# Parametric and Semiparametric Frailty Models for Spatio-Temporally Correlated

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**Abstract**

Survival models have a long history in the literature (see e.g. Cox and Oakes, 1984), and are enormously popular in the analysis of time-to-event data. Very often these data will be grouped into strata, such as clinical sites, geographic regions, and so on. Such data will often be available over multiple time periods and for multiple diseases. In this paper, we consider hierarchical spatial process models for multivariate survival datasets which are spatio-temporally arranged. Such models must account for correlations between survival rates in neighboring spatial regions, in adjacent time periods, and for similar diseases (say, two different forms of cancer). We investigate both parametric (e.g. Weibull) and semiparametric (e.g. Cox) survival modeling approaches, adding temporal effects in a hierarchical structure. Due to data limitations and computational complexity issues, we avoid geostatistical (kriging) models, and instead handle spatial correlation by placing a particular multivariate generalization of the conditionally autoregressive (MCAR) distribution on the region-specific frailties. Exemplification is provided using time-to-event data for various cancers from the Surveillance, Epidemiology, and End Results (SEER) database.