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Benders Decomposition for Equilibrium Problems with Risk Aversion

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Resumo

The Benders decomposition algorithm is suitable for problems with block-structured constraints involving "hard" variables. This structure arises naturally in models whose variables are divided in two parts, for instance corresponding to investment in capacity and operational decisions.

Introduced more than 50 years ago, the Benders' technique has already proven its worth in optimization. The extension to variational inequalities was provided only in 2010, by S. A. Gabriel and J. D. Fuller. The resulting method was revisited in 2013 by R. G. Egging to find an equilibrium of a large natural gas market where all the agents are risk neutral.

In this work we proceed further in the generalization by presenting a Benders' decomposition approach that is suitable for finding equilibria in a market whose agents exhibit risk aversion. The risk-averse setting introduces an additional coupling that needs to be properly addressed and cannot be handled by the existing proposal. Furthermore, in our method there is no need of feasibility cuts, a feature that notably improves the numerical behavior of the algorithm, even for risk-neutral problems.

We present the new decomposition technique, show that the method finds an equilibrium under suitable assumptions, and assess its performance on a set of stochastic variational inequalities with and without risk aversion.