Dependent censoring based on copulas

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Abstract

Consider a survival time T that is subject to random right censoring, and suppose that T is stochastically dependent on the censoring time C. We are interested in the marginal distribution of T. This situation is often encountered in practice. Consider for instance the case where T is the time to death of a patient suffering from a certain disease. Then, the censoring time C is for instance the time until the person leaves the study or the time until he/she dies from another disease. If the reason for leaving the study is related to the health condition of the patient or if he/she dies from a disease that has similar risk factors as the disease of interest, then T and C are likely dependent. In this paper we propose a new model that takes this dependence into account. The model is based on a parametric copula for the relationship between T and C, and on parametric marginal distributions for T and C. Unlike most other papers in the literature, we do not assume that the parameter defining the copula function is known. We give sufficient conditions on these parametric copula and marginals under which the bivariate distribution of (T, C) is identified. These sufficient conditions are then checked for a wide range of common copulas and marginal distributions. We also study the estimation of the model, and carry out extensive simulations and the analysis of data on pancreas cancer to illustrate the proposed model and estimation procedure.

Keywords: Copulas; dependent censoring; identifiability, inference.