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The Composite Iteration Algorithm for Finding Efficient and Financially Fair Risk-Sharing Rules

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Abstract

We consider the problem of finding an efficient and fair ex-ante rule for division of an uncertain monetary outcome among a finite number of von Neumann-Morgenstern agents. Efficiency is understood here, as usual, in the sense of Pareto efficiency subject to the feasibility constraint. Fairness is defined as financial fairness with respect to a predetermined pricing functional. We show that efficient and financially fair allocation rules are in one-to-one correspondence with positive eigenvectors of a non-linear homogeneous and monotone mapping associated to the risk sharing problem. We establish relevant properties of this mapping. On the basis of this, we obtain a proof of existence and uniqueness of solutions via nonlinear Perron-Frobenius theory, as well as a proof of global convergence of the natural iterative algorithm. We argue that this algorithm is computationally attractive, and discuss its rate of convergence.

Keywords: risk sharing, fair division, Perron-Frobenius theory, eigenvector computation, collectives.

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