Abstract

Sufficient Instruments Filter for Causal Discovery

October 10, 2024

This paper introduces a novel five-layered deep learning-based tractable procedure to filter out sufficient information from many instruments for estimating parameters in regression models with endogenous regressors. The method draws its merit from three key properties: the ability to incorporate supervision, the flexibility to accommodate non-linearity, and the capability for sufficient dimension reduction. This method is consistent and asymptotically normal when many instruments are correlated. Simulation exercises show that this method consistently achieves lower bias and root mean squared error compared to competing benchmarks, across many specifications. Two real-world applications in industrial organizations(IO) and finance are considered, yielding meaningful insights into causal relationships. The method remains robust when the number of instruments exceeds the sample size, and performs well with weak and even invalid observed instruments, as long as there exists at least one linear combination of common factors among the observed instruments that serves as a valid instrument.