MFE405 Project 7

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Problem 1.

(a)

Stock Price (S0)	Explicit FD dx1	Explicit FD dx2	Explicit FD dx3	Black Scholes	Error dx1	Error dx2	Error dx3
4	5.80198	5.80198	5.80198	5.80199	-0.00001	-0.00001	-0.00001
5	4.80198	4.80198	4.80198	4.80199	-0.00001	-0.00001	-0.00001
6	3.80210	3.80205	3.80211	3.80206	0.00004	-0.00000	0.00005
7	2.80550	2.80565	2.80558	2.80536	0.00014	0.00029	0.00022
8	1.84583	1.84737	1.84784	1.84427	0.00156	0.00311	0.00357
9	1.02760	1.02693	1.02773	1.02443	0.00317	0.00250	0.00330
10	0.46985	0.47229	0.47162	0.46469	0.00516	0.00759	0.00692
11	0.17249	0.17481	0.17234	0.17154	0.00095	0.00328	0.00080
12	0.05342	0.05495	0.05346	0.05246	0.00096	0.00249	0.00100
13	0.01408	0.01540	0.01460	0.01365	0.00043	0.00175	0.00094
14	0.00310	0.00332	0.00387	0.00311	-0.00001	0.00021	0.00076
15	0.00068	0.00071	0.00072	0.00063	0.00004	0.00008	0.00008
16	0.00021	0.00020	0.00020	0.00012	0.00009	0.00008	0.00008

(b)

Stock Price (S0)	Implicit FD dx1	Implicit FD dx2	Implicit FD dx3	Black Scholes	Error dx1	Error dx2	Error dx3
4	5.80199	5.80199	5.80199	5.80199	0.00001	0.00001	0.00000
5	4.80199	4.80199	4.80199	4.80199	0.00001	0.00000	0.00000
6	3.80213	3.80209	3.80214	3.80206	0.00007	0.00003	0.00008
7	2.80568	2.80583	2.80576	2.80536	0.00032	0.00047	0.00041
8	1.84620	1.84772	1.84818	1.84427	0.00193	0.00345	0.00391
9	1.02744	1.02682	1.02762	1.02443	0.00301	0.00240	0.00319
10	0.46936	0.47175	0.47108	0.46469	0.00466	0.00705	0.00638
11	0.17214	0.17450	0.17202	0.17154	0.00060	0.00297	0.00048
12	0.05347	0.05500	0.05352	0.05246	0.00101	0.00254	0.00106
13	0.01424	0.01556	0.01475	0.01365	0.00059	0.00191	0.00110
14	0.00321	0.00343	0.00398	0.00311	0.00010	0.00032	0.00087
15	0.00073	0.00076	0.00077	0.00063	0.00009	0.00013	0.00014
16	0.00024	0.00023	0.00023	0.00012	0.00012	0.00011	0.00011

(c)

Stock Price (S0)	C-N FD dx1	C-N FD dx2	C-N FD dx3	Black Scholes	Error dx1	Error dx2	Error dx3
4	5.80199	5.80198	5.80198	5.80199	-0.00000	-0.00000	-0.00000
5	4.80199	4.80198	4.80198	4.80199	-0.00000	-0.00000	-0.00000
6	3.80212	3.80207	3.80212	3.80206	0.00006	0.00001	0.00006
7	2.80559	2.80574	2.80567	2.80536	0.00023	0.00038	0.00031
8	1.84603	1.84754	1.84801	1.84427	0.00176	0.00328	0.00374
9	1.02749	1.02688	1.02767	1.02443	0.00307	0.00245	0.00324
10	0.46963	0.47202	0.47135	0.46469	0.00494	0.00732	0.00665
11	0.17230	0.17466	0.17218	0.17154	0.00076	0.00312	0.00064
12	0.05344	0.05497	0.05349	0.05246	0.00098	0.00251	0.00103
13	0.01416	0.01548	0.01468	0.01365	0.00051	0.00183	0.00102
14	0.00315	0.00338	0.00392	0.00311	0.00005	0.00027	0.00082
15	0.00070	0.00074	0.00074	0.00063	0.00007	0.00010	0.00011
16	0.00022	0.00021	0.00021	0.00012	0.00010	0.00010	0.00009

Three finite difference schemes yield very close results to the theoretical value (Black-Scholes Method). Some of the stock values does not exist in the grid, so the value of the corresponding option is interpolated. When the options are deep in-the-money or out-of-the-money, the finite difference method generated very accurate approximations of European Put Option. The largest errors of the finite difference approximations are incurred near at-the-money prices. The error generally increases with larger dx chosen
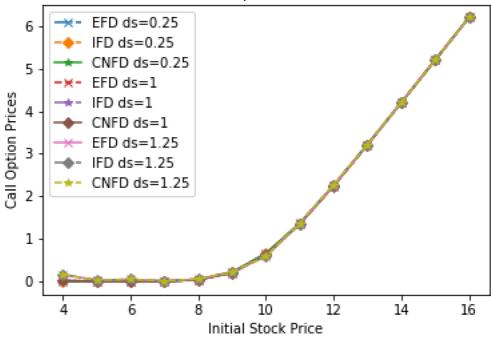
Problem 2
(a)

	call, ds = 0.25	call, ds = 1	call, ds = 1.25	put, ds = 0.25	put, ds = 1	put, ds = 1.25
S0=4	0.00112	0.02482	0.16571	6.00000	6.00000	6.00000
S0=5	0.00065	0.00772	0.03103	5.00000	5.00000	5.00000
S0=6	0.00085	0.01619	0.05318	4.00000	4.00000	4.00000
S0=7	0.00354	0.00674	0.01541	3.00000	3.00000	3.00000
S0=8	0.04207	0.04318	0.05954	2.00000	2.00000	2.00000
S0=9	0.22104	0.20105	0.22217	1.08128	1.05163	1.05437
S0=10	0.66080	0.62305	0.59631	0.48066	0.43998	0.41533
S0=11	1.36833	1.34813	1.36754	0.17506	0.15445	0.17371
S0=12	2.25003	2.24499	2.26158	0.05312	0.04815	0.06433
S0=13	3.21157	3.21159	3.21763	0.01378	0.01388	0.01973
S0=14	4.20112	4.20174	4.20311	0.00314	0.00380	0.00512
S0=15	5.19866	5.19901	5.19917	0.00065	0.00100	0.00118
S0=16	6.19814	6.19828	6.19860	0.00012	0.00026	0.00059

(b)

	call, ds = 0.25	call, ds = 1	call, ds = 1.25	put, ds = 0.25	put, ds = 1	put, ds = 1.25
S0=4	0.00121	0.02513	0.16632	6.00000	6.00000	6.00000
S0=5	0.00072	0.00792	0.03141	5.00000	5.00000	5.00000
S0=6	0.00095	0.01657	0.05378	4.00000	4.00000	4.00000
S0=7	0.00371	0.00691	0.01569	3.00000	3.00000	3.00000
S0=8	0.04241	0.04351	0.05982	2.00000	2.00000	2.00000
S0=9	0.22092	0.20106	0.22219	1.08057	1.05125	1.05419
S0=10	0.66022	0.62229	0.59553	0.47973	0.43908	0.41443
S0=11	1.36800	1.34788	1.36733	0.17459	0.15417	0.17349
S0=12	2.25008	2.24508	2.26159	0.05313	0.04825	0.06437
S0=13	3.21172	3.21172	3.21774	0.01394	0.01402	0.01986
S0=14	4.20121	4.20181	4.20318	0.00325	0.00389	0.00521
S0=15	5.19869	5.19903	5.19920	0.00069	0.00105	0.00122
S0=16	6.19814	6.19828	6.19861	0.00014	0.00028	0.00061

(c)

	call, ds = 0.25	call, ds = 1	call, ds = 1.25	put, ds = 0.25	put, ds = 1	put, ds = 1.25
S0=4	0.00116	0.02497	0.16600	6.00000	6.00000	6.00000
S0=5	0.00069	0.00782	0.03121	5.00000	5.00000	5.00000
S0=6	0.00090	0.01638	0.05347	4.00000	4.00000	4.00000
S0=7	0.00362	0.00682	0.01554	3.00000	3.00000	3.00000
S0=8	0.04224	0.04334	0.05967	2.00000	2.00000	2.00000
S0=9	0.22098	0.20105	0.22218	1.08092	1.05144	1.05428
S0=10	0.66051	0.62267	0.59592	0.48019	0.43953	0.41488
S0=11	1.36816	1.34800	1.36744	0.17482	0.15431	0.17360
S0=12	2.25005	2.24503	2.26159	0.05312	0.04820	0.06435
S0=13	3.21165	3.21165	3.21768	0.01386	0.01395	0.01979
S0=14	4.20117	4.20178	4.20315	0.00320	0.00384	0.00517
S0=15	5.19868	5.19902	5.19918	0.00067	0.00103	0.00120
S0=16	6.19814	6.19828	6.19861	0.00013	0.00027	0.00060

Call Option Prices

Put Option Prices