

Efficient Competing Risks Regression

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Direct regression for the cumulative incidence function (CIF) has become increasingly popular since the Fine and Gray model was suggested (Fine & Gray, 1999) due to its more direct interpretation on the probability risk scale. We here consider estimation within the Fine and Gray model using the theory of semiparametric efficient estimation. We show that the Fine and Gray estimator is semiparametrically efficient in the case without censoring. In the case of right-censored data, however, we show that Fine and Gray estimator is no longer semiparametrically efficient and derive the semiparametrically efficient estimator that involves an augmentation term.

We further study an augmented version of the Fine and Gray estimator that is also more efficient than the Fine and Gray estimator and simpler to study than efficient estimator. In some settings the obtained efficiency gain is considerable. While the augmentation term involves the CIF of the competing risk, it also leads to a robustness property: the proposed estimators remain consistent even if one of the models for the censoring mechanism or the CIF of the competing risk are misspecified. We illustrate this robustness property using simulation studies, comparing the Fine-Gray estimator and its augmented version. When the competing cause has a high cumulative incidence we see a substantial gain in efficiency from adding the augmentation term.