

A universal algebraic approach for conditional independence

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Abstract In this paper we show that elementary properties of joint probability density functions naturally induce a universal algebraic structure suitable for studying probabilistic conditional independence (PCI) relations. We call this algebraic system the cain. In the cain algebra, PCI relations are represented in equational forms. In particular, we show that the cain satisfies the axioms of the graphoid of Pearl and Paz (Advances in artificial intelligence. North-Holland, Amsterdam, 1987) and the separoid of Dawid (Ann. Math. Artif. Intell. 32:335–372, 2001), these axiomatic systems being useful for general probabilistic reasoning.

Keywords Cain · Conditional independence · Graphical model · Graphoid · Probability density function · Separoid