

C++ Project Description February 2, 2009

A financial data graphical calculator

We mean to produce a software that displays a graphical representation of the implicit volatility and the call price in function of the strike price for a given maturity. The input are tables of calls/puts downloaded from the FT website or equivalent, as well as tables of interest rates from EURIBOR and www.boursorama.com for all maturities used.

We shall make use of the following list of modules:

1. DATA: download and parse call/put data tables.
2. INTERESTRATES: download and parse interest rates data tables.
3. SOLVER: computation of implicit volatility in function strike price and maturity, as follows.

In the Black-Scholes model the only non-observable parameter is volatility.

$$\begin{aligned} \lim_{\sigma \rightarrow 0} C^{BS}(\sigma) &= (S_t - Ke^{r(T-t)})^+ \\ \lim_{\sigma \rightarrow \infty} C^{BS}(\sigma) &= S_t \\ \frac{\partial C^{BS}}{\partial \sigma} &= S_n(D_1)\sqrt{T-t} \\ \frac{\partial^2 C^{BS}}{\partial \sigma^2} &= \frac{S_n(d_1)\sqrt{T-t}}{\sigma} \left(\frac{\log^2 m}{\sigma^2(T-t)} - \frac{\sigma^2(T-t)}{4} \right) \end{aligned}$$

where $m = \frac{S_t}{Ke^{-r(T-t)}}$ is the option moneyness. The second-order derivative shows that $C^{BS}(\sigma)$ is convex on the interval $(0, \sqrt{\frac{2|\log m|}{T-t}})$ and concave on $(\sqrt{\frac{2|\log m|}{T-t}}, \infty)$. This implies that the equation $C^{BS}(\sigma) = C$ for $S_t - Ke^{-r(T-t)} < C < S_t$ can be solved by the Newton method using the following algorithm:

$$\begin{aligned} \sigma_0 &= \sqrt{\frac{2|\log m|}{T-t}} \\ \sigma_{n+1} &= \sigma_n + \frac{C - C^{BS}(\sigma_n)}{\frac{\partial C^{BS}}{\partial \sigma}(\sigma_n)}. \end{aligned}$$

4. LINEARSOLVER: Matrix inversion code corresponding to the implicit resolution schema for the PDE (one might use LU decomposition).
5. OUTPUT: integration of output data for production of a graphical format.
6. GRAPHICAL USER INTERFACE: Input and output forms including: data acquisition choices, graphical output display, possibly 3D volatility surfaces.

→ calls a function in class' API

