Financial derivative and stochastic analysis, fall 2004

TMA285 or MAM695

Home assignment II

Dead-line December 6, 1.15 pm

If more data is needed for any of the following problems, please either find it yourself, or assume something suitable, but be careful about to note what you assume, or what additional facts you are using.

1. (a) Assume that the Ericsson B stock can be modelled using a geometric Brownian motion with constant volatility σ and drift α. Use the data in the file `http://www.math.chalmers.se/Math/Grundutb/CTH/tma285/0405/EricssonB.xls` to find estimates for σ and α.

   (b) Use the Black-Scholes-Merton formula to give an expression for the value of a call option with strike price K and exercise date T (after November 18).

   (c) Compare this with the data given in the html-file: `http://www.math.chalmers.se/Math/Grundutb/CTH/tma285/0405/Ericsson B, call options.html` Any comments?

   (d) What if you use a generalized geometric Brownian motion model for the Ericsson B stock, can you plot your estimated $\alpha(t)$ and $\sigma(t)$.

   (e) Take your suggested $\alpha(t)$ from above, and assume you want to use the Vasiček's model to simulate $\alpha(t)$.

   (f) Suppose you bought 10000 call options for the right price according to the estimated $\sigma(0)$ (and $\alpha(0)$) above, at 2003-11-18 with mature date 2004-11-18 and with strike price 12 SEK. What would that price be?

   (g) Let us now hedge that call option by updating a portfolio with the stock. Plot the stock position $\Delta(t)$ using the historical data.

   (h) Do the same thing, but update only once a week. What will be the difference? Can you come up with a way to measure the efficiency of such a hedging depending on how often the portfolio is updated?

2. (a) Exercise 5.4.

   (b) Suppose that $\sigma(t)$ and $r(t) = \alpha(t)$ are non-random and given in the estimations in the above problem. Use this to estimate $c(0, S(0))$, where $t = 0$ on November 18, 2003.

You may work in pairs. Note that this assignment is not compulsory, but you can gain up to 1.5 bonus points to add to your final score.

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