Scientific Report on the implementation of the project "Portfolio Selection Models and Applications" 2014

Objectives of the project for the year 2014

1. Research on the efficient frontier portfolio selection models
2. Single period portfolio selection models with complementary constraints.

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

- Research on the efficient frontier of the portfolio selection models for various risk measures;
- Analysis of the efficient frontier of some models for sustainable development.

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.

Research activities related to the objective: "Single period portfolio selection models with complementarity constraints" are:

- Formulation of single period portfolio selection models with complementarity constraints.
- A mixed-binary approach to single period portfolio optimization models.

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

- Single period portfolio selection models with complementarity constraints.
- Research report, dissemination of results in symposiums / national / international conferences

Research regarding the efficient frontier of portfolio selection models can be found in the papers [1], [2], [6] and [7]. Results were disseminated at conferences [C01] - [C05] [C07] and [C08].
In the paper [1] have been formulated several models based on portfolio theory for crop planning in the presence of environmental constraints. The models aim to solve the tradeoff between economic objectives and environmental objectives (mitigation of the applied amount of fertilizers and pesticides).

We studied several numerical examples. Efficient frontiers of the models were analyzed. In the paper [2] several crop planning models in continuous variable were formulated. The models are based on portfolio theory and the risk is measured using two symmetric measures: mean absolute deviation and variance of the return. Decision variables of the model are the land areas allocated to crops. Among the models considered we mention the financial risk minimization model and the maximization of the expected return model. Unlike previously considered crop planning models that were discrete models, models in [2] are mathematical

programming models in continuous variable. Several numerical examples for models, with symmetrical risk measures, were analyzed. Comparisons were made between efficient frontiers of the models.
In the paper [6] a model for a multi-objective crop planning that takes into account environmental issues was presented. The model falls into the category of crops diversification models and it provides optimal allocations of land to plots. Since the model avoids monoculture its application helps the farmer to reduce the amount of fertilizers and pesticides applied to crops. The crop planning model is a binary mathematical programming model. Efficient frontier of the model is analyzed.
In the paper [7] a multi-objective model for finding optimal locations for wind farms and solar plants was presented. The model is inspired from the theory of financial portfolio selection. Location of plants to produce electricity from renewable sources is a very important decision as it can have an important impact on the stability of energy produced. At first we formulate a bi-criteria optimization model. Based on this model two models with a single objective for the optimal location of power plants based on renewable energy are formulated. These models are models of capacity expansion because they suppose the existence of some capacities for generating electricity based on renewable energy. The models are integer programming models. A numerical result for the minimum variance model is studied.

The results related to the second objective (Single period portfolio selection models with complementary constraints) are original, were included in the research report [9] and were disseminated in talk given in a conference [C06].
The research report [9] defines a class of mathematical programming problems with complementarity constraints. Such restrictions increase the difficulty of the problems that now fall into the category of combinatorial optimization problems. The set of feasible solutions, for the problems belonging to the above class, is the union of a family of convex sets. Unfortunately the feasible set is not convex.
In this paper we present an algorithm for solving optimization problems with complementarity constraints that involves solving a series of mathematical programming problems with convex set of feasible solutions. The algorithm requires a large computational effort. Applications are considered for portfolio selection models which include transaction costs and initial holdings for the investor. For the case of linear transaction costs an equivalent formulation of optimization models with complementary constraints with mixed-binary type models is given. A numerical example is analyzed.
All the targets of the research project were successfully met in the 2014 stage.
Tasks to disseminate the results obtained in the 2014 stage have been met. The results were disseminated in the context of talks given at prestigious scientific conferences.
The expected results to be obtained were published in ISI indexed journals, in international conferences proceedings, and in a research report on the subject.

Papers published in international journals (ISI indexed)

[1] Rădulescu M., Rădulescu C.Z., Zbaganu Gh., A portfolio theory approach to crop planning under environmental constraints, Annals of Operations Research, vol. 219, (2014), 243–264. (2013 impact factor 1.103) Relative Influence Score: 1.175.

[2] Radulescu M., Radulescu C.Z., Crop planning models with symmetric risk measures, Studies in Informatics and Control, Vol. 23, No. 4, (2014), 333-340. (2013 impact factor 0.605)

[3] Vasile S. L., Query optimization on random databases, Studies in Informatics and Control, vol. 23 (3), (2014), 257-265. (2013 impact factor 0.605)

[4] Vasile S. L., Some estimations in database queries, Bull. Math. de la Soc. Sci. Math. Roumanie, vol. 57 (3), (2014), 319-325. (2013 impact factor 0.452)

[5] Rădulescu M., Rădulescu S., On the Maksa-Volkmann functional inequality $|f(x+y)| \geq |f(x)+f(y)|$ when the range of f is a space of functions, Carpathian Journal of Mathematics, vol. 30, no. 2, (2014), 253 – 256. (2013 impact factor 0.642)

Papers published in Proceedings of international conferences

[6] Radulescu M., Radulescu C.Z., A multi-objective crop planning model with environmental constraints. Proc. Int. Conf. Ag. Eng., AgEng2014, Zurich. Eur. Soc. Ag. Eng. (EurAgEng), (2014), 7 p. ISBN: 978-0-9930236-0-6.

Papers submitted for publication at ISI indexed journals

[7] Radulescu M., Radulescu C.Z., Mean-variance models for the location problem of renewable power plants, Computers and OR., submitted. (2013 impact factor 1.718), (Relative Influence Score: 1.996)

[8] Raducan A. M., Vernic R., Zbaganu Gh., Recursive calculation of ruin probabilities at or before claim instants for non-identically distributed claims, ASTIN Bull., submitted. (2013 impact factor 0,612), (Relative Influence Score: 0.658)

Research report

[9] Radulescu M., Single period portfolio selection models with complementarity constraints.

Dissemination of the results in prestigious conferences in the field

Talks given at the national conferences

[C01] Radulescu M., Radulescu S., Radulescu C. Z., Mean-variance models for crop planning, A 17-a CONFERINȚĂ a SOCIETĂȚII de PROBABILITĂȚI si STATISTICĂ, Bucuresti 2014.

Talks given at international conferences

[C02] Radulescu M., Radulescu C.Z., A multi-objective crop planning model with environmental constraints, The International Conference on Agricultural Engineering - 2014" (AgEng-2014).

[C03] Radulescu M., Radulescu C. Z., Application of portfolio theory to optimal location of renewable power plants, International Conference in Optimization Theory and its Applications, ALEL 2014.

[C04] Fulga C., Mathematical modeling of risk preferences with application to portfolio optimization, The 10th Conference on Dynamical Systems, Differential Equations and Applications, AIMS 2014.

[C05] Radulescu M., Radulescu S., Radulescu C. Z., Duality between mean-risk models, "12ème Colloque Franco-Roumain de Mathématiques Appliquées" CFR2014.

[C06] Radulescu M., Radulescu S., Radulescu C. Z., Portfolio optimization models with transaction costs and initial holdings, "12ème Colloque Franco-Roumain de Mathématiques Appliquées" CFR2014.

[C07] Radulescu M., Radulescu S., Radulescu C. Z., Formulation of mean-risk models in a very general framework, International Conference in Optimization Theory and its Applications, ALEL 2014.

[C08] Radulescu M., Radulescu C.Z., Mean-variance models for the location problem of renewable power plants, International Conference OR 2014.

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