

Option Pricing with Hull White Model

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1 Hull White Model

The Hull-White model is a model of future interest rates. It belongs to the class of no-arbitrage models that can fit today's term structure of interest rates. The short-rate model has the following dynamics:

$$dr(t) = [\theta(t) - \alpha(t)r(t)]dt + \sigma(t)dW(t), \text{ where } r \text{ is the interest rates}$$

2 Geometric Brownian Motion

A geometric Brownian motion (GBM) is a continuous-time stochastic process in which the logarithm of the randomly varying quantity follows a Brownian motion with drift. A stochastic process S_t is said to follow a GBM if it satisfies the following stochastic differential equation (SDE):

$$dS_t = (\mu S_t)dt + (\sigma S_t)dW_t$$

where μ is the percentage drift, and σ is the percentage volatility. Since W_t is a Wiener process or Brownian motion which follows Gaussian process with mean 0, variance t and covariance $\min(s, t)$, we can derive

$$\ln S_t \sim N\left(\ln S_0 + \left(\mu - \frac{\sigma^2}{2}\right)t, \sigma^2 t\right)$$

3 Reference

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Geometric Brownian Motion