$$h_2(\tilde{\gamma}) = min(1, \tilde{A}) \tag{15}$$

Then the jump condition can be defined as

$$\phi(t, \tilde{A}, \tilde{\gamma}) = \max_{\tilde{\gamma}}(h_1(\tilde{\gamma})\phi(t, h_2(\tilde{A}, \tilde{\gamma})) + \tilde{\gamma}) \tag{16}$$

We now have all the parts necessary to solve for the optimal withdrawal strategy of the GMIB VA product. Replacing the appropriate sections described in 3.1 - 3.3 using the new equations and constants will lead to the solution of the GMIB VA.

# 4. Results

The main goal of this project was to successfully apply a PINN to pricing American options and GMIB VAs, and to hopefully demonstrate a non-negligible improvement of PINNs over typical benchmark methods. Though we weren't able to outperform the FDMs, we were able to demonstrate the use of PINNs in the finance and insurance industries. We chose to pick two American options with differing parameters, as well as two GMIB VAs to showcase the performance of our models.

We utilized a Crank-Nicolson discretization scheme for solving for the American option premium as described in [4] to act as our benchmark method. The solution of an American Put with strike price \$70, 2 years to expiration, underlying stock volatility of 50%, underlying stock spot price of \$72, risk-free interest rate of 3%, and dividend yield of 1% can be plotted as shown

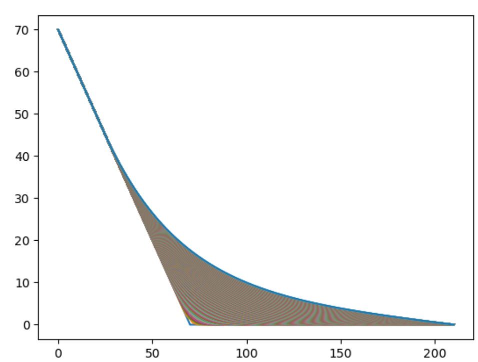


Figure 1: American Put FDM Solution in 2D

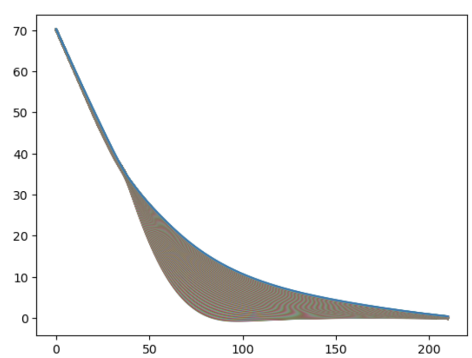


Figure 2: American Put PINN Solution in 2D