

Review on Doctoral thesis

Title: Game theory in Waste Management

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Reviewer: Doc. RNDr. Ing. Miloš Kopa, Ph.D.

Description of the Doctoral Thesis

The main goal of the thesis was to apply the theory of cooperative and non-cooperative games to selected waste management problems using techniques of single-level and bi-level optimization.

Structure of the Doctoral Thesis

The doctoral dissertation thesis consists of five chapters. After Introduction, theoretical background is summarized. It provides all the necessary details from Game Theory (GT) needed for solving the selected waste management (WM) problems. It is followed by literature review on GT applications to sustainable research. The most interesting part is Chapter 4 where the author formulates and solves two selected waste management problems using no-cooperative and cooperative game theory as well as bi-level optimization techniques. The last chapter concludes the doctoral thesis.

Comments and questions to the Doctoral Thesis

- 1, The theoretical background is written with all the mathematical precision, but the definitions are not numbered.
- 2, At p. 9: The Correspondence is defined as a mapping from X to 2^Y . What 2^Y stands for? And how we should understand it in Theorem 2.1.1 where the Correspondence is considered as a mapping from X to X ?
- 3, At p. 16: For superadditive games we have that the core coincides with the set of undominated imputations. However, as you point out, this need not to be true for non-superadditive games. Can you present some simple example showing that, please?
- 4, In section 2.2.2 (Page 23): a coalition structure is considered, however, the mathematical definition of this term is missing. What exactly is the coalition structure from the mathematical point of view? Is it a set of subsets of N ? If so, it has to fulfil some conditions...I missed it in the thesis.
- 5, There is a "strange" formula in the first line of Chapter 4.1.3. Could you please explain it?
- 6, The formulation of the problem at page 38 seems to be incomplete. The definition of $x_{i,j}^*$ is missing as well as non-negativity constraints on $x_{i,j}$.
- 7, In the first exemplary case study, the pessimistic approach in bi-level programming was used. How would the results differ if optimistic or some other approach would be employed? Are there some non-unique optimal solutions at the lower level?

8, In the second exemplary case study, three larger (non-singleton) coalitions were formed. Are there some common (socio-economic) factors for members of a coalition (at least for one coalition)? What are the relative savings (in percentage) of these coalitions comparing to the starting point where every player formed its own coalition?

Evaluation

Despite of the above mention comments, this thesis is of very high quality. It presents original results from theoretical, algorithmic and application point of view. Some of them already have been published in impact factor journals. The thesis formulates, solves and analysis two difficult (but very interesting) WM problems which have not been addressed before. The formal level of the thesis is also very high, there are almost no typos or mathematical imperfections. I have no doubts that the thesis fulfils all the requirements.

Therefore, **I fully recommend to accept the thesis** for the defense.

In Prague, 28.1.2024

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