QF 2023/2024 June exam

June 3, 2023

1 Profit and Loss

Let's suppose we have a put option with strike $\kappa = 1.03$ and maturity $T = 1.13$ on a stock with $S(t_o) = 1.0$. Markets have decided to evolve $S(t)$ according to the XX model (XX will be specified later).

Exercise 1.1. *Compute, according to the XX model, today's value of the option:*

$$\Pi(0) = P(0,T)\mathbb{E}\left[(\kappa - S(T))^+\right] \tag{1}$$

We are fully unaware that markets follow the XX model, so we believe in the Black-Scholes model with a volatility σ obtained as implied volatility from eq.(1) We want to gain some insight on how risky is our portfolio and we decide to study the distribution of prices six months from now $t_m = 6$ months.

Exercise 1.2. *For each RV $S^j(t_m)$ (j labels the different trajectories generated by the XX model) we can compute (using BS and the derived volatility) the price of the option conditional on the trajectory, that is:*

$$\Pi^j(t_m) = P(t_m,T)\mathbb{E}\left[(\kappa - S^j(T))^+|\mathcal{F}_{t_m}\right]$$

The quantity:

$$\mathcal{V}^j \stackrel{def}{=} \Pi(0) - P(0,t_m)\Pi^j(t_m),$$

is a random variables that describes profit and/or loss occurred if the realized scenario were S^j. Build the histogram for the RV $\mathcal{V}$ and compute the VAR at 10%, 5% and 1%.

The discount curve is deterministic, use a constant interest rate of 1%.

Exercise 1.3.

solve the two exercises above with XX = Heston using parameters given in table 1

solve the two exercises above with XX = VG using the parameters given in table 2.

parameter	**value**
λ	7.7648,
$\overline{\nu}$	0.0601,
η	2.017,
ν_0	0.0475,
ρ	-0.6952

Table 1: Table of parameters for the Heston model

parameter	**value**
η	0.1494
ν	0.0626
θ	-0.6635

Table 2: Table of parameters for the VG model for the stochastic time diffusion parametrsation