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# Proportional coalition values for monotonic games on convex geometries with a coalition structure

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**Abstract:** A new model called games on convex geometries with a coalition structure is introduced, where all players and the coalition structure form a convex geometry, respectively. An explicit form of the proportional coalition solidarity value is given, which endows each union with the solidarity value in quotient games, and then allocates this value to players in a union following the proportions of their solidarity values in original games on convex geometries (i.e., without unions). Meanwhile, an axiomatization of this value is offered. Furthermore, the proportional coalition Shapley value is introduced. Its explicit form is offered, and an axiomatic system is studied.

**Keywords:** game theory; coalition structure; convex geometry; proportional coalition solidarity value; proportional coalition Shapley value

## 1. Introduction

Games with a coalition structure are an important researching topic that has been received considerable attention in recent years. [Aumann and Drèze \[1\]](#) first noted such cooperative forms and introduced a model for games with a coalition structure. In this model, unions are independent with each other, and every player's payoff is only related to subgame on union including him. Different from Aumann and Drèze's model, [Owen \[2\]](#) introduced another model for games with a coalition structure, where the probability of cooperation among unions is considered. A coalitional value called the Owen value is proposed, which can be seen as an extension of the Shapley value on classical games. Later, [Owen \[3\]](#) and [Alonso-Mejide and Fiestras-Janeiro \[4\]](#) presented the Banzhaf-Owen value and the symmetric coalitional Banzhaf value for Owen's model, respectively. To show the rationality of these coalitional values, researches about axiomatic systems can be seen in the literature [\[5-8\]](#). Different from these coalitional values, [Alonso-Mejide and Carreras \[9\]](#) defined a coalitional value for monotonic games with a coalition structure called the proportional coalition Shapley value. For this value: each union's payoff coincides with its Shapley value in quotient games, and players in the union share this payoff according to their Shapley values in original games (i.e., without unions). Meanwhile, the authors studied two axiomatizations of this value.

Due to various reasons, such as history, social system, and economy development level, players cannot cooperate freely. In the game theory, this type of cooperative models is called games under precedence constraints. [Myerson \[10\]](#) researched such games and defined the Shapley value for games with communication structure. [Faige and Kern \[11\]](#) presented a special type of games under precedence constraints and defined the Shapley value. [Gilles et al. \[12\]](#) studied games with conjunctive permission

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