

## **LIST OF RESEARCH ACCOMPLISHMENTS**

Methodology for computer-aided decision making  
based on varied types of indirect preference information  
and comprehensive robustness analysis

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Poznan, October 31, 2016

## I. LIST OF PAPERS CONSIDERED AS THE SCIENTIFIC ACCOMPLISHMENT

### A. TITLE OF THE SCIENTIFIC ACCOMPLISHMENT

Methodology for computer-aided decision making based on varied types of indirect preference information and comprehensive robustness analysis

### B. SERIES OF PAPERS CONSIDERED AS THE SCIENTIFIC ACCOMPLISHMENT

The series consists of 12 papers published in the journals covered by the Journal Citation Reports. The notation used to refer to the papers in all sections agrees with the one used in the summary of professional accomplishments (Appendix 2).

[P1] M. Kadziński, T. Tervonen, Stochastic ordinal regression for multiple criteria sorting problems. *Decision Support Systems*, 55(1):55-66, 2013.

- co-author of the stochastic ordinal regression method for multiple criteria sorting problems (Sections 3.3 and 3.4);
- author of the mathematical programming models for computing the possible and necessary assignments (Section 3.1);
- author of a definition of the assignment-based preference relation and of the mathematical programming models that allow to verify its necessity and possibility in view of the set of all preference model instances compatible with the decision maker's preferences (Section 3.2);
- co-author of an adaptation of the algorithm for rejection-sampling of value functions to the context of the proposed method (Section 3.5);
- author of a discussion on the interrelations between the outcomes of robust and stochastic ordinal regression for multiple criteria sorting (Section 3.6) and on the impact of the holistic assignment examples on the robust outcomes (Section 3.7);
- author of a procedure for selection of a representative value function based on the assignment-based pairwise outranking indices (Section 3.8);
- author of an analysis of a problem concerning assigning Asian countries to different types of democracy regimes (including elaboration of all tables and figures) and of a discussion on its results (Section 4);
- author of the preliminary version of all sections;
- estimated percentage contribution: 75%.

[P2] M. Kadziński, T. Tervonen, Robust multi-criteria ranking with additive value models and holistic pair-wise preference statements. *European Journal of Operational Research*, 228(1):169-180, 2013.

- co-author of the stochastic ordinal regression method for multiple criteria ranking (Sections 2.2 and 2.4);
- author of a theorem on no jumps in the range of possible ranks attained by each alternative in the set of additive value functions (Section 2.4);
- author of a discussion on the interrelations between the outcomes of robust and stochastic ordinal regression for multiple criteria ranking (Sections 2.2 and 2.4) and on the impact of the holistic pairwise comparisons on the robust outcomes (Section 3.1);
- author of a procedure for selection of a representative value function based on the pairwise winning indices (Section 3.2);
- author of an analysis of a problem concerning ranking different countries based on the quality of their universities (including elaboration of all tables and figures) and of a discussion on its results (Section 4);
- author of the preliminary version of all sections;
- estimated percentage contribution: 75%.

- [P3] S. Corrente, S. Greco, M. Kadziński, R. Słowiński. Robust ordinal regression in preference learning and ranking. *Machine Learning*, 93(2-3):381-422, 2013.
- author of the concept of robust ordinal regression for multiple criteria ranking and choice based on varied types of indirect preference information and comprehensive robustness analysis;
  - author of the mathematical programming models which allow to jointly represent different types of indirect preference information (Section 3), to conduct multidimensional robustness analysis (Section 4), or to resolve inconsistencies in the provided preferences (Section 6);
  - author of a discussion on the evolution of the results with incremental specification of preference information (Section 5);
  - author of all computational tests performed for the analysis of innovation in European countries (including elaboration of all tables and figures) and of a discussion on its results (Section 7);
  - main author of the comparison between the disciplines of Multiple Criteria Decision Aiding and Machine Learning concerning a few dozens of issues (in all sections);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 65%.
- [P4] M. Kadziński, S. Greco, R. Słowiński, Robust Ordinal Regression for Dominance-based Rough Set Approach to multiple criteria sorting. *Information Sciences*, 283:211-228, 2014.
- author of the concept of robust ordinal regression with a rule-based preference model for multiple criteria sorting;
  - author of the algorithms for inducing an exhaustive set of minimal rules (Section 3) and generating all minimal-cover sets of rules (Section 4);
  - author of the concept of robustness analysis with all minimal-cover sets of rules (Section 6);
  - author of a procedure for selection of a representative set of rules (Section 7);
  - author of the concept of decisive rule (Section 8);
  - author of all computational tests required for the risk analysis in an application typical for the environmental science (including elaboration of all tables and figures) and of a discussion on the obtained results (in all sections);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 75%.
- [P5] M. Kadziński, S. Corrente, S. Greco, R. Słowiński, Preferential reducts and constructs in robust multiple criteria ranking and sorting. *OR Spectrum*, 36(4):1021-1053, 2014.
- co-author of the concept of preferential reduct (Section 4);
  - author of the algorithms for identification of a preferential reduct in the context of results typical for both multiple criteria ranking and sorting (Section 4);
  - author of the concept of preferential core and of the algorithm for its generation (Section 4);
  - author of the concept of preferential construct and of the mathematical programming model for its identification (Section 4);
  - author of a discussion on the computational costs related to the proposed algorithms (Section 5);
  - author of extensions of the basic algorithms that account for the credibility of preference information and some background knowledge that should be included in the generated explanations (Section 6);
  - author of all computational tests performed for the analysis of an illustrative problem in the field of political science (including elaboration of all tables and figures) and of a discussion on the obtained results (in all sections);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 65%.

- [P6] M. Kadziński, K. Ciomek, R. Słowiński, Modeling assignment-based pairwise comparisons within integrated framework for value-driven multiple criteria sorting. *European Journal of Operational Research*, 241(3):830-841, 2015.
- author of the concept of robust ordinal regression for multiple criteria sorting based on varied types of indirect preference information and comprehensive robustness analysis with value-based preference model;
  - co-author of the mathematical programming models which allow to jointly represent different types of indirect preference information (Section 4) and to conduct multidimensional robustness analysis (Section 5);
  - author of a discussion on the impact of different types of indirect preference information on the robust outcomes and on the evolution of the results with incremental specification of preference information (Section 6);
  - author of a plan of experimental tests performed for the analysis of a problem concerning evaluation of different cities in terms of liveability (Section 7);
  - author of the preliminary version of Sections 1-6;
  - estimated percentage contribution: 55%.
- [P7] M. Kadziński, R. Słowiński, Parametric evaluation of research units with respect to reference profiles. *Decision Support Systems*, 72:33-43, 2015.
- author of the mathematical programming models which allow to perform non-compensatory pairwise comparisons of alternatives (Section 4.1) and to compute their comprehensive scores (Section 4.2) in the process of constructing the separating class profiles;
  - author of the concept of robustness analysis in view of potential existence of multiple sets of reference profiles consistent with the provided preference information (Section 5);
  - author of all computational tests performed for the categorization of exemplary research units (including elaboration of all tables and figures) and of a discussion on the obtained results (Section 6);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 75%.
- [P8] M. Kadziński, T. Tervonen, J. Figueira, Robust multi-criteria sorting with the outranking preference model and characteristic profiles. *Omega*, 55:126-140, 2015.
- co-author of the concept of robust ordinal regression for multiple criteria sorting with the outranking preference model and characteristic profiles;
  - author of the detailed analysis of the ascending and descending rules of Electre TRI-C (Section 4.2) and of the formulation of new rules which indicate the lower and upper classes unambiguously (Section 4.5);
  - author of the mathematical programming models for disaggregating the preferences in the context of Electre TRI-C (Section 4.3 and Appendix I);
  - author of the mathematical programming models for deriving the possible and necessary assignments (Section 4.4);
  - author of the assignment rules of Electre TRI-rC (Section 5);
  - author of the theorem on no class jumps in the range of possible assignments (Section 5);
  - author of a plan of experimental tests performed for the analysis of an illustrative problem in the field of environmental management and of a discussion on its results (Section 7);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 70%.
- [P9] M. Kadziński, R. Słowiński, S. Greco, Multiple Criteria Ranking and Choice with All Compatible Minimal Cover Sets of Decision Rules. *Knowledge-Based Systems*, 89:569-583, 2015.
- author of the concept of robust ordinal regression with a rule-based preference model for multiple criteria ranking and choice;
  - author of an algorithm for generating all minimal-cover sets of rules (Section 3);

- author of the concept of robustness analysis with all minimal-cover sets of rules (Section 4);
  - author of the procedures for exploiting the preference structure imposed by the necessary or stochastic relations (Section 5);
  - author of the method's extension to the case of variable precision (Section 6);
  - author of the concept of decisive rule (Section 8);
  - author of all computational tests performed for the analysis of a problem concerning innovativeness of cities (including elaboration of all tables and figures) and of a discussion on its results (in all sections);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 70%.
- [P10] M. Kadziński, K. Ciomek, P. Rychły, R. Słowiński, Post factum analysis in robust multiple criteria ranking and sorting. *Journal of Global Optimization*, 65(3):521-562, 2016.
- author of the concept of post factum analysis for multiple criteria ranking and sorting;
  - author of the definitions of the necessary and possible, comprehensive or partial modifications of the alternative's performances that allow it to attain or maintain some target result (Sections 5.2 and 5.3);
  - author of the mathematical programming models which allow to determine the necessary or possible improvements or deteriorations of the performances in view of targets typical for multiple criteria ranking (Sections 5.2 and 5.3);
  - co-author of the analogous problems in view of targets typical for multiple criteria sorting (Sections 5.2 and 5.3);
  - author of the propositions concerning the comparison of outcomes of post factum analysis for different scenarios (Section 5.2);
  - author of a plan of computational tests performed for the analysis of an illustrative problem in the field of environmental science and of a discussion on its results (Section 6);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 55%.
- [P11] M. Kadziński, M. Michalski, Scoring procedures for multiple criteria decision aiding with robust and stochastic ordinal regression. *Computers & Operations Research*, 71:54-70, 2016.
- author of the procedures for constructing univocal ranking based on the outcomes of robustness analysis (Section 3 and Appendix A);
  - author of the three new measures for quantifying agreement in the suggested recommendation for multiple criteria ranking and choice (Section 4);
  - author of a plan of experimental tests aiming at investigating the ability of the procedures to suggest the same recommendation as the one obtained with the assumed decision maker's true value system (Section 5.1);
  - author of a discussion on the results of experiments (Section 5.2 and Appendix C);
  - author of a plan of computational tests requires for illustrating the use of proposed procedures on an exemplary decision problem (Appendix B);
  - author of all sections;
  - estimated percentage contribution: 80%.
- [P12] M. Kadziński, K. Ciomek, Integrated framework for preference modeling and robustness analysis for outranking-based multiple criteria sorting with ELECTRE and PROMETHEE. *Information Sciences*, 352:167-187, 2016.
- author of the concept of robust ordinal regression for multiple criteria sorting based on varied types of indirect preference information and comprehensive robustness analysis with outranking-based preference model defined in the spirit of Electre or Promethee;
  - co-author of the mathematical programming models which allow to jointly represent different types of indirect preference information (Section 3) and to conduct multidimensional robustness analysis (Section 4);

- author of a discussion on the possible jumps in the range of possible assignments for the Electre method (Section 5);
- author of a plan of computational tests performed for the analysis of a problem concerning evaluation of research units (Section 6);
- co-author of the models which can be used for preference modeling and robustness analysis with any method that provides precise assignments for the alternatives (Section 7);
- author of the preliminary version of all sections;
- estimated percentage contribution: 60%.

## II. LIST OF OTHER PUBLISHED RESEARCH STUDIES

### A. LIST OF SCIENTIFIC PAPERS PUBLISHED IN THE JOURNALS COVERED IN THE JOURNAL CITATION REPORTS

The papers denoted by [D1]-[D10] in the below list had been published or accepted for publication before I obtained PhD degree. I am the main author of the methods presented in [D3], [D5], [D7], [D8], and [D10], and a co-author of the research problems raised in [D1], [D2], [D4], [D6], and [D9]. For all these papers, I have been:

- the main author of the proposed solutions (including the formulation of mathematical programming models, the definitions of new concepts as well as the discussion on the properties of results delivered by the methods);
- the author of all computational tests and the discussion of their results (including conducting all computer simulations for the studies used to illustrate the usefulness of the proposed methods, elaboration of all figures and tables);
- the author of preliminary version of all sections.

In view of the above provided explanation, for papers [D1]-[D10] I present solely an estimated percentage of my contribution, while for the remaining papers I discuss my contribution in detail.

- [D1] S. Greco, M. Kadziński, V. Mousseau, R. Słowiński. ELECTRE<sup>GKMS</sup>: Robust ordinal regression for outranking methods. *European Journal of Operational Research*, 214(1):118-135, 2011.
- estimated percentage contribution: 50%.
- [D2] S. Greco, M. Kadziński, R. Słowiński. Selection of a representative value function in multiple criteria sorting. *Computers & Operations Research*, 38(11):1620-1637, 2011.
- estimated percentage contribution: 60%.
- [D3] M. Kadziński, S. Greco, R. Słowiński. Extreme ranking analysis in robust ordinal regression. *Omega*, 40(4):488-501, 2012.
- estimated percentage contribution: 70%.
- [D4] S. Greco, M. Kadziński, V. Mousseau, R. Słowiński. Robust ordinal regression for multiple criteria group decision problems: UTA<sup>GMS</sup>-GROUP and UTADIS<sup>GMS</sup>-GROUP. *Decision Support Systems*, 52(3):549-561, 2012.
- estimated percentage contribution: 50%.
- [D5] M. Kadziński, S. Greco, R. Słowiński. Selection of a representative set of parameters for robust ordinal regression outranking methods. *Computers & Operations Research*, 39(11):2500-2519, 2012.
- estimated percentage contribution: 70%.
- [D6] M. Kadziński, R. Słowiński. Interactive robust cone contraction method for multiple objective optimization problems. *International Journal of Information Technology & Decision Making*, 11(2):327-357, 2012.
- estimated percentage contribution: 70%.
- [D7] M. Kadziński, S. Greco, R. Słowiński. Selection of a representative value function in robust multiple criteria ranking and choice. *European Journal of Operational Research*, 217(3):541-553, 2012.
- estimated percentage contribution: 65%.

- [D8] M. Kadziński, S. Greco, R. Słowiński. RUTA: a framework for assessing and selecting additive value functions on the basis of rank related requirements. *Omega*, 41(4):735-751, 2013.
- estimated percentage contribution: 70%.
- [D9] M. Kadziński, S. Greco, R. Słowiński. Selection of a representative value function for robust ordinal regression in group decision making. *Group Decision and Negotiation*, 22(3):429-462, 2013.
- estimated percentage contribution: 70%.
- [D10] M. Kadziński, R. Słowiński. DIS-CARD: a new method of multiple criteria sorting to classes with desired cardinality. *Journal of Global Optimization*, 56(3):1143-1166, 2013.
- estimated percentage contribution: 70%.

before being awarded PhD ↑

after being awarded PhD ↓

- [F1] D. O'Sullivan, Sz. Wilk, W. Michalowski, R. Słowiński, R. Thomas, M. Kadziński, K. Farion, Learning the preferences of physicians for the organization of result lists of medical evidence articles. *Methods of Information in Medicine*, 53(5):344-56, 2014.
- author of the concept of multiple criteria ranking method used for the analysis of a real-world case study presented in the paper; its essence consists in constructing a group compromise preference model by removing the conflicting pairwise comparisons given by the smallest number of decision makers (Section 3.1);
  - author of all computational tests for the analyzed problem as well as all tables and figures (Sections 3.3 and 4);
  - author of the preliminary version of Sections 3.1, 4.1 and 4.3 in parts related to the methodology and discussion of results;
  - estimated percentage contribution: 20%.
- [F2] T. Tervonen, A. Sepehr, M. Kadziński, A multi-criteria inference approach for anti-desertification management. *Journal of Environmental Management*, 162:9-19, 2015.
- author of the multiple criteria decision aiding method that has been applied to a real-world case study on the anti-desertification management in Iran;
  - author of a procedure for selection of a representative value function for multiple criteria sorting based on the outcomes of robust ordinal regression (Section 2.2 and Appendix A);
  - author of all computational tests performed for the analysis (including elaboration of all tables and figures) and of a discussion on its results (Section 3);
  - author of Sections 2.2 and 3, and Appendix A; co-author of Sections 1 and 4;
  - estimated percentage contribution: 40%.
- [F3] M. Kadziński, R. Słowiński, S. Greco, Robustness Analysis for Decision Under Uncertainty with Rule-based Preference Model. *Information Sciences*, 328:321-339, 2016.
- co-author of the concept of robust ordinal regression with a rule-based preference model for decision under uncertainty;
  - author of the algorithms for inducing all minimal rules (Section 4) and constructing all minimal-cover sets of rules (Section 5);
  - author of the algorithms for inducing all satisfactory rules (Section 4) and constructing all satisfactory sets of rules (Section 5);
  - author of the concept of comprehensive robustness analysis with all minimal-cover sets of rules (Section 6);
  - author of a procedure for constructing univocal recommendation for multiple criteria sorting based on the outcomes of robustness analysis (Section 7);
  - author of the method's extension to the case of group decision (Section 8);

- author of all computational tests performed for the analysis of an illustrative problem involving decision under uncertainty (including elaboration of all tables and figures) and of a discussion on its results (in all sections);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 70%.
- [F4] S. Corrente, S. Greco, M. Kadziński, R. Słowiński. Inducing probability distribution on the set of value functions by Subjective Stochastic Ordinal Regression. *Knowledge-Based Systems*, 112:26-36, 2016.
- author of the stochastic ordinal regression method which has been extended in this paper;
  - co-author of the concept of using uncertain preference information, definition of the necessary and possible probabilistic preference relations as well as acceptability indices suitably adjusted to the scope of the proposed method (Section 2);
  - co-author of the final version of Sections 2 and 3;
  - estimated percentage contribution: 25%.
- [F5] M. Kadziński, A. Labijak, M. Napieraj, Integrated framework for robustness analysis using ratio-based efficiency model with application to evaluation of Polish airports. *Omega*, doi:10.1016/j.omega.2016.03.003, 2016.
- author of the concept of an integrated framework for robustness analysis using ratio-based efficiency model (Section 2);
  - author of the mathematical programming models which allow to conduct exact robustness analysis and co-author of the specification of relevant acceptability indices, whose values are estimated with the Monte Carlo simulation (Section 2);
  - author of a plan for implementing the proposed framework in form of the elementary components designed for the diviz platform (Section 3);
  - author of a plan of computational tests performed for the analysis of efficiency of Polish airports (Section 4);
  - author of a discussion on practical usefulness of the proposed framework in view of the results obtained for the considered problem (Section 5);
  - author of a discussion on the interrelations between the robust results derived from linear programming and Monte Carlo simulations (Appendix B), the evolution of robust outcomes with incremental specification of weight constraints (Appendix C), and on the impact of removing or introducing outlier decision making units on the results (Appendix D);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 70%.

**B. MONOGRAPHS, SCIENTIFIC PUBLICATIONS IN THE INTERNATIONAL OR NATIONAL JOURNALS NOT COVERED BY THE JOURNAL CITATION REPORTS**

- [B1] S. Greco, M. Kadziński, R. Słowiński, The most representative value function for robust ordinal regression in group decision problems. *Proceeding of 25<sup>th</sup> Mini-Euro Conference "Uncertainty and Robustness in Planning and Decision Making" (URPDM 2010)*, Coimbra, ISBN 978-989-95055-3-7, 2010.
- main author of the concept of a representative value function for group decision and of the mathematical programming models that allow its construction (Section 3);
  - author of all computational tests required for the exemplary multiple criteria problem considered in the paper (including elaboration of all tables and figures) and of a discussion on its results (Section 4);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 70%.



- [B2] M. Kadziński, New Directions in Robustness Analysis and Preference Modeling in Multiple Criteria Decision Aiding, *Poznan Monographs in Computing and Its Applications*, NAKOM, Poznań, ISBN 978-83-89529-94-7 (Edition 1, Volume 7), 2012.
- before being awarded PhD ↑
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- after being awarded PhD ↓
- [B3] M. Kadziński, R. Słowiński, Preference-Driven Multiobjective Optimization Using Robust Ordinal Regression for Cone Contraction, *Multiple Criteria Decision Making*, University of Economics in Katowice, 8:67-83, 2013.
- main author of the interactive cone contraction method (Section 3);
  - author of all computational tests for the exemplary multiple objective optimization problem (including elaboration of all tables and figures) (Section 4);
  - author of the preliminary version of all sections;
  - estimated percentage contribution: 70%.
- [B4] S. Corrente, S. Greco, M. Kadziński, R. Słowiński, Robust Ordinal Regression, *Wiley Encyclopedia of Operations Research and Management Science*, 1-10, doi:10.1002/9780470400531.eorms1090.
- a review paper presenting state-of-the-art robust ordinal regression methods (I am a co-author of the majority of these approaches);
  - co-author of the final version of all sections;
  - estimated percentage contribution: 25%.
- [B5] R. Słowiński, M. Kadziński, S. Greco, Robust Ordinal Regression for Dominance-Based Rough Set Approach under Uncertainty, *Rough Sets and Intelligent Systems Paradigms*, Volume 8537 of the series Lecture Notes in Computer Science, 77-87, 2014.
- co-author of the concept of robust ordinal regression with a rule-based preference model for decision under uncertainty;
  - author of the algorithms for inducing all minimal rules (Section 3) and constructing all minimal-cover sets of rules (Section 4);
  - author of the concept of robustness analysis (Section 5);
  - author of all computational tests performed for the analysis of an illustrative problem (including elaboration of all tables and figures in Sections 2-5);
  - author of the preliminary version of Sections 2-5;
  - estimated percentage contribution: 50%.
- [B6] M. Kadziński, M. Tomczyk, Using ordinal regression for interactive evolutionary multiple objective optimization with multiple decision makers, *Outlooks and Insights on Group Decision and Negotiation*, Volume 218 of the series Lecture Notes in Business Information Processing, 185-198, 2015.
- author of the interactive evolutionary multiple objective optimization method for group decision (Section 4);
  - author of the plan of experimental tests required for the verification of the quality of the proposed algorithms and of the discussion on the obtained results (Section 5);
  - author of all sections;
  - estimated percentage contribution: 65%.
- [B7] M. Kadziński, R. Słowiński, M. Szeląg, Dominance-based rough set approach to multiple criteria ranking with sorting-specific preference information, *Studies in Computational Intelligence* 605, 155-171, 2016.
- co-author of the concept of multiple criteria ranking method with sorting-specific preference information;
  - co-author of the definition of the lower and upper approximations of pairs of class unions (Section 2);

- co-author of the concept of applying decision rules for computing a comprehensive score for each alternative (Sections 4 and 5);
- author of all computational tests performed for the analysis of an exemplary multiple criteria sorting problem (including elaboration of all tables, figures and discussion on the obtained results in Section 5);
- author of the preliminary version of Sections 2-6;
- estimated percentage contribution: 40%.

*Comparison of the main contributions of the papers published before and after being awarded PhD*

In the papers that had been published or accepted for publication before I obtained PhD degree, the methodological contributions in terms of preference modeling and robustness analysis were limited in scope. In particular, one has proposed:

- ordinal regression methods for multiple criteria ranking with an outranking-based preference model [D1, D3] and for group decision with a value-based model [D4, D9], where preference information and robustness analysis have only one dimension;
- mathematical programming models which allow to account for preference information in form of rank-related requirements [D8] and desired class cardinalities [D10], or deriving extreme ranks [D3] for methods incorporating a value-based preference model;
- linear programming problems for selection of a representative preference model instance emphasizing the outcomes of robust ordinal regression [D2, D5, D7, D9, B1].

In the series of papers submitted as the scientific accomplishment, the issues related to preference model and robustness analysis have been addressed more comprehensively. The most important original contributions contained in this series, not having counterparts in the previous works, are the following:

- establishment of the *robust ordinal regression methods* based on varied types of indirect preference information and comprehensive robustness analysis using value-, outranking- and rule-based preference models [P3, P4, P6, P9, P12]; the most important characteristic of these approaches derives from a multidimensional correspondence between the accepted inputs and provided outputs;
- proposing *stochastic ordinal regression*, which employs Monte Carlo simulations for estimating probability of the truth of different parts of the arrived recommendation [P1, P2]; thus computed stochastic acceptability indices are complementary to the necessary, possible, and extreme outcomes derived from exact robustness analysis based on mathematical programming;
- extending the scope of usability of robustness analysis tools to the methods based on a *rule-based preference model* [P4, P9], which construct a set of all compatible preference model instances explicitly rather than defining it with a set of linear constraints as in value- or outranking-based methods;
- proposing the methods for construction of a *univocal recommendation* by exploiting the robust outcomes without singling out a specific preference model instance [P11], which gives birth to a new research stream in robustness analysis for preference disaggregation methods;
- formulation of the procedures for selection of a *representative preference models instance based on the outcomes of stochastic acceptability analysis* [P1, P2, P4, P9], which allows to formulate more adequate requirements with respect to the form of a representative instance and the underlying recommendation;
- incorporation of *reference* (characteristic or boundary) *profiles* into robust multiple criteria decision analysis, which aims at increasing interpretability of the arrived recommendation [P7, P8];
- specification of the algorithms for *generating explanations* of the recommended decision in view of the holistic preference information provided by the decision maker [P5], which enhances her/his trust in the methods;

- extending the scope of robustness analysis tools by simulating the consequences of modifying performances of alternatives within the framework of *post factum analysis* [P10];
- formulating the *theorems and propositions* concerning data processing and provided results, which vastly contribute to ensuring the consistency between value system of the stakeholders, the evolution of the decision process and recommendation of a specific decision.

Moreover, in the papers not included in the main scientific accomplishment, the methodological and practical issues related to preference modeling and robustness analysis have been raised in view of: data envelopment analysis [F5], interactive evolutionary multiple objective optimization [B6], decision under uncertainty [F3, F4], group decision aiding [F1, F3, B6], hybrid methods merging ideas specific to different types of problems [B7], and analysis of real-world decision problems [F1, F2, F5].

### C. PRESENTATIONS AT INTERNATIONAL CONFERENCES

1. S. Greco, M. Kadziński, R. Słowiński, The most representative value function in robust multiple criteria sorting. *23<sup>rd</sup> European Conference on Operational Research (EURO 2009)*, Bonn, Germany, July 5-8, 2009.
2. M. Kadziński, R. Słowiński, Interactive cone contraction method for multiple objective optimization problems, *Complex System Modeling 2009 (CSM 2009)*, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, August 30 - September 2, 2009.
3. M. Kadziński, Robust multiple criteria sorting on Decision Deck platform. *5<sup>th</sup> Decision Deck Workshop*, Brest, France, September 17-18, 2009.
4. M. Kadziński, M. Harat, J. Jelonek, E. Gorzelańczyk, Psychomotor function after one-sided ablative surgery for patients with Parkinson's disease, *3<sup>rd</sup> World Congress on Controversies in Neurology (CONy 2009)*, Prague, Czech Republic, October 8-11, 2009.
5. S. Greco, M. Kadziński, V. Mousseau, R. Słowiński, Robust ordinal regression for outranking methods. *ROADEF 2010*, Toulouse, France, February 24-26, 2010.
6. M. Kadziński, S. Greco, R. Słowiński, The most representative parameter set for robust outranking approach. *71<sup>st</sup> Meeting of the EURO Working Group Multiple Criteria Decision Aiding (MCDA 71)*, Turin, Italy, March 25-27, 2010.
7. M. Kadziński, Robust ordinal regression methods for ranking problems on Decision Deck platform. *6<sup>th</sup> Decision Deck Workshop*, Coimbra, Portugal, April 14-15, 2010.
8. M. Kadziński, S. Greco, R. Słowiński, The most representative value function for robust ordinal regression in group decision problems, *25<sup>th</sup> Mini-EURO Conference Uncertainty and Robustness in Planning and Decision Making (URPDM 2010)*, Coimbra, Portugal, April 15-17, 2010.
9. M. Kadziński, S. Greco, R. Słowiński, Extreme ranking analysis in robust ordinal regression. *73<sup>rd</sup> Meeting of the EURO Working Group Multiple Criteria Decision Aiding (MCDA 73)*, Corte, France, April 14-16, 2011.
10. M. Kadziński, S. Greco, R. Słowiński, Interactive selection of representative preference models in robust ordinal regression. *21<sup>st</sup> International Conference on Multiple Criteria Decision Making (MCDM 2011)*, Jyväskylä, Finland, June 13-17, 2011.
11. M. Kadziński, S. Greco, R. Słowiński, RUTA: a framework for assessing and selecting additive value functions on the basis of rank related requirements. *74<sup>th</sup> Meeting of the EURO Working Group Multiple Criteria Decision Aiding (MCDA 74)*, Yverdon, Switzerland, October 6-8, 2011.
12. M. Kadziński, S. Greco, R. Słowiński, Extreme ranking analysis and rank related requirements in multiple objective optimization, *Learning in Multiobjective Optimization (Dagstuhl Seminar 12041)*, Dagstuhl, Germany, January 22-27, 2012.
13. M. Kadziński, T. Tervonen, Stochastic ordinal regression for multiple criteria sorting problems. *75<sup>th</sup> Meeting of the EURO Working Group on MCDA (MCDA 75)*, Tarragona, Spain, April 12-14, 2012.

before being awarded PhD ↑

after being awarded PhD ↓

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15. M. Kadziński, R. Słowiński, Interactive robust cone contraction method for multiple objective optimization problems, *77<sup>th</sup> Meeting of the EURO Working Group on MCDA (MCDA 77)*, Rouen, France, April 11-13, 2013.
16. M. Kadziński, Using diviz in teaching MCDA, *77<sup>th</sup> Meeting of the EURO Working Group on MCDA (MCDA 77)*, Rouen, France, April 11-13, 2013.
17. M. Kadziński, New Directions in Robustness Analysis and Preference Modeling in Multiple Criteria Decision Aiding, *22<sup>nd</sup> International Conference on Multiple Criteria Decision Making (MCDM 2013; during the final of MCDM Doctoral Dissertation Award 2013 competition)*, Malaga, Spain, June 17-21, 2013.
18. M. Kadziński, T. Tervonen, Stochastic ordinal regression for multiple criteria sorting problems, *22<sup>nd</sup> International Conference on Multiple Criteria Decision Making (MCDM 2013)*, Malaga, Spain, June 17-21, 2013.
19. M. Kadziński, T. Tervonen, Robust multi-criteria ranking with additive value models and holistic pair-wise preference statements, *26<sup>th</sup> EURO-INFORMS Conference (EURO 2013)*, Rome, Italy, July 1-4, 2013.
20. M. Kadziński, New Directions in Robustness Analysis and Preference Modeling in Multiple Criteria Decision Aiding, *26<sup>th</sup> EURO-INFORMS Conference (EURO 2013; during the final of the EURO Doctoral Dissertation Award 2013 competition)*, Rome, Italy, July 1-4, 2013.
21. M. Kadziński, S. Corrente, S. Greco, R. Słowiński, Preferential reducts and constructs in robust multiple criteria ranking and sorting, *78<sup>th</sup> Meeting of the EURO Working Group on MCDA (MCDA 78)*, Catania, Italy, October 24-26, 2013.
22. M. Kadziński, R. Słowiński, Parametric evaluation of research units with respect to reference profiles, *79<sup>th</sup> Meeting of EURO Working Group on Multicriteria Decision Aiding (MCDA 79)*, Demokritos Research Center, Athens, Greece, April 3-5, 2014.
23. R. Słowiński, M. Kadziński, S. Greco, Robust Ordinal Regression for Dominance-Based Rough Set Approach under Uncertainty, *2014 Joint Rough Set Symposium (JRS 2014)*, Madrid/Granada, Spain, July 9-13, 2014.
24. M. Kadziński, K. Ciomek, R. Słowiński, Integrated Preference Disaggregation Framework for Value-Driven Multiple Criteria Sorting, *20<sup>th</sup> Conference of the International Federation of Operational Research Societies (IFORS 2015)*, Barcelona, Spain, July 13-18, 2014.
25. S. Greco, S. Corrente, M. Kadziński, R. Słowiński, Inducing Probability Distributions on the Set of Value Functions, *20th Conference of the International Federation of Operational Research Societies (IFORS 2015)*, Barcelona, Spain, July 13-18, 2014.
26. R. Słowiński, M. Kadziński, S. Greco, Robust Ordinal Regression for Dominance-based Rough Set Approach to Decision under Risk, *20<sup>th</sup> Conference of the International Federation of Operational Research Societies (IFORS 2015)*, Barcelona, Spain, July 13-18, 2014.
27. T. Tervonen, A. Sepehr, M. Kadziński, Regional Anti-Desertification Management with a Multi-Criteria Inference Approach: A Study of the Khorasan Razavi Province in Iran, *20<sup>th</sup> Conference of the International Federation of Operational Research Societies (IFORS 2015)*, Barcelona, Spain, July 13-18, 2014.
28. M. Kadziński, S. Greco, R. Słowiński, Robust Ordinal Regression for Dominance-based Rough Set Approach to Multiple Criteria Sorting, *80<sup>th</sup> Meeting of EURO Working Group on Multiple Criteria Decision Aiding (MCDA 80)*, Universite LAVAL, Quebec, Canada, October 9-11, 2014.
29. M. Kadziński, Latest PUT contributions to the web-services effort, *12<sup>th</sup> Decision Deck Meeting*, Telecom Bretagne, Brest, France, October 30 - November 1, 2014.

30. M. Kadziński, R. Słowiński, Preference-driven cone contraction for multi-objective optimization, *INFORMS Annual Meeting 2014*, San Francisco, USA, November 9-12, 2014.
31. M. Kadziński, Preference learning in EMO: organization of interaction with the decision maker and group decision perspective, Dagstuhl Seminar 15031 - Understanding Complexity in Multiobjective Optimization, Dagstuhl, Germany, January 11-16, 2015.
32. M. Kadziński, M. Tomczyk, Using Ordinal Regression for Interactive Evolutionary Multiple Objective Optimization with Multiple Decision Makers, *Group Decision and Negotiation 2015* (GDN 2015), Warsaw School of Economics, Warsaw, Poland, June 22-26, 2015.
33. M. Kadziński, T. Tervonen, J. Figueira, Robust multi-criteria sorting with the outranking preference model and characteristic profiles, *27<sup>th</sup> European Conference on Operational Research* (EURO 2015), University of Strathclyde, Glasgow, United Kingdom, July 12-15, 2015.
34. M. Barbati, S. Greco, M. Kadziński, R. Słowiński, Portfolio decision analysis using interactive multi-objective optimization guided by Dominance-based Rough Set Approach, *27<sup>th</sup> European Conference on Operational Research* (EURO 2015), University of Strathclyde, Glasgow, United Kingdom, July 12-15, 2015.
35. M. Kadziński, M. Michalski, Scoring Procedures for Multiple Criteria Decision Aiding with Robust and Stochastic Ordinal Regression, *23<sup>rd</sup> International Conference on Multiple Criteria Decision Making* (MCDM 2015), Helmut Schmidt University, Hamburg, Germany, August 2-7, 2015.
36. M. Kadziński, T. Mieszkowski, M. Tomczyk, S. Bigaret, Construct your own ELECTRE, *82<sup>nd</sup> Meeting of EURO Working Group on Multicriteria Decision Aiding* (MCDA 82), University of Southern Denmark, Odense, Denmark, September 24-26, 2015.
37. M. Kadziński, K. Ciomek, R. Słowiński, Integrated Preference Disaggregation Framework for Value-Driven Multiple Criteria Sorting, *INFORMS Annual Meeting 2015* (INFORMS 2015), Philadelphia, USA, November 1-4, 2015.
38. M. Kadziński, K. Govindan, R. Sivakumar, Evaluation and selection of a green supplier in food supply chain using Promethee-based multiple criteria ranking approach for group decision making, *83<sup>rd</sup> Meeting of EURO Working Group on Multicriteria Decision Aiding* (MCDA 83), ESADE Business School, Barcelona, Spain, March 31 - April 2, 2016.
39. M. Kadziński, K. Ciomek, P. Rychły, R. Słowiński, Post factum analysis for robust multiple criteria ranking and sorting, *28<sup>th</sup> European Conference on Operational Research* (EURO 2016), Poznan, Poland, July 3-6, 2016.
40. K. Ciomek, M. Kadziński, T. Tervonen, Heuristics for prioritizing pair-wise elicitation questions with additive multi-attribute value models, *28<sup>th</sup> European Conference on Operational Research* (EURO 2016), Poznan, Poland, July 3-6, 2016.
41. M. Cinelli, M. Kadziński, K. Ciomek, S. Coles, M. Nadagouda, R. Varma, K. Kirwan, Co-constructive development of a sustainability assessment model, *28<sup>th</sup> European Conference on Operational Research* (EURO 2016), Poznan, Poland, July 3-6, 2016.
42. M. Kadziński, Construct your own Electre method, *13<sup>th</sup> Decision Deck Workshop*, CentraleSupélec, Paris, France, October 14, 2016.
43. M. Kadziński, Latest experience from using and future plans for developing diviz, *13<sup>th</sup> Decision Deck Workshop*, CentraleSupélec, Paris, France, October 14, 2016.

### III. INFORMATION CONTAINED IN THE SUMMARY OF PROFESSIONAL ACCOMPLISHMENTS (APPENDIX 2)

1. List of research visits - Section III.
2. Citations according to Web of Science, Scopus, and Google Scholar - for each paper individually (Section V) and all papers comprehensively (Section VI).

3. Bibliometric data (including the impact factor and the numbers of points awarded by the Polish Ministry of Science and Higher Education) - for each paper individually (Section V) and all papers comprehensively (Section VI).
4. Hirsch index according to Web of Science, Scopus, and Google Scholar - Section VI.
5. Description of the main contribution of the papers not included in the scientific accomplishment - Section VII.
6. Achievements in teaching and supervision of students - Section VIII.
7. Achievements in popularizing science - Section IX.
8. Leadership and participation in research projects - Section X.
9. International scientific collaboration - Section X.
10. Membership of the organizing and program committees - Section X.
11. Editorial boards' membership - Section X.
12. Reviewing for the international and national journals - Section X.
13. Membership of the international scientific organizations and societies - Section X.
14. International and national awards and distinctions for the scientific achievements - Section XI.

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