



A Distance Covariance-based Kernel for Nonlinear Causal Clustering in Heterogeneous Populations

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Distance Covariance-based Kernel for Causal Clustering

- ▶ **Question:** How to tell if samples generated by different underlying causal structures?
- ▶ **Our solution:** Project samples into causally-interpretable space and measure distance/similarity between the points there:
 - use distance covariance to define *dependence contribution kernel*;
 - using kernel trick, directly calculate similarity between samples;
 - avoid explicit (and computationally expensive) projection.
- ▶ The dependence contribution kernel gives a statistically consistent estimator of when two sets of samples come from different causal structures.
- ▶ Even stronger, we establish an isometry between distance in the sample space and distance in the space of causal ancestral graphs.
 - This allows us to compare generating causal models of samples without having to explicitly learn the models!

