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Between Equality and Proportionality: The Generalized Divisor Method*

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Abstract

In the paper, we address the problem of dividing indivisible goods, taking into account both proportionality and equality, which are key issues in practical applications such as the division of parliamentary seats or the allocation of resources. Traditional divisor methods focus primarily on proportional division, while the literature lacks tools for flexible modeling of intermediate solutions that combine proportionality with equal treatment of participants. In particular, traditional divisor methods are not applicable to arbitrary degressively proportional allocations. In response to this gap, we propose the Generalized Divisor Method (GDM), which extends the classical approaches widely described in the literature that focus on a single global divisor. To this end, we introduce additional individual divisors assigned to each participant in the division, enabling, among other things, precise shaping of the degree of degressive proportionality. Further on, we formalize the conditions ensuring the preservation of degressive proportionality with respect to the vector of entitlements and introduce parameterization allowing to control the trade-off between proportionality and equality. We show how the proposed GDM method guarantees monotonicity and fairness of allocation thanks to the parameterization used. The results obtained indicate that the proposed methodology allows for the generation of allocations covering the full spectrum of solutions, from completely proportional, through gradual transitions towards degressive proportionality, to equality-based distributions. This flexibility allows the fairness criteria to be adapted to the specificities of different apportionment problems.

Keywords: Apportionment problems, divisor methods, fair division, degressive proportionality

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