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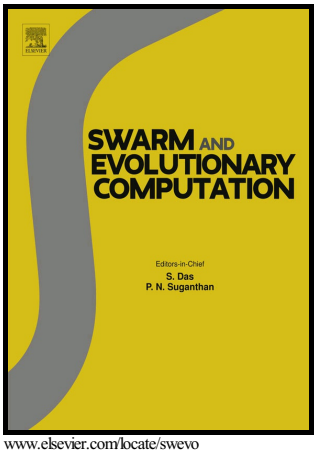

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Multi-criteria algorithms for portfolio optimization under practical constraints

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Abstract

Selection of promising assets and allocating capital among them is a crucial part of the financial decision making process. Modern portfolio theory formulated it as a quadratic optimization problem of maximizing expected returns and minimizing risk of the portfolio. This problem was modified to incorporate investor's preferences resulting in discrete non-linear search space which cannot be handled by traditional quadratic programming approaches. Relevant literature shows the success of evolutionary algorithms in modelling some of these preferences in a constrained optimization problem. This study proposes a candidate generation procedure and a repair mechanism for practical portfolio optimization model in multi-objective evolutionary algorithm (MOEA) settings. Both these methods together can handle a larger class of constraints namely cardinality, preassignment, budget, quantity (floor and ceiling) and round-lot constraints. Proposed methods can easily be incorporated in existing evolutionary algorithms. In order to evaluate their effectiveness, four MOEAs namely Non-dominated Sorting Genetic Algorithm-II (NSGA-II), Strength Pareto Evolutionary Algorithm 2 (SPEA2), Global Weighting Achievement Scalarizing Function Genetic Algorithm (GWASFGA) and Pareto Envelope-based Selection Algorithm-II (PESA-II) have been adapted and their capability of approximating unconstrained efficient frontier are discussed. For empirical testing, seven datasets involving maximum up to 1290 assets are used. All the adapted algorithms are compared and evaluated on the basis of five well-known performance metrics for MOEAs. The potential of our adapted algorithms is presented in comparison with existing MOEAs for the identical problems.

Keywords: Portfolio optimization, Multi-objective optimization, Cardinality constrained

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