Are Deterministic Descriptions And Indeterministic Descriptions Observationally Equivalent?

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Abstract

The central question of this paper is: are deterministic and indeterministic descriptions observationally equivalent in the sense that they give the same predictions? I tackle this question for measure-theoretic deterministic systems and stochastic processes, both of which are ubiquitous in science. I first show that for many measure-theoretic deterministic systems there is a stochastic process which is observationally equivalent to the deterministic system. Conversely, I show that for all stochastic processes there is a measure-theoretic deterministic system which is observationally equivalent to the stochastic process. Still, one might guess that the measure-theoretic deterministic systems which are observationally equivalent to stochastic processes used in science do not include any deterministic systems used in science. I argue that this is not so because deterministic systems used in science even give rise to Bernoulli processes. Despite this, one might guess that measure-theoretic deterministic systems used in science cannot give the same predictions at every observation level as stochastic processes used in science. By proving results in ergodic theory, I show that also this guess is misguided: there are several deterministic systems used in science which give the same predictions at every observation level as Markov processes. All these results show that measure-theoretic deterministic systems and stochastic processes are observationally equivalent more often than one might perhaps expect. Furthermore, I criticise the claims of the previous philosophy papers Suppes (1993, 1999), Suppes and de Barros (1996) and Winnie (1998) on observational equivalence.

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