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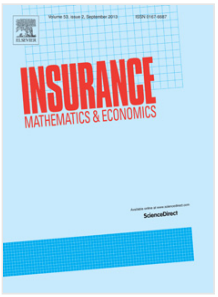

Tail negative dependence and its applications for aggregate loss modeling

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Tail negative dependence and its applications for aggregate loss modeling

Lei Hua*

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Abstract. Tail order of copulas can be used to describe the strength of dependence in the tails of a joint distribution. When the value of tail order is larger than the dimension, it may lead to tail negative dependence. First, we prove results on conditions that lead to tail negative dependence for Archimedean copulas. Using the conditions, we construct new parametric copula families that possess upper tail negative dependence. Among them, a copula based on a scale mixture with a generalized gamma random variable (GGS copula) is useful for modeling asymmetric tail negative dependence. We propose mixed copula regression based on the GGS copula for aggregate loss modeling of a medical expenditure panel survey dataset. For this dataset, we find that there exists upper tail negative dependence between loss frequency and loss severity, and the introduction of tail negative dependence structures significantly improves the aggregate loss modeling.

Key words: Tail order, scale mixture, loss frequency, loss severity, MEPS data, Archimedean copula, GGS copula.

1 Introduction

As more data become available for statistical inference, one can now observe more new dependence patterns that have not previously attracted enough attention, probably due to technical obstacles or the non-availability of relevant dataset. The existing statistical models may not be capable of well capturing those new dependence structures. To this end, copula becomes a very flexible tool. The challenge, however, is to create a new copula family that is suitable for describing new dependence patterns, as well being computable and easy to implement. Observing an asymmetric

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