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A Transformed Linear Approximation to Copula Regression

Rahul Parsa, Paul Ferrara¹

¹ Drake University, USA; pgf2r@virginia.edu

In the paper, *Copula Regression, Variance 2011 Volume 5 Issue 1*, Rahul Parsa and Stuart Klugman presented a form of copula regression which captures both the generality of GLM's and the flexibility of Copula techniques. One of the advantages of this alternative approach to GLM's is that there are no restrictions on the probability distributions that can be used to model the random variables. Hence heavy-tailed distributions, which are ubiquitous in Actuarial science, can be modeled. However, the copula regression methodology, itself, suggests yet another possibility, specifically, that of a transformed linear approximation to Copula Regression. In this method, one first performs a suitable transformation of all variables, and then OLS regression is performed on the resulting variables. Similar to the use of Box-Cox transformations within OLS, upon applying the ascribed transformations, the resulting variables are normally distributed. The final predicted values are then obtained by transforming back to the scale of the original data via the inverse of this CDF transformation. A significant difference between this method and the use of Box-Cox transformations is in the specific form of the transformations. In this linear approximation to copula regression, the transformations depend on the marginal distributions of each variable, which obviates the need to determine the optimal form of the transformation, and also offers more flexibility than most standard transformation methods. This potential approximation to copula regression begs the question, what is the difference between copula regression and this transformed linear approximation to Copula Regression? When are they equal, and when are they unequal, is there some systematic bias in the estimates from this approximation? In this research, the relationship between the estimates arrived at using these two methods; Copula Regression and the CDF transformed linear approximation to Copula Regression, are analytically explored. Surprisingly, it will be shown that estimates from this parsimonious approximation to Copula Regression often exhibit a consistent bias with respect to Copula Regression. The precise conditions on the marginal distributions of the data, F , which ensure the existence of this bias, are elucidated, in general, and in particular, for the most common distributions used for actuarial modeling.