

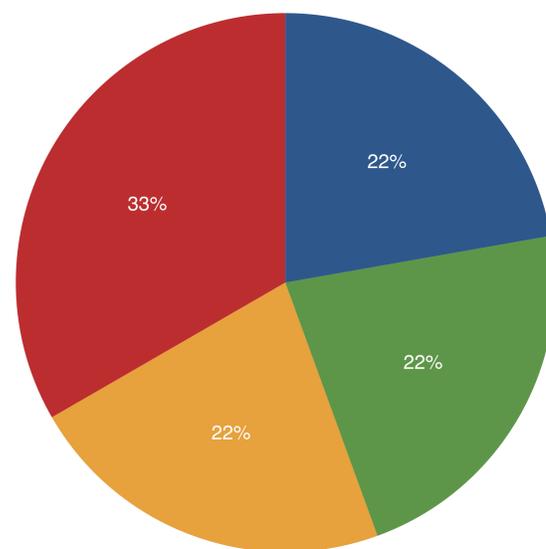
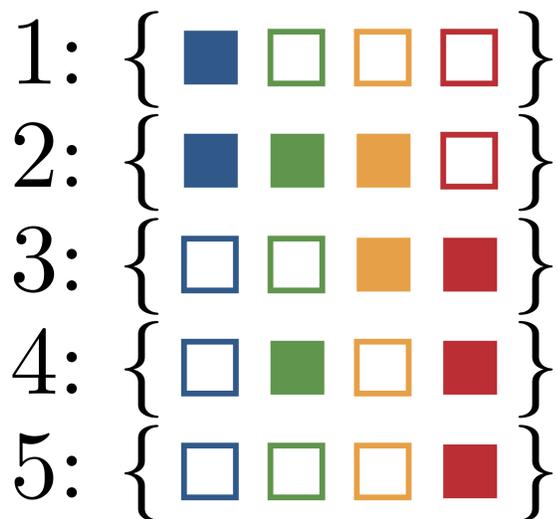
How to Split a Budget with Approvals

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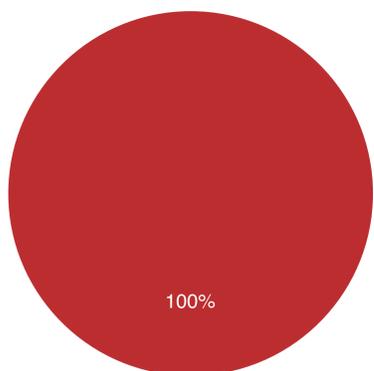
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We need to divide a budget among projects. Voters want money to be spent on approved projects.

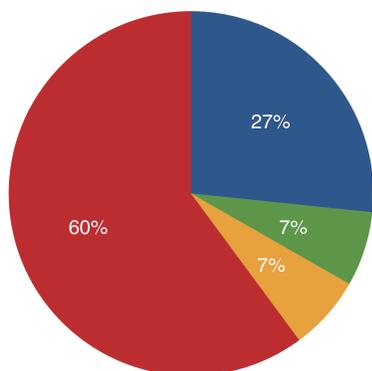


UTILITARIAN
*pick the split maximising welfare
spend everything on approval winner*



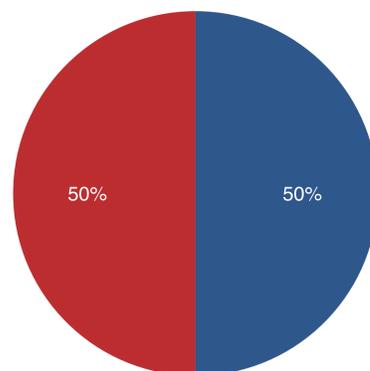
- ✓ Pareto-efficient
- ✓ strategyproof
- ✗ fair to individuals
- ✗ fair to groups

EQUAL SHARES
*each voter decides on 1/n of budget
spends on projects with highest score*



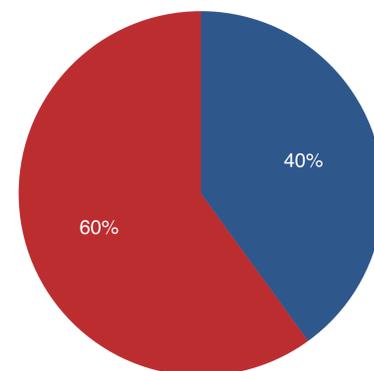
- ✗ Pareto-efficient
- ✓ strategyproof
- ✓ fair to individuals
- (✓) fair to groups

LEXIMIN
*pick the split maximising
leximin welfare*



- ✓ Pareto-efficient
- ✗ strategyproof
- ✓ fair to individuals
- ✗ fair to groups

NASH PRODUCT
*pick the split maximising
Nash product of utilities*



- ✓ Pareto-efficient
- ✗ strategyproof
- ✓ fair to individuals
- ✓ fair to groups

based on Aziz, Bogomolnaia, Moulin (arXiv 2017)

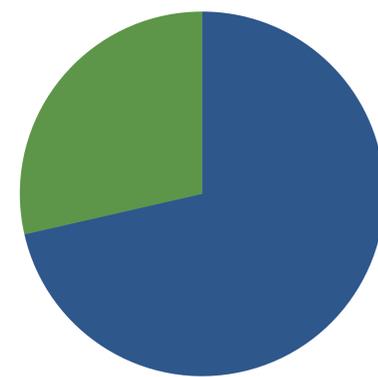
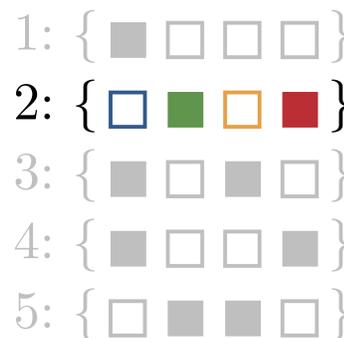
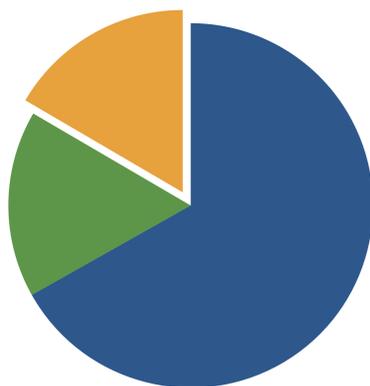
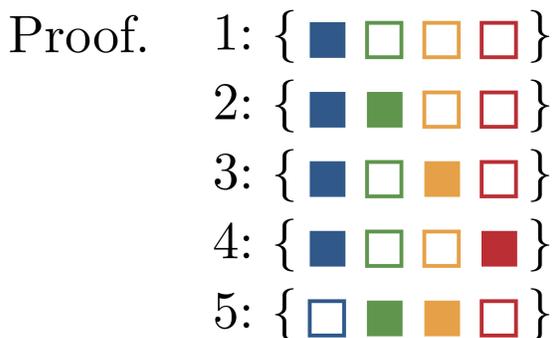
Q: Can we be efficient, strategyproof, and fair?

A: No, not even for extremely weak versions of these axioms.

Bogomolnaia, Moulin, and Stong (JET 2005) obtain a similar impossibility with much stronger axioms.

We do not need anonymity or neutrality. Our fairness notion only requires no voter has utility 0.

We show: every efficient and fair rule is vulnerable to *free-riding*.



Other Applications

- Electing a Parliament
what fraction of seats should a party get?
- Participatory Budgeting
for regions, companies, etc.
- Multi-Criteria Decision Making
how important are different criteria?
- Donor Coordination
to which charities should we donate?

Method

- Use SAT solvers to find impossibility theorems
- Discretise problem, translate to propositional logic -> UNSAT
- Can obtain human-readable proof
- Also used for committee elections, characterisations, voting...