Beyond the Markowitz portfolio theory – human preference driven decision support for Pareto front navigation in large–scale investment portfolio selection problems

Term convention. Below, we use the terms "objective" and "multiobjective optimization" whenever decisional context is not explicitly specified and the narration pertains to computational issues, and terms "criteria" and "multiple criteria decision making" in explicitly defined decisional contexts. Unfortunately, in the literature there is no clear standard for that.

The playground

The starting point for the project is the obvious observation that almost every practical decision making instance is a multiple criteria decision making problem, i.e. it comprises at least two criteria. Thus, multiobjective optimization is the right formal framework which underlies problems of that sort. And in fact, with two criteria Harry Markowitz, the Nobel Prize laureate in 1970, was able to propose his famous mean–variance model for investment portfolio selection, which directly addresses the profit–risk trade–off dilemma.

For decades, the Markowitz model has served as a reference for research in financial investments and a range of its modifications have aimed at better grasp of market behaviors. However, any attempt to extend this model to incorporate more criteria faces unsurmountable, as yet, cognitive and technical barriers.

The project aims at breaking through those barriers. This ambitious goal is firmly founded of the following three premises.

- Evolutionary (by the nature - approximate) optimization computations have to be employed for the purpose, because they are insensitive to the forms and properties of criteria and constraints.
- The members of the project team have developed a methodology for assessing the accuracy of solutions in evolutionary multiobjective optimization computations.
- The members of the project team have developed of tools for navigating over the set efficient (in the sense of Pareto) according to investor's preferences expressed in natural–looking language.

The aforementioned developments by the project team members have been published in leading journals.

Expected effects of the project

It is expected that by a purposeful and skillful combination of project team members developments achieved thus far, properly extended and adapted to the portfolio selection problem, will have two tangible results.

- Developing a comprehensive methodology for effective, investor's preference driven decision support for the Pareto front navigation in large–scale portfolio selection problems, for cases with more than two criteria, without restrictions on number and classes of criteria (linear and quadratic, as in the original Markowitz model).
- Bringing the methodology up to the level of implemented and tested algorithms.