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Stability in Combinatorial Markets with Side Payments

Alexander Grosz, Chiara Vanoli

Combinatorial markets provide a general framework for trading bundles of indivisible goods. Building on the combinatorial market models of Bikhchandani & Ostroy and Bichler & Waldherr, we introduce explicit side payments, thereby allowing restricted transfers of utility among subsets of agents and capturing different forms of financial collusion.
This extension results in a large number of seemingly distinct market settings. However, we establish a systematic classification of their expressive power. Most notably, we show that higher-order market settings (i.e., those with more personalized prices and less clearinghouse power) are essentially equivalent in terms of market properties when side payments are permitted between buyers. An analogous collapse occurs for the third- and higher-order settings when side payments are permitted between sellers. In contrast, we identify a fundamental structural separation between the second- and third-order settings.
To analyze stability in these environments, we generalize the classical concepts of stability with and without transferable utility (TU and NTU) to a partition-based notion of restricted transferability (the T-core). We relate stable outcomes across different settings to appropriate stability notions, identify market instances in which partially transferable utility yields a better (or any) stable outcome, and show that under personalized pricing, all stability notions collapse to NTU-stability.

Perpetually Fair Assignments Via Balanced Sequences of Permutations

Terrence Adams, Erel Segal-Halevi

There is a set of n indivisible items (or chores), and a set of n players. Each day, a single item should be assigned to each player. We want to ensure that all players feel that they have been treated fairly, not only after the last day, but after every single day. We present two 'balance' conditions on sequences of permutations. One condition can always be satisfied, but is arguably too weak; a second condition is strong, and can be satisfied for all n ¡= 11, but cannot be satisfied for some larger values of n including all n¿61.
We then relate the 'balance' condition to the requirement that the cumulative assignment is proportional up to one item (PROP1), where proportionality holds in a strong ordinal sense — for every valuations that are consistent with the item ranking. We present a third balance condition that implies ordinal PROP1. We show that a sequence guaranteeing this balance condition exists for all n ¡= 12, but might not exist when n=6k for any k ¿= 19.
Finally, we present a fourth, weaker balance condition on a sequence, that guarantees ordinal proportionality up to two items (PROP2). Whether or not this condition can be satisfied for all n remains an open question.

Distributed Agent-Constrained Truthful Facility Location

Argyrios Deligkas, Panagiotis Kanellopoulos, Alexandros Voudouris

We study a distributed facility location problem in which a set of agents, each with a private position on the real line, is partitioned into a collection of fixed, disjoint groups. The goal is to open k facilities at locations chosen from the set of positions reported by the agents. This decision is made by mechanisms that operate in two phases. In Phase 1, each group selects the position of one of its agents to serve as the group's representative location. In Phase 2, k representatives are chosen as facility locations. Once the facility locations are determined, each agent incurs an individual cost, defined either as the sum of its distances to all facilities (sum-variant) or as the distance to its farthest facility (max-variant). We focus on the class of strategyproof mechanisms, which preclude the agents from benefiting through strategic misreporting, and establish tight bounds on the approximation ratio with respect to the social cost (the group-normalized average individual cost) in both variants.

Minimizing Cumulative Envy in Allocating a Sequence of Items

Paul Goldberg, Isaac Robinson, Nicholas Teh

We study temporal fair division with indivisible goods that arrive sequentially and must be allocated irrevocably. In contrast to the usual online model, we assume that valuations and future arrivals are known in advance, and ask how unfairness evolves during the process. We introduce *cumulative maximum envy*: the sum, over all rounds, of the maximum pairwise envy at that round. Equivalently, this is the area under the worst-envy curve, and it captures both the magnitude and the duration of envy. For a fixed arrival order, we show that this optimization problem is strongly NP-complete and admits no constant-factor approximation, even under identical valuations and even under binary valuations. We complement these hardness results with a dynamic program that gives pseudopolynomial-time solvability for a constant number of agents, polynomial-time algorithms in further restricted settings, and an FPTAS for fixed n under identical integer valuations. We then study a sequencing variant where the algorithm may choose the arrival order. This variant remains NP-complete even for two agents with identical valuations; however, a simple greedy algorithm achieves a $3/2$-approximation for $n = 2$ agents, an $n/(n-1)$-approximation for any number of agents, and an additive guarantee depending on the maximum value of any good.

Distributionally Robust Contract Design with Deferred Inspection

Halil Ibrahim Bayrak, Martin Bichler

We study a robust contract design problem with deferred inspection, in which a principal allocates a scarce resource to an agent, observes the agent's realized outcome ex post at negligible cost, and conditions transfers on this information through rewards. The principal faces ambiguity about the agent's value distribution and seeks to maximize worst-case expected revenue subject to incentive compatibility and limited liability. In contrast to existing work on inspection mechanisms, which relies on common-prior assumptions, we adopt a distributionally robust approach based on moment information. Our main contribution is a clear characterization of the robust contract design problem with a single agent. When the ambiguity set is defined by the first moment, we identify a robustly optimal contract with a concave allocation rule and a linear payment rule. We further show that robustness does not uniquely pin down transfers: we construct a Pareto robustly optimal contract that preserves the same allocation while extracting maximal feasible payments from all types, yielding strictly higher expected revenue under non-worst-case distributions. We also derive structural results for multi-agent extensions. For ambiguity sets defined by the first N moments, we show that robust optimality requires aggregate payments to be lower bounded by a multi-dimensional polynomial of degree N. However, unlike the single-agent case, robust multi-agent mechanisms are substantially more complex: dominant-strategy incentive compatibility becomes necessary, simple monotone mechanisms are no longer tractable, and worst-case distributions may involve correlated types or degenerate to a Dirac distribution at the mean.

On the Power of Deception in Repeated Games

Melissa Dutz, Dimitar Chakarov, Saba Ahmadi, Avrim Blum

In repeated games, opponents often predict what we'll do next by looking at what we have done so far. This allows us to deceive them: we can deliberately behave one way for a period of time to shape their expectations, then switch strategies to profit from the induced response. We study deception in repeated two-player normal-form games against count-based learners, whose behavior depends only on how often we have played each action in the past. We formalize deceptive and non-deceptive play, and introduce the notion of a deception bonus, the payoff gain of the best deceptive strategy over the best fixed mixed strategy. We establish structural results on deception in general-sum games. We design exact dynamic programs for optimizing against any count-based learner when the action space or opponent's memory is small, and develop approximation algorithms for settings where the opponent's memory or the time horizon is large. We also provide an approximation algorithm for learning to deceive an opponent whose count-based learning rule is unknown. To complement our algorithmic results, we show that approximating the optimal deceptive payoff against the classic Empirical Risk Minimization (ERM) learning rule is NP-hard, including obtaining any constant-factor approximation or even a T^a-additive approximation for any $0 < a < 1$. Finally, we empirically measure the deception bonus in random games with i.i.d. payoffs.

Computing Fair and Efficient Indivisible Chore Allocations with Bounded Surplus

Nicholas Teh

We study the problem of allocating indivisible chores with additive costs, seeking allocations that are weighted envy-free up to one chore (WEF1) and fractionally Pareto optimal (fPO). Mahara (SODA 2026) recently proved that such allocations always exist, but finding one in polynomial time for general instances remains open. We give a polynomial-time algorithm for the setting with bounded surplus chores: for every fixed constant s, a WEF1 and fPO allocation can be computed whenever the number of chores is at most the number of agents plus s. This guarantee allows for arbitrarily many agents and arbitrarily many distinct cost functions. Our approach works through a prescribed bundle size problem. The key parameter is the number of chores assigned beyond the first chore in each nonempty bundle. When this surplus is S, we decide whether there is a WEF1 and fPO allocation respecting the prescribed bundle sizes, and compute one if it exists, in time $m^S \mathrm{poly}(n, m, L)$, where L is the total input bit length. The algorithm relies on two structural observations: with positive costs and fixed bundle sizes, fPO is equivalent to minimizing the product of assigned costs; and agents who receive at most one chore impose no nontrivial WEF1 constraints. We complement the algorithm with a hardness result showing that the prescribed bundle size problem becomes strongly NP-hard when the surplus is unbounded, even with two agent types and bundle sizes restricted to $\{3, 5\}$.

Network Allocation Games with Anonymous Preferences

Argyrios Deligkas, Eduard Eiben, Šimon Schierreich, Alexandros Voudouris

We study network allocation games in which a set of agents must be allocated to (a subset of) the vertices of a graph topology. The agents are anonymous and strategic: Each of them aims to maximize her utility, which is a function of the number of agents in the neighborhood of their allocated vertex. We focus on the existence and the computation of stable allocations under various notions of stability. More specifically, we study swap-based stability notions, where agents can exchange locations between them, and jump-based stability notions, where agents can jump to an empty vertex of the graph. For almost all stability notions we consider, we provide dichotomies between existence and intractability that depend on the structure of the utility functions of the agents and the topology. In addition, we prove strong intractability results for computing allocations that are Pareto optimal, or that maximize various notions of welfare.

Temporal Fair Division of Indivisible Goods with Structured Constraints

Kui-Wang Choi, Minming Li

This paper investigates temporal fair division, a setting where items are allocated over multiple rounds and agents require cumulative fairness over time. We focus on dynamic extensions of classic fairness notions: Temporal Envy-Freeness Up to Any Good (TEFX), along with its approximation α-TEFX, and Temporal Maximin Share (TMMS). Because these strict fairness criteria are known to be impossible to satisfy in general, we analyze the model under constraints to map the boundary between what is possible and what is impossible.
Our contribution systematically maps the structural boundaries of these temporal fairness notions. Our main technical result introduces a novel dynamic backtracking framework that achieves exact TEFX for Strong Generalized Binary Valuations. We prove, via a lexicographical potential function argument, that this bounded historical reallocation systematically resolves temporal envy cycles and terminates in finite time. Finally, we establish tight approximation ratios for α-TEFX under identical valuations and bi-valued goods, alongside targeted impossibility results for TEFX and TMMS, demonstrating exactly where temporal fairness is mathematically unattainable, and properly contextualizing prior algorithms that only implicitly satisfied our newly defined TMMS metric.

Robustness of Persuasion to Receiver Preferences

Ronen Gradwohl, Fengming Hu, Rann Smorodinsky

We study the robustness of Bayesian persuasion to uncertainty about the receiver's preferences. We analyze two conceptually distinct notions: continuity, in which only the modeler lacks precise knowledge, but where the model's predictions are nonetheless accurate; and robustness, in which the sender also lacks precise knowledge, but where the outcome is insensitive to this ignorance. We model preference uncertainty as infinitesimally small, non-probabilistic (Knightian) uncertainty, and the sender's behavior as either minimizing the regret or maximizing the minimum utility. We show that continuity holds if and only if robustness holds, and that both notions are generic. Thus, while some instances of Bayesian persuasion are fragile, typical instances are both continuous and robust with respect to a small amount of ignorance.

Improved Lower Bounds and Output Augmentation for Facility Location Mechanisms

Rafael Gomes, Sophie Klumper, Guido Schäfer, Jens Schlöter

We study the facility location problem in Euclidean space under the egalitarian objective, where a mechanism selects a facility location based on the reported positions of n agents so as to minimize the maximum distance to any agent. While the line case is well understood, much

less is known in higher dimensions: even in the plane the achievable approximation guarantees of randomized mechanisms that are strategyproof in expectation are poorly understood.
We prove a lower bound of $1+\sqrt{d/(2(d+1))}$ on the approximation ratio of any strategyproof in expectation mechanism in any dimension d as $n \to \infty$, improving the previous best lower bound of 1.118 in the plane to 1.577. The construction is based on a simple geometric configuration that extends to higher dimensions. We show that this barrier is driven by large populations: for $n = 2$ we derive a $\sqrt{2}$-approximate mechanism, while for $n \geq 3$ we prove a lower bound of 1.277.
We then study output augmentation, where the facility may lie outside the agents' domain. For agents on a line with facility in the plane, we design a deterministic strategyproof $\sqrt{2}$-approximate mechanism with a matching lower bound. This already breaks the 3/2 lower bound for randomized mechanisms without augmentation, establishing that output augmentation allows for strictly more powerful mechanisms.
As our main technical result, we obtain a randomized 3/2-approximate mechanism that is group-strategyproof in expectation for agents on the unit circle and facility in the plane. The mechanism distributes probability mass in a report-dependent way between the optimal facility location and extreme agent locations. We complement this with a lower bound of 2 for deterministic group-strategyproof mechanisms, showing the limitations of output augmentation without randomization.

Simultaneous Ordinal Maximin Share and Envy-Based Guarantees

Timo Reichert, Hannaneh Akrami

We study the fair allocation of indivisible items among agents with additive valuations. The fair division literature has traditionally focused on two broad classes of fairness notions: envy-based notions and share-based notions. Within the share-based framework, most attention has been devoted to the maximin share (MMS) guarantee and its relaxations, while envy-based fairness has primarily centered on EFX and its relaxations. Recent work has shown the existence of allocations that simultaneously satisfy multiplicative approximate MMS and envy-based guarantees such as EF1 or EFX.
Motivated by this line of research, we study–for the first time–the compatibility between *ordinal* approximations of MMS and envy-based fairness notions. In particular, we establish the existence of allocations satisfying the following combined guarantees for goods: (i) simultaneous 1-out-of-$\lceil 3n/2 \rceil$ MMS and EFX for ordered instances; (ii) simultaneous 1-out-of-$\lceil 3n/2 \rceil$ MMS and EF1 for top-n instances; and (iii) simultaneous 1-out-of-$4\lceil n/3 \rceil$ MMS and EF1 for ordered instances. For chores, we prove the existence of allocations that simultaneously satisfy 1-out-of-$\lfloor 2n/3 \rfloor$ MMS and EF1 for instances that are both top-n and top-$2n$.

Single-Agent Stability in Additively Separable Hedonic Games with Constrained Coalition Sizes

Martin Bullinger, Adam Dunajski, Edith Elkind, Matan Gilboa

We study stability in additively separable hedonic games when coalition sizes have to respect a fixed lower bound lambda and upper bound mu. We consider four classic notions of stability based on single-agent deviations, namely, Nash stability, individual stability, contractual Nash stability, and contractual individual stability. For each stability notion, we consider two variants: in one, the coalition left behind by a deviator must still be of size lambda, and in the other there is no such constraint. We provide a full picture of the existence of stable outcomes with respect to given parameters lambda and mu. Additionally, when there are only upper bounds on coalition sizes, we fully characterize the computational complexity of the associated existence problem.

In particular, we obtain polynomial-time algorithms for contractual individual stability and contractual Nash stability, where the latter requires mu = 2. We obtain further results for Nash stability and contractual individual stability when lambda is at least 2.

Control and Bribery in Stable Marriage and Roommates: A Complete Complexity Landscape

Jiehua Chen, Ildikó Schlotter

We study control and bribery problems for stable matchings: a central authority (the controller, resp., briber) may add agents, delete agents, delete acceptable pairs, swap two adjacent agents in some agent's preference list, or arbitrarily reorder some agent's preference list, in an instance of Stable Marriage or Stable Roommates. We extend previous work on control and bribery in stable matchings by Boehmer et al. (JAIR, 2021). We consider goals capturing individual and pair inclusion, stability, and uniqueness requirements: matching a designated agent (MA), matching a designated pair (MP), realizing a stable matching consistent with a given matching (SM), making a given matching the unique stable matching (USM), or guaranteeing that a stable (resp., perfect and stable) matching exists (ESM/PSM). We provide a unified complexity map for all non-trivial action–goal combinations in both settings, consolidating known results and extending the study to the roommates model, where stable matchings need not exist.

Fair Division with Binary Valuations: Characterizations

Florian Brandl, Warut Suksompong, Nicholas Teh

When allocating indivisible goods, the maximum Nash welfare (MNW) rule has attracted significant attention for its desirable properties. Recent work characterized MNW for additive valuations as the unique rule within the class of welfarist rules that satisfies envy-freeness up to one good (EF1). We provide two characterizations of MNW for binary valuations—where it coincides with the leximin rule as well as any additive welfarist rule with a strictly concave function—within the space of all rules. Specifically, we show that for any number of agents, MNW is the only rule that satisfies EF1, strategyproofness, neutrality, minimal completeness, and invariance under disapproving unassigned goods (IDU). Moreover, we present an alternative characterization for two agents, where we replace IDU with non-redundancy and resource-monotonicity. We also establish the necessity of all axioms in both characterizations.

Bribery's Influence on Ranked Aggregation

Pallavi Jain, Anshul Thakur

Kemeny Consensus is a well-known rank aggregation method in social choice theory. In this method, given a set of rankings, the goal is to find a ranking Π that minimizes the total Kendall tau distance to the input rankings. Computing a Kemeny consensus is NP-hard, and even verifying whether a given ranking is a Kemeny consensus is coNP-complete. Fitzsimmons and Hemaspaandra [IJCAI 2021] established the computational intractability of achieving a desired consensus through manipulative actions. Kemeny Consensus is an optimisation problem related to Kemeny's rule. In this paper, we consider a decision problem related to Kemeny's rule, known as Kemeny Score, in which the goal is to decide whether there exists a ranking Π whose total Kendall tau distance from the given rankings is at most k. Computation of Kemeny score is known to be NP-complete. In this paper, we investigate the impact of several manipulation actions on the Kemeny Score problem, in which given a set of rankings, an integer k, and a ranking X, the question is to decide whether it is possible to manipulate the given rankings so that the total Kendall tau distance of X from the manipulated rankings is at most

k. We show that this problem can be solved in polynomial time for various manipulation actions. Interestingly, these same manipulation actions are known to be computationally hard for Kemeny consensus.

Individual Rationality in Constrained Hedonic Games: Friends, Enemies, and Neutrals

Šimon Schierreich, Ildikó Schlotter

We study constrained coalition formation in games induced by *friends*, *enemies*, and *neutrals*, under the two standard refinements of additively separable preferences: *friend-oriented* and *enemy-oriented*. We ask for partitions that are *individually rational* (IR), while additionally requiring exactly k non-empty coalitions, each satisfying a prescribed lower and upper bound on its size. Although IR alone is trivial to satisfy for any hedonic game, the size constraints make it computationally intractable to decide whether a feasible partition exists.
The two models tell strikingly different stories. Under enemy-oriented preferences, the problem collapses to size-constrained graph coloring, and its complexity follows accordingly. Under friend-oriented preferences, however, the picture is far more intricate, and is governed by the *enmity structure* rather than the friendships. The complexity is further shaped by two factors: how strict the imposed size requirements are, and whether relationships are *symmetric* or *asymmetric*, with several cases turning out tractable in the symmetric setting but intractable once asymmetry is allowed. Charting this boundary in terms of both classical and parameterized complexity, we provide a complete understanding of which properties of the friend/enemy structure are responsible for hardness.

Improved Approximation Guarantees for Groupwise Maximin Share Fairness

Georgios Amanatidis, Anna Korfiati, Evangelos Markakis, Christodoulos Santorinaios

We study the problem of fairly allocating a set of indivisible goods to a set of n agents with additive valuation functions. We focus on the very demanding notion of *groupwise maximin share fairness* (GMMS), which requires that each agent i receives value comparable to their maximin share, where the latter is computed *with respect to any subset of agents that contains* i. We show that it is possible to compute $(\phi-1)$-approximate GMMS allocations in polynomial time, where $\phi \approx 1.618$ is the golden ratio). This improves on the previously known guarantee of $4/7$ of Chaudhury et al. [SICOMP; 2021] and Amanatidis et al. [TCS; 2020]. We use a simple algorithm that maintains the same main properties as the Draft-and-Eliminate algorithm of Amanatidis et al. [TCS, 2020] and we improve on the approximation guarantee analysis by carefully bounding the relevant value of any subinstance induced by the restriction of our allocation to a subset of agents. Our analysis is asymptotically tight for algorithms that share these said properties and has the additional benefit of giving improved guarantees for restricted settings; in particular, when the agents agree on the top n goods or when the number of agents is small. To illustrate the challenges of going beyond the guarantees of our algorithm, we also present a variant with an improved approximation of $(\sqrt{10}-1)/3 \approx 0.72$ for the case of three agents. To achieve this improvement we partially characterize the maximin share guarantees of short picking sequences for a small number of goods.

Nucleolus Computation by Non-Zero-Constrained Optimization

Daniel Ebert, Antonia Ellerbrock

We extend the list of games where the nucleolus is computable in polynomial time. Based on the classical MPS scheme, nucleolus computation can be reduced to the problem of finding a coalition with minimum excess that does not belong to a given linear subspace. We call this problem LSA-MinExcess, and show that it is equivalent to NZ-MinExcess: Given integral values per player, find a coalition with minimum excess whose player values do not sum up to 0. Exploiting this representation, we prove that the nucleolus is computable in polynomial time for arboricity games, network strength games, and certain b-matching games. Along these lines, we show that for b-matching games with $b \leq 2$, LSA-MinExcess is polynomially equivalent to Shortest Non-Zero Cycle. Further, we prove that in general, linear subspace avoidance strictly increases the complexity of the minimum excess problem, even for monotone games. We still provide a reduction that trades linear subspace avoidance against an arbitrarily small approximation error. Finally, we show that the nucleolus is unstable in the following sense: A small change in the value function of the game can lead to a change in the nucleolus that is exponential in the number of players.

Hospitals/Residents with Inseparable Couples: Finding a Coalition-Stable Assignment Is NP-Hard

Zeyuan Hu, Greg Plaxton

In recent work on course allocation, Rodríguez and Manlove considered the complexity of finding a stable assignment under four notions of stability, including two coalitional notions. In one case, which they call pair-size stability, they show that a stable assignment always exists and they provide a polynomial-time algorithm to find one. In a second case, called pair stability, they observe that an earlier NP-hardness result of McDermid and Manlove holds for a special case of course allocation called Hospitals/Residents with Sizes (HRS). In a third case, called first-coalition stability, they use a reduction from HRS to show it is NP-hard to find a stable assignment. They leave open the complexity of finding a stable assignment under so-called coalition stability. Building on ideas from McDermid and Manlove, we resolve the open problem of Rodríguez and Manlove by showing that it is NP-hard to find a coalition-stable assignment for HRS. Indeed, our proof shows that the problem remains NP-hard when the hospital capacities and resident sizes are at most two. Accordingly, our NP-hardness result applies to the special case of HRS known as Hospitals/Residents with Inseparable Couples (HRIC). Finally, we introduce a novel and natural notion of coalitional stability for both HRS and course allocation, and show that our NP-hardness result extends to this notion.

Leveraging Matchings in Constrained Fair Division with a Conflict Graph

Evangelos Markakis, Michalis Samaris

We study the problem of allocating indivisible goods under constraints, expressed via a conflict graph G. In such an instance, the m items are the vertices of G and connected items cannot be allocated in the same bundle. Under this model, it is already known that EF1 allocations may not exist. Our main contribution is an analysis parametrized by the maximum degree $\Delta(G) = \Delta$ on the existence and computation of complete EF1 allocations. We address this question in various cases by leveraging results from matching theory. First, we provide a tight existence result for agents with ordered valuations and for the broader class of tiered valuations. We present an algorithm that returns an EF1 allocation when then number of items does not exceed a specific bound. This bound is determined by n and Δ, and it is tight when Δ is greater than $2n/3$. We also construct an approximation algorithm when m exceeds this bound. For general additive valuations the problem becomes more challenging. Given the current impossibility results, we focus on the case where the number of items is at most $2n$. For this case, we provide an almost complete picture for the instances that admit EF1 allocations, by combining Round Robin with matchings.

Realist Vampire(s) Seeking Consenting Suicidal Person(s)

Fabien Mathieu

Most people believe that the principal weaknesses of vampires are sunlight, wooden stakes in inconvenient places, and extortionate dentist bills. Most people are mistaken. Being creatures of undeniably aristocratic persuasion, vampires fear social humiliation above all. In particular, exhibiting symptoms of haematological indigestion (typically induced by an incompatible blood type) constitutes a social death sentence, occasionally followed by the literal kind.
To preserve gastric decorum within the undead community, we study the Ghoul Exchange Programme, an online matching market in which vampires trade ghouls so as to align blood types. We model it as a stochastic matching problem, prove that no policy can stabilise it under a natural symmetry condition on arrivals (called mirror invariance), and analyse two ways to recover stability: admitting human volunteers, or tolerating a bounded discard rate. Both yield a trade-off between delay and waste.
The framework maps directly onto Kidney Exchange Programmes: volunteers become deceased donors, discard becomes wait-list mortality, and an uncomfortable corollary follows on the implicit valuation of patient outcomes carried by any matching policy.

Complexity of Eliminating (Majority) Illusion in Directed Networks

Sougata Jana, Sanjukta Roy

We study illusion elimination problems on directed social networks where each vertex is colored either red or blue. A vertex is under majority illusion if it has more red out-neighbors than blue out-neighbors when there are more blue vertices than red ones in the network. In a more general phenomenon of p-illusion, a vertex under illusion has at least p fraction of the out-neighbors (as opposed to 1/2 for majority) of a vertex is red. In the directed illusion elimination problem, we recolor minimum number of vertices so that no vertex is under p-illusion, for $p \in (0, 1)$. Unfortunately, the problem is NP-hard for p = 1/2 even when the network is a grid. Moreover, the problem is NP-hard and W[2]-hard when parameterized by the number of recoloring for each $p \in (0, 1)$ even on bipartite DAGs. Thus, we can neither get a polynomial time algorithm on DAGs, unless P=NP, nor we can get a FPT algorithm even by combining solution size and directed graph parameters that measure distance from acyclicity, unless FPT=W[2]. We show that the problem can be solved in polynomial time in structured, sparse networks such as outerplanar networks, outward grids, trees, and cycles. Finally, we show two tractable algorithms parameterized by treewidth of the underlying undirected graph and maximum p-deficiency, and by the number of vertices under illusion.

Extension of Excess Demand Ascending Auction to Multi-Demand Model by Discrete Convex Analysis Approach

Kazuo Murota, Akiyoshi Shioura

We consider the problem of finding the (unique) minimalWalrasian equilibrium price in multi-item, multi-unit auction models: there are multiple indivisible items for sale, with several units of each item, and a bidder may be interested in buying more than one copy of each item. In its special case with unit-demand bidders, where each bidder demands at most one unit of any item, Andersson, Andersson, and Talman (2013) proposed a general framework of ascending auction algorithms based on the concept of excess-demand item set. This paper extends this approach to the multi-unit case by exploiting the discrete convexity of the Lyapunov function associated with the auction model. In particular, we make use of the facts that (i) the equilibrium price vectors are characterized as the minimizers of the Lyapunov function, (ii) the Lyapunov function is an instance of an Lconvex function, and (iii) a concept generalizing "excess-demand item set" can be defined in Lconvex function minimization in general.