

Development of open source code for computing the nucleolus of cooperative games

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Abstract

The nucleolus is one of the most widely used solution concepts in cooperative game theory, it has many attractive properties, such as (under mild assumptions) it exists and is unique, it is a continuous function of the game, etc. It thus provides one of the most stable and fair solutions. However, its computation is an extremely complex task due to its exponential size in the number of players.

In my thesis, I implement the state-of-the-art algorithm computing the nucleolus, the lexicographic descent method, in Python environment and perform an extensive numerical comparison with other classical algorithms from the literature.

The Python environment is a widely used and rapidly spreading language both in academia and industry, thus we can reach a large number of potential users by implementing these methods in Python. However, this environment poses many challenges, as it is a new type of implementation.

Altogether four algorithms are implemented and compared to each other by different properties. These evaluating aspects are mainly the average runtime and number of iterations, as long as absolute error is within reasonable boundaries.

After reading the related literature, we started to build up and implement each algorithm one by one using concrete examples of games to be able to check the correctness of the code. In the meantime we faced a few difficulties, but we were able to solve these problems during the work.

After all, we have successfully achieved our main goal and tested the algorithms. The results did not reflect totally all the previously set expectations and had different outcomes than in the literature, thus, in the following, I plan to review the implementations and introduce new directions of development.