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Some copula inference procedures adapted to the presence of ties

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Abstract

When modeling the distribution of a multivariate continuous random vector using the so-called *copula approach*, it is not uncommon to have ties in the coordinate samples of the available data because of rounding or lack of measurement precision. Yet, the vast majority of existing inference procedures on the underlying copula were both theoretically derived and practically implemented under the assumption of no ties. Applying them nonetheless can lead to strongly biased results. Some of the existing statistical tests can however be adapted to provide meaningful results in the presence of ties. It is the case of some tests of exchangeability, radial symmetry, extreme-value dependence and goodness of fit. Detailed algorithms for computing approximate p-values for the modified tests are provided and their finite-sample behaviors are empirically investigated through extensive Monte Carlo experiments. An illustration on a real-world insurance data set concludes the work.

Keywords: bootstrap; exchangeability; extreme-value dependence; goodness of fit; parametric bootstrap; radial symmetry; statistical tests; ties.

1 Introduction

The copula approach to the modeling of multivariate continuous distributions is increasingly applied in numerous fields such as environmental modeling (Salvadori et al., 2007), quantitative risk management (McNeil et al., 2015) or econometric modeling (Patton, 2012), to name a few.

Let $\boldsymbol{X}_1, \ldots, \boldsymbol{X}_n$ be independent and identically distributed (i.i.d.) copies of a random vector $\boldsymbol{X}$ with d-dimensional cumulative distribution function (c.d.f.) F. The use of copulas to model F from $\boldsymbol{X}_1, \ldots, \boldsymbol{X}_n$ becomes particularly meaningful when the d univariate marginal c.d.f.s (*margins* for short) $F_1, \ldots, F_d$ associated with F are assumed continuous.

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