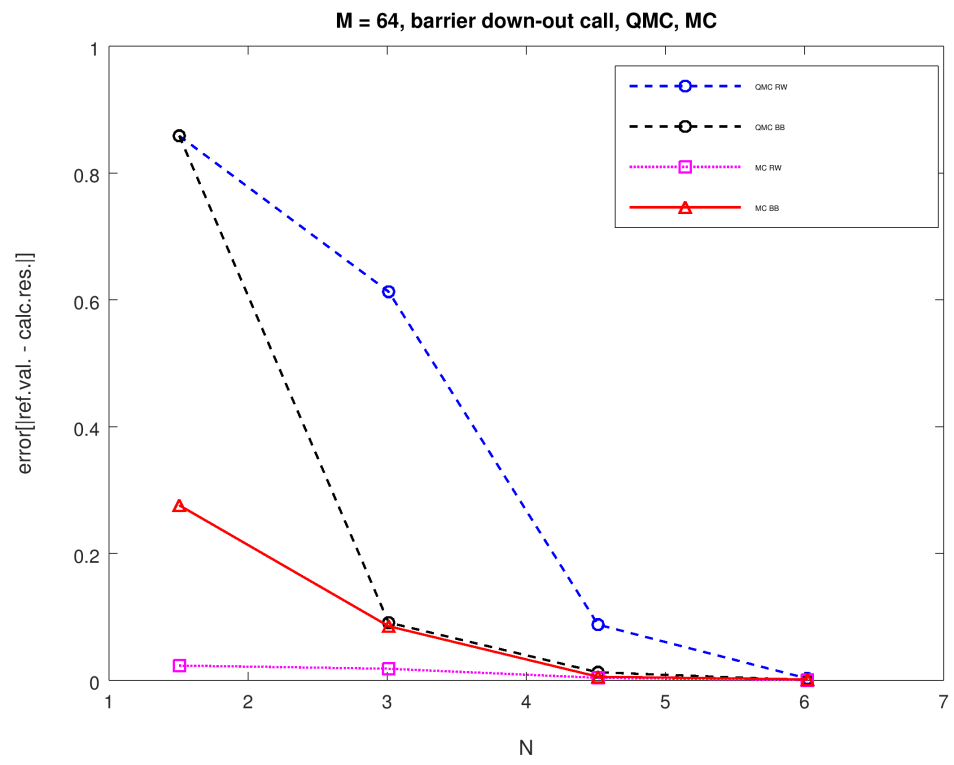


## Task 2

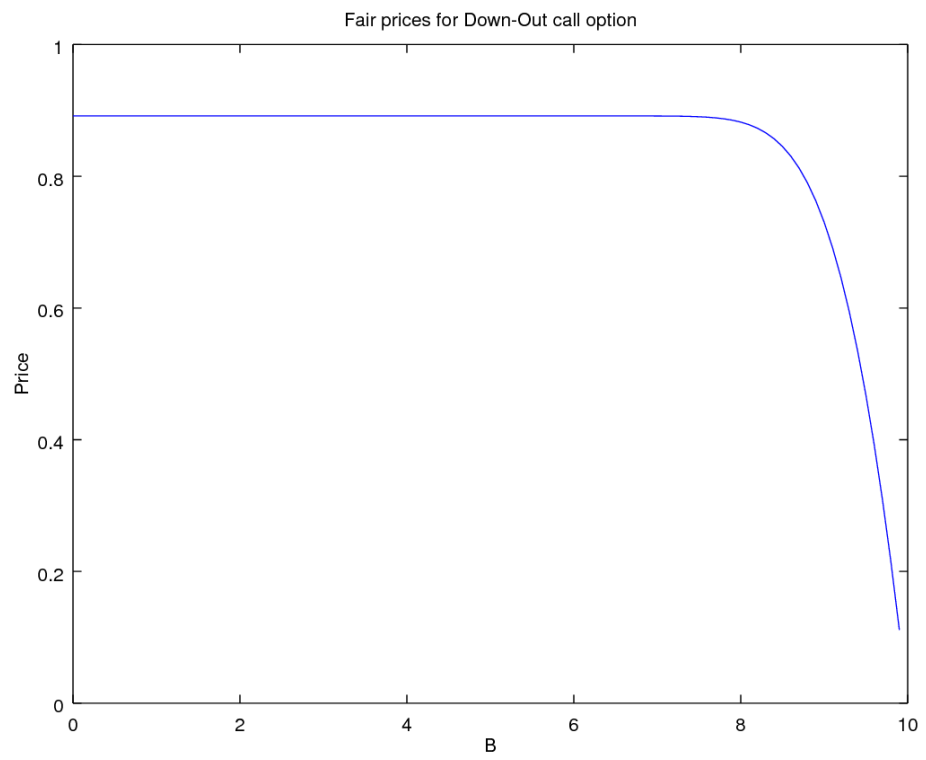


- On this figure value of barrier Down-Out Call option using different methods is plotted against number of used points( $10^N$ ).
- Pink dashed line is reference value which you get, if precision is too low. So, if precision is too low then reference value lies above or below the actual price.
- From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

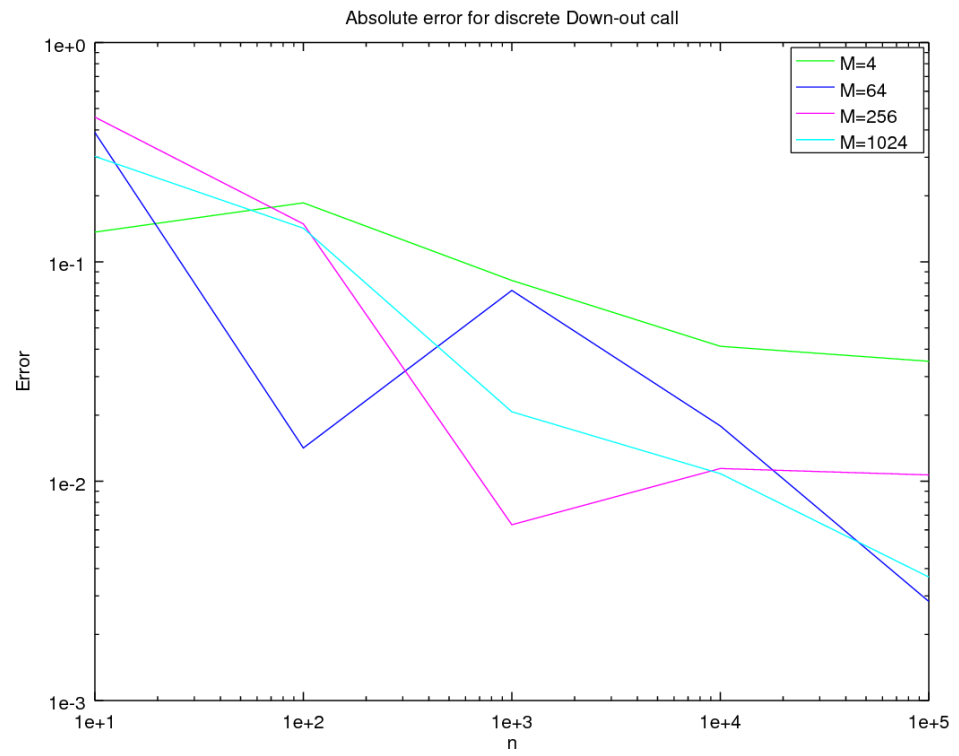
Next figure represents error convergence-rates of the above figure.



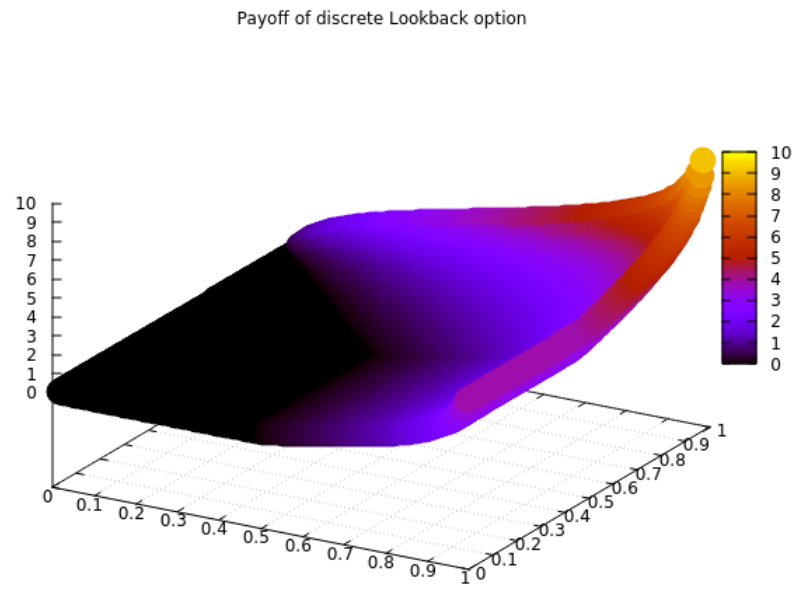
### Task 3



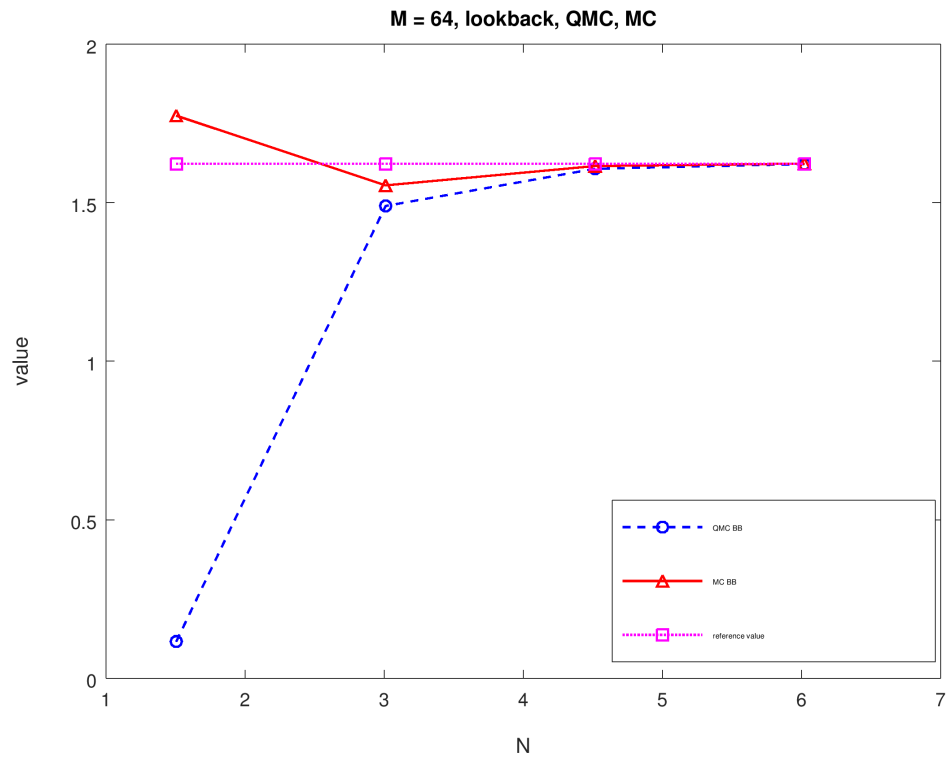
## Task 4



## Task 5

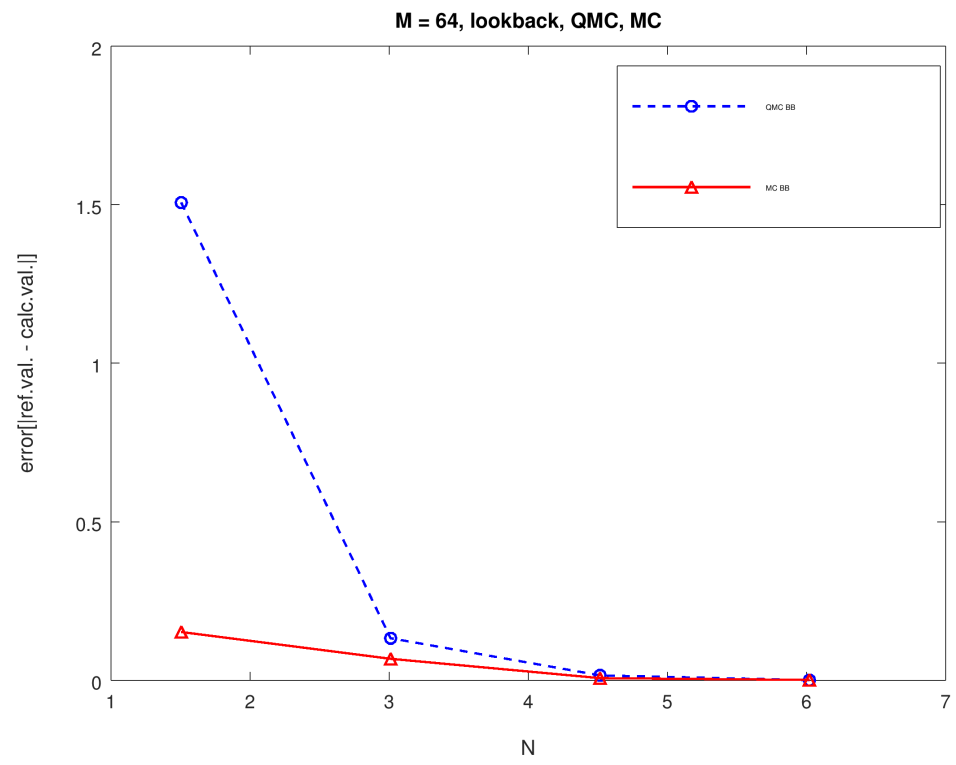


## Task 6



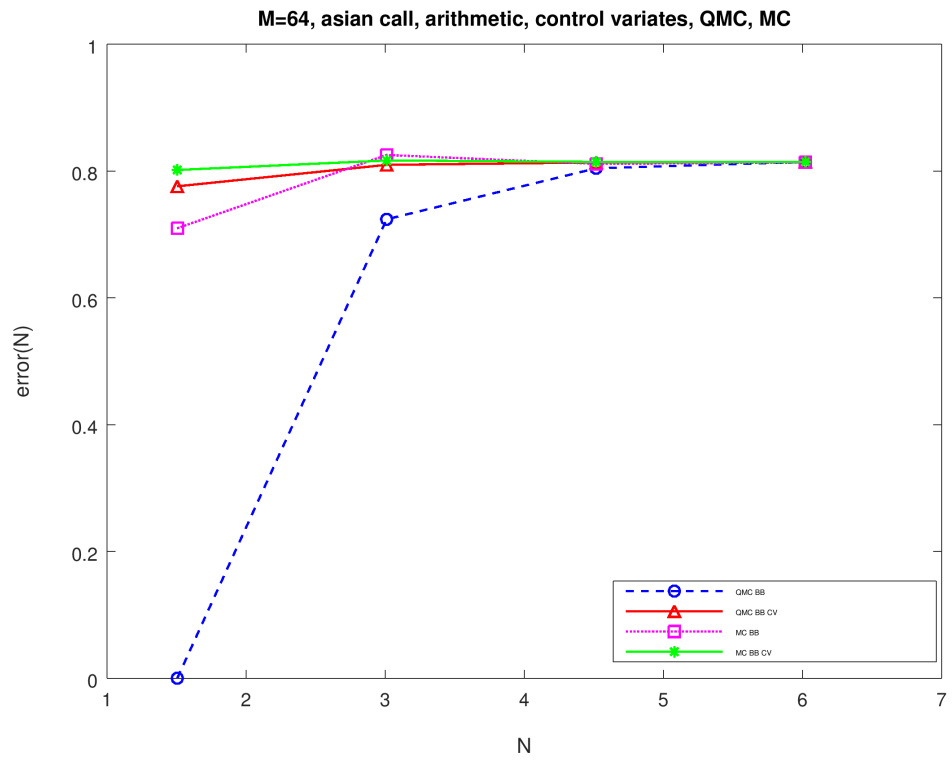
- On this figure value of lookback call option computed with QMC and MC methods using Brownian-Bridge is plotted against number of points.

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



## 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