

Strategic Cost Selection in Participatory Budgeting

Extended Abstract

Piotr Faliszewski
AGH University
Kraków, Poland
faliszew@agh.edu.pl

Łukasz Janeczko
AGH University
Kraków, Poland
ljaneczk@agh.edu.pl

Andrzej Kaczmarczyk
AGH University
Kraków, Poland
andrzej.kaczmarczyk@agh.edu.pl

Grzegorz Lisowski
AGH University
Kraków, Poland
glisowski@agh.edu.pl

Piotr Skowron
University of Warsaw
Warsaw, Poland
p.skowron@mimuw.edu.pl

Stanisław Szufa
AGH University
Kraków, Poland
s.szufa@gmail.com

ABSTRACT

We study strategic behavior of project proposers in the context of participatory budgeting. We assume that the votes are fixed and known and the proposers want to set as high project prices as possible, provided that their projects get selected and the prices are not below the minimum costs of their delivery. We study the existence of Nash equilibria in such games. Furthermore, we report an experimental study of the games we propose.

KEYWORDS

Participatory Budgeting; Equilibria; Cost Selection; Game Theory

ACM Reference Format:

Piotr Faliszewski, Łukasz Janeczko, Andrzej Kaczmarczyk, Grzegorz Lisowski, Piotr Skowron, and Stanisław Szufa. 2024. Strategic Cost Selection in Participatory Budgeting: Extended Abstract. In *Proc. of the 23rd International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2024)*, Auckland, New Zealand, May 6 – 10, 2024, IFAAMAS, 3 pages.

1 INTRODUCTION

Consider a certain city that wants to use participatory budgeting [2, 3, 7] to let its inhabitants decide what improvements to implement. The city council fixed the available budget and asked people to submit their ideas. Specifically, each citizen could submit a project where he or she would outline the type of action to take as well as the cost of carrying it out. The citizens quickly seized the opportunity and came up with a number of proposals. However, they also realized that choosing the costs of the projects is not obvious. For example, to find the cost of building a bike path one might ask a construction company for a quote, but one would get a whole range of costs, depending on the width of the path, the materials used, the possible adaptations of the surrounding area, and so on. Indeed, the more expensive a project is, the better it fulfills its goals, but also the less likely it is to be funded (for example, due to a limited budget). Our approach is to analyze the strategic nature of project cost selection under various participatory budgeting rules.

The Game. We assume that the sets of projects and of voters, who indicate which projects they approve, are fixed. Each project is controlled by a different proposer choosing its cost so that it is as high as possible while remaining selected. However, each project also has the lowest cost under which it can be reasonably implemented and the proposers prefer costs that are at least as high. Importantly, whether a voter approves a project or not, does not depend on its cost. The projects are chosen according to a given rule. In other words, we consider a game where project proposers (or, for simplicity, the projects) are the players, project costs are their strategies, and costs of selected projects (minus their delivery costs) are their payoffs. We analyze whether these games have pure Nash equilibria and, if so, what costs are reported under these equilibria.

2 PRELIMINARIES

Participatory Budgeting. We define a *PB instance* as a tuple $E = (P, V, B, cost)$, where $P = \{p_1, \dots, p_m\}$ is a set of projects, $V = \{v_1, \dots, v_n\}$ is a set of voters, $B \in \mathbb{R}_+$ is the available *budget*, and $cost: P \rightarrow \mathbb{R}_+$ is a function specifying the *cost* of each project. Each voter v_i casts a nonempty *approval ballot* $A(v_i) \subseteq P$. Also, $A(p_i)$ is the set of voters that approve p_i . Then, $|A(p_i)|$ is the *approval score* of p_i . We assume that $|A(p_i)| \geq 1$. Given a subset of projects P' , we let $cost(P') = \sum_{p' \in P'} cost(p')$. Further, each PB instance comes with an implicit tie-breaking order $>$ over the projects.

Participatory Budgeting Rules. A *PB rule* is a function f that for a PB instance $E = (P, V, B, cost)$ outputs a set $f(E) \subseteq 2^P$ of projects, with total cost not exceeding the budget. We focus on the following:

BasicAV. It starts with $W = \emptyset$ and considers all the projects following their nonincreasing approval scores (with ties broken using $>$), inserting a considered project p into W if $cost(W \cup \{p\}) \leq B$.

AV/Cost. It is like BasicAV, but orders projects by $|A(p)|/cost(p)$.

Phragmén [1, 4]. Phragmén starts with $W = \emptyset$. Initially, the voters have empty accounts and they continuously earn money at the same pace. When there is a project p whose voters have $cost(p)$ funds and is within the remaining budget, p is included in W , the accounts of voters in $A(p)$ are set to zero, and p is removed from consideration. If $cost(W \cup \{p\}) > B$, then p is removed from consideration. At a time, the best such project in $>$ is taken. The rule outputs W when all projects are removed from consideration.

Method of Equal Shares (MES-Cost) [5, 6]. First, each voter receives $B/|V|$ amount of money. Then, we let $W = \emptyset$. Within



This work is licensed under a Creative Commons Attribution International 4.0 License.

