**Black Scholes PDE**

We have delta hedged portfolio (P) of 2 positions:

* short position in one Option (V)
* and long position in shares

We can notice that term has cancelled which means that stochastic term is removed (uncertainty is removed) only deterministic terms remains. Therefore, the portfolio must yield return to other riskless instruments, otherwise there will be an arbitrage opportunity. Therefore:

We have Black Scholes PDE:

**Finite Difference Scheme**

**Forward Difference**

* For time derivative
* For first spot derivative use central difference
* For second spot derivative use

Moreover

* dS = ∆S
* dt = ∆t
* M∆S = S\_max
* N∆t = T
* V(i,j) denotes V(i∆t, j∆S)

BS PDE

**Boundary Conditions**

V(n,j) = max(j∆S – K ,0)

V(i,0) = 0

V(i,M) = S\_max - Ke^(-r\*(i∆t))

**Solution**

To solve, you can start solving for the uknowns backward in time (starting from maturity time T), since the boundary conditions are known for V(n,j) = max(j∆S – K ,0)

You can do as loop, or in matrix form

Backward Difference