

MSF 526  
Illinois Institute of Technology  
Homework 1  
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## Monte Carlo Methods for Option Pricing

### Problem 1:

Parameters:  $S_0 = 100.0$ ,  $K = 110.0$ ,  $T = 2.5$ ,  $\text{Sigma} = 0.4$

Calculated  $r = 0.14500000000000002$

Checkpoints: [ 100 1000 10000 100000 1000000 10000000]

Expected results:

# matlab: [Call, Put] = blsprice(100,110,0.145,2.5,0.4)

# Call = 35.4805

Calculated results:

TV: 35.49653984428261

Means:

[34.39654686320733, 33.732872405872264, 35.28498242177358, 36.0344525995199,  
35.59248294108394, 35.49653984428261]

StdDevs:

[49.52242479655789, 57.0501619951988, 60.69357472205613, 62.25308071358687,  
61.671569721735935, 61.54007341980069]

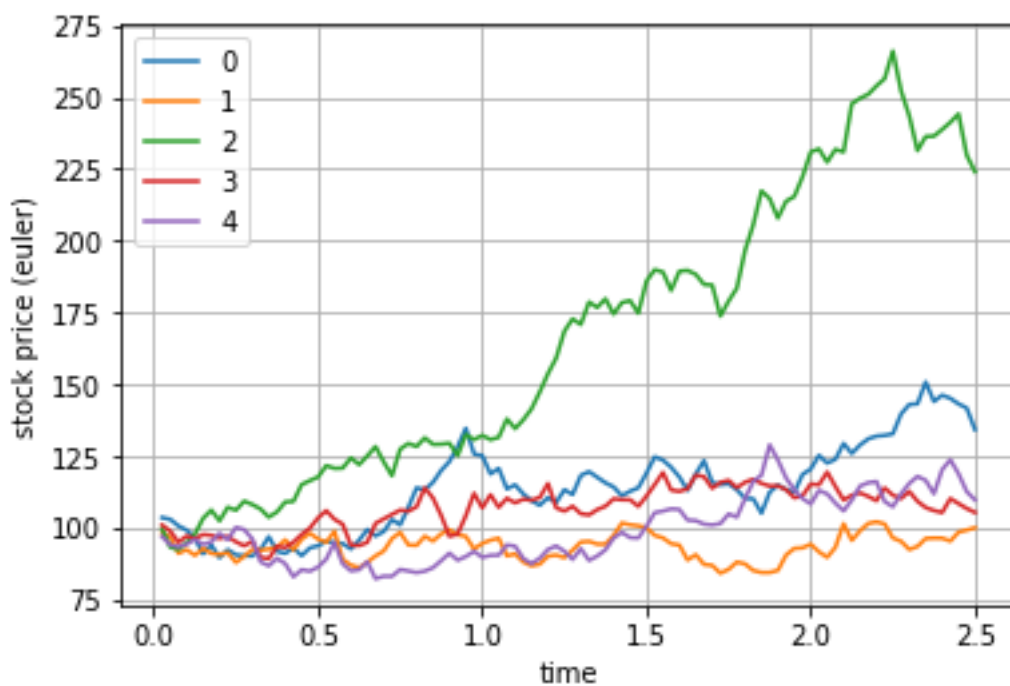
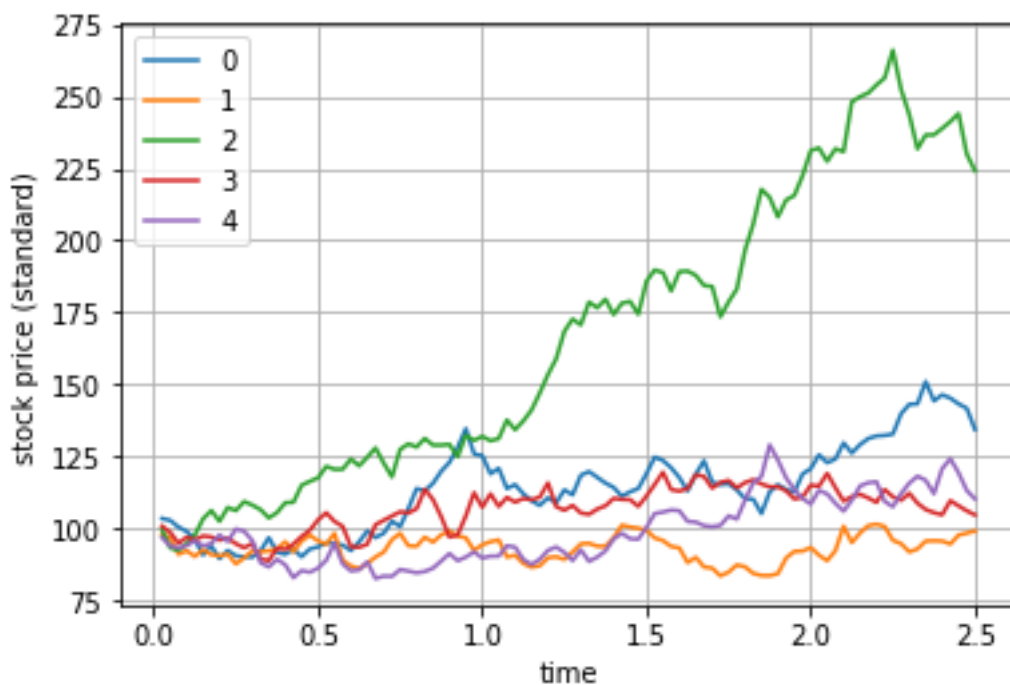
StdErrs:

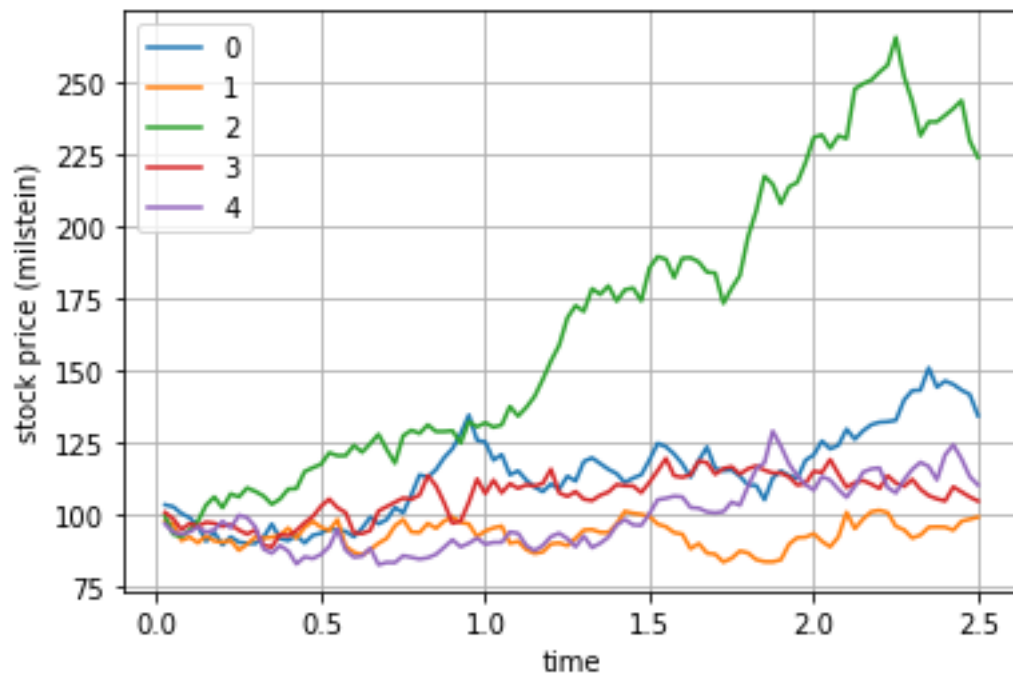
[4.977190962387117, 1.8049872472239428, 0.606966096284121, 0.19686251073224917,  
0.06167160055754393, 0.019460680911089826]

As we can see Monte Carlo Method is computationally intensive method. To achieve good precision we need to make a lot of calculations

## Problem 2:

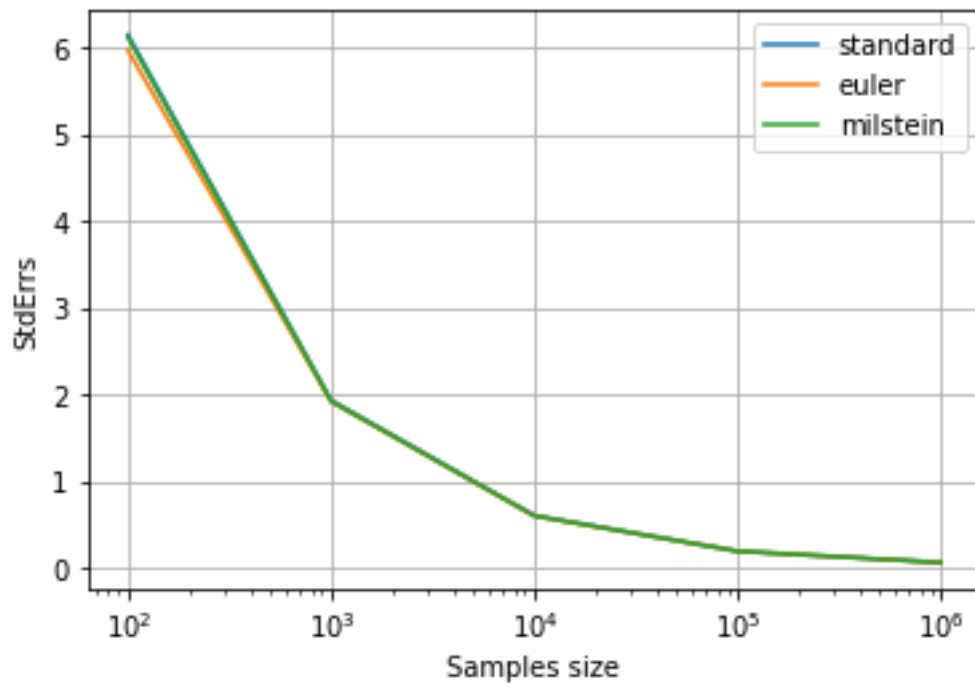
Stock price simulation using Monte Carlo Method. As we can see, while using the same seed for random numbers all three methods produced similar and reliable results.



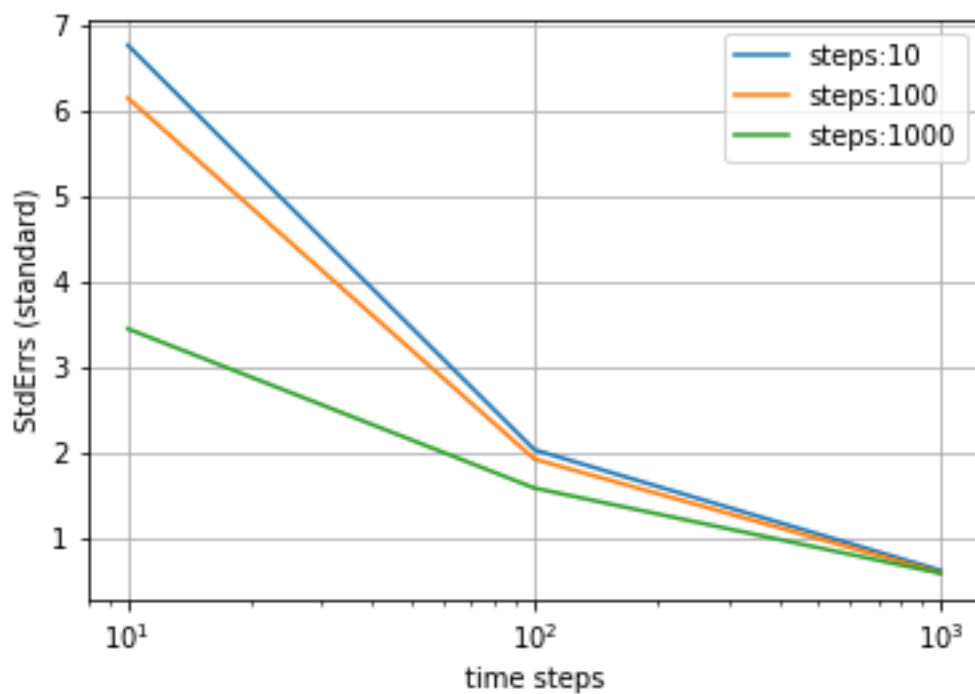


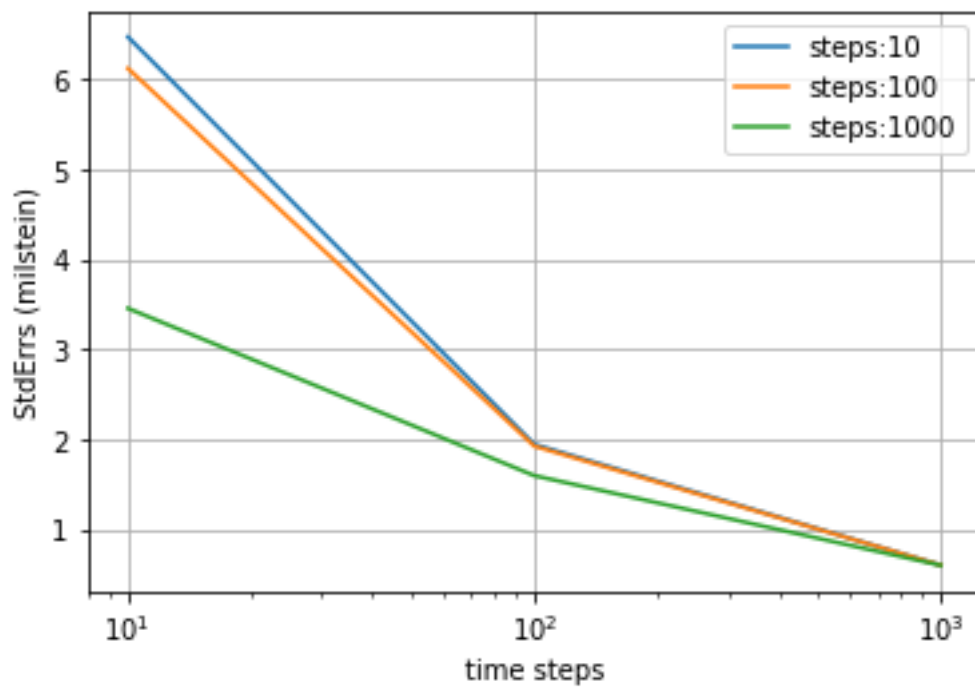
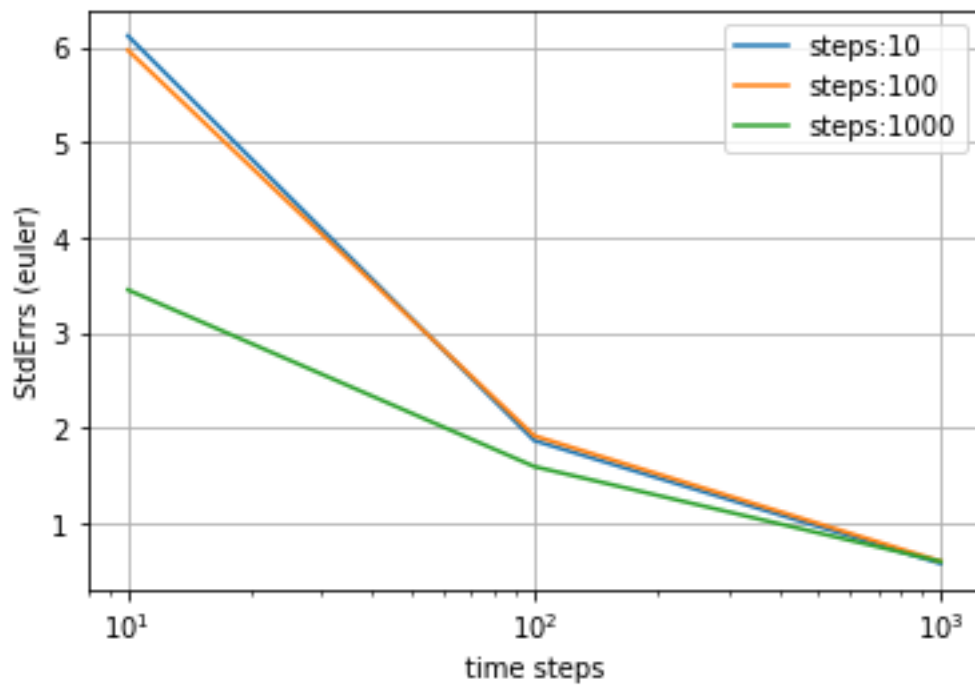
### Problem 3:

Option pricing using Monte Carlo Methods. Convergence study with respect to samples size and time steps.



All three methods converge nicely with increasing samples size. Euler method seems to be a little more precise on smaller samples but we know that it can produce negative results. Milstein method is known for its reliability.





All three methods demonstrate increased convergence with increased number of time steps. Euler seems to be more precise on the smaller number of steps.