

MFE409; Risk HW8

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Problem 1:

Please read in details the paper "Risk Management Lessons from Long-Term Capital Mangement" by Philippe Jorion (on BruinLearn Module 10). Write short essays answering the following questions:

1. What was the broad trading strategy of LTCM?
 - LTCM was trading a highly leveraged, risky arbitrage strategy in fixed-income securities. LTCM aimed to exploit pricing discrepancies between related securities, believing those will converge over time. Their strategies included convergence trades, relative value, and statistical arbitrages.
2. Why did they need so much leverage?
 - Since they were trading small discrepancies, they used leverage to amplify returns.
3. How did their demise happen?
 - Demise was triggered by a series of events in 1998, more specifically, the Russian debt default and the subsequent market turmoil. Those events led to a severe widening of spreads and increased volatility resulting on substantial losses on LTCM's position. High leverage exacerbated these losses and capital vanished. Markets continued to move against LTCM, and they faced a liquidity crisis, unable to meet margin calls. This led to a bailout by the Fed.
4. What were the most important issues with their risk management approach?
 - The main issue was the underestimation of Risk; LTCM underestimated the likelihood of extreme market events. Another issue was model dependence, the model LTCM used heavily related on quantitative models that assumed normal market conditions. Finally, LTCM had lots of concentration Risk and did not adequately test their portfolio. Despite appearing diversified, they had exposure to correlated risks across different markets and had overconfidence in their strategy's resilience.
5. How would you manage risk for a fund trying to trade similar strategies?
 - The main concern will, of course, be restrained leverage, although it does amplify returns in case of a black swan event; you drown faster. Other 'legs of the table' would be diversification, better stress-testing and risk-models.

Problem 2.

A company's equity is 4 billion and the volatility of equity is 60percent. The face value of debt is 15 billion, and the time to debt maturity is 3 years. The risk-free rate is 5.5%.

1. What is the distance to default?
2. What is the default probability?
3. What is the expected recovery rate on the debt?

Make sure to show and explain all steps.

```
In [1]: import numpy as np
        from scipy.stats import norm
        from scipy.optimize import fsolve
```

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In [4]: equity = 4
        sigma = 0.60
        D = 15
        T = 3
        r = 0.055

        def equations(vars):
            V, sigma_V = vars
            d1 = (np.log(V / D) + (r + 0.5 * sigma_V**2) * T) / (sigma_V * np.sqrt(T))
            d2 = d1 - sigma_V * np.sqrt(T)
            eq1 = equity - (V * norm.cdf(d1) - D * np.exp(-r * T) * norm.cdf(d2))
            eq2 = sigma - (V / equity) * sigma_V * norm.cdf(d1)
            return [eq1, eq2]

        initial_guess = [D, sigma]
        V, sigma_V = fsolve(equations, initial_guess)

        d1 = (np.log(V / D) + (r + 0.5 * sigma_V**2) * T) / (sigma_V * np.sqrt(T))
        d2 = d1 - sigma_V * np.sqrt(T)

        DD = d1
        PD = norm.cdf(-d2)
        expected_recovery_rate = (1 - PD) * 100
        print(f"Distance to Default: {DD}")
        print(f"Default Probability: {PD * 100:.2f}%")
        print(f"Expected Recovery Rate on the Debt: {expected_recovery_rate:.2f}%")
```

Distance to Default: 0.9161407807711276
 Default Probability: 27.35%
 Expected Recovery Rate on the Debt: 72.65%