

## fd\_gauss\_cir1d\_zcbond

Input parameters:

- Space StepNumber  $N$
- Time StepNumber  $M$

Output parameters:

- Price

The stochastic differential equation representing the short rate is given by

$$dr_t = k(\theta - r_t)dt + \sigma \sqrt{r_t}dW(t)$$

The price of the zero-coupon bond is solution of the following PDE

$$u_t + \frac{1}{2}\sigma^2 r u_{rr} + [k(\theta - r)]u_r - ru = 0, u(r, T, T) = 1$$

that we solve using standard Crank-Nicholson scheme. We apply boundary condition at  $r = 0$  solving

$$u_t + [k(\theta)]u_r = 0$$

using a one-sided finite difference scheme. The price of the coupon bearing is obtained as linear combination of zero-coupon prices, taking in account properly of the coupon adjustment. A swaption can also be seen as an option of strike 1 over a certain coupon bearing.