Autocallable Note Analytics

Autocallable note provides periodic coupons that are linked to the performance of a basket of equities. There is a knock-out barrier level for the total coupon amount; if reached, the notional is returned and the deal is cancelled.

The instrument pays regular coupons with values up to a maximum total return. Once the accumulated value of the coupons reaches this limit, the trade is automatically cancelled and the principal returned to the holder.

The pricing model uses the quanto Monte Carlo, which incorporates the volatility skew of the underlying stocks. The risk sensitivities are calculated using the finite difference approach.

Prices and key risk sensitivities are computed using asset price paths built with the standalone Monte Carlo simulation with volatility skew, where local volatility surfaces are calibrated using local splines in log-money space.

There are two ways to build random asset price paths with the Monte Carlo simulation. The first approach is to divide the total period covered by the simulation into a series of small time steps (e.g., $\Delta t = 1$ day). A normal random variable is then drawn for each step, and a path built to the specified maturity.

However, it is not necessary to simulate a large number of small time steps if the option value depends on the underlying asset price on one particular date or a set of dates (e.g., coupon valuation dates). In such cases, paths are constructed using the methodology outlined below.

Consider an option that depends on the forward value, F, of an asset at times Tj (where $j = 0, 1, \dots, n$). Assume that the marginal distributions of F at times Tj are known, and denote the corresponding cumulative probabilities as Sj. Also assume that there is a normal process, X, with volatility. In order to proceed from *Tj* to *Tj*+1, it is necessary to first calculate $X_{j+1} = X_j + \left(\sqrt{T_{j+1} - T_j}\right)W$, where *W* is drawn from the standard normal distribution. Next, calculate the probability of the process *X* to arrive at *Xj*+1 at time *Tj*+1. This is given by

$$p = N\left(\frac{X_{j+1}}{\sqrt{T_{j+1}}}\right),$$

where *N* is the cumulative standard normal distribution. The final step is to take the appropriate marginal distribution of *F* and calculate $F_j = S_j^{-1}(p)$. If there are several correlated underliers, then both *X* and *F* are vectors.

Although the procedure is computationally more expensive *per path segment* than building paths with small time steps, far fewer steps are required. Within the Monte Carlo simulation, the generation method is selected.

Within the model, local volatility surfaces are calibrated with a Levenberg-Marquardt least-squares optimization routine that uses local splines in log-money space. A full description of the local spline approach is included in the model summary for the quanto version of the Monte Carlo engine. The Local Spline Dupire enhancement is described in a separate document that is also provided with this request.

The main risk uncertainties are the volatilities and correlations of basket components. For quanto deals, additional sources of uncertainty are the volatilities of the exchange rates and the correlations between the basket components and the exchange rates.

Reference:

https://finpricing.com/lib/EqBarrier.html