

### MIE1622 Assignment 3 Tutorial

Credit Risk Modeling and Simulation

Xiaotian (Gilbert) Zhu

March 16, 2018 University of Toronto xiaotian.zhu@mail.utoronto.ca

## In-sample vs Out-of-sample

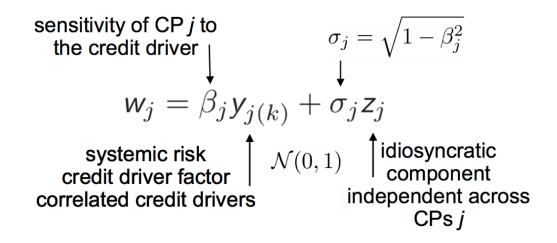


• 2 Monte Carlo in-sample scenarios

• 1 out-of-sample scenario (Monte Carlo) as the true distribution

### Credit worthiness Index





sqrt\_rho = (chol(rho))';
% Cholesky decomp of rho (for generating correlated Normal random numbers)

### Loss for each bond



- [Ltemp, CS] = max(prob, [], 2);
- exposure(:, 1) = (1-recov\_rate) .\* exposure(:, 1);
- CS\_Bdry = norminv( cumsum(prob(:,1:C-1), 2) );

Use exposure and CS\_Bdry to determine losses

#### Var and CVar Estimation



#### From MC simulation:

- Given a random sample of size N, let  $\lambda_{(k)}$  be the  $k^{\text{th}}$  order statistic, i.e.,  $\lambda_{(1)} \leq \lambda_{(2)} \leq \ldots \leq \lambda_{(N)}$ 
  - An estimate of  $VaR_{\alpha}$  is  $VaR_{\alpha,N} = \ell_{(\lceil N\alpha \rceil)}$
  - An estimate of  $\mathrm{CVaR}_{\alpha}$  is

$$CVaR_{\alpha,N} = \frac{1}{N(1-\alpha)} \left[ (\lceil N\alpha \rceil - N\alpha) \,\ell_{(\lceil N\alpha \rceil)} + \sum_{k=\lceil N\alpha \rceil+1}^{N} \ell_{(k)} \right]$$

#### Var and CVar Estimation



#### From Normal Distribution:

VaR for Normally distributed losses:

$$\operatorname{VaR}_{\alpha}^{\mathcal{N}} = \mu_{\mathcal{L}} + \Phi^{-1}(\alpha) \cdot \sigma_{\mathcal{L}}$$

CVaR for Normally distributed losses:

$$CVaR_{\alpha}^{\mathcal{N}} = \mu_{\mathcal{L}} + \frac{\phi(\Phi^{-1}(\alpha))}{1 - \alpha} \cdot \sigma_{\mathcal{L}}$$

 $\Phi$  is the cdf of  $\mathcal{N}(0,1)$  $\phi$  is the pdf of  $\mathcal{N}(0,1)$ 

Mu and sigma from MC simulation

# Portfolio Loss plot



