MIE1622 Computation Finance and Risk Analysis Assignment 3

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Problem Background

A corporate bond is issued by a business to raise their own finances, and each bond is paid off at a pre-established time which may have several investment periods. Depending on the credit state of the corporation, the bond may be defaulted, may be paid for a less then pre-determined amount (loss), if the company's credit state falls or may be paid more than the pre-determined amount (profit), if the company's credit state rises. The objective of this assignment is to simulate 3 different scenarios on 2 different portfolios and evaluate the results based on the portfolios risk, namely VaR and CVaR.

Results

Portfolio 1

Out-of-sample: VaR 99.0% = $44904949.20, CVaR 99.0% = $52008645.34
In-sample MC1: VaR 99.0% = $38351426.79, CVaR 99.0% = $46104531.97
In-sample MC2: VaR 99.0% = $30268490.07, CVaR 99.0% = $37346148.13
In-sample No: VaR 99.0% = $31987394.56, CVaR 99.0% = $52556137.94
In-sample N1: VaR 99.0% = $15127887.61, CVaR 99.0% = $29739232.51
In-sample N2: VaR 99.0% = $13915697.82, CVaR 99.0% = $25530779.56

Out-of-sample: VaR 99.9% = $61026020.72, CVaR 99.9% = $66675900.23
In-sample MC1: VaR 99.9% = $55505933.75, CVaR 99.9% = $63148724.88
In-sample MC2: VaR 99.9% = $46275020.32, CVaR 99.9% = $52714345.88
In-sample No: VaR 99.9% = $31987395.32, CVaR 99.9% = $61225716.81
In-sample N1: VaR 99.9% = $15127888.38, CVaR 99.9% = $35897810.63
In-sample N2: VaR 99.9% = $13915698.58, CVaR 99.9% = $30426454.23

Portfolio 2

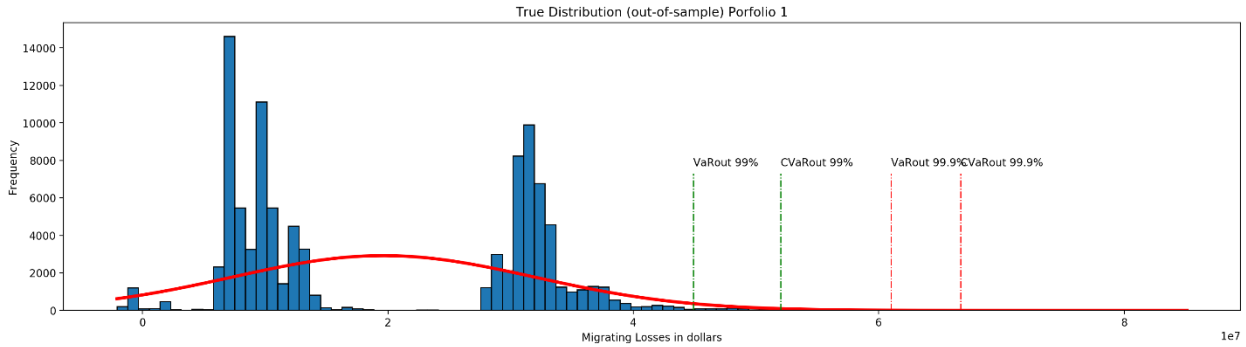
Out-of-sample: VaR 99.0% = $26778360.58, CVaR 99.0% = $31678284.35
In-sample MC1: VaR 99.0% = $27666961.72, CVaR 99.0% = $33615761.37
In-sample MC2: VaR 99.0% = $25854898.45, CVaR 99.0% = $31424929.46
In-sample No: VaR 99.0% = $15979966.45, CVaR 99.0% = $25870833.66
In-sample N1: VaR 99.0% = $12717926.28, CVaR 99.0% = $23525907.11
In-sample N2: VaR 99.0% = $12395604.95, CVaR 99.0% = $22050569.54

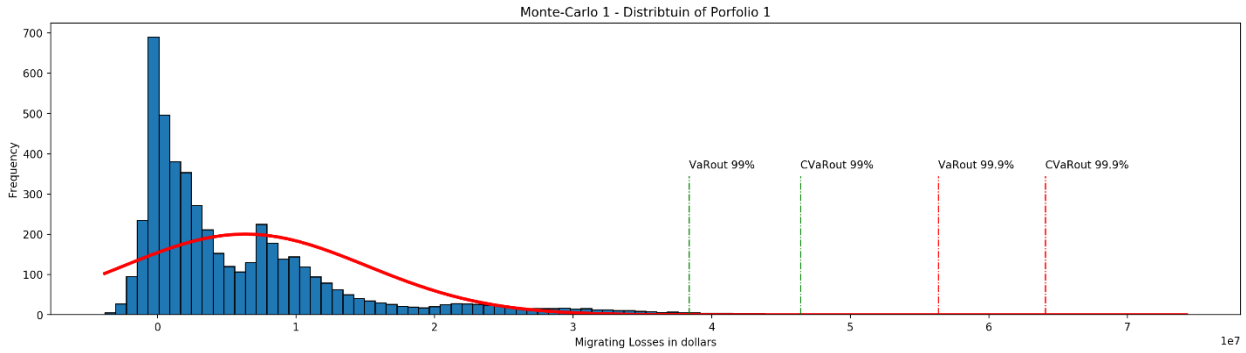
Out-of-sample: VaR 99.9% = $38457165.01, CVaR 99.9% = $44261649.93
In-sample MC1: VaR 99.9% = $40973060.43, CVaR 99.9% = $47118621.70
In-sample MC2: VaR 99.9% = $38262959.22, CVaR 99.9% = $43615435.98
In-sample No: VaR 99.9% = $15979967.22, CVaR 99.9% = $30039764.26

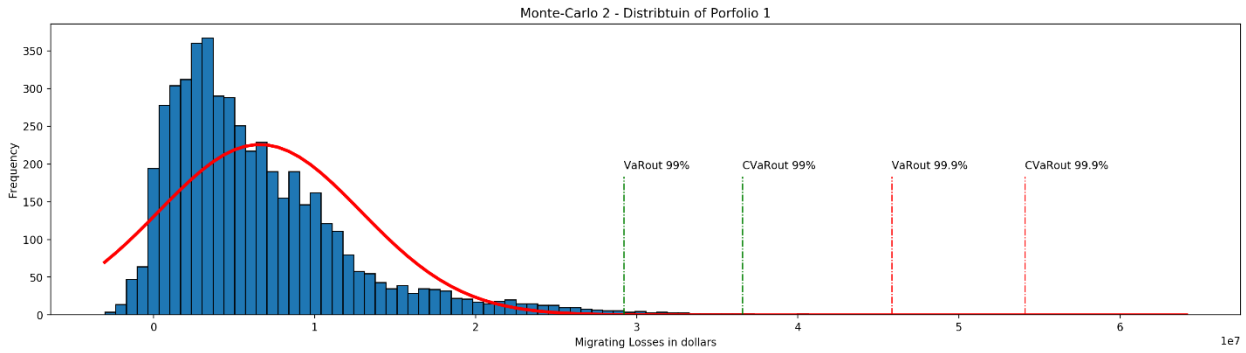
In-sample N1: VaR 99.9% = $12717927.04, CVaR 99.9% = $28081394.53
In-sample N2: VaR 99.9% = $12395605.72, CVaR 99.9% = $26120068.88

Visualizing the Results

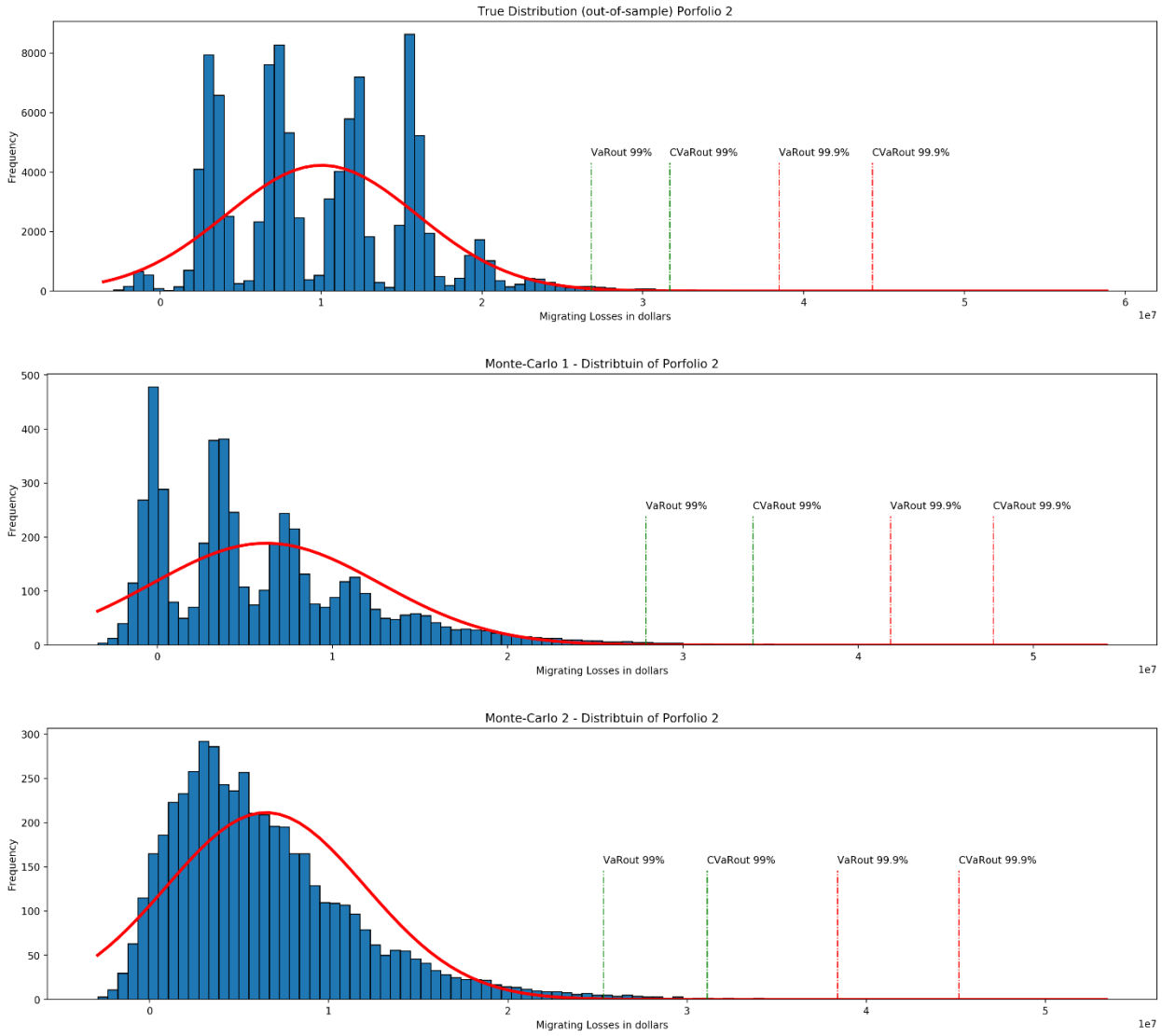
Portfolio 1







Portfolio 2



Analysis

From our analysis, for portfolio 1, we find both Monte-Carlo approximations under-report our risk values, namely VaR and CVaR. However, from the graphs we see that Monte-Carlo approximation 1 better illustrates portfolio 1, as can be seen from the VaR and CVaR values calculated. This is true for both non-normal and normal approximations. The sampling error for Monte-Carlo approximation 2 is higher in terms of portfolio 1.

However, we see the opposite for portfolio 2, the Monte-Carlo approximations over-report in the first scenario and under-report for the second scenario depending on how we use it. The Monte-

Carlo approximation 2 is much closer in reporting our actual value for the true distribution. The sampling error of Monte-Carlo approximation 1 is higher in terms of portfolio 2.

Our normal approximations are several times lower than our actual values for VaR and CVaR, as we would expect, since normal distribution does not accurately represent our sampling methods. These should always be avoided, as this can seriously undermine the risk we take.

If we look at the normal approximations our Monte-Carlo approximations make, we undermine the normal value for VaR and CVaR from our true distribution, with the Monte-Carlo approximation 1 having the least sampling error out of the two for both portfolios.

Discussion

If we are to under-report our in-sample results for VaR and CVaR respectively, we would be undermining the risk of our portfolio, which would make the bank in this case hold less capital in case of an emergency. If for some reason, the worst situation comes about, the bank would have to pay more than what they predicted.

In the case of over-reporting the VaR and CVaR due to sampling error, we would be be implying an over-prediction of the capital the bank should hold in the case of the worst situation. This may result in the bank missing potential profits gained from investing that capital rather than keeping it as an emergency measure.

We can also try to minimize the impacts of our sampling or model errors. A suggestion would be to use more models for similar portfolios. We can also use historical data or implement a model from historical data. We can also run potential models and take the average to avoid the bias of taking a single model. Increasing simulation size or generating multiple simulations and taking the average would improve in reducing the variance of the portfolios. Using different random generation techniques rather than a normal random distribution would also minimize sample error.