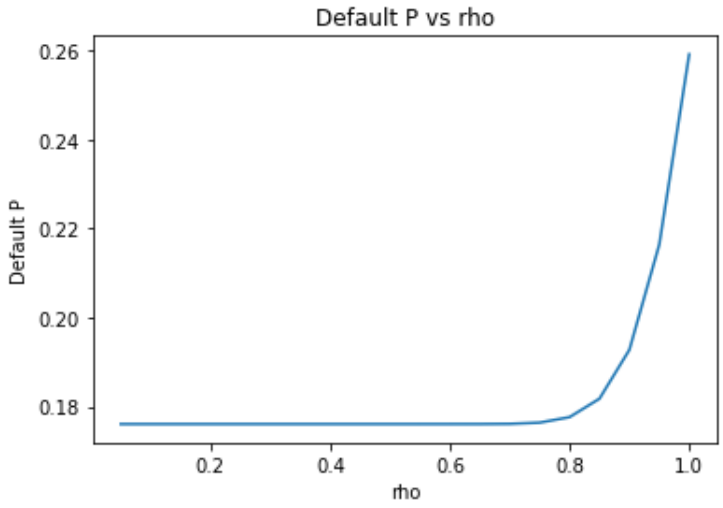
Due on Oct 21

Problem 1
Black Cox model: constant default threshold

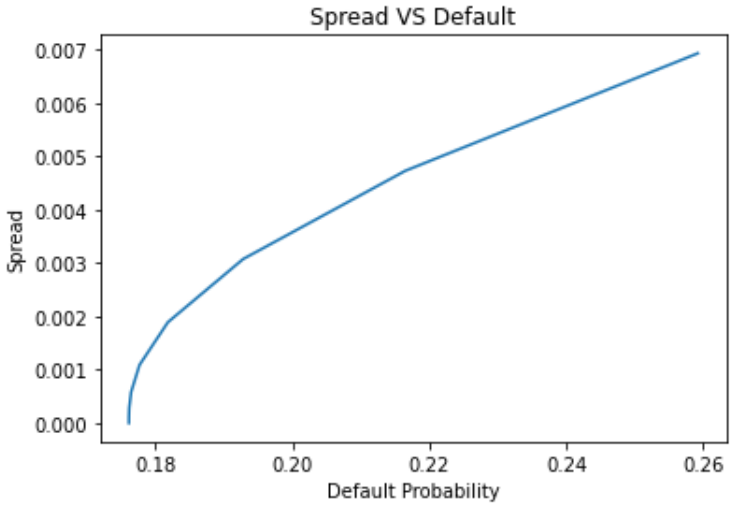
- The asset value of the company V0 = 12.5 million USD.
- The volatility of the asset value $\sigma_V = 20\%$.
- The principal of the debt $D = 10$ million USD and has maturity $T = 2$ years.
- The risk free rate is $r = 4\%$.
- The safety covenant (default threshold), $K_1 \leq De^{-rT}$ is constant.
- Let $\rho = \frac{K_1}{De^{-rT}}$, $0 < \rho \leq 1$. Consider $\rho = 0.05, 0.1, 0.15, \ldots 1$.

Work on the following questions:
a) For each ρ calculate:
- The default probability and plot it as a function of ρ
- The credit spread s of the debt value (use definition from Merton model)
b) Plot credit spread as a function of default probability
c) Set up the the asset prices scenarios by Monte Carlo. Consider $\rho = 0.9$ and $\rho = 0.0001$ .Verify the analytical values for default probability by Monte Carlo simulations.

Solution: $\{a\}$



The spread s is about **0.012**.
$\{(b)\}$



(c) I used N = 10000 to simulate, the simulated result for $\rho = 0.9$ is about **0.19** and the analytical solution is **0.19277864766609543**.
Similarly, he simulated result for $\rho = 0.0001$ is about **0.18** and the analytical solution is **0.1760941859222841**.
The formula for the analytical solution is as following: