On Nicod’s Condition, Rules of Induction and the Raven Paradox in Bayesian Confirmation theory

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Abstract

Confirmation theory is asking how one can confirm a universal statement like e.g. “All ravens are black”. Early authors discussed how one’s degree of belief in such a statement should change with new evidence and suggested various rules of induction. A well known example is Nicod’s Condition (NC) saying that the claim that all $F$ are $G$ is supported by observing a particular previously unseen object that is both $F$ and $G$. This has the peculiar consequence known as the raven paradox presented by Hempel in 1945, that observing a white sock supports that all ravens are black. In recent time confirmation is often studied by using subjective conditional probability as degrees of belief with Kolmogorov’s axioms being the main rules of induction. The old rules of induction are, however, still studied within a probabilistic Bayesian framework. Maher (2004) as well as Rathmaner & Hutter (2011) have considered particular a priori probability distributions with respect to which they have studied confirmation and the paradoxical conclusion in the raven paradox. Maher considered Carnap’s measure and Rathmaner & Hutter studied Solomonoff’s universal distribution. Besides the choice of measure (assumed to assign positive probability to all hypothesis), i.e. subjective background knowledge, we consider knowledge that can be expressed as an event and call it objective background knowledge. Philosophers writing about the ravens paradox often note that Nicod’s Condition holds given some set of background information, and fails to hold for others, but rarely go any further. We study NC in two specific settings. In the first case, a complete description of some individuals is known, e.g. one knows of each of a group of individuals whether they are black and whether they are ravens. In the second case, the number of individuals having a particular property is given, e.g. one knows how many ravens or how many black things there are (in the relevant population). Our most interesting result is that in the second setting, NC violates a simple kind of inductive inference (namely projectability). We suggest that the weaker principle of reasoning by analogy is a more appropriate rule. This state that if we observe an individual that is both $F$ and $G$, then when we next observe an indvivial that is $F$ it is more likely to also be $G$ due to the previous observation. A longer technical report of this work can be found at http://arxiv.org/abs/1307.3435