Introduction to causal inference

ECTS : 4

Volume horaire : 24

Description du contenu de l'enseignement :

This course provides an introduction to causal inference. It covers both the Neyman–Rubin potential outcomes framework and Pearl's do-calculus. The former is used to introduce the fundamental problem of causal inference and the notion of counterfactuals. The core hypotheses needed for causal identification of average treatment effects are presented: (conditional) exchangeability, positivity, and consistency. Estimation based on generalised linear models and on machine learning approaches is explored, including the double-machine learning approach.

The second part of the course covers Pearl's do-calculus. The course introduces graphical models, with a focus on directed models, followed by structural causal models. The simple Markovian case is used to link this framework to the potential outcomes one and to derive classical techniques such as the back-door criterion. The semi-Markovian case is then explored as the general way of representing causal hypotheses in the presence of unobserved confounding variables. Identification is revisited in the light of the do-calculus and of the IDC algorithm.

The final part of the course reviews causal discovery algorithms and open research questions.

Compétence à acquérir :

This course is an introduction to causal inference with a strong emphasis on the use of graphical models. After the course, the students should be able

- to apply consistent average treatment effect estimation procedures
- to turn causal hypotheses into structural causal models
- to analyse graphical models to determine independence structures
- to use do-calculus and the IDC algorithm to identify causal estimands

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