Derivatives Lab

Sessions 10–11

October 15–16, 2012

1. Recall that the price of a European Call option with current stock price S, strike price K, annualized volatility σ, annual risk-free interest rate r, and maturity time T is given by the Black–Scholes formula

   $$C = S\,\Phi(x) - K\,\mathrm{e}^{-rT}\,\Phi(x - \sigma\sqrt{T})\,,$$

   where

   $$x = \frac{\ln(S/K) + (r + \sigma^2/2)\,T}{\sigma\sqrt{T}}$$

   and Φ denotes the cumulative distribution function of the standard normal distribution with mean zero and variance one.

   Compare your call option prices from the binomial tree model against those computed by the Black–Scholes formula. Does the error scale like a power of N? (Plot the logarithm of the error vs. N. Do you obtain a straight line?)

2. Modify your binomial tree algorithm to price an American put option (the holder may exercise the option at any time before expiration). Is the price of an American put higher or lower than that that of a European put with otherwise identical parameters?

3. Look up stock option quotes for European call options on the stock of a major corporation. Plot the implied volatility vs. the strike price, while the time to maturity is fixed. (The applicable interest rate is the spot rate for zero coupon bonds of the same maturity.)