

Homework 4: Merton Model

Credit Risk (MF772) Fall 2020

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Due date: Oct 9 , 2020 before the class. Please, note that late assignments will not be accepted.

Problem 1

Finish the problem we started in class (with one additional question)

- (a) The initial value of assets $V_0 = 120$ MM, yearly asset volatility $\sigma_V = 0.25$, maturity $T = 4$ years, interest rate $r = 0.05$
- (b) Let the debt $D=40, 100, 180$ MM.

For each debt value calculate

1. The credit spread s
2. The probability of default at time T .
3. What is the value of the debt for which credit spread $s = 0.04$?

Problem 2

Fix $\sigma_V = 0.3$, $r = 0.05$ (per year). Let $T = 1, 2, 3, \dots, 100$ years. Consider the following 4 cases:

$$\frac{D}{V_0} = 0.5, 1, 1.5$$

1. For each choice of $\frac{D}{V_0}$ plot credit spreads s versus time to maturity T
2. Summarize your observations.

Problem 3

Fix $\sigma_V = 0.3$, $r = 0.05$ (per year). Let $T = 2$ years. Let

$$\frac{D}{V_0} = 1$$

Calculate the probability that the recovery in case of default is more than 50% (conditioned on default). Use the fact that the value of the assets at maturity T is lognormally distributed.

Problem 4, optional

Rewrite the formula for credit spread s (slide 14) in terms of σ_V , T and leverage L . Calculate analytically (in general case) the derivative of the credit spread s w.r.t to the leverage L .

$$\frac{\partial s}{\partial L}$$

Confirm with the behavior of credit spread in problem 2 . Check numerically (by finite difference) the derived formula for particular cases.