14 Valuation Under Uncertainty – Part 2

This Chapter builds on Chapters 12 and 13, and introduces "other" pricing models to illustrate techniques and constructions that include additional market and trading issues beyond the basic forecasting/valuation model developed thus far.

The approach here is to provide the formulas, but importantly in the context of a qualitative presentation. This should permit trading floor staff to make "business" decision in respect of model development and choices (rather than the ability to derive complex differential equations).

There many critically important aspects to such a development, three of which are:

- Remember that the models must suit your business mandate, and that is considerably more than simply deriving some basic stochastic calculus. [1] provides a detailed introduction to these matters.
- Most valuation models are expressed in or derived in terms of price of returns, but remember that there is delivery to be made, and at the end of the day, it is risk-adjusted holding period P&L that is important.
- Often a simple model, with cleverly chosen inputs or usage, can be a more practical real world solution than a fancy mathematically development.
- Always "prove it" by assessing the viability of the valuation model in a manner appropriate for your business (e.g. PaR, trade history audit, etc).

With these boundaries in mind, this Chapter introduces several model and constructions that incorporate selected real world issues not supported by the basic model. The key areas reviewed here:

- Arithmetic vs. Geometric representation.
- Mean reverting and "variable variance" representation.
- Stochastic volatility.
- Multi-dimensional/multi-factor representation for correlated and structured products:
    - Spread options
    - Convertible bonds
- Term-structure methods and selected models.
- Consideration of non-Gaussian models and generalised distributions.

For the most part, these models will be presented as derived in a risk-neutral Gaussian/Root2 framework.

The model developments in this Chapter all aim to alter the shape of uncertainty and the manner in which it evolves over time. Notably, the vast majority of methods seen here accomplish this not by altering the uncertainty component of the model, but rather via the drift term.

This may seem counterintuitive at first, but this approach has the very considerable advantage of preserving the Brownian/Root2 core of the uncertainty term, and so it is amenable to Ito calculus.

Importantly, these "drift" adjustments are still within a risk neutral framework and so still rely on a risk free rate of drift (on-average).

Methods that attempt to incorporate drift adjustment for the "proper" reason of inducing some market related (risky) drifts are deferred to later Chapters, such as 15.

Finally, from a purely practical point, though these models are presented in the context of trading and risk management of securities and derivatives, much of the mathematics has been already developed in other fields (notably physics and communications). As such, if you are in need some new model or alteration, it may "pay" to review the literature in other fields and possibly avoid "re-inventing the wheel".