

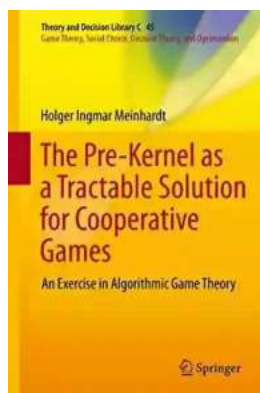
# The Pre Kernel As Tractable Solution For Cooperative Games

Cooperative games have been a subject of interest for researchers in the field of game theory and computer science. Understanding how players can cooperate to achieve mutually beneficial outcomes is crucial in various domains such as economics, politics, and social networks. Over the years, several solution concepts have been developed to address the challenges posed by cooperative games.

One of the prominent solution concepts is the pre kernel, which has gained attention due to its tractability properties. The pre kernel provides a unique allocation of payoffs to players that satisfies certain desirable properties. In this article, we will explore the pre kernel solution concept and its applications in cooperative games.

## What is the Pre Kernel?

The pre kernel is a solution concept in cooperative game theory that aims to allocate payoffs to players in a fair and efficient manner. It is based on the idea of stability, where a coalition of players cannot deviate from their allocated payoffs and form a more beneficial coalition.



## The Pre-Kernel as a Tractable Solution for Cooperative Games: An Exercise in Algorithmic Game Theory (Theory and Decision Library C Book 45)

by Holger Ingmar Meinhardt(2014th Edition, Kindle Edition)

★★★★☆ 4 out of 5

Language : English

File size : 15914 KB  
Text-to-Speech : Enabled  
Enhanced typesetting : Enabled  
Word Wise : Enabled  
Print length : 471 pages  
Screen Reader : Supported



Formally, a pre kernel allocation satisfies three properties:

- **Efficiency:** The sum of payoffs allocated to all players is equal to the worth of the grand coalition, i.e., the maximum achievable payoff when all players cooperate.
- **Individual Rationality:** No player can obtain a payoff higher than the worth of their own contribution.
- **Coalition-Proofness:** No coalition of players can deviate from their allocated payoffs and form a coalition that yields higher total payoff.

These properties ensure that the pre kernel allocation provides a fair and stable solution for cooperative games. However, computing the pre kernel can be computationally expensive for large games, which has limited its practical applications.

## Applications of the Pre Kernel

Despite the computational limitations, the pre kernel has found diverse applications in various domains. Let's explore some of its notable applications:

### Resource Allocation

In resource allocation problems, the pre kernel can be used to distribute resources among multiple agents or organizations in a fair and efficient manner. By allocating payoffs based on stability and coalition-proofness, the pre kernel ensures that no agent can gain more resources than their respective contributions.

## **Network Formation**

In social network formation, the pre kernel can be utilized to model the formation of coalitions or groups. By allocating payoffs that satisfy individual rationality and coalition-proofness, the pre kernel enables the efficient formation of stable networks where players have balanced contributions and rewards.

## **Power Distribution**

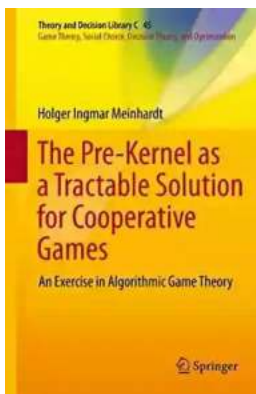
In political or organizational settings, the pre kernel can be employed to distribute power among different entities. By considering stability and coalition-proofness, the pre kernel guarantees that no group can gain more power than their proportional share, leading to a fair and balanced distribution of decision-making authority.

## **Challenges and Future Directions**

While the pre kernel offers a tractable solution for cooperative games, it still faces certain challenges. One of the main challenges is the computational complexity involved in computing the pre kernel for large games.

Future research is focused on developing efficient algorithms and approximation techniques to overcome these computational barriers. Additionally, there is a need for the application of the pre kernel in practical scenarios to assess its effectiveness and impact in real-world cooperative settings.

The pre kernel solution concept provides a tractable and fair solution for cooperative games. By satisfying efficiency, individual rationality, and coalition-proofness, the pre kernel ensures that payoffs are allocated in a stable and beneficial manner. Although computational challenges exist, the pre kernel has promising applications in resource allocation, network formation, and power distribution. Continued research in this area will further enhance our understanding and practical utilization of the pre kernel in cooperative game settings.



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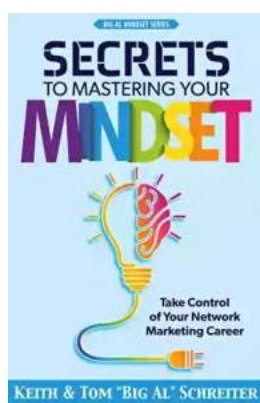
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This present book provides an alternative approach to study the pre-kernel solution of transferable utility games based on a generalized conjugation theory from convex analysis. Although the pre-kernel solution possesses an appealing axiomatic foundation that lets one consider this solution concept as a standard of fairness, the pre-kernel and its related solutions are regarded as obscure and too technically complex to be treated as a real alternative to the Shapley value.

Comprehensible and efficient computability is widely regarded as a desirable feature to qualify a solution concept apart from its axiomatic foundation as a standard of fairness. We review and then improve an approach to compute the pre-kernel of a cooperative game by the indirect function. The indirect function is known as the Fenchel-Moreau conjugation of the characteristic function. Extending the approach with the indirect function, we are able to characterize the pre-kernel of the grand coalition simply by the solution sets of a family of quadratic objective functions.



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