PROPORTIONAL HAZARDS MODELS WITH UNKNOWN LINK FUNCTION

Keywords: Proportional Hazards models, Local Likelihood, Link function.

Context of the project

In survival analysis, one is interested in exploring the possible relationship between a survival time T and a covariate X. Proportional hazards models, introduced by Cox in [2] are the most used models for this purpose. They assume the conditional hazard function of T given $X = x$ to be related to x as:

$$\lambda(t \mid X = x) = \lambda_0(t) \exp(\psi(x)) \tag{1}$$

where $\lambda_0(\cdot)$ is the baseline hasard function corresponding to $x = 0$, and $\psi(\cdot)$ is called the link function.

The standard Cox model assume the function $\psi(\cdot)$ to be the identity function. However, in reality the link function is unknown and needs to be estimated.

The main purpose of this project is to use the method presented in [1] to estimate the $\psi(\cdot)$ function when the baseline is assumed to be parametrized as $\lambda_0(t; \theta)$.

Work to be performed

The work asked to the students goes in two different directions.

Theoretical results

First it is asked to the students to understand the method used in Reference [1] (Section 2). This presents an estimation procedure based on local likelihood method to estimate $\psi(\cdot)$.

Numerical results

The second type of results is to perform numerical simulations in order to validate the method, from a practical point of view (compare estimated link function (resp. estimated reliability function) to the true link function (resp. true reliability function).

Finally, one can apply the proposed method *Lung* data set to evaluate the relationship between age and the time to death (due lung cancer). This data set is available in the *survival package*.

The numerical simulations and applications will be perfomed d with R Markdown or python notebook.

References

[1] Irene Gijbels Fan, Jianqing and Martin King. "local likelihood and local partial likelihood in hazard regression.". *The Annals of Statistics 25, no. 4.*, (1997.

[2] Cox David R. "regression models and life-tables". *Journal of the Royal Statistical Society, Series B. 34 (2)*, 1972.