Crank-Nicolson method for vanilla TRS

I – Fully implicit method/CK method

Contrary to previously highlighted explicit method, implicit method discretization leads to following formulas for TRS:

$$\frac{\partial TRS}{\partial t} + (r - C_{yield})S - rTRS = 0$$
$$\xRightarrow[discrete]{} \frac{TRS_{t+1}^k - TRS_t^k}{\delta t} + (r - C_{yield})S^k - rTRS_{t+1}^k = 0$$

But contrary to option's equation and due to delta one characteristics, the target discretization is highly simplified without the usual linear equations system solver:

$$TRS_{t+1}^k = \frac{\delta t(r - C_{yield})}{1 + r\delta t} S^k + \frac{1}{1 + r\delta t} TRS_t^k$$

Then this methodology in vanilla TRS context can be seen as an "exercise" or POC, in order to show that algorithm/methodology also works for TRS.

Still du to simplified formula and hence simplified discretization, fully implicit and Crank-Nicolson method are equal.

II – Program of study – numerical results

- The model will be developed through python and C++ through finite difference method using CK scheme.
- Output value should be like explicit scheme.