Modeling games with finitely additive probabilities

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Abstract

There are no conclusive or compelling arguments why probabilities should be modeled as countably additive and not just finitely additive. Among many cogent arguments there are conceptual reasons for finite additivity, but the theory of countably additive probabilities seems to be easier to build. Finite additivity means that if we take a finite number of disjoint sets, $A_1, \ldots, A_n$ and $A_i \cap A_j = \emptyset$, for all $i = j$, then $P(\cup_{i=1}^{n} A_i) = \sum_{i=1}^{n} P(A_i)$. We make use of probabilities when we take the mixed extension of non-cooperative games. Our goal is to investigate Nash-equilibria in games where players use finitely additive probabilities to mix their strategies. This is intriguing when the strategy set is infinite. Our first approach is to look at two-player, constant-sum games, where the payoff can only be 0 or 1 and the pure strategies are the natural numbers. We would like to understand when and what kind of differences finitely additive strategies may cause.