

Function implementation in R software to determine an optimal cut-point for a continuous covariate with competing risks

See our application in: Giannelli V et al. Impact of cardiac function, refractory ascites and beta blockers on the outcome of patients with cirrhosis listed for liver transplantation. J Hepatol (2019) (<https://doi.org/10.1016/j.jhep.2019.10.002>)

A first step consisted in the research of an optimal cut-point for the continuous covariate in presence of competing risks. We used maximally selected Gray's statistic (described in Contal C *et al.* and Woo S *et al.*).

We worked with a primary event: death on the waiting list and a competing risk: transplantation, in a sample of 584 observations with 353 possible unique values of LVWSI, denoted Z.

For each possible value of the continuous covariate Z fixed μ , we calculated with $k=74$ times of death on the waiting list:

$$U_{\mu} = \sum_{i=1}^k \left(d_i^+ - d_i \cdot \frac{r_i^{*+}}{r_i^*} \right)$$

With:

- d_i^+ : The number of deaths in the group $Z > \mu$ at the i^{th} time
- d_i : The total number of deaths at the i^{th} time
- r_i^{*+} : The number at risk in the group $Z > \mu$ at the i^{th} time & the number of patients in the group $Z > \mu$ which had observed the competing event before the i^{th} time.
- r_i^* : The total number at risk at the i^{th} time & the total number of patients which had observed the competing event before the i^{th} time.

And we calculated the standardized statistic Q as:

$$Q_{\mu} = \frac{U_{\mu}}{\sigma \sqrt{D-1}}$$

Where $\sigma = \sqrt{\frac{1}{D-1} \cdot \sum_{i=1}^D \left(1 - \sum_{j=1}^i \frac{1}{D+1-j} \right)^2}$, with $D=102$ the total number of deaths.

Then, the optimal cut-point was determined by the maximum value of Q associated to the μ value: $\mu=64.1$.

Bibliography

- Woo, S., Kim, S. & Kim, J. Determining cutoff values of prognostic factors in survival data with competing risks. Comput Stat 31, 369–386 (2016) doi:10.1007/s00180-015-0582-x
- Contal, C., O'Quigley, J. An application of changepoint methods in studying the effect of age on survival in breast cancer. Computational Statistics & Data Analysis. 30, 253-270 (1999) doi :10.1016/S0167-9473(98)00096-6