

M2 Research internship in mathematical statistics: Censored Deconvolution for relative survival.

Context

Survival analysis is a statistical theory targeted at the study of human lifetime. In particular, relative survival methodology deals with the case of datasets that do not contain the reason of death of the patients, this information (supposed binary: studied cause or other causes) being unavailable. This is often the case in large cancer studies extracted from cancer registries. The relative survival methodology [1], developed explicitly for this issue, is based on competing risks and considers the overall lifetime of patients as being the minimum between a populational survival time and an excess survival time. This is unfortunately not very practical to estimate the lost lifetime due to the disease, a key metric in the literature [2]. This internship explores new deconvolutional approaches to estimate the lost lifetime due to the disease.

Objectives

The main objective of the internship is to explore deconvolutional approaches in relative survival field targeted at direct estimation of the distribution of the lost lifetime w.r.t. the disease in a relative survival setup. A few different leads are already identified to propose non-parametric estimations procedures for this distribution: extending the work of [3] to a slightly different setup and/or the proposals in [4] are two of the potential directions to construct relevant estimators. We expect the development of theoretical results for the produced estimators, alongside small and large sample properties.

The proposed work is part of the *NetPlus* project funded by the *Cancéropôle PACA*. Communication and publication of the results will be integral part of the work. Simulations and real data applications will be done in the *—rising—*Julia programming language. Upon success and common agreement, a follow-up through a 1-year contract is possible.

Candidate's profile

The following are strictly required:

- A master 2 level in mathematics, with majors in analysis, probability and statistics
- Strong knowledge in mathematical modeling and theoretical statistics
- Very good written English and programming skills, with good experience in latex and git

Knowledges of standard survival analysis, deconvolutional statistics and the Julia programming language (which will be used for investigations) are not required but will be nice bonuses.

Additional information

- **Length:** 5 to 6 months, with a potential follow-up by a one-year engineer contract.
- **Location:** At SESSTIM, on the *Faculté des Sciences Médicales et Paramédicales* in Marseille, France.
- **Wages:** Regulatory internship stipend at the Université Aix-Marseille (4€35/hour for 35h/week, about 600€/month)
- **To apply:** Please carefully read the announcement and review the references before applying. Then, please send your application with a resume and a few motivational lines by mail, **with [Internship2025] in the subject**, to oskar.laverny@univ-amu.fr. You can add link to previous scientific (unrelated) projects you did, if any.

[1] M. Pohar Perme, J. Stare, et J. Estève, « On Estimation in Relative Survival », *Biometrics*, vol. 68, n° 1, p. 113-120, mars 2012, doi: [10.1111/j.1541-0420.2011.01640.x](https://doi.org/10.1111/j.1541-0420.2011.01640.x).

[2] D. Manevski, N. Ružić Gorenjec, P. K. Andersen, et M. Pohar Perme, « Expected life years compared to the general population », *Biomedical journal* 2023, doi: [10.1002/bimj.202200070](https://doi.org/10.1002/bimj.202200070).

[3] F. Comte, A. Samson, et J. J. Stirnemann, « Hazard estimation with censoring and measurement error: application to length of pregnancy », *Test* 2018, doi: [10.1007/s11749-017-0548-0](https://doi.org/10.1007/s11749-017-0548-0).

[4] I. Van Keilegom et E. Kekeç, « Estimation of the density for censored and contaminated data », *Stat*, vol. 13, n° 1, p. e651, 2024, doi: [10.1002/sta4.651](https://doi.org/10.1002/sta4.651).