C++ Programming for Financial Engineering Level 9 Group D Writeup

QuantNet

Minghan Li

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a)

The working code for Group D is stored in **Projects/MC folder**. See functions implemented in TestMC.cpp

b)

Batch 1 Call SD

Sum of Call SD	Column Labels		
Row Labels	100	300	500
10000	4.54234	4.4639	4.48322
100000	4.5113	4.51716	4.49796
1000000	4.50672	4.51	4.52079
3000000	4.51319	4.52396	4.51821
5000000	4.50742	4.51644	4.51733

Batch 1 Call SE

Sum of Call SE	Column Labels		
Row Labels	100	300	500
10000	0.0454234	0.044639	0.0448322
100000	0.014266	0.0142845	0.0142238
1000000	0.00450672	0.00451	0.00452079
3000000	0.00260569	0.00261191	0.00260859
5000000	0.00201578	0.00201981	0.00202021

Batch 1 Put SD

Sum of Put SD	Column Labels		
Row Labels	100	300	500
10000	6.05727	6.08277	6.05935
100000	6.02739	6.04398	6.04499
1000000	6.05189	6.05552	6.04626
3000000	6.0481	6.05223	6.04762
5000000	6.04795	6.04882	6.04524

Batch 1 Put SE

Sum of Put SE	Column Labels		
Row Labels	100	300	500
10000	0.0605727	0.0608277	0.0605935
100000	0.0190603	0.0191127	0.0191159
1000000	0.00605189	0.00605552	0.00604626
3000000	0.00349187	0.00349426	0.00349159
5000000	0.00270473	0.00270511	0.00270352

Batch 2 Call SD

Sum of Call SD	Column Labels		
Row Labels	100	300	500
10000	13.212	13.0063	13.0796
100000	13.1449	13.153	13.1016
1000000	13.1285	13.1342	13.1616
3000000	13.144	13.1686	13.1554
5000000	13.1302	13.1526	13.1525

Batch 2 Call SE

Sum of Call SE	Column Labels		
Row Labels	100	300	500
10000	0.13212	0.130063	0.130796
100000	0.0415677	0.0415934	0.0414309
1000000	0.0131285	0.0131342	0.0131616
3000000	0.00758867	0.00760287	0.00759528
5000000	0.005872	0.00588204	0.00588199

Batch 2 Put SD

Sum of Put SD	Column Labels		
Row Labels	100	300	500
10000	10.4813	10.4996	10.4258
100000	10.366	10.3993	10.396
1000000	10.4166	10.421	10.4014
3000000	10.4103	10.4157	10.4044
5000000	10.4095	10.4071	10.4004

Batch 2 Put SE

Sum of Put SE	Column Labels		
Row Labels	100	300	500
10000	0.104813	0.104996	0.104258
100000	0.0327802	0.0328856	0.0328751
1000000	0.0104166	0.010421	0.0104014
3000000	0.00601039	0.00601349	0.006007
5000000	0.00465526	0.00465421	0.00465118

From the output of Batch 1 and Batch 2, we observe that SE tends to decrease as NSIM increases, while SD almost stays the same. There appears to be no relationship between N and SD or SE.

This result is expected. As the Monte Carlo simulations are obtained by adding multiple independent random variables coming from a normal distribution. The standard deviation measures the amount of variability, or dispersion, for a subject set of data from the mean. This value should not change very much as the number of simulations increases, because these data should fall into a normal distribution. Increasing the number of steps will also not change this value, since the sum of mean and variance these independent variables are the same, no matter how you dissect the variables.

On the other hand, standard error measures how far the sample mean of the data is likely to be from the true population mean. The law of large numbers suggests that as the number of simulations increases, the mean of the stimulations is converging to the population mean. Thus, SE should decrease as NSIM increases.