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THE IDENTIFIABILITY OF COPULA MODELS FOR DEPENDENT COMPETING RISKS DATA WITH EXPONENTIALLY DISTRIBUTED MARGINS

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Abstract: We prove the identifiability property of Archimedean copula models for dependent competing risks data when at least one of the failure times is exponentially distributed. With this property, it becomes possible to quantify the dependence between competing events based on exponentially distributed dependent censored data. We demonstrate our estimation procedure using simulation studies and in an application to survival data.

Key words and phrases: Archimedean copula models, copula graphic estimator, identifiability of competing risks data.

1. Introduction

The identifiability of competing risks models has been a challenging topic in statistical research. Suppose that T is a time to an event and C is a time to a competing event, so that one can only observe $(\min\{T, C\}, I(T < C))$. How to evaluate the true association between T and C is an important research issue. Tsiatis (1975) has proved the nonidentifiability of competing risks models for this type of data, without any model or covariate information. Wang (2012) has proved the nonidentifiability of Archimedean copula models based on dependent censored data. Heckman and Honoré (1989) have proposed a set of conditions to make a competing risks model identifiable with additional covariate information. Wang et al. (2015) established a set of simpler conditions to make an Archimedean copula model (a special class of competing risks model) identifiable with covariate information.

In survival data analysis, survival times are often assumed to be exponentially distributed. We are interested in finding models that are identifiable when the time to an event is exponentially distributed and subject to dependent censoring. It turns out that the Archimedean copula model assumption is good enough to

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