Supplementary Table 1. Copula data and maximum pseudo-likelihood

Let the pairs of ranks $(R_{11}, R_{21}), ..., (R_{1i}, R_{2i}), ..., (R_{1N}, R_{2N})$, where R_{1i} stands for the rank of observation X_{1i} in the random vector X_1 and R_{2i} stands for the rank of observation X_{2i} in the random vector X_2). The copula data are derived by normalizing the ranks by a factor of $1/(N+1)$. The *empirical copula* is defined as

$$C_N(u_1, u_2) = \frac{\sum_{i=1}^{N} 1(\frac{R_{1i}}{N+1} \leq u_1, \frac{R_{2i}}{N+1} \leq u_2)}{N} \quad \text{[A.1]}$$

with domain $(0,1)^2$; *1(.)* is an indicator function. The method of maximum pseudo-likelihood maximizes the rank-based, log-likelihood function

$$l(\theta) = \sum_{i=1}^{N} \ln\{c_\theta(\frac{R_{1i}}{N+1}, \frac{R_{2i}}{N+1})\} \quad \text{[A.2]}$$

where c_θ is the PDF of a copula with parameter vector θ (*e.g.* Genest *et al*., 1995; Genest & Favre, 2007).

Note that [A.2] is derived by replacing the unknown marginal distribution functions, F_1 and F_2, in the classical log-likelihood function $l(\theta) = \sum_{i=1}^{N} \ln[c_\theta\{F_1(X_{1i}), F_2(X_{2i})\}]$ by their empirical counterparts $F_{1N}(u_1) = \frac{\sum_{i=1}^{N} 1(X_{1i} \leq u_1)}{N+1}$ and $F_{2N}(u_2) = \frac{\sum_{i=1}^{N} 1(X_{2i} \leq u_2)}{N+1}$; θ is the parameter vector (equal to θ or ρ for the one-parameter copulas and to (θ_1, θ_2) for the two-parameter copulas, in accordance with Table 1).

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