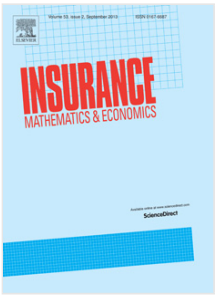
# Accepted Manuscript




A new class of copulas involved geometric distribution: Estimation and applications

Kong-Sheng Zhang, Jin-Guan Lin, Pei-Rong Xu

PII: S0167-6687(15)00150-X
DOI: http://dx.doi.org/10.1016/j.insmatheco.2015.09.008
Reference: INSUMA 2134

To appear in: *Insurance: Mathematics and Economics*

Received date: February 2015
Revised date: April 2015
Accepted date: 18 September 2015

Please cite this article as: Zhang, K.-S., Lin, J.-G., Xu, P.-R., A new class of copulas involved geometric distribution: Estimation and applications. *Insurance: Mathematics and Economics* (2015), http://dx.doi.org/10.1016/j.insmatheco.2015.09.008

# A New Class of Copulas involved Geometric Distribution: Estimation and Applications

Kong-Sheng Zhang, Jin-Guan Lin,* Pei-Rong Xu
Department of Mathematics, Southeast University, Nanjing 210096, China

**Abstract:** Copula is becoming a popular tool for modelling the dependence structure among multiple variables. Commonly used copulas are Gaussian, $t$ and Gumbel copulas. To further generalize these copulas, a new class of copulas, referred to as geometric copulas, is introduced by adding geometric distribution into the existing copulas. The interior-point penalty function algorithm is proposed to obtain maximum likelihood estimation of the parameters of geometric copulas. Simulation studies are carried out to evaluate the efficiency of the proposed method. The proposed estimation method is illustrated with workers' compensation insurance data and exchange rate series data.

**Key words:** Copula; geometric distribution; maximum likelihood estimation; interior-point penalty function method;

**MSC:** 62F10;

## 1 Introduction

Copula has received considerable attention during the past three decades. It has been widely used in many fields such as risk management (Embrechts et al., 2003), econometrics (Patton, 2012) and hydrology (Genest and Favre, 2007). According to Sklar's theorem (Sklar, 1959), any multivariate cumulative distribution can be expressed as the composition of a copula and marginal distributions, more precisely, the concerning copula is unique if the multivariate cumulative distribution function is continuous. Hence, modelling multivariate distribution can be divided into two parts: one is marginal modelling and another is dependence structure modelling.

Both the inversion method and geometric weighting method are used to construct copulas (Nelsen, 2006; Cuadras, 2009; Zhang et al., 2013). Marshall and Olkin (1997) proposed a method involved geometric distribution and maximum operator to construct a new class of family of

*Corresponding author, E-mail: jglin@seu.edu.cn