Personal Statement
Itai Ashlagi

I. Research

My principal research is in market design, which studies how the rules and operations governing the marketplace affect economic outcomes. My research is both theoretical and applied and I use tools from operations, economics and computer science to study and (re)design marketplaces. One concrete example is kidney exchange, where my algorithms and recommendations have been widely adopted by transplant centers and kidney exchange (KE) networks.

Kidney exchange and organ allocation. KE organize swaps between patient-donor incompatible pairs and account for about 14% of live donor transplants in the US. I have studied several operational and economic design challenges.

KE matching policies. My early research demonstrates the importance of using chains initiated by altruistic donors in pools with many highly sensitized patients (Ashlagi et al., 2011b,a). I developed a stochastic dynamic matching framework that informs what matters for matching in different environments; Chains reduce waiting (Anderson et al., 2017) (unless there are many "easy-to-match" agents (Ashlagi et al., 2016)). Despite concerns that KE platforms in the US have shifted to frequent matching, I find that greedy matching (which ignores future match opportunities) performs well (Ashlagi et al.) and minimizes waiting time asymptotically (Anderson et al., 2017; Ashlagi et al.).

More recently I analyzed the trade-off between match rates and waiting times with both hard- and easy-to-match agents and find that it vanishes under greedy matching Ashlagi et al. (2022b).

The KE market. In Agarwal et al. (2019) I study the efficiency in the US and identify two market failures that account for the loss of hundreds of annual transplants: hospitals do not internalize the patients' benefits, and platforms do not provide hospitals adequate incentives. About half of the exchanges are facilitated within hospitals using many easy-to-match pairs.[1] I propose simple token mechanisms to encourage hospital participation on platforms. Such a system is used at the National Kidney Registry (NKR) and adopted by the Alliance for Paired Kidney Donation (APKD).

Further impact. As part of an interdisciplinary team associated with the APKD, a multi-hospital program, I was a Franz Edelman finalist. I developed matching algorithms (Anderson et al., 2015) and created software (pro-bono) with advanced histocompatibility capabilities that is widely adopted.[2] I received the Terasaki Medical Innovation award from the NKR for "significant impact and advancing paired exchange transplantation and saving the lives of those facing kidney failure".[3] Since 2020 I am grateful to be involved in international collaborations such as with Israel, Austria and the Czech Republic. I used my platform to identify the first exchange between Israel and the UAE, enabled by the recent Abraham accords.

Cadaver organ allocation. I am recently interested in the inefficiencies in the national waitlist system (e.g., 20% kidneys are discarded). The 2014 kidney allocation reform, evaluated allocation rules using an acceptance-rejection simulating tool that is invariant to the priority rule. In (Agarwal et al., 2021) I developed an empirical methodology, using historical match data, for evaluating priority-based allocation rules (match quality and waste) when doctors/patients have private preferences.

In (Ashlagi et al., 2021b) I study dynamic assignment without money of objects with different qualities to agents with private information. It is optimal to pool adjacent object types and there

[1] As predicted in (Ashlagi and Roth, 2014).

[2] Few examples are Israel, Portugal, and Methodist at San Antonio, the largest single hospital program worldwide.

[3] The overview paper by Ashlagi and Roth (2012) was cited by the Nobel committee in the scientific background for the 2012 Economics Prize awarded to Alvin Roth.

are two simple equivalent implementations: through a disjoint waiting list, or a FCFS queue with deferrals.[4] This offers insights towards how to "fast track" organs. I am now working on classifying organs by their difficulty to place towards improving the allocation process and reducing discards.[5]

Since 2020 I am serving on a NASEM committee for improving the national allocation system.

Two-sided matching markets. Stable matching theory has been instrumental in the study and design of two-sided markets. The literature traditionally asks whether good properties can be guaranteed. This led to negative results and further provides almost no link between market characteristics and outcomes. By adopting a stochastic approach, I have addressed several fundamental issues in matching markets.

Typical outcomes. In Ashlagi et al. (2017), by considering random preferences, I find that matching markets generally have a small core, solving a longstanding puzzle explaining why small cores are ubiquitous. So in NRMP-like clearinghouses it is irrelevant which stable algorithm is used and hence safe for all agents to act sincerely. I also find random markets to be very competitive with large advantage to agents on the short side (blogpost). I am currently expanding this research to study agents' typical matches when preferences exhibit more correlation (Ashlagi et al., 2021a).

When complementarities are present (married doctors seeking pairs of positions) stability may fail to exist. I establish constructive existence with high probability as long as the number of couples grows slower than the market size Ashlagi et al. (2014).

Congestion. This is a topic I am actively working in recent years. Forming matches often requires extensive and costly communication between participants. Under arbitrary preferences reaching a stable matching may require a high level of communication (Segal 2007). In (Ashlagi et al., 2020) I find that when the unobservable component of agents' preferences satisfies natural assumptions, one can recommend matches and use signals to reach stable outcomes with little communication.

There is an alarming increase in the number of interviews in the residency and fellowship markets. I am currently studying market designs towards recommending interviews and reducing the burden (Melcher et al., 2018). More generally I am interested in matching when agents have only a priori preferences.

Service allocation: school choice and beyond. Many cities use school choice systems to assign students based on their preferences and priorities at different schools. I have written on policy decisions that impact students' assignments.

Optimal assignment. Prior to 2014, Boston Public Schools faced high busing costs, representing 10% of the budget. The city was divided into three "zones" and families could rank schools within their zone. With my student Peng Shi I studied how to allocate *optimally* heterogeneous services to agents under incomplete information (Ashlagi and Shi, 2016).[6] Using a large market approximation, I find that incentive compatible and Pareto efficient mechanisms are simple: planners can optimize over priorities and *menus* of services, which agents can rank.[7] The solution outperforms the current design with respect to efficiency and equity. The paper bridges assortment planning with markets without money and was awarded MSOM best publication in service management. The 2014 Boston school choice reform is based on a simplification of this work (offering families home-based menus).

I am actively working with the San Francisco Unified School District on student assignment

[4] I also find that when agents learn object qualities, batch offers reduce herding effects (Kang et al., 2021).

[5] I received an award from the Kidney Transplant Collaborative to develop this study.

[6] Little is known about optimal allocation without money when agents have multi-dimensional preferences.

[7] This is applied in Ashlagi and Shi (2014) to study when community cohesion can be improved without sacrificing choice; the key is using correlated lotteries that maintain incentive constraints.

reform to improve diversity, proximity and predictability.

Lotteries in school choice. Lotteries resolve ties between students in schools with excess demand. Following debates in NYC and Amsterdam, I study whether schools should use a common or separate lotteries. Separate lotteries seem fairer but may create artificial inefficiencies. I find that in *popular* schools a single lottery stochastically dominates separate lotteries (Ashlagi and Nikzad, 2020; Allman et al., 2022), alleviating much of the early confusion (a common lottery effectively randomizes who gets a seat in a popular school, leaving for preferences to decide at which one).[8]

Dynamic matching with *heterogeneous* match values. This is a topic I have been studying extensively more recently. In a few of papers I study markets with stochastic arrivals and the role of uncertainty on allocative efficiency. Waiting lists offer agents choice among types of items and associated wait times. In Ashlagi et al. (2022a) I study a decentralised waitlist mechanism by considering the fluctuations in queue lengths as a price discovery process. By drawing a connection to stochastic gradient descent I find that the waitlist mechanism achieves the optimal allocative efficiency minus a loss due to price fluctuations that is bounded by the granularity of price changes.

With my student Suleyman Kerimov I characterize matching networks, in which the positive externality from delaying decisions is negligible; a policy can be almost optimal at *all* times (Kerimov et al., 2021a,b). I find a stark difference between multi-way and 2-way networks: while small delays and optimization are needed in the former, greedy-like policies are sufficient in the latter. A quantity corresponding to the stability of the market characterizes the regret and the required delay.

Motivated by pooling problems, I also devise approximation algorithms that perform well in the worst-case when agents can be delayed for a limited time (Ashlagi et al., 2019).

Mechanism design. Early on I have contributed to theoretical mechanism design. In quasi-linear, single dimensional settings, Myerson characterizes incentive compatibility via monotonicity. This does not extend to multi-dimensional settings. In Ashlagi et al. (2010) I characterize the domains of preferences, in which monotonicity is necessary and sufficient for implementing an allocation rule. In Ashlagi et al. (2012), I address an open problem from Nisan and Ronen (1999) about scheduling tasks on unrelated machines. I find that anonymous incentive compatible mechanisms for minimizing the makespan must be far-from-optimal. (Outstanding Paper award in EC.)

II. Teaching

Since arriving at Stanford I have developed and taught five courses in the area of operations management and market design, advised a number of graduate students and organized research and reading group meetings. I especially value engaging students on two fronts: theoretical foundations and identifying questions in the real world and thoroughly enjoy interacting with students.

I updated much of the curriculum of *Introduction to Operations Management* (MS&E 260), which familiarizes students with classic OM tool topics in revenue management. Two new courses I developed are *Service Operations* (MS&E 267), focusing on service systems, and Introduction to Market Design (MS&E 230). I expanded and teach Introduction to Game Theory (MS&E 232). These are all undergraduate and master-level courses. I also created a PhD-level course, *Advanced Topics in Market Design* (MS&E 365/ECON 287), which covers a combination of foundations as well as recent advanced papers. A major goal is to enable students to start a research project. I enjoy giving guest lectures in courses across campus and have offered several mini courses in my research area at different graduate level venues.

A long-term goal is a new major to train students in operations, computer science and economics.

[8] I was invited to present this to policymakers prior to school choice reform in Chile.

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