MMF 1928 / STA 2503 – Project 2 Delta-Gamma Hedging

In this project you will investigate hedging in discrete time within the Black-Scholes model.

You are to assume that an asset $S = (S_t)_{t \geq 0}$ follows the Black-Scholes model with $S_0 = 100$, $\sigma = 20\%$, $\mu = 10\%$ and the risk-free rate is constant at 2%.

You have just sold an at-the-money $\frac{1}{4}$ year put written on this asset and you wish to hedge it. Assume that, if needed, you may also trade in a call option (on the same asset) struck at $K = 100$ (maturity $\frac{1}{2}$ year), the stock, and the bank account. As well, you will account for transaction costs by assuming you are charged 0.005\$ on every one unit of equity traded, and 0.01\$ on every unit of options traded.

[NOTE: the call that you trade when Gamma hedging has a FIXED maturity date, but that implies its time to maturity keeps reducing as time flows forward – just like the put that you sold.]

1. Compare the move-based with the time-based delta hedging strategy. For the move-based hedge assume a band of 0.1 around your current delta position and place edge bands of 0.01 and 0.99 below/above which you do not alter your hedge position. Also, determine the price that you should charge using time- and move- based hedging so that the conditional value-at-risk at level 0.90 is no larger than 0.02.
2. Compare the move-based with the time-based hedging strategy with delta and gamma hedging.
3. Using at least three different bands (in addition to 0.1) show the role that the rebalancing-band plays on the delta hedge.

Comment on any observations.