Project7

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Problem 1

$\Delta X = \sigma\sqrt{\Delta t}$

```
library(knitr)
df1 = read.csv('problem1_1.csv')
df2 = read.csv('problem1_3.csv')
df3 = read.csv('problem1_4.csv')


kable(df1)
```

stock.price	efd	ifd	cnfd	black.scholes	efd_error	ifd_error	cnfd_error
4	5.7860465	5.7860621	5.7860543	5.8019867	-0.0027474	-0.0027447	-0.0027460
5	4.7797375	4.7797534	4.7797454	4.8019869	-0.0046334	-0.0046301	-0.0046317
6	3.7960312	3.7960598	3.7960449	3.8020578	-0.0015851	-0.0015776	-0.0015815
7	2.8128452	2.8130521	2.8129627	2.8053574	0.0026691	0.0027428	0.0027110
8	1.8476606	1.8478310	1.8476539	1.8442686	0.0018392	0.0019316	0.0018356
9	1.0363577	1.0367222	1.0367669	1.0244281	0.0116451	0.0120009	0.0120446
10	0.4641262	0.4641415	0.4644212	0.4646945	-0.0012229	-0.0011901	-0.0005883
11	0.1656655	0.1649359	0.1650858	0.1715369	-0.0342282	-0.0384816	-0.0376073
12	0.0549412	0.0552284	0.0552026	0.0524596	0.0473041	0.0527801	0.0522869
13	0.0144287	0.0144994	0.0144174	0.0136511	0.0569576	0.0621394	0.0561292
14	0.0028162	0.0029484	0.0028959	0.0031075	-0.0937242	-0.0511892	-0.0680830
15	0.0006715	0.0007127	0.0006881	0.0006346	0.0582536	0.1230904	0.0843882
16	0.0001025	0.0001156	0.0001082	0.0001188	-0.1368792	-0.0268133	-0.0888714

$\Delta X = \sigma\sqrt{3\Delta t}$

```
kable(df2)
```

stock.price	efd	ifd	cnfd	black.scholes	efd_error	ifd_error	cnfd_error
4	5.7928996	5.7929152	5.7929074	5.8019867	-0.0015662	-0.0015635	-0.0015649
5	4.8218854	4.8219012	4.8218933	4.8019869	0.0041438	0.0041471	0.0041455
6	3.8044931	3.8045226	3.8045078	3.8020578	0.0006405	0.0006483	0.0006444
7	2.8028214	2.8030026	2.8029122	2.8053574	-0.0009040	-0.0008394	-0.0008716
8	1.7983610	1.7987103	1.7985358	1.8442686	-0.0248920	-0.0247026	-0.0247973
9	1.0435759	1.0434936	1.0435344	1.0244281	0.0186912	0.0186108	0.0186507
10	0.4641527	0.4635921	0.4638726	0.4646945	-0.0011659	-0.0023723	-0.0017687
11	0.1760469	0.1757206	0.1758835	0.1715369	0.0262917	0.0243899	0.0253395
12	0.0494538	0.0495270	0.0494902	0.0524596	-0.0572970	-0.0559017	-0.0566031
13	0.0133190	0.0134828	0.0134011	0.0136511	-0.0243327	-0.0123339	-0.0183193
14	0.0028037	0.0029076	0.0028558	0.0031075	-0.0977611	-0.0643252	-0.0809841
15	0.0006699	0.0007187	0.0006943	0.0006346	0.0556993	0.1325830	0.0942030
16	0.0001351	0.0001527	0.0001439	0.0001188	0.1377068	0.2851394	0.2111323

$\Delta X = \sigma\sqrt{4\Delta t}$

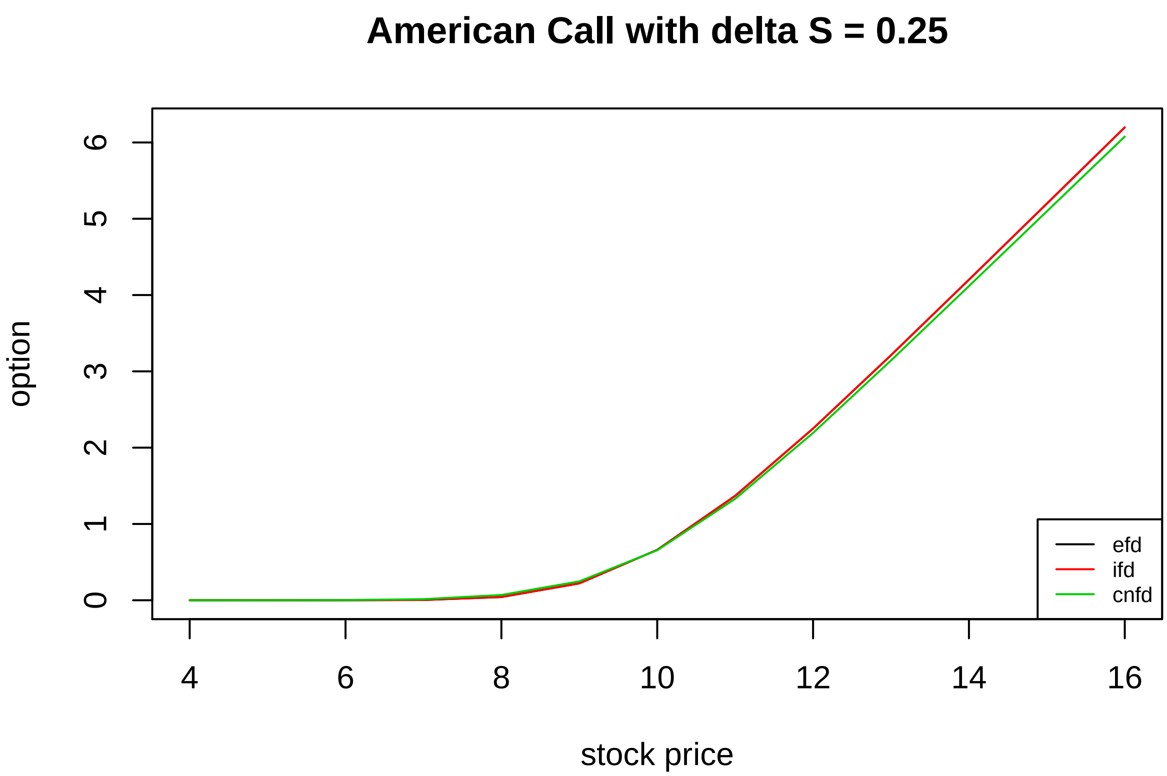
```
kable(df3)
```

stock.price	efd	ifd	cnfd	black.scholes	efd_error	ifd_error	cnfd_error
4	5.7860440	5.7860597	5.7860519	5.8019867	-0.0027478	-0.0027451	-0.0027464
5	4.8244545	4.8244703	4.8244624	4.8019869	0.0046788	0.0046821	0.0046805
6	3.8494957	3.8495233	3.8495094	3.8020578	0.0124769	0.0124841	0.0124805
7	2.8129247	2.8131029	2.8130140	2.8053574	0.0026974	0.0027610	0.0027293
8	1.7821144	1.7824616	1.7822881	1.8442686	-0.0337012	-0.0335130	-0.0336071
9	1.0363338	1.0362451	1.0362891	1.0244281	0.0116217	0.0115352	0.0115781
10	0.4638783	0.4633168	0.4635977	0.4646945	-0.0017565	-0.0029649	-0.0023602
11	0.1833648	0.1830220	0.1831932	0.1715369	0.0689529	0.0669543	0.0679524
12	0.0549823	0.0550354	0.0550086	0.0524596	0.0480875	0.0491004	0.0485895
13	0.0121455	0.0123079	0.0122269	0.0136511	-0.1102963	-0.0983961	-0.1043312
14	0.0028708	0.0029754	0.0029233	0.0031075	-0.0761613	-0.0425010	-0.0592718
15	0.0005464	0.0005892	0.0005678	0.0006346	-0.1389800	-0.0714388	-0.1051738
16	0.0001361	0.0001535	0.0001448	0.0001188	0.1458481	0.2924593	0.2188630

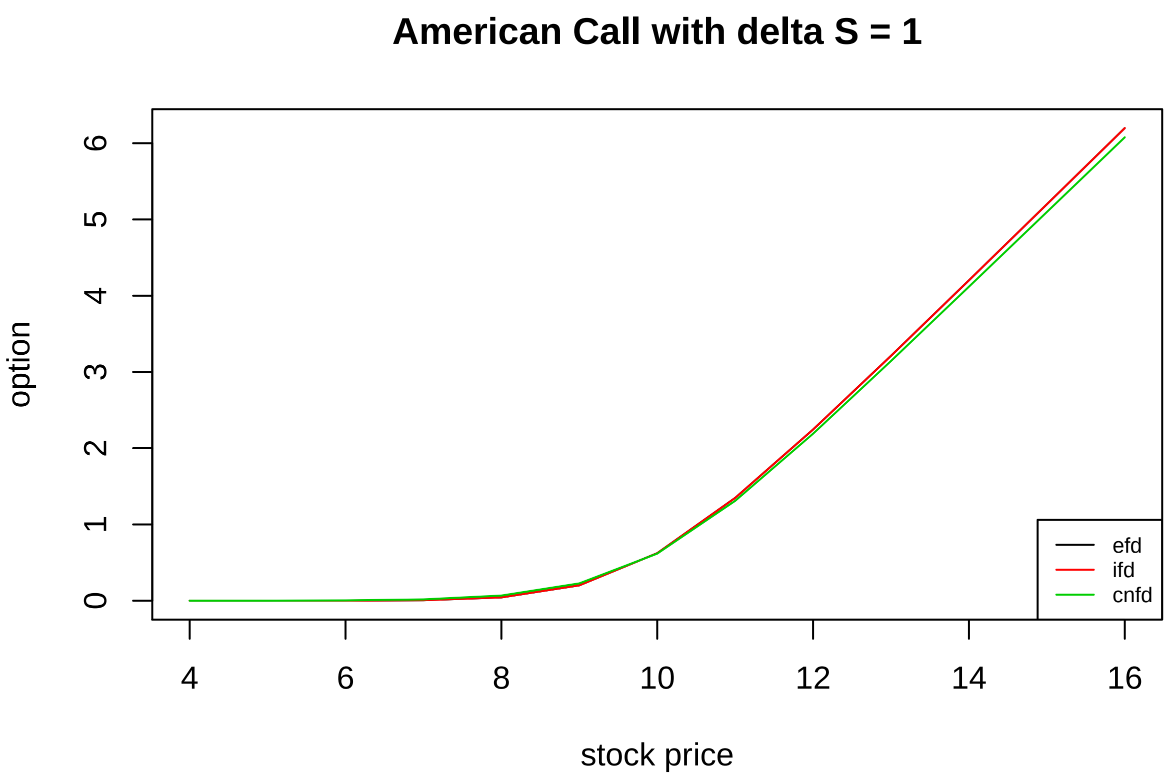
Option prices are more accurate in the middle of stock price range. In general, the result of CNFD relies in between of EFD and IFD.

Problem 2

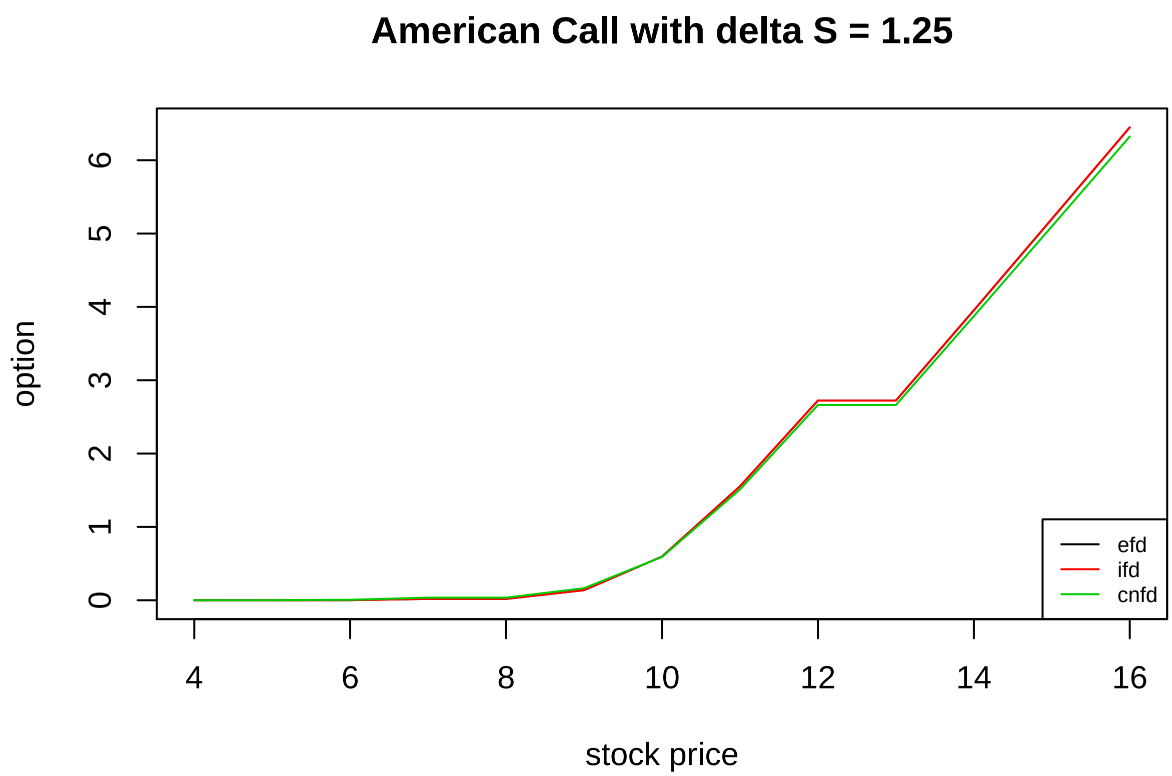
```
plot_func = function(file,main){
  df = read.csv(file)
  plot(df$stock.price,df$efd,type = 'l',col = 1,xlab = 'stock price', ylab = 'option', main = main)
  lines(df$stock.price, df$ifd, col = 2)
  lines(df$stock.price,df$cnfd, col = 3)
  legend("bottomright", legend = c("efd", "ifd", "cnfd"), col = c(1:3), lwd = 1, cex = 0.65)
}

plot_func('problem2call_1.csv', 'American Call with delta S = 0.25')
```



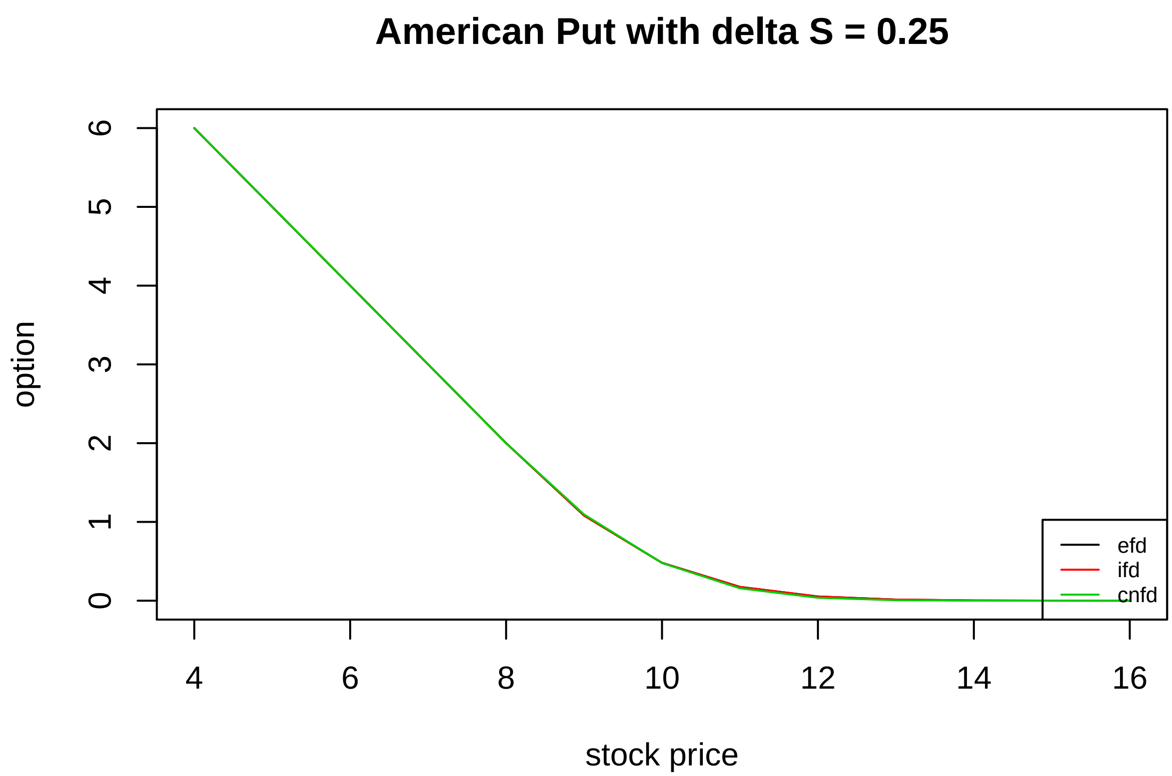

```
plot_func('problem2call_4.csv', 'American Call with delta S = 1')
```



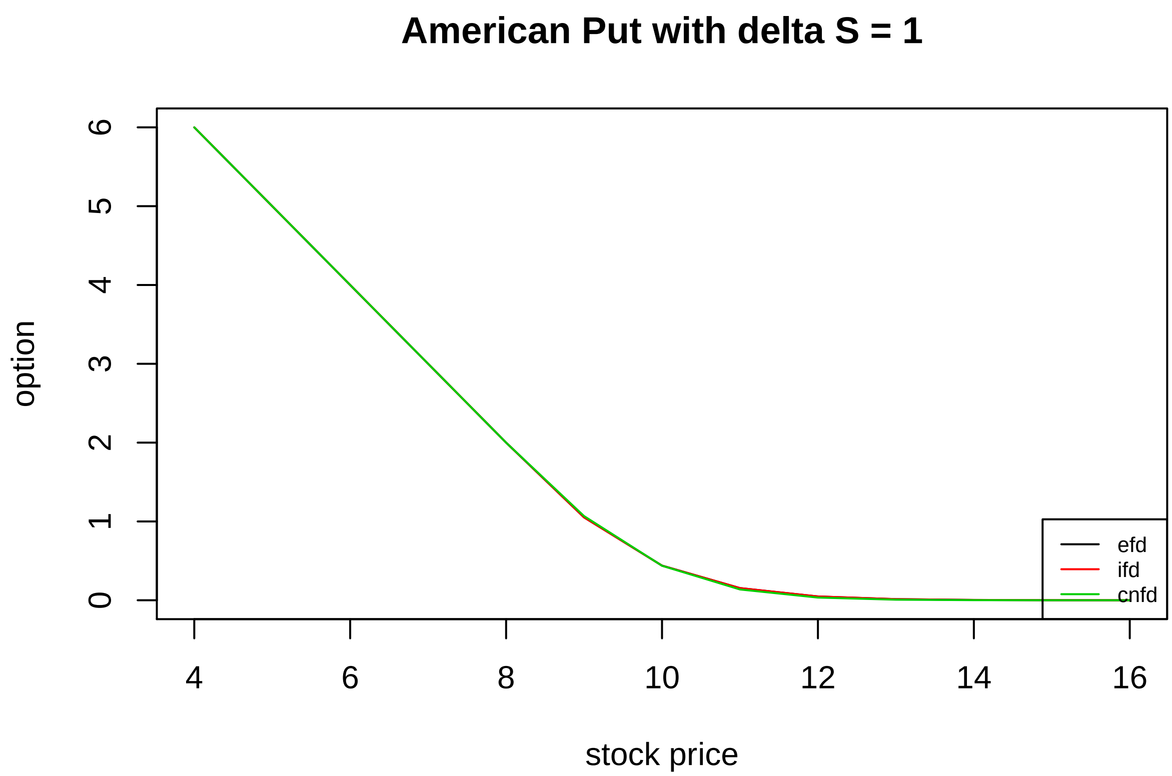

```
plot_func('problem2call_5.csv', 'American Call with delta S = 1.25')
```



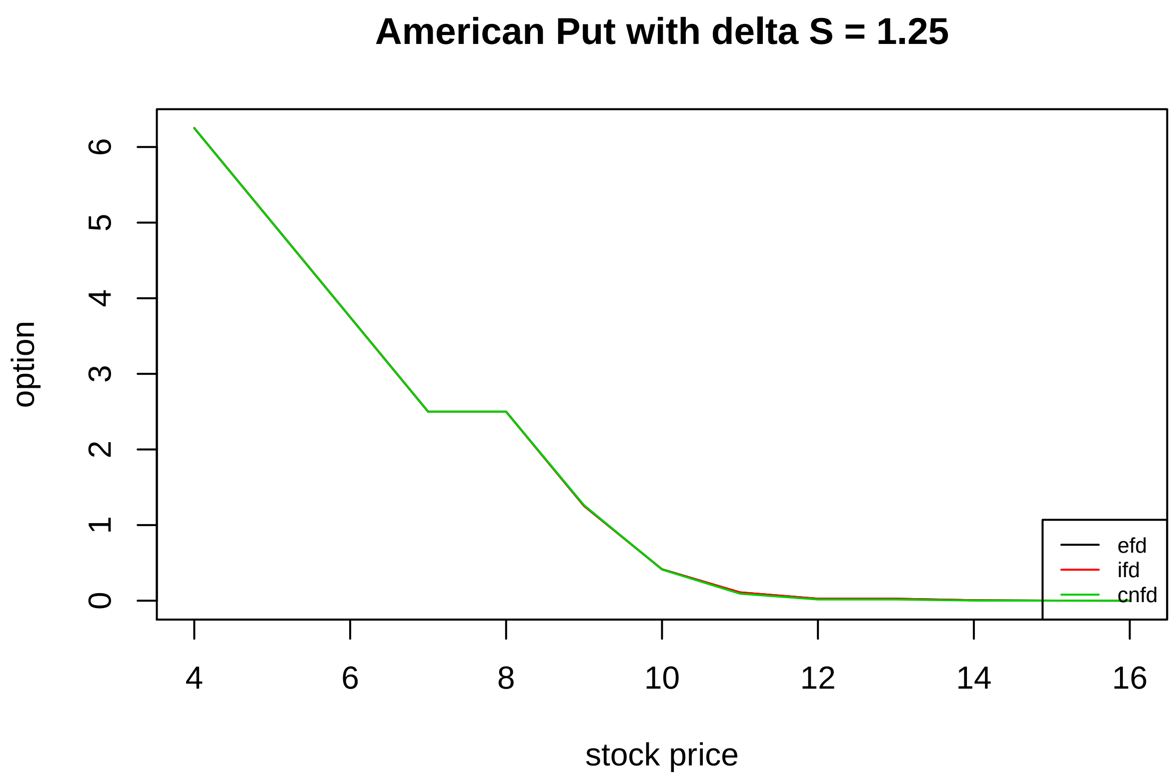

```
plot_func('problem2put_1.csv', 'American Put with delta S = 0.25')
```




```
plot_func('problem2put_4.csv', 'American Put with delta S = 1')
```




```r
plot_func('problem2put_5.csv', 'American Put with delta S = 1.25')
```



For $\Delta S = 1.25$, because we cannot get the exact point of most of stock price from \$4 to \$16 with increamental of \$1, the results are based on the rounded stock prices. Therefore, there are kinks on the lines.