A combinatoric approach to identifying almost invariant aggregates in nearly uncoupled Markov chains

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Abstract

A finite Markov chain is a sequence of random variables x_t with a finite state space $\mathcal{S}$ that are homogeneous with respect to the discrete parameter t. We refer to such a Markov chain as *nearly uncoupled* if there are disjoint collections of states $\mathcal{S}_k$ such that if $x_t \in \mathcal{S}_k$ then the probability that $x_{t+1} \in \mathcal{S}_k$ is very high. i.e. The random process is nearly uncoupled if it tends to remain within a single collection $\mathcal{S}_k$ for long periods of time. We refer to such collections as *almost invariant aggregates.* Identifying nearly uncoupled Markov chains and their almost invariant aggregates is an important problem in pharmaceutical drug design and other practical areas of research as it aids in simplifying long-term analysis of systems which evolve randomly over time. We present an algorithm that utilises a combinatoric approach to construct almost invariant aggregates of a given Markov chain.