jeroen.kerkhof@solvay.edu for contacting me

Credit Risk: Coursework Dependence

Jeroen Kerkhof

9 June, 2020

Coursework: Introduction

- The aim of the coursework is to get familiar with dependence modeling. It is recommended that you read the slides of Lectures 2 and 3 before you do the coursework.
- The results can be obtained using Python, matlab, R or other software packages.
- The results should be uploaded on the blackboard no later than 14 July 2020.
- Please make sure the answers are to-the-point and concise. The results should be summarised on no more than 2 pages.

Simulation Study of Gaussian and t-copula

Exercise: Populate the table below with default probabilities (in percent, 2 decimals).

	Gaussian copula ($\rho =$)			Student t-copula ($\rho =$)		
	0%	20%	40%	0%	20%	40%
$P(D \geq 9, \tau \leq 1y)$	.	.	.	.	.	.
$P(D \geq 11, \tau \leq 1y)$	.	.	.	.	.	.
$P(D \geq 14, \tau \leq 1y)$	.	.	.	.	.	.
$P(D = 0, \tau > 1.5y)$	.	.	.	.	.	.
$P(D = 0, \tau > 2.5y)$	.	.	.	.	.	.
$P(D = 0, \tau > 3.5y)$	.	.	.	.	.	.

Discuss the results in the table.

0 default in first 3.5y

Simulation Study of Gaussian and t-copula

- The number of assets in the portfolio equals 30,
- $P(D \geq 9, \tau \leq 1y)$: the probability of 9 or more defaults within the first year,
- $P(D = 0, \tau > 2.5y)$: the probability of zero defaults within the first 2.5 years,
- Number of simulations $=$ 250,000,
- Columns 2, 3 and 4 (5, 6 and 7) should have the results using a Gaussian copula framework (Student t-copula framework).

Gaussian Copula Framework

- Generate X_1, X_2,... and X_{30} which are jointly normal distributed variables with means zero, standard deviations one and correlation 0%, 20% and 40%, respectively.
- Use Cholesky decomposition: $\Gamma\Gamma' = \sum$

$$X \sim N(0, I) \text{ and } \Gamma X \sim N(0, \Gamma\Gamma')$$

- Let $U_i = \Phi(X_i)$ where Φ is the univariate cumulative normal distribution function.
- Calculate the default times (τ) using the following assumptions for the $\lambda = 10\%$.

Student-t Copula Framework

- Generate X_1, X_2,... and X_{30} which are jointly Student t distributed variables with correlation 0%, 20% and 40%, respectively, and degrees of freedom $\nu = 4$.
- Let $U_i = t_\nu(X_i)$ where t_ν is the univariate cumulative Student t distribution function.
- Calculate the default times (τ) using the following assumptions for the $\lambda = 10\%$.
- Compare your results to those of the Gaussian Copula framework.

- How do you use the above techniques to value CDO tranches?
- How do you use the above techniques to value an n-to-default?