Homework 5: Solving for asset volatility

Credit Risk (MF772) Fall 2021 Instructor: Roza Galeeva

Due date: Oct 14 , 2021 8am. Please, note that `late assignments will not be accepted.`

Problem 1

Problem 1
Solving nonlinear equations for asset volatility. Let debt (per share) $D = 97$, stock price is $S = 45.52$, time horizon $T = 1$ (year), equity volatility $\sigma_S = 50.722\%$, and yearly interest rate $r = 4\%$ Find the asset value V_0 and asset volatility σ_V so that the error in calculated equity value and equity volatility based on the solutions are within 10^{-4} error.

Problem 2
Iterative process to find the asset volatility (hypothetical example). Use stock data in the attached spreadsheet. Assume the following:

1. The maturity of the debt is March 2 2023
2. Assume interest $r = 0$
3. The debt value per share stays constant $D = 100$.

Find the asset volatility σ_V using iterative process:

- Start with initial guess σ_0 . For example use the volatility of log returns of the stock.
- Solve nonlinear equations for the asset values (each day)
- Calculate asset volatility σ_1 of log returns using the asset values
- Continue the process until the difference between σ_n and σ_{n-1} is less than 0.0001.
- Using the last calculated asset values and the asset vol σ_n , for each day calculate the distance to default

$$DD_n = \frac{V_n - D}{V_n \sigma_V}.$$

Note In calculating log returns R_i , you can take into account the time difference between the observations.

$$R_n = \frac{\ln \frac{V_n}{V_{n-1}}}{\sqrt{t_n - t_{n-1}}}$$

Then to annualize daily vol, you should use the factor $\sqrt{365}$. If you don't apply the time adjustment (just take log-returns), then to annualize daily vol, you need to use $\sqrt{252}$.