# Scientific Report on the implementation of the project "Portfolio Selection Models and Applications" 2013

Objectives of the project for the year 2013:

1. Research on the efficient frontier portfolio selection models;
2. Research on absolutely optimal portfolios.

Activities connected to realization of the first objective (Research on the efficient frontier portfolio selection models) are:

- Definition of efficient frontier set and function associated to a portfolio selection model in general framework;
- Properties of efficient frontier set and efficient frontier function.

The expected results to be obtained for the first objective are:

- Dissemination of the results in symposiums / national / international conferences;
- Scientific articles published in ISI indexed journals.

Activities related to the objective: "Research on absolutely optimal portfolios" are:

- Research on the financial markets that allow absolutely optimal portfolios.
- Examples of absolute optimal portfolios and studies on stochastic vectors that allow absolutely optimal portfolios

The expected result to be obtained for the second objective is:

- Dissemination of the results in symposiums / national / international conferences;

Research regarding the first objective (the efficient frontier of portfolio selection models) can be found in the papers [1]-[5]. Results were disseminated at conferences [C01] and [C03] - [C07].

Several problems connected with the efficient frontier associated to a portfolio selection model were investigated. In order to avoid several confusions that had arisen in the literature of portfolio theory we associated the notions of efficient frontier set and efficient frontier map to a general parametric optimization problem. Consequently five portfolio selection models were defined: two minimum risk models, two maximum expected return models and a compromise optimization model. Conditions under which the efficient frontier set associated to the minimum risk model is equal or it is included in the efficient frontier set associated to the maximum expected return model were investigated. Taking into account various hypotheses on the covariance matrix and on the vector of expected returns we proved several relations between the efficient frontier sets and the efficient frontier maps associated to the mean-variance portfolio selection models. Some abstract problems in which the risk map and the map of expected returns are convex or quasi-convex functions were considered.

In [1] a general method that converts a non-convex optimization problem in a problem which has better properties was proposed. Under some assumptions the local convexity of the Lagrangean function is ensured and thus the class of the optimization models to which the dual method applies is extended. A numerical application for a particular optimization problem which belongs to the class of portfolio selection models is presented. The efficient frontier of the problem is analyzed.
In [2] are studied portfolio selection models of mean-variance type in which there are missing data. It presents a formalization of the construction of the vector of means and of the NaN covariance matrix for these models. Based on this idea, starting from a matrix containing historical data on the rate of return and from a sequence of binary matrices that describe the location of missing data in the matrix containing historical data on the rate of return, the efficient frontier of the minimum risk models is studied.
In [3] a crop planning model in the presence of environmental penalties is studied. The model aims to find an allocation of land lots crops so as to reduce the impact of agricultural practices on the environment. The objective function of the model is linked to environmental taxes paid by the farmer, so it has the significance of environmental risk. The purpose of the model is to minimize the objective function. Simulations were performed on the efficient frontier model mentioned above in terms of historical data of different lengths.
In [4] several models based on application of the portfolio theory to the crop planning crop in the presence of environmental constraints have been formulated. The models aim to solve the tradeoff between economic goals and those of reducing the fertilizer and pesticide application.
In [5] a LR fuzzy possibilistic portfolio selection model was proposed. The model is of Mean – VaR type and contains a special class of fuzzy numbers. An algorithm for solving the model is proposed. The algorithm is then applied to a numerical example in order to illustrate the potential applications of the new model.

Research on the second objective (absolutely optimal portfolios) is contained in [C02] şi [C03].
A research on the financial markets that allow absolutely optimal portfolios was performed.
A definition of the absolutely optimal portfolios was given. Given a portfolio, necessary and sufficient conditions for the existence of a stochastic vector such that the given portfolio is absolutely optimal were established. Examples of absolute optimal portfolios were also given.

All the targets of the research project were successfully met in the 2013 stage.
Tasks to disseminate the results obtained in the 2013 stage have been met. The results were disseminated in the talks given at prestigious scientific conferences.
The expected results to be obtained were published in ISI indexed journals and in international conferences proceedings.

**Papers published in international journals (ISI indexed)**

[1] Fulga C., Convexification Technique and Portfolio Optimization, Studies in Informatics and Control, Vol. 22, No. 4, (2013), 1-6. (2012 impact factor 0.554)

[2] Rădulescu M., Rădulescu C.Z., Mean-variance models with missing data, Studies in Informatics and Control, Vol. 23, No. 2, (2014), 1-6. (2012 impact factor 0.554)

**Papers published in Proceedings of international conferences**

[3] Radulescu M., Radulescu C. Z., Simulation and Optimization for Crop Planning Under Risk, Proceedings of the 8th EUROSIM Congress on Modelling and Simulation, EUROSIM 2013, Cardiff, UK, 2013, pg 409-414. IEEE 2013. ISBN 978-0-7695-5073-2.
DOI 10.1109/EUROSIM.2013.117

**Papers published in ISI indexed journals (online)**

[4] Rădulescu M., Rădulescu C.Z., Zbaganu Gh., A portfolio theory approach to crop planning under environmental constraints, Annals of Operations Research, DOI: 10.1007/s10479-011-0902-7, (paper published online) (2012 impact factor 1,029) Relative Influence Score: 1,1743

**Papers accepted for publication at ISI indexed journals**

[5] Fulga C., Popescu C. C., Possibilistic portfolio optimization with LR(1/2) -piecewise linear fuzzy parameters, RAIRO Operations Research, pg 1-15. Relative Influence Score: 0,237

**Published book**

Radulescu C.Z., Multicriteria decision-making, methods and applications in sustainable development, Editura Printech, 278 pg, 2013, ISBN: 978-606-23-0025-8. (Romanian).

**Dissemination of the results in prestigious conferences in the field**

**Talks given at the national conferences**

[C01] Radulescu M., Radulescu S., Radulescu C. Z., The efficient frontiers of parametric optimization problems, A 16-a CONFERINȚĂ a SOCIETĂȚII de PROBABILITĂȚI si STATISTICĂ, Bucuresti 2013.

**Talks given at international conferences**

[C02] Radulescu M., Radulescu S., Radulescu C. Z., Zbaganu Gh., On the duality between mean-risk models and absolute portfolios, The International Conference "Differential Geometry and Dynamical Systems - 2013" (DGDS-2013)

[C03] Radulescu M., Radulescu S., Radulescu C. Z., Zbaganu Gh., Efficient frontiers and absolute portfolios, The 21st Conference on Applied and Industrial Mathematics CAIM 2013.

[C04] Radulescu M., Radulescu C. Z., Stochastic programming models for optimal location of renewable energy power plants, Conferinta XIII International Conference on Stochastic Programming (ICSP2013).

[C05] Fulga C., Optimization and performance evaluation in the portfolio selection problem, Conferinta XIII International Conference on Stochastic Programming (ICSP2013).

[C06] Radulescu M., Radulescu S., Radulescu C. Z., The Efficient Frontiers of the Mean –Risk Portfolio Selection Problems, International Conference on Operations Research (OR 2013).

[C07] Radulescu M., Radulescu C. Z., Simulation and Optimization for Crop Planning Under Risk, 8th EUROSIM Congress on Modelling and Simulation, (EUROSIM2013), Cardiff, UK.

Project Director
Dr. Radulescu Marius
Senior research worker