

# Internship proposal

## Identifying anomalies that explain other anomalies in epidemiology

**Context:** The Pierre Louis Institute of Epidemiology and Public Health (IPLESP), co-accredited by Inserm and Sorbonne University, brings together research strengths in epidemiology and public health within Sorbonne University. IPLESP's main objective is to produce original knowledge on pressing public health issues and related intervention effectiveness, focusing on emerging infectious diseases, chronic diseases, environmental health, and mental health. To tackle these challenges, causal inference [Pearl, 2000, Hernan and Robins, 2023] emerges as an indispensable tool. Therefore, at IPLESP, we are establishing a new team dedicated to developing advanced methodologies rooted in causal inference. One objective of this team is to address root cause analysis challenges in epidemiology, requiring robust methodologies amid increasing data volumes and the intricate interplay of various factors.

A novel root cause analysis method called EasyRCA [Assaad et al., 2023] has recently emerged, utilizing observational temporal data and a summary causal graph derived from a Markovian model [Assaad et al., 2022] to elucidate anomalies that may explain other anomalies within a given system. Originally crafted for IT systems, the adaptability of this method to epidemiological data can enrich root cause analysis in public health research. Recognizing its potential applicability and alignment with the distinctive challenges of epidemiology, we aim to adapt and implement this methodology in the field of public health research.

**Proposal:** The main aim of this internship is to investigate the applicability of the EasyRCA method on epidemiological data. And propose modifications and background knowledge that can enhance the performance of the EasyRCA method.

**Required skills:** Highly motivated candidate with an M2 degree and strong background in probability, machine learning, and causal inference, along with a keen interest in epidemiology. Proficiency in programming is also required. The candidate will have the opportunity to pursue a PhD in causal inference.

**Location:** The intern will work at IPLESP (<https://iplesp.fr/>), located in Paris. She/he will be supervised by Charles Assaad.

**Dates:** Starting date: Mars 2023, for a duration of 5-6 months.

**Contact:** To apply, please send a CV and a cover letter to Charles Assaad [charles.assaad@ens-lyon.fr](mailto:charles.assaad@ens-lyon.fr)

## References

- C. K. Assaad, E. Devijver, and E. Gaussier. Survey and evaluation of causal discovery methods for time series. *J. Artif. Int. Res.*, 73, apr 2022. doi: 10.1613/jair.1.13428.
- C. K. Assaad, I. Ez-Zejjari, and L. Zan. Root cause identification for collective anomalies in time series given an acyclic summary causal graph with loops. In F. Ruiz, J. Dy, and J.-W. van de Meent, editors, *Proceedings of The 26th International Conference on Artificial Intelligence and Statistics*, volume 206 of *Proceedings of Machine Learning Research*, pages 8395–8404. PMLR, 25–27 Apr 2023.
- M. Hernan and J. Robins. *Causal Inference: What If*. Chapman & Hall/CRC Monographs on Statistics & Applied Probab. CRC Press, 2023. ISBN 9781420076165.
- J. Pearl. *Causality: Models, Reasoning, and Inference*. Cambridge University Press, New York, NY, USA, 2000. ISBN 0-521-77362-8.