Assignment 1

Option price in Matlab

Price a European Call Option with the following characteristics:

Strike price:	1 Euro
value date:	15th of February 2008
time-to-maturity (ttm):	3 month (consider a yearfrac 1/4)
volatility:	22% (per year)
ttm-zero-rate:	3%
Underlying:	equity stock
Dividend Yield:	6%
Settlement:	physical delivery
Number of contracts:	1 Mln
Underlying price	1 Euro

Questions

a. Price the option,
considering an underlying price equal to 1 Euro (i.e a derivative Notional of 1 Mln Euro):
i) via blkprice Matlab function;
ii) with a CRR tree approach;
iii) with a Monte-Carlo (MC) approach.

b. Consider M, as the number of intervals in CRR and as the number of simulations in the MC. Focus on a call. Select M according to the criteria mentioned in the class.
[Hint1: As error for the CRR consider the difference in absolute value w.r.t. to the exact value, while as error for the MC an estimation of the unbiased standard deviation of the MC price]
[Hint2: Option bid/ask for these equity options is 1bp (0.01%).]

c. Show that the numerical errors for a call rescale with M as $1/M$ for CRR and as $1/\sqrt{M}$ for MC.
[Hint3: Show, for a call, the error for CRR and MC varying M in a log-log scale.]

d. Price also a European Call Option with European barrier at €1.3 (up&in) and same parameters with the two numerical techniques (tree & MC). Does it exist a closed formula also in this case? If yes, compare the results.

e. For this barrier option, plot the Vega (possibly using both the closed formula and a numerical estimate) with the underlying price in the range 0.70 Euro and 1.5 Euro. Comment the results.

f. [Facultative]. Does antithetic variables technique (Hull 2009, Ch.19.7) reduce MC error of point b.?

g. [Faculative] Price also -with the Tree- a Bermudan option, where the holder has also the right to exercise the option at the end of every month, obtaining the stock at the strike price.

h. [Faculative] Pricing the Bermudan option, vary the dividend yield between 0% and 6% and compare with the corresponding European price. Discuss the results.

Function signatures

a. optionPrice=EuropeanOptionClosed(F0,K,B,T,sigma,flag), flag 1 call, -1 put.
b. optionPrice=EuropeanOptionMC(F0,K,B,T,sigma,N,flag)
c. optionPrice=EuropeanOptionCRR(F0,K,B,T,sigma,N,flag)
d. [M,errorCRR]=PlotErrorCRR(F0,K,B,T,sigma); M=2^m with m=1:10; (return row vectors)
e. [M,stdEstim]=PlotErrorMC(F0,K,B,T,sigma); M=2^m with m=1:20; (return row vectors)
f. optionPrice=EuropeanOptionKIMC(F0,K, KI,B,T,sigma,N)
g. optionPrice=EuropeanOptionKICRR(F0,K, KI,B,T,sigma,N)
h. gamma= VegaKI(F0,K,KI,B,T,sigma,N,flagNum), flagNum=1 CRR, flagNum=2 MC, flagNum=3 Exact.

Comment codes, use explicative variable names and divide into sections. It's IMPORTANT to use **exactly the same** signatures provided above.

Delivery Date: Friday 18:00 the 23th of February. Pay attention to the delivery address below.

Email Subject: Follow rules instructions