Risk Analytics: Risk and regulation tutorial sheet

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1 Copulas

1. Show by example (in R or otherwise) that a two-party default model with 2-d t-copula with a given correlation parameter (e.g. $\rho = 0.5$) and degree of freedom approaching infinity converges to default model with a 2-d Gaussian copula with the same correlation coefficient ρ as in the lecture.

2. *Model risk* is the risk of losing money (directly or indirectly through e.g. reputational damage) via inappropriate use of models. Included under this heading are:

   - Failure of key model assumptions
   - Overfitting

   The second item refers to the tension in statistical learning theory between *learning* error and *estimation* error.

   Discuss the model risk of modeling dependency with a Gaussian vs t-copula.

3. *[1] Let $\mathbf{X} = (X_1, \ldots, X_k)$ be a random variable on $\mathbb{R}^k$ (i.e. $\mathbf{X} : \Omega \to \mathbb{R}^k$, where Ω is universe of events), and let $F_1, \ldots, F_k$ be the marginal CDFs of $\mathbf{X}$. By Skar's Theorem, there exists a unique copula C such that $F(\mathbf{X}) = C\left(F_1(x_1), \ldots, F_k(x_k)\right)$.

   Let $\alpha_1, \ldots, \alpha_k$ be strictly increasing functions $\alpha_i : \mathbb{R} \to \mathbb{R}$. Show that $\left(\alpha_1(X_1), \ldots, \alpha_k(X_k)\right)$ also has copula C. (Hint: First try to prove this for a 2-d copula.)

2 Capital Ratios

1. How would a loan and a (long) CDS protecting against that loan go into a bank's balance sheet?

2. What can go wrong with the balance sheet view of a CDS?

3. * Same as above for a CDO.

[1] The asterisk indicates a more challenging problem