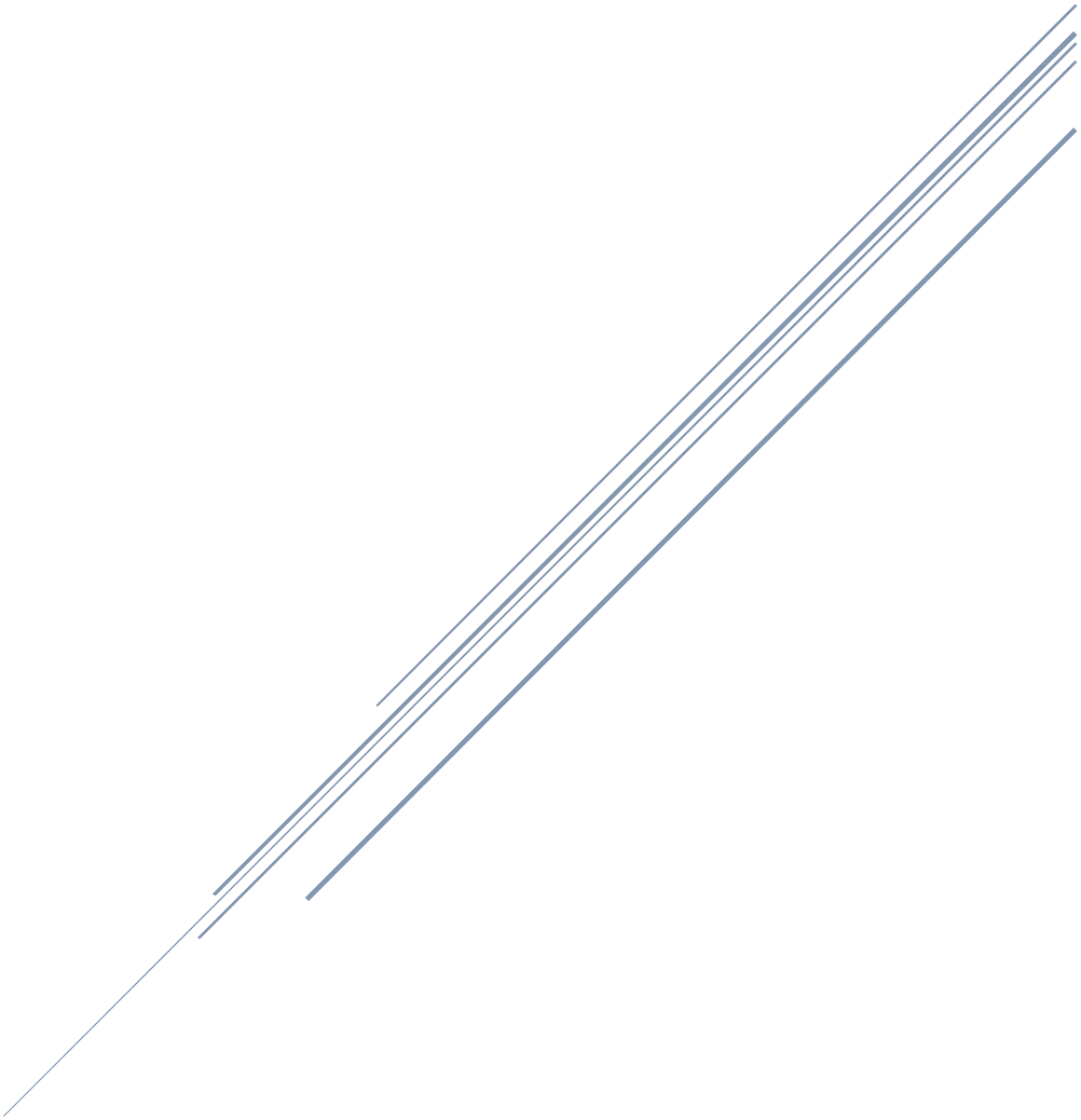
MIE 1622H-S ASSINMENT 3 REPORT



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Contents

1. Problem Description

Generate 3 sets of simulation for 100 counterparties with 50 credit drivers:

Use two different portfolios: 1. Equal value and 2. Equal unit of stock. Also compute Normal distribution for 3 sets of simulation. Compute VaR and CVaR at 99% and 99.9% for the two portfolios

- Monte Carlo 1: N = 1000 * 5 in sample scenario, non-Normal distribution
- Monte Carlo 2: N = 5000 * 1 in sample scenario, non-Normal distribution
- True Distribution N = 100000 * 1 out of sample scenario, non-normal distribution

2. Methods

2.1 Program

The following table shows the MATLAB program used for this assignment:

Function name	Purpose
Credit_risk_simul.m	Main program

Table 1: MATLAB Program List

3. Results

3.1 VaR and CVaR

The following results are produced after running MATLAB program.

Portfolio 1:

Out-of-sample: VaR 99.0% = $86870168.96, CVaR 99.0% = $124934216.42

In-sample MC1: VaR 99.0% = $86793472.45, CVaR 99.0% = $128048760.88

In-sample MC2: VaR 99.0% = $87154751.02, CVaR 99.0% = $127799452.12

In-sample No: VaR 99.0% = $47540736.32, CVaR 99.0% = $53540717.49

In-sample N1: VaR 99.0% = $48152102.77, CVaR 99.0% = $54240798.55

In-sample N2: VaR 99.0% = $48160012.00, CVaR 99.0% = $54249064.54

Out-of-sample: VaR 99.9% = $178413009.80, CVaR 99.9% = $218195921.21

In-sample MC1: VaR 99.9% = $182485942.88, CVaR 99.9% = $223119048.34

In-sample MC2: VaR 99.9% = $183034384.96, CVaR 99.9% = $223574594.53

In-sample No: VaR 99.9% = $61066104.84, CVaR 99.9% = $65968159.68

In-sample N1: VaR 99.9% = $61877454.86, CVaR 99.9% = $66851990.57

In-sample N2: VaR 99.9% = $61886168.33, CVaR 99.9% = $66860995.53

Portfolio 2:

Out-of-sample: VaR 99.0% = $76295831.77, CVaR 99.0% = $117027493.32

In-sample MC1: VaR 99.0% = $77388130.33, CVaR 99.0% = $120399393.35

In-sample MC2: VaR 99.0% = $77174816.63, CVaR 99.0% = $120112593.65

In-sample No: VaR 99.0% = $43670067.58, CVaR 99.0% = $49128039.58

In-sample N1: VaR 99.0% = $44461140.86, CVaR 99.0% = $50029443.41

In-sample N2: VaR 99.0% = $44420531.86, CVaR 99.0% = $49982951.82

Out-of-sample: VaR 99.9% = $176707759.02, CVaR 99.9% = $216208819.73

In-sample MC1: VaR 99.9% = $179598175.42, CVaR 99.9% = $221975838.63

In-sample MC2: VaR 99.9% = $180743878.90, CVaR 99.9% = $221215666.01

In-sample No: VaR 99.9% = $55973619.97, CVaR 99.9% = $60432846.97

In-sample N1: VaR 99.9% = $57013404.24, CVaR 99.9% = $61562772.59

In-sample N2: VaR 99.9% = $56959534.50, CVaR 99.9% = $61504096.70

The following figure shows the in portfolio 1 out of sample 99%VaR vs in sample 99%VaR.

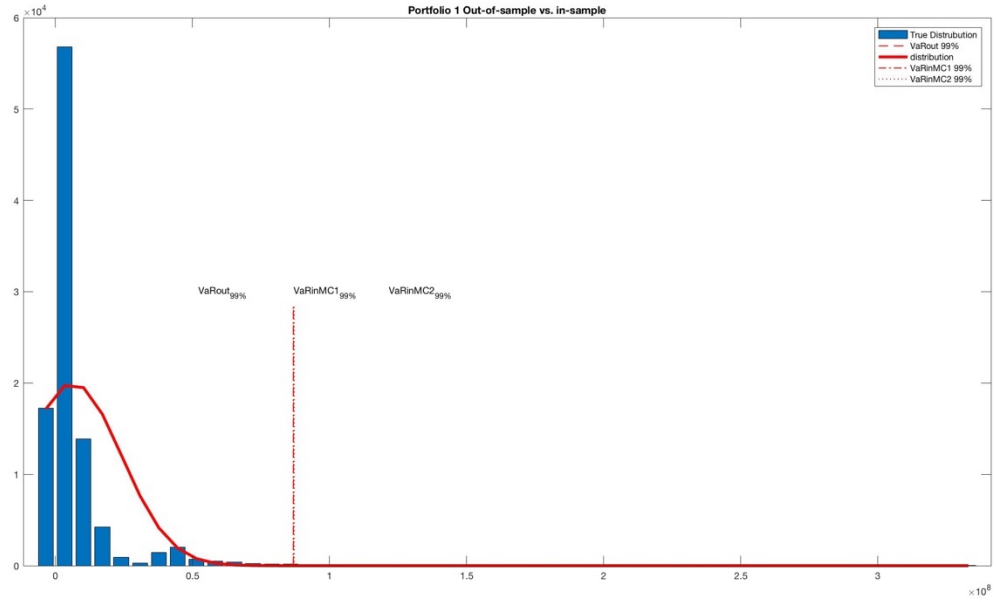

Figure 1: Portfolio 1 out of sample 99%VaR vs in sample 99%VaR.

The following figure shows the in portfolio 2 true distribution 99%VaR vs in sample 99%VaR.

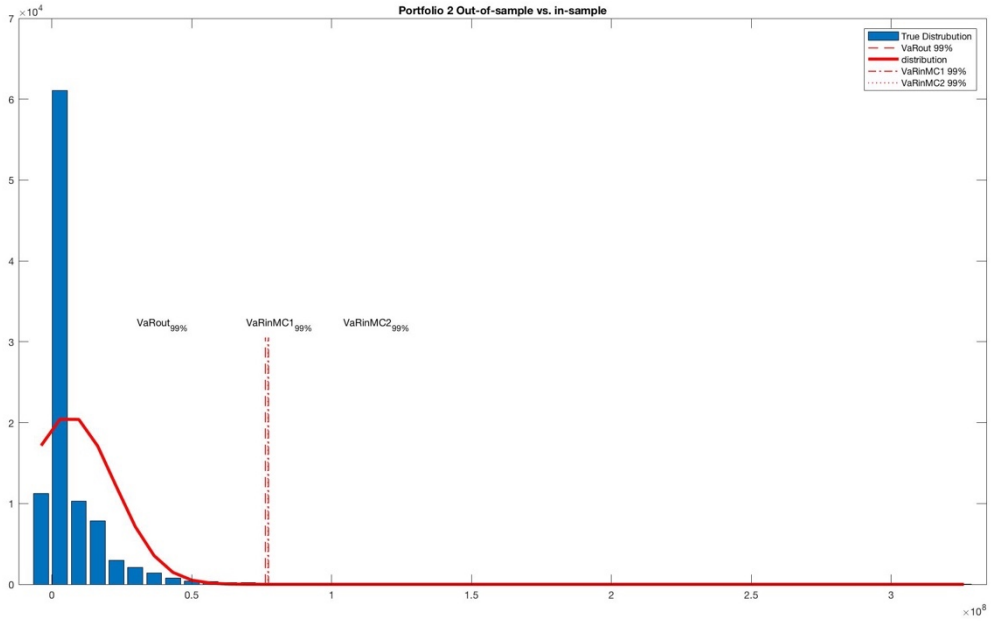

Figure 2: Portfolio 2 out of sample 99%VaR vs in sample 99%VaR.

The following figure shows the in portfolio 1 true distribution 99%VaR vs Normal distribution 99%VaR.

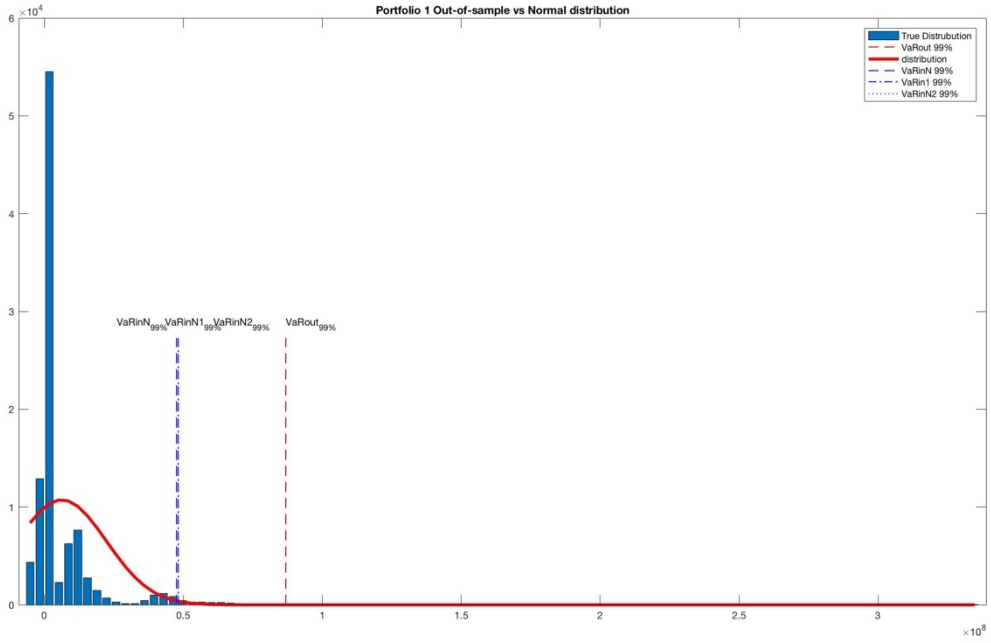

Figure 3: Portfolio 1 true distribution 99%VaR vs Normal distribution 99%VaR

The following figure shows the in portfolio 1 true distribution 99%VaR vs Normal distribution 99%VaR.

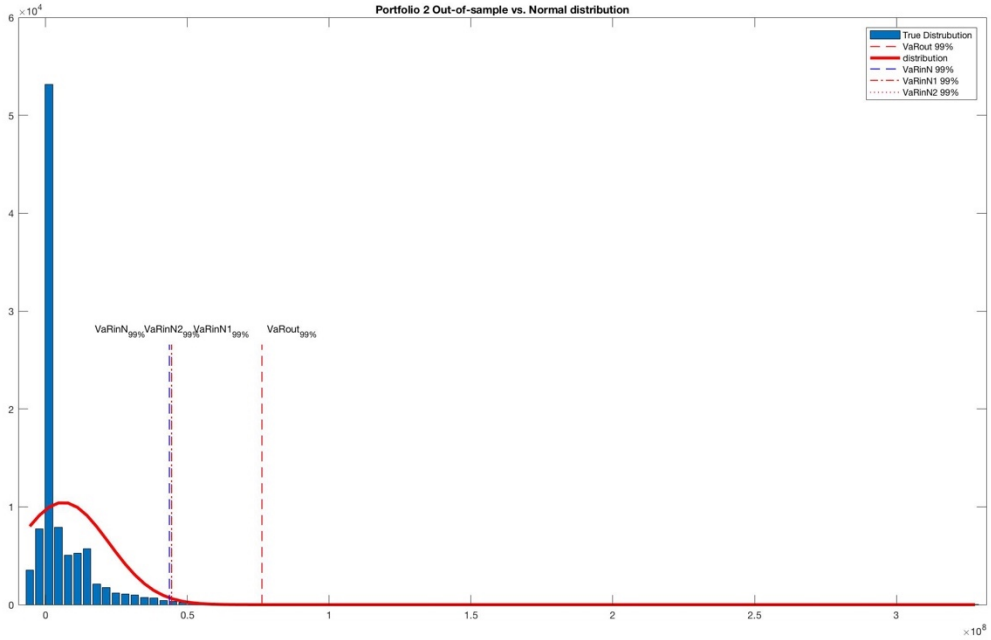

Figure 4: Portfolio 2 true distribution 99%VaR vs Normal distribution 99%VaR.

3.2 Result Analysis

3.2.1 Out of Sample vs. In Sample

For VaR 99% of both portfolio, according to figure 1 ,2, and the result printed out, the Monte Carlo simulation (in sample results) are actually larger than the true distribution (out of sample) result. Between the two in sample results, N = 5000 scenario produces larger VaR 99% value than N = 1000 * 5 scenario, making it further away from the correct value. The same thing happens to Portfolio 2.

3.2.2 Out of Sample vs. Normal distribution

For VaR 99% of both portfolio, according to figure 3 ,4 and the result printed out, all the normal approximations seems to undermine the 99% VaR loss. The true 99%VaR value is significantly larger than the normal approximation values.

3.2.2 VaR and CVaR Comparison, Effect of Sampling Error and Model Error

If we look at all the VaR and CVaR of the in-sample results and compare them to those of out of sample results, we can see that in sample results always over predict the 99% VaR loss. This further implies sampling error will over predict the loss.

If we look at VaR and CVaR of Normal distribution results against those of out of sample results, we can tell that Normal distribution always underestimates the 99% VaR loss. This further implies that the model error will underestimate the loss.

4. Discussion

4.1 Reporting In-sample VaR and CVaR

The results and plots from the MATLAB codes from Section 3 has told us that the in-sample VaR and CVaR will over predict the loss, therefore result in over predicting the capital requirements of the bank. The bank will have more money put into the capital requirement than the law requires. This will result the bank missing the potential profit it can generate from the over-predicted amount of money.

4.2 Minimizing Sampling and Modeling error

To minimize modeling error, we can

- Use historical data
- Obtain model from historical data
- Run multiple models to avoid bias of a single model

To minimize sampling error, we can

- Increase the simulation size
- Generate multiple simulation for the same portfolio and then take average of the multiple simulations
- Use different methods to generate random number in the simulation