

Finance Quantitative

Pricing Vanna-Volga

Le groupe de travail

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The purpose of this problem set is to explore the Vanna-Volga pricing model.

Getting started

- Using the Rmetrics library (fOptions), verify that you know how to compute the price and the “greeks” of a vanilla option.
- Identify or write a robust function to compute the implied volatility, given the price of a vanilla option.

Questions

Volatility Interpolation

Given the implied volatility at three strikes, we will use the Vanna-Volga pricing method to interpolate the volatility curve. Assume $r = 0, b = 0, T = 1, \text{Spot} = 100$. The Black-Scholes volatility for three strikes is given below.

Strike	80.00	100.0	120.000
Volatility	0.32	0.3	0.315

1. Write utility functions to compute the risk indicators Vega, Vanna and Volga, all by finite difference.
2. Compute vectors of vega, vanna, volga for the three benchmark instruments
3. Choose a new strike for which you want to compute the implied volatility.
4. Compute the risk indicators for a call option struck at that strike.
5. Compute the Vanna-Volga price adjustment and the corresponding implied volatility.
6. Wrap the above logic in a function in order to interpolate/extrapolate the volatility curve from $K = 70$ to $K = 130$. Draw a plot of the interpolated volatility curve.

Pricing a digital call

Recall that a digital call with strike K pays one euro if $S_T \geq K$, and nothing otherwise.

Using the same logic as in the previous question, price a digital call, maturity $T = 1$, struck at $K = 105$.