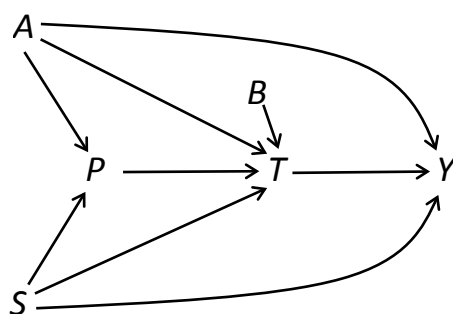


## Introduction to Causal Diagrams / Graphical Models

Workshop / Peter M. Steiner

During the last decades, the importance of causal inference has been continuously increasing in all social sciences. Randomized experiments have been known as the “gold standard” for causal investigations because they rely on the fewest and weakest assumptions. But what about observational studies, where selection into treatment conditions is not under the investigator’s control? How do we know for a given data set whether a causal effect of interest is identified, and if so, how can the effect be estimated? While statistics and econometrics textbooks are often clear about the technical assumptions needed to estimate a causal effect (e.g., no omitted variables), these assumptions are frequently not informative about whether they are actually met for a given data set (e.g., whether an omitted variables problem is present, and if so, which variables one would need to measure to avoid omitted variables bias). However, causal diagrams, also called graphical models (Pearl, 2002; Spirtes, Glymour, Scheines, 1993), can be used to address this type of questions because they combine a rigorous theory of causation with subject-matter theory. But graphical models can do much more!



A causal diagram.

This one-day workshop provides an applied introduction to the theory of causal diagrams (graphical models). We first discuss the most important terminology and major building blocks of graphical models, learn to draw causal diagrams from subject-matter theory, and talk about the diagrams’ relation to structural causal models and probability distributions. Then we use the diagrams to define what we actually mean by a “causal effect”, and introduce one of the most important graphical identification criteria—the backdoor criterion—which allows us to check whether a causal effect is actually identified and estimable for a given data set. We will also discuss how testable implications (for probing the causal assumptions) can be derived from causal diagrams. The workshop will conclude with some remarks on counterfactual analysis and causal search algorithms.

The workshop targets students and researchers interested in causation and causal inference. The introduction to causal diagrams aims at providing a thorough understanding of what causation might be and what the major challenges in research practice are. There are no required prerequisites for this course. A lack of statistical knowledge may actually be helpful, but knowledge of basic probability theory is at least not harmful. Though this introduction is rather applied, it is nonetheless theoretical—there will be no explicit discussions of estimation methods nor any applied data analyses. It’s all about diagrams and causal reasoning!