Maximin Fair Allocation

Authors
Taj Allamby

Affiliations
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The Problem
We wish to find the best way to allocate a number of indivisible items to a number of people (called agents). For the purpose of our research, we worked with 3 agents.

Why do we care?
Solving this problem helps us find the best way to fairly divide items up between a group of people. For example, let’s say you and two friends were presented with a group of indivisible items to an number group of individuals. We had two different methods we explored for finding the best MMS- allocation:

1. Proportional Share
2. Maximin Share

Exhaustive Search Formula

Given n is the number of agents and m is the number of items.

\[ MMS = \max_{A} \min_{i} \frac{\sum_{j \in A_i} v_j}{|A_i|} \]

MMS Proof
We assume that n is 3, and that j is 1 ≤ j ≤ 1 ≤ 3 ≤ j ≤ 1. We wish to prove that MMS is greater than or equal to 1.

Exhaustive Search

This algorithm tries all possible allocations and selects an allocation with the highest value of p_i, where p_i is the minimum value of p_j over all agents.

Atomic Exhaustive Search

This algorithm partitions items into n m atomic bundles, where there is a possibility that some of the bundles may be empty.

Drawbacks

- Not clear to analyze what value of p is being guaranteed.
- Runs in exponential time to m, as it goes over all n^m possibilities.

Want more info? Scan here for the paper!